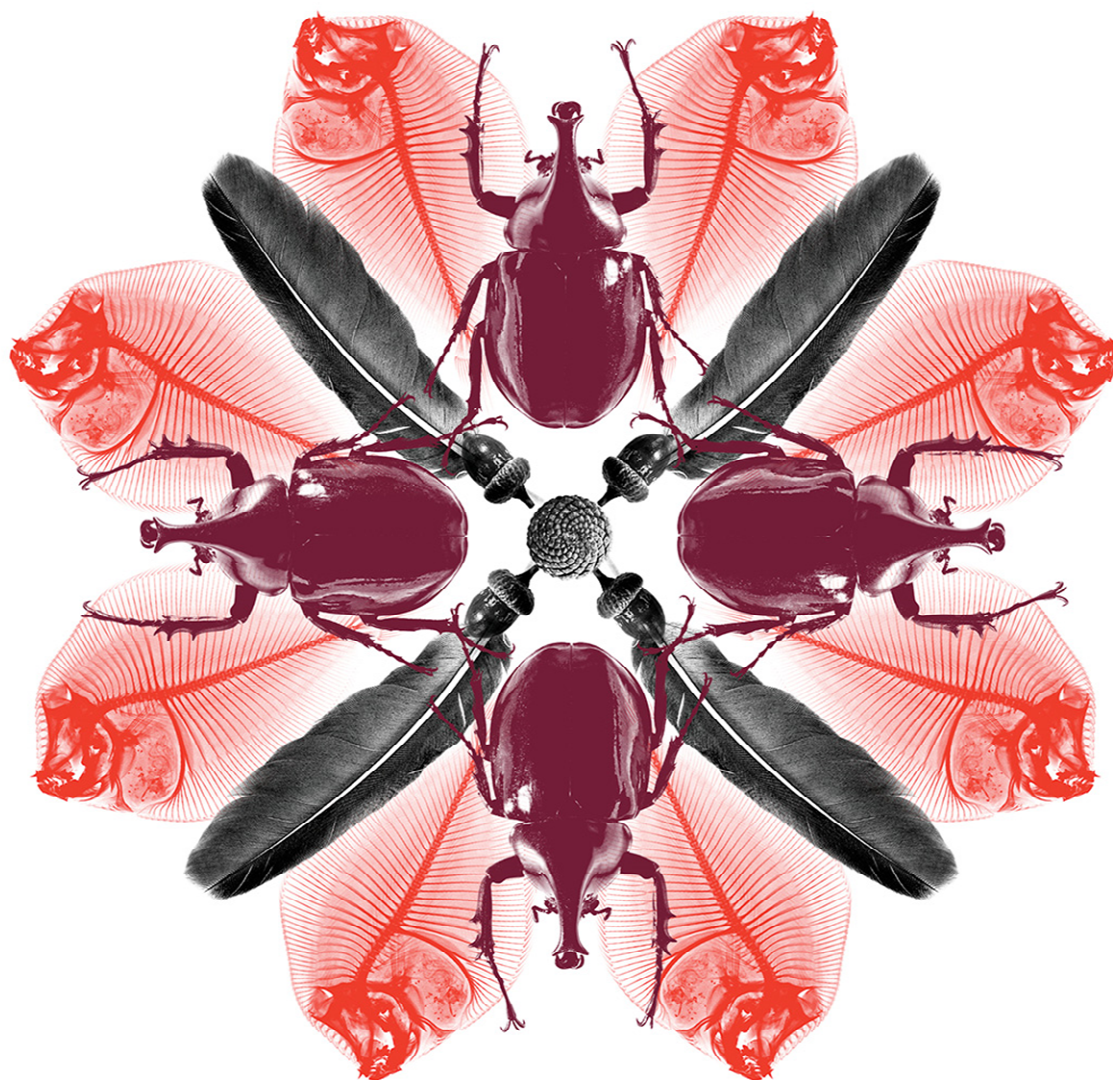




Australian Government
Department of Agriculture,
Water and the Environment

Final review of import conditions for apiaceous vegetable seeds for sowing

March 2021



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This publication is available at agriculture.gov.au.

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Acronyms and abbreviations

Term or abbreviation	Definition
ACT	Australian Capital Territory
ALOP	Appropriate level of protection
BIRA	Biosecurity Import Risk Analysis
ELISA	Enzyme-linked immunosorbent assay
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
PCR	Polymerase Chain Reaction
PRA	Pest risk analysis
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures
the department	The Department of Agriculture, Water and the Environment
WTO	World Trade Organization

Summary

Australia imports large quantities of seeds annually and depends heavily on them to produce a wide range of crops, including vegetable crops.

The distributions of seed-borne pathogens are expanding globally, and new risks continually emerge. The vegetable seeds trade has become globalised and is evolving—seed lines are usually developed, commercially multiplied, and processed in various countries rather than at a single origin. Therefore, the risks of seeds' exposure to new pathogens and the likelihood that these pathogens may enter Australia via imported seeds have increased.

Acknowledging the change in risk profile associated with this trade, the Department of Agriculture, Water and the Environment (the department) is undertaking a series of seed reviews of the import conditions for four key vegetable families: Apiaceae, Brassicaceae, Cucurbitaceae, and Solanaceae. These reviews were initially funded by the Australian Government's Agricultural Competitiveness White Paper and are one means by which Australia continues to strengthen its biosecurity surveillance and analysis. This review of apiaceous vegetable seeds for sowing is the third of the series to be finalised.

Under Australia's existing import policy, all seeds for sowing, including apiaceous vegetable seeds, are subject to the department's standard import conditions. In September 2017, the department published the *Final pest risk analysis for 'Candidatus Liberibacter solanacearum' associated with apiaceous crops*, which recommended pest risk management measures for seeds of six apiaceous species (*Anthriscus cerefolium*—chervil, *Apium graveolens*—celery, *Daucus carota*—carrot, *Foeniculum vulgare*—fennel, *Pastinaca sativa*—parsnip and *Petroselinum crispum*—parsley).

In addition to 'Candidatus Liberibacter solanacearum', this review has identified three other quarantine pests associated with the seeds of apiaceous vegetable crops: *Cercospora foeniculi* (for fennel), *Diaporthe angelicae* (for carrot) and *Strawberry latent ringspot virus* (SLRSV; for parsley and parsnip). The unrestricted risks of these quarantine pests on the seeds for sowing pathway do not achieve the appropriate level of protection (ALOP) for Australia. Consequently, additional pest risk management measures are required to mitigate the risks posed by the identified quarantine pests to achieve the ALOP for Australia.

In addition to the department's standard seeds for sowing import conditions, three pest risk management options (see Chapter 4) are recommended for seeds of *A. cerefolium*, *A. graveolens*, *D. carota*, *F. vulgare*, *P. sativa* and *P. crispum*:

- Option 1. Polymerase chain reaction (PCR) test—a measure that is applicable to all four identified quarantine pests.
- Option 2. Broad-spectrum fungicidal treatment—a measure that is applicable to *C. foeniculi* and *D. angelicae*.
- Option 3. Hot water treatment (50°C for 20 minutes)—a measure that is applicable to 'Candidatus Liberibacter solanacearum'.

If the required treatment or testing is undertaken off-shore, phytosanitary certification is required with the additional declaration that the testing or treatment has been conducted in accordance with Australia's requirements.

A. cerefolium, *A. graveolens*, *D. carota*, *F. vulgare*, *P. sativa* and *P. crispum* seeds to be used for sprouting or micro-greens production for human consumption are exempt from these additional measures if imported directly for germination at a production facility operated under an Approved Arrangement. This is to mitigate risks from the potential diversion of seeds to other end-uses.

Alternatives to testing or treatment, such as sourcing seed from pest free areas or pest free places of production, or sourcing seed produced under a systems approach, may be considered. However, supporting documentation demonstrating pest free area status, pest free place of production status, or details of a proposed systems approach will be required for the department to consider these options on a case-by-case basis.

Seeds of most apiaceous vegetable species reviewed were not found to be hosts of quarantine pests for Australia and will continue to be subject only to the department's standard seeds for sowing import conditions.

Comments raised by stakeholders on the *Draft review of import conditions for apiaceous crop seeds for sowing into Australia* have been taken into consideration in the preparation of the final report (key responses are presented in Appendix B). A review of scientific literature, including literature published since the draft report was released was also undertaken.

The key changes were made in the final report:

- seven quarantine pests identified in the draft report as potentially requiring measures have been reassessed as not requiring measures because:
 - three of the pests are no longer considered to be seed-borne in apiaceous hosts (*Calophoma complanata*, *Fusarium oxysporum* f. sp. *coriandrii* and *Ramularia foeniculi*) as any evidence was found to be insufficient
 - three of the pests are no longer considered to pose risks that exceed the ALOP for Australia (*F. oxysporum* f. sp. *cumini*, *Passalora malkoffii* and *Phomopsis diachenii*)
 - one of the pests has been taxonomically reclassified (*R. coriandri*) and the new definition of this species indicates it is present in Australia and not under official control.
- *Diaporthe angelicae* was included as a newly recognised quarantine pest associated with this pathway.

The department considers that the pest risk management measures recommended in this review are suitable for both organic and non-organic seeds sectors and will mitigate the risks posed by the identified quarantine pests associated with apiaceous vegetable seeds to a level that achieves the ALOP for Australia.

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 policy development. It enables the Australian Government to formally consider the level of biosecurity risk that may be associated with proposals to import goods into Australia. If the biosecurity risks do not achieve the appropriate level of protection (ALOP) for Australia, risk management measures are recommended to reduce the risks to an acceptable level. If the risks cannot be reduced to an acceptable level, the goods will not be imported into Australia until suitable measures are identified or developed.

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 involves consultation with stakeholders at various stages during the process.

Risk analyses may take the form of a biosecurity import risk analysis (BIRA) or a review of biosecurity import requirements (such as scientific reviews of existing policy and import conditions, pest-specific assessments, weed risk assessments, biological control agent assessments or scientific advice).

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: <http://www.agriculture.gov.au/biosecurity/risk-analysis/guidelines>.

1.2 This risk analysis

1.2.1 Background

Seeds are essential to the agri-food system, with the global commercial seed market valued at around US\$48.5 billion in 2015 (Bonny 2017; IIGB 2016). Safe seed trade demands appropriate phytosanitary measures.

The global vegetable seed sector has evolved through several waves of expansion, consolidation and technological innovation (Bonny 2017; Bruins 2009). It operates inter-continental and counter-seasonal production cycles with extensive pathways for exchange of seeds, which range from small seed lots for breeding or selection purposes to commercial wholesale and retail supplies. Processes such as seed multiplication, conditioning (drying, cleaning, sorting, priming and coating), testing and packing occur on a global scale. Frequently, these activities are sub-

contracted in regions with relatively lower production costs and often occur over lengthy periods (IIGB 2016).

Globalisation of vegetable seed production and trade is also increasing the risk of the introduction of seed-borne pathogens to new areas. In 2014, '*Candidatus Liberibacter solanacearum*' was detected in carrot seeds in Spain. In October 2014, Australia introduced emergency measures to manage the risk of introductions of this bacterium into Australia. In March 2017, the emergency measures were updated in response to the detection of this bacterium in the seeds of additional hosts in other countries. In September 2017, the *Final pest risk analysis for 'Candidatus Liberibacter solanacearum' associated with apiaceous crops* was published, providing the justification for the emergency measures (DAWR 2017).

Acknowledging the change in risk profile, the department is undertaking an extensive review of the existing import conditions for vegetable seeds, including those for apiaceous vegetables. The analysis is being conducted as a review of import conditions, consistent with the *Biosecurity Act 2015*, to assess the biosecurity risks associated with seeds being imported into Australia. The review of the seed pathway for several commodity groups, including apiaceous vegetables, was initially funded under the Australian Government's Agricultural Competitiveness White Paper and is one means by which Australia is continuing to strengthen its biosecurity.

1.2.2 Scope

The family Apiaceae (Umbelliferae) has 428 genera and approximately 3,500 species (Mabberley 2008). However, this review of existing import conditions focusses on the seeds of 12 key genera of apiaceous vegetables currently allowed entry into Australia from all sources (Table 1.1). The taxonomy of apiaceous crops is complex, and the physical characteristics and uses of individual species can vary widely, as evidenced in Table 1.1.

This review aims to:

- identify pathogens associated with seeds of the apiaceous vegetables listed in Table 1.1
- evaluate the effectiveness of the existing risk management measures for these pathogens
- recommend revised risk management measures, where necessary.

Table 1.1 Apiaceous vegetable seeds under review

Scientific name	Synonyms/subordinate taxa	Common name
<i>Anethum graveolens</i> L.	<i>Anethum sowa</i> Roxb. ex Fleming, <i>Peucedanum graveolens</i> (L.) Benth. ex Clarke	Dill, garden dill
<i>Angelica archangelica</i> L.	<i>Angelica archangelica</i> subsp. <i>litoralis</i> (Fr.) Thell., <i>Angelica litoralis</i> Fr., <i>Angelica officinalis</i> Moench, <i>Archangelica officinalis</i> (Moench) Hoffm.	Angelica
<i>Angelica atropurpurea</i> L.	—	American angelica
<i>Angelica dahurica</i> (Hoffm.) Benth. & Hook. ex Franch. & Sav.	<i>Angelica porphyrocaulis</i> Nakai & Kitag., <i>Callisace dahurica</i> Hoffm.	Bai Zhi, Chinese angelica
<i>Angelica gigas</i> Nakai	—	Korean angelica
<i>Angelica glauca</i> Edgew.	—	Smooth angelica
<i>Angelica pachycarpa</i> Lange	—	Portuguese angelica

Scientific name	Synonyms/subordinate taxa	Common name
<i>Angelica pubescens</i> Maxim.	—	Pubescent angelica
<i>Angelica setchuenensis</i> Diels	—	Si chuan dang gui
<i>Angelica sinensis</i> (Oliv.) Diels	<i>Angelica polymorpha</i> var. <i>sinensis</i> Oliv.	Chinese angelica
<i>Angelica sylvestris</i> L.	—	Wild angelica
<i>Angelica taiwaniana</i> Ying	—	Purple angelica
<i>Angelica triquinata</i> Michx.	—	Mountain angelica
<i>Angelica ursina</i> (Rupr.) Maxim.	—	Bear's angelica
<i>Anthriscus caucalis</i> M. Bieb.	<i>Anthriscus scandicina</i> Mansf.	Burr chervil
<i>Anthriscus cerefolium</i> (L.) Hoffm.	<i>Anthriscus longirostris</i> Bertol., <i>Scandix cerefolium</i> L.	Chervil
<i>Anthriscus sylvestris</i> (L.) Hoffm.	<i>Anthriscus fumarioides</i> (Waldst. & Kit.) Spreng., <i>Anthriscus sylvestris</i> subsp. <i>alpina</i> (Vill.) Gremli, <i>Anthriscus sylvestris</i> subsp. <i>fumarioides</i> (Waldst. & Kit.) Spalik, <i>Anthriscus sylvestris</i> subsp. <i>nemorosa</i> (Bieb.) Koso-Pol., <i>Chaerophyllum alpinum</i> Vill., <i>Chaerophyllum nemorosum</i> Bieb., <i>Scandix fumarioides</i> Waldst. & Kit.	Wild beaked parsley
<i>Apium graveolens</i> L.	<i>Apium dulce</i> Mill., <i>Apium graveolens</i> var. <i>dulce</i> (Mill.) DC., <i>Apium graveolens</i> var. <i>rapaceum</i> (Mill.) DC, <i>Apium graveolens</i> var. <i>secalinum</i> Alef., <i>Apium rapaceum</i> Mill.	Celery, celeriac
<i>Apium prostratum</i> Labill. ex Vent.	—	Sea celery
<i>Carum carvi</i> L.	—	Caraway
<i>Carum copticum</i> (L.) Clarke	<i>Carum ajowan</i> ., <i>Trachyspermum ammi</i> (L.) Sprague ex Turrill	Ajowan, Ajwain
<i>Coriandrum sativum</i> L.	—	Coriander
<i>Cuminum cyminum</i> L.	—	Cumin
<i>Daucus carota</i> L.	—	Carrot
<i>Daucus glochidiatus</i> (Labill.) Fisch. & Mey.	<i>Daucus brachiatus</i> Sieber ex DC, <i>Scandix glochidiata</i> Labill.	Australian carrot
<i>Foeniculum vulgare</i> Mill.	—	Fennel
<i>Pastinaca sativa</i> L.	<i>Pastinaca sativa</i> subsp. <i>sativa</i> , <i>Pastinaca sativa</i> subsp. <i>urens</i> (Req. ex Godr.) Čelak., <i>Pastinaca urens</i> Req. ex Godr.	Parsnip
<i>Petroselinum crispum</i> (Mill.) Fuss	<i>Apium crispum</i> Mill., <i>Apium petroselinum</i> L., <i>Carum Petroselinum</i> (L.) Benth. & Hook, <i>Petroselinum crispum</i> var. <i>neapolitanum</i> Danert, <i>Petroselinum crispum</i> var. <i>tuberosum</i> (Bernh.) Mart. Crov., <i>Petroselinum hortense</i> Hoffm., <i>Petroselinum sativum</i> Hoffm. ex Gaudin, <i>Petroselinum vulgare</i> Lag.	Parsley
<i>Pimpinella anisum</i> L.	—	Aniseed
<i>Pimpinella leptophylla</i> Pers.	<i>Apium ammi</i> Urb., <i>Apium leptophyllum</i> (Pers.) Muell. ex Benth, <i>Cyclospermum leptophyllum</i> (Pers.) Sprague ex Britton & Wilson	Five-leaved celery
<i>Pimpinella saxifraga</i> L.	—	Greater burnet saxifrage

1.2.3 Existing import conditions for seeds for sowing

Standard conditions

Seeds of many species, including those of apiaceous vegetables (Table 1.1) can be imported from all sources under the department's standard seeds for sowing import conditions. Details of these standard conditions are provided in Section 4.1.

Apiaceous vegetable seeds imported for the end-use of sprouting or micro-greens production for human consumption are also currently subject to the department's standard seeds for sowing import conditions.

Specific measures

In addition to the standard seeds for sowing conditions, seeds of *Anthriscus cerefolium*, *Apium graveolens*, *Daucus carota*, *Foeniculum vulgare*, *Pastinaca sativa* and *Petroselinum crispum* are subject to additional pest risk management measures (testing or treatment, on-shore or off-shore) for the presence of '*Candidatus Liberibacter solanacearum*'. The rationale for and details of these additional required measures are provided in Section 4.1.

Provided the additional requirements are met, seeds of these host species can be released from biosecurity control without further restrictions.

Domestic arrangements

The Australian Government is responsible for regulating the movement of goods such as plants and plant products into and out of Australia. However, the state and territory governments are responsible for plant health controls within their individual jurisdiction. Legislation relating to resource management or plant health may be used by state and territory government agencies to control interstate movement of plants and their products. After imported plants and plant products have been cleared by Australian Government biosecurity officers, they may be subject to interstate movement regulations/arrangements. It is the importer's responsibility to identify and ensure compliance with all requirements.

1.2.4 Consultation

The draft report was released on 12 September 2017 (Biosecurity Advice 2017-21) for comment by stakeholders, for a period of 60 days concluding on 13 November 2017. The department received nine written technical submissions on the draft report. All submissions were carefully considered and, where relevant, changes were made to this final report.

A summary of key stakeholder comments and the department's responses are provided in Appendix B of this report. Supplementary details of potential risk mitigation options, and their consideration, are also provided in this report (Appendix C).

Further consultation with domestic stakeholders was undertaken during and after close of the stakeholder comment period. The department has also engaged with Australian state and territory governments during the preparation of this report.

1.2.5 Next steps

This final report will be published on the department's website with a notice advising stakeholders of its release. The department will also notify the WTO Secretariat of the release of the final report. The biosecurity requirements recommended in this final report will form the basis of revised import conditions published on the department's Biosecurity Import Conditions (BICON) system.

2 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 'World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures' (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 used 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.

2.1 Stage 1 Initiation

The initiation of a risk analysis involves identifying the pest(s) and pathway(s) that should be considered for risk analysis in relation to the identified PRA area.

The identities of the pests considered in this review 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 instances where the cited literature has used a different scientific name.

A list of pathogens of the apiaceous vegetables under review was tabulated from the available published scientific literature including, but not limited to, reference books, journals and database searches. This list identifies the pathway association of pests recorded on the apiaceous vegetables under review and their status in Australia, their potential to establish or spread, and their potential for economic consequences. This information is set out in Appendix A and forms the basis of the pest categorisation process. The department acknowledges that

several pathogens associated with apiaceous vegetables are seed-borne in other hosts. However, at the time of publishing this document, no evidence of an association with seeds of apiaceous vegetables was available for these pathogens. Similarly, at the time of publishing this document, no evidence was available on the potential economic consequences of some of the pathogens associated with the seed pathway. Consequently, these pathogens were not considered further. The department will continue to review the literature in relation to the seed-borne nature and pest status of pathogens of apiaceous vegetables and may amend this policy accordingly.

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.

2.2 Stage 2 Pest risk assessment

A pest risk assessment is an 'evaluation of the probability of the introduction and spread of a pest, and the magnitude of the associated potential economic consequences' (FAO 2019b). The pest risk assessment provides technical justification for identifying quarantine pests and for establishing phytosanitary import requirements.

2.2.1 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 (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.

The results of pest categorisation are set out in Appendix A. The quarantine pests identified during categorisation were carried forward for pest risk assessment and are listed in Table 3.1.

2.2.2 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 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, 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. ISPM 11 (FAO 2019c) states that the likelihood of entry of a pest depends on the pathways from the exporting country to the destination, and the frequency and quantity of pests associated with them. ISPM 11 (FAO 2019c) lists various factors which should be taken into account when assessing 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.

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 and 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.

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.

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 2.1). 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 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 2.1 Nomenclature of likelihoods

Likelihood	Descriptive definition	Indicative range
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 2.2). 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]

low x moderate = low

entry x establishment = [EE]

low x high = low

[EE] x spread = [EES]

low x very low = very low

Table 2.2 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. However, in the case of a high risk propagative commodity such as seeds for sowing, the import volume may be restricted in order

to effectively manage the biosecurity risks they present. Other factors listed in ISPM 11 (FAO 2019c) may not be relevant to seeds for sowing.

2.2.3 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.

The direct and indirect 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).

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

Table 2.3 Decision rules for determining the consequence impact score based on the magnitude of consequences at four geographical 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 2.4 Decision rules for determining the overall consequence rating for each pest 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 2.4). These rules are mutually exclusive, and are assessed in numerical order until one applies.

Table 2.4 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

2.2.4 Estimation of the unrestricted risk

Once the assessment of the likelihood of entry, establishment and spread, and 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 2.5) 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 product 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 2.5 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

2.2.5 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 is defined in the *Biosecurity Act 2015*, is 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 the ALOP for Australia.

2.3 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 a 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 recommended phytosanitary measures (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 achieve 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 of risk management measures which may be applied to seeds for sowing consignments include:

- Import from pest free areas only (ISPM 4 and 10)—the establishment and use of a pest free area by a National Plant Protection Organisation (NPPO) may provide for the export of seeds from the exporting country to the importing country without the need for the application of additional phytosanitary measures when certain requirements are met.
- Testing for freedom from regulated pests—this is a practical measure for management of pests which do not produce visible symptoms.
- Inspection and certification (ISPM 7, 12 and 23)—the exporting country may be asked to inspect the shipment and certify that the shipment is free from regulated pests before export.
- Specified conditions for preparation of the consignment—the importing country may specify steps that must be followed in order to prepare the consignment for shipment. These conditions can include the requirement for seeds to be produced from appropriately tested parent material.
- Removal of the pest from the consignment by treatment or other methods—the importing country can specify chemical or physical treatments that must be applied to the consignment before it may be imported.
- Prohibition of commodities—the importing country may prohibit the commodity 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. Relevant measures are presented in Chapter 4 of this report.

3 Pest risk assessment for quarantine pests

Pests of apiaceous vegetable seeds considered in this review are listed in the pest categorisation table (Appendix A), and the identified seed-borne quarantine pests are listed in Table 3.1.

Table 3.1 Quarantine pests associated with seeds of apiaceous vegetables

Scientific name	Common name	Host(s) (a)
Bacteria		
' <i>Candidatus</i> Liberibacter solanacearum' (b)	Yellows decline	Carrot, celery/celeriac, chervil, fennel, parsley, parsnip
Fungi		
<i>Cercospora foeniculi</i>	Cercospora blight	Fennel
<i>Diaporthe angelicae</i>	-	Carrot
<i>Fusarium oxysporum</i> f. sp. <i>cumini</i>	Cumin blight	Cumin
<i>Passalora malkoffii</i> (c)	Cercospora leaf blight	Aniseed
<i>Phomopsis diachenii</i>	-	Caraway
Viruses		
<i>Strawberry latent ringspot virus</i> (SLRSV)	Strawberry latent ringspot	Parsley, parsnip

(a) Aniseed (*Pimpinella anisum*), Caraway (*Carum carvi*), Carrot (*Daucus carota*), Celery/Celeriac (*Apium graveolens*), Chervil (*Anthriscus cerefolium*), Cumin (*Cuminum cyminum*), Fennel (*Foeniculum vulgare*), Parsley (*Petroselinum crispum*), Parsnip (*Pastinaca sativa*).

(b) A species that has been assessed previously and for which an existing policy is in place.

(c) *Passalora malkoffii* is the currently accepted name of *Cercospora malkoffii* (Farr & Rossman 2020) and this has been adopted in the final report.

Since publication of the draft report, an additional pest has been identified that is seed-borne in carrots—*Diaporthe angelicae* (Bastide et al. 2017). Therefore, this pest has been included in this final report.

The department will also continue to review the literature in relation to the seed-borne status of pathogens associated with apiaceous vegetable seeds and may amend this policy accordingly.

3.1 Assessment of the likelihood of entry, establishment and spread

This review collectively assesses the likelihoods of entry, establishment and spread of the quarantine pests identified in Table 3.1. Key factors that contribute to the likelihoods of entry, establishment and spread have been highlighted in the risk assessment section. However, assessments of the potential consequences of the entry, establishment and spread of each pest are individually presented to estimate the magnitude of the potential consequences.

ISPM 11 (FAO 2019c) states that the intended end-use of a commodity affects the risk of introduction and spread of associated pests. For example, an end-use such as seeds for sowing poses a higher risk of a pest establishing or spreading than an end-use such as processing (FAO 2019c).

Seeds also play an important role in the survival, introduction and spread of associated pests (Elmer 2001). Seed association provides a mechanism whereby a pathogen can persist under

conditions in which other sources of inoculum have been eliminated (Stace-Smith & Hamilton 1988). Seed association is also epidemiologically important because it ensures that the pest is physically associated with and distributed throughout the planted crop by means of infected seeds, which are randomly dispersed in the field. Resultant infected seedlings can then serve as further sources of inoculum from which secondary spread can occur (Stace-Smith & Hamilton 1988). Seeds for sowing are deliberately introduced, distributed, and aided to establish. As a result, any pest that is associated with seeds of apiaceous vegetables intended for sowing will be aided in its entry, establishment and spread in Australia.

3.1.1 Likelihood of entry

The likelihood of entry is considered in two parts, the likelihood of importation (the likelihood that the identified pathogens will arrive when host apiaceous vegetable seeds for sowing are imported) and the likelihood of distribution (the likelihood that the identified pathogens will be viable and be transferred to a suitable host in Australia).

Likelihood of importation

The likelihood that the identified quarantine pests will be imported on host apiaceous vegetable seeds for sowing is assessed as **High**.

This is because the identified quarantine pests are known to be seed-borne, and are likely to remain viable during transport and storage. They are also likely to be present but effectively undetectable in the large volumes of apiaceous vegetable seeds for sowing that Australia imports each year.

The supporting evidence for this assessment is provided.

It is highly likely that the identified pests are associated with the pathway

- Infected seeds for sowing are one of the main pathways for the introduction of seed-borne pathogens into new areas. Global trade and the movement of infected seeds across borders is known to have introduced seed-borne pathogens into new areas (Constable et al. 2019; Constable et al. 2018; Cromney et al. 1987; Vannacci et al. 1999).
- A low incidence in the field may enhance a plant pathogen's chances of escaping detection. If the level of infection is very low and symptomatic plants are randomly scattered throughout a field, an infection may go undetected at the time of harvest.
- Large volumes of apiaceous vegetable seeds are imported into Australia each year for planting. Seed-borne pathogens associated with the seed internally (endosperm and/or embryo) or externally (seed surface) may not be detected during on-arrival visual inspection (Elmer 2001). Therefore, there is high potential for the identified pests to repeatedly enter Australia through the seeds for sowing pathway.

Cercospora foeniculi

- *Cercospora foeniculi* naturally infects *Foeniculum vulgare* (fennel) causing Cercospora blight disease (Khare, Tiwari & Sharma 2014).
- *Cercospora foeniculi* has been reported to be seed-borne in fennel (Dwivedi, Agrawal & Agrawal 2008; Khare, Tiwari & Sharma 2014). This species has been reported to be present

on the seed surface, mainly on the apical end of the seed (Dwivedi, Agrawal & Agrawal 2008).

Diaporthe angelicae

- *Diaporthe angelicae* naturally infects *Angelica*, *Anthriscus*, *Carum*, *Daucus*, *Foeniculum* and *Pastinaca* species causing stem decay and leaf spot (Castlebury et al. 2003; Farr & Rossman 2020).
- *Diaporthe angelicae* has recently been detected on seed lots derived from *Daucus carota* (carrot) seed production fields in France (Bastide et al. 2017).

Fusarium oxysporum f. sp. *cumini*

- *Fusarium oxysporum* f. sp. *cumini* naturally infects *Cuminum cyminum* (cumin) causing Fusarium wilt disease (Mehta et al. 2012; Pappas & Elena 1997; Tawfik & Allam 2004).
- This pathogen was isolated from naturally infected cumin seeds and demonstrated to be internally seed-borne (Singh, Choudhary & Patel 1972).

Passalora malkoffii

- *Passalora malkoffii* naturally infects *Pimpinella anisum* (aniseed) causing Cercospora/Passalora leaf blight disease (Erzurum et al. 2005; Ullah et al. 2013).
- *Passalora malkoffii* was detected on seeds of aniseed by a washing test and an agar method (Erzurum et al. 2005). The same study also demonstrated seed transmission of this pathogen by sowing naturally infected seeds in disease-free soils.

Phomopsis diachenii

- *Phomopsis diachenii* naturally infects *Carum carvi* (caraway) and *Pastinaca sativa* (parsnip) causing umbel (inflorescence) browning, brown spots and dieback (Connolly 2011; Zalewska, Machowicz-Stefaniak & Król 2013b).
- *Phomopsis diachenii* has been reported to be seed-borne in caraway (Mačkinaitė 2011).

Strawberry latent ringspot virus (SLRSV)

- SLRSV infects a wide range of plants and its host range exceeds 126 species belonging to 27 families (Tzanetakis et al. 2006). It naturally infects *Apium graveolens* (celery/celeriac), *Pastinaca sativa* (parsnip) and *Petroselinum crispum* (parsley) (Bellardi & Bertaccini 1991; Hicks, Smith & Edwards 1986; Walkey & Mitchell 1969).
- SLRSV has been reported to be seed-borne in parsnip (Cooper 1981; Hicks, Smith & Edwards 1986) and parsley (Bellardi & Bertaccini 1991; Bos, Huttinga & Maat 1979; Hanson & Campbell 1979).

It is highly likely that the identified pests will survive storage and transport

- The identified pathogens are highly likely to survive during transport and storage since the primary conditions for their survival are fulfilled by the presence of live host material (seeds) and the associated environmental conditions. Conditions such as temperature and humidity are unlikely to affect the viability of the associated pathogens.

- Most seed-borne pathogens infect and use seeds as a vehicle for transport and survival (Elmer 2001). Seed associations can provide long-term survival mechanisms for pathogens, and survival is not likely to be diminished during transport and storage (Elmer 2001).
- Previous interceptions of seed-borne pests in various countries demonstrate generally that these pests are highly likely to persist during processes of storage and transport to Australia.

Likelihood of distribution

To have an impact a pest must be transported in or on a pathway and must then be capable of transferring to a suitable host. The likelihood of this transfer occurring depends on the dispersal mechanisms of the pest and the intended use of the commodity.

The likelihood that the identified quarantine pests will be distributed across Australia on imported apiaceous vegetable seeds for sowing and be transferred from the resulting plants to a suitable host is assessed as **High**.

This assessment is based on the facts that apiaceous vegetable seeds intended for sowing are commercially distributed throughout Australia, and that seed association has been reported for the identified pathogens. This transmission mechanism provides the means by which these pests encounter a new host plant, most notably, the new seedling that is germinated from the seed.

The supporting evidence for this assessment is provided.

It is highly likely that imported apiaceous vegetable seeds will be distributed throughout Australia

- Imported apiaceous vegetable seeds are intended for commercial sale in vegetable growing areas throughout Australia. The imported seeds will be distributed through commercial and retail outlets to multiple destinations throughout Australia. Following sale, any contaminated imported seeds will be planted in suitable habitats.
- The distribution of infected imported seeds to commercial seedling nurseries may also facilitate the distribution of the identified seed-borne pathogens. Asymptomatic seedlings that develop from infected seeds may be overlooked and sold to commercial growers and householders.

It is highly likely that the identified seed-borne pests will be distributed in a viable state

- Seed-associated pests have evolved many different types of associations with their seed hosts. Pathogens associated with seeds can be transmitted as an internal infection of endosperm and/or embryo, or as an infestation of the seed surface (Agarwal & Sinclair 1996). The pathogen's ability to survive on or in a seed acts to ensure their viability en route to, and during distribution across Australia.
- Conditions during transport and storage, such as temperature and humidity, are unlikely to affect the viability of the associated pathogens.
- Seeds for sowing are imported specifically for the purpose of propagation and are likely to be sown directly into suitable habitats at multiple locations throughout Australia. The distribution of infected or infested seeds for sowing for commercial purposes is likely to facilitate the distribution of the associated pathogens.

- Seed-borne bacteria are often carried on the surface of the seed, but bacteria causing vascular or systemic infections are frequently found in the seed coat or other tissues of the seed (Neergaard 1977).
 - '*Candidatus Liberibacter solanacearum*' has been reported to be present in the seed internally, in the phloem and sieve tubes of the seed coat (Bertolini et al. 2015).
- Seed-borne fungi exist in seeds as spores and hyphae and can survive for long periods on the seed coat and in the internal diseased tissues (Elmer 2001).
 - *Fusarium oxysporum* f. sp. *cumini* was found to be present in the seed coat and endosperm of cumin seeds (Singh, Choudhary & Patel 1972).
- Seed-borne viruses can be present in seed embryos, either through infection of gametes prior to fertilisation, or infection of the embryo after fertilisation (Maule & Wang 1996), and most survive for as long as the seed embryo remains viable (Stace-Smith & Hamilton 1988).
 - SLRSV was found to be present in the embryo and endosperm of seeds from infected parsnip (Hicks, Smith & Edwards 1986).

It is highly likely that the identified seed-borne pests will be transferred to a suitable host

- The identified pests in imported seeds for sowing are already associated with suitable hosts that will be planted and grown under favourable conditions. The pests will have no need to move from the import pathway to a suitable host.
- The seed-borne nature and seed transmissibility of the identified pests, and establishment of an infected plant, provide the means for these pests to become associated with a new host plant in Australia. The new seedling is the new host.
- *Diaporthe* species can survive on crop and weed stubble (Udayanga et al. 2015; Udayanga et al. 2011), and are also opportunistic pathogens on various herbaceous weeds (Udayanga et al. 2015).

Overall likelihood of entry

The likelihoods of importation and distribution of the identified quarantine pests are combined to give an overall likelihood of entry using the matrix of rules for combining likelihoods (Table 2.2).

The overall likelihood that the identified quarantine pests will enter Australia and be transferred to a suitable host via apiaceous seeds for sowing is assessed as **High**.

3.1.2 Likelihood of establishment

In overview, the likelihood of establishment of the identified quarantine pests within Australia will depend upon availability of hosts and suitable climate, and the reproductive strategies and methods of persistence of the pests. Based on a comparison of factors that affect pest survival and reproduction in the source and destination areas, the likelihood of establishment is assessed as **High**.

This assessment is based on the extensive planting of apiaceous vegetables in Australia, the deliberate introduction and establishment of plants grown from imported seeds for sowing, the

reported potential for the transmission of the identified quarantine pests from infected seed to seedlings, the wide distribution of suitable hosts, and the broad availability of suitable climates in Australia.

The supporting evidence for this assessment is provided.

It is highly likely that the identified seed-borne pests will establish in Australia given the broad availability of host plants

- Imported apiaceous vegetable seeds are intended for propagation and are deliberately introduced, distributed and aided in establishment. Imported seeds will enter, potentially in substantial numbers, and then be maintained in a suitable habitat. Therefore, the introduction and establishment of plants from imported seeds can also establish those pests associated with the seed.
- Some of the identified pests (*Cercospora foeniculi* and *Diaporthe angelicae*) are largely known to be pests of apiaceous vegetables (Bastide et al. 2017; Jaiman et al. 2013; Khare, Tiwari & Sharma 2014; Koike, Gladders & Paulus 2007; Mishra 2005) and these crops are widely cultivated throughout Australia, with many residential and semi-rural properties in metropolitan areas growing vegetables in their backyards.
- The identified pests are already associated with the seeds of host plants, giving them a distinct advantage for establishment in Australia. The importation and distribution of seeds intended for sowing through commercial and retail outlets provides seed-borne pests with the means to establish in multiple apiaceous vegetable-growing areas across Australia.
- SLRSV is known to infect a range of horticultural crops including cherry (Allen, Davidson & Briscoe 1970), grapes (Martelli & Walter 1993; Rüdel 1985), olive (Faggioli et al. 2002), and peach (Smith et al. 1988). These crops are widely cultivated in Australia, increasing the number of potential hosts that could enable SLRSV to establish in Australia.
- Asymptomatic infection or infestation of the seed by a pathogen can facilitate long-distance movement and establishment in new areas. This can allow a pathogen to repeatedly enter a new site and go unnoticed for an extended period (Elmer 2001).
 - SLRSV is symptomless in parsley (Bellardi & Bertaccini 1991) and was introduced to the USA through parsley seeds from Europe (Hanson & Campbell 1979).
- A low incidence of a pathogen in or on seeds can affect detection in routine seed health tests (McGee 1995). Therefore, a low incidence of the pathogen in the field may enhance a pathogen's chance of escaping detection. If the level of infection is very low and symptomatic plants are randomly scattered in the field, the infection may go undetected for some time. This would provide further opportunity for the pest to proliferate and establish in new areas.

It is highly likely that the identified seed-borne pests will establish in Australia given the suitability of climatic conditions

- The identified quarantine pests have established in areas with a wide range of climatic conditions (EPPO 2010; Haapalainen 2014; Khare, Tiwari & Sharma 2014; Lee et al. 2006; Machowicz-Stefaniak, Zalewska & Król 2009). There are similar climatic regions in parts of Australia that would be suitable for the establishment of these pests.

- Extensive cultivation of imported seeds potentially infested or infected with the identified pests, and seed-to-seedling transmission will help establish these pathogens in apiaceous vegetable growing areas in Australia. As host plant material is likely to be maintained in places with similar climates to the area of seed production, climatic conditions are expected to favour the identified pest's establishment.
- Seed-borne pathogens commonly have traits that help them establish, such as an ability to rapidly infect new hosts and/or survive long-term in the soil.
- The establishment of seed-borne pathogens may be influenced by the length of time the commodity remains in production. For example, short crop cycles such as those of annual crops, like celery and parsnip (Davis & Raid 2002), may limit pathogen build-up and establishment. The opposite might be true for perennial crops, which are kept longer in production, providing a greater opportunity for pathogen build-up that results in a high likelihood of survival and establishment.

3.1.3 Likelihood of spread

The likelihood of spread describes the likelihood that the identified quarantine pests, once having entered Australia on imported apiaceous vegetable seeds and become established, will spread from a point of introduction to new areas.

Based on a comparison of factors relevant to the expansion of geographic distributions of the pests in the source and destination areas, the assessed likelihood of spread is:

- **Low** for '*Candidatus Liberibacter solanacearum*' if vectors are absent from Australia (DAWR 2017).
- **High** for '*Candidatus Liberibacter solanacearum*' if vectors are present in Australia (DAWR 2017).
- **Moderate** for all other identified pathogens.

This assessment is based on the suitability of the natural and managed environments for natural spread, the ability of seed-borne pathogens to survive for long periods of time in or on seeds, the symptomless nature of some pathogens in assisting the inadvertent multiplication and distribution of pathogens across continental borders, and the known role of seeds in the spread of pathogens globally.

The supporting evidence for this assessment is provided.

It is highly likely that the environment in Australia will support the spread of the identified seed-borne pests

- Apiaceous vegetables are grown in various regions of Australia. The natural environments in apiaceous vegetable growing areas in Australia are conducive to the spread of the identified pests. The pests will be within suitable host growing areas where biotic factors such as wind, water, rain splash dispersal or mechanical transmission could aid spread once established.
 - *Cercospora/Passalora* species are spread by wind, splashing water, and farm staff (McPartland, Clarke & Watson 2000). These fungal species overwinter as mycelium in dead leaves, seeds and plant residues (Erzurum et al. 2005). Survival on crop debris is

the most important source of inoculum for many *Cercospora/Passalora* species (Kimber 2011).

- *Diaporthe/Phomopsis* species are spread by rain splash and irrigation water over short distances (Anco, Madden & Ellis 2013; Kmetz, Ellett & Schmitthenner 1979; Schilder 2006). They can survive on crop and weed stubble (Udayanga et al. 2015; Udayanga et al. 2011), and are also opportunistic pathogens on various herbaceous weeds (Udayanga et al. 2015). Alternative hosts may act as sources of inocula, posing a challenge to managing the potential spread of this pathogen (Udayanga et al. 2011).
- SLRSV can be dispersed locally by the nematode *Xiphinema diversicaudatum* (EPPO 2010). However, it is not dependent on the presence of nematode vectors for spread in the field (Tang, Ward & Clover 2013), being also mechanically transmissible (El-Morsy et al. 2017).
- The managed environments in nurseries, garden centres and private gardens are all favourable for the spread of the identified pests, as host plants are abundantly available, plants are closely placed and sprinkler irrigation favours local spread. Nursery (transplant) trade networks, which are common between Australian nurseries, favour wider spread of these pests.

The presence of natural barriers in Australia could limit the spread of the identified pests

- Commercial seed distribution systems would help the identified seed-borne pests to establish throughout Australia, providing a high risk for continued spread post-border. However, natural barriers, such as arid areas, mountain ranges, climatic differentials, and possible long distances between suitable hosts in parts of Australia may hinder or prevent the long-range natural spread of the identified pests.

There is potential for domestic trade to facilitate the spread of the identified pests

- Human-mediated movement of infected seeds and seedlings (transplants) is considered the primary method for the introduction of plant pathogens into new areas. As visual symptoms may not be present, infected seeds or seedlings could easily be moved into new areas. The introduction of infected seeds/seedlings establishes the pests in new areas and unregulated movement of infected hosts may accelerate the spread of the identified pests across Australia.
- Distribution of infected *Anthriscus cerefolium*, *Apium graveolens*, *Carum carvi*, *Cuminum cyminum*, *Daucus carota*, *Foeniculum vulgare*, *Pastinaca sativa*, *Petroselinum crispum* and *Pimpinella anisum* seeds throughout production areas could help spread the identified pests across Australia. Additionally, SLRSV can be spread via infected *Mentha arvensis* and *Prunus avium* seeds (Allen, Davidson & Briscoe 1970; Taylor & Thomas 1968).
- Infected and/or infested seeds are the most effective way to spread seed-borne pests over long distances (Constable et al. 2019; Constable et al. 2018; Vannacci et al. 1999). The distribution and sowing of infected seeds will help the introduction and spread of these seed-borne pests throughout the crop-growing areas of Australia. Infected seeds can play a significant role in pathogens spreading over greater distances and seed-derived materials can also serve as a reservoir for pathogens in the soil (du Toit & Pelter 2003; Elmer 2001; Elmer & Lacy 1987).

- In the absence of statutory control, it is likely that the identified pests will spread within Australia through the trade of seeds/seedlings for propagation. Planting of infected seeds and seedlings in production fields is likely to introduce the identified pests into the environment.

The absence of vectors could limit the secondary spread of some identified pests

- Once established, the identified pests have the potential to spread from their point of introduction into new areas across Australia by natural means (short distance spread by wind and water-splash) and human mediated activities (long distance spread via trade of infected seed/seedlings).
- Seed-borne pests are likely to have the ability to spread in and from seeds produced by infected plants in the field, potentially through multiple generations and irrespective of the presence of vectors or other abiotic factors.
- Biotic factors such as insect or nematode vectors may help spread pathogens from infected plants to healthy plants. Pests that are dependent on vectors, where the vectors are absent from Australia, will have a lower likelihood of spread.
 - ‘*Candidatus Liberibacter solanacearum*’ associated with apiaceous species is known to be vectored naturally by *Bactericera trigonica* and *Trioza apicalis* (Haapalainen 2014). Neither of these vector species are present in Australia. However, it has been reported that the pest can be seed transmitted (Bertolini et al. 2015). Survival within seeds and trade in infected seed could help spread this pathogen within Australia.
 - SLRSV can be dispersed locally by the nematode *Xiphinema diversicaudatum* (EPPO 2010). However, it is not dependent on the presence of nematode vectors for spread in the field (Tang, Ward & Clover 2013).

3.1.4 Overall likelihood of entry, establishment and spread

The overall likelihood of entry, establishment and spread is determined by combining the individual likelihoods of entry, establishment and spread using the matrix of rules for combining descriptive likelihoods (Table 2.2).

The overall likelihood that the identified quarantine pests will enter Australia, be distributed in a viable state to susceptible hosts, establish in that area and subsequently spread within Australia is assessed as:

- **Low** for ‘*Candidatus Liberibacter solanacearum*’ if vectors are absent from Australia (DAWR 2017).
- **High** for ‘*Candidatus Liberibacter solanacearum*’ if vectors are present in Australia (DAWR 2017).
- **Moderate** for all other identified pathogens.

3.2 Assessment of potential consequences

The entry, establishment and spread of the identified pests is likely to have unacceptable economic consequences, particularly for Australia’s agricultural and food production sectors.

Seed-borne pests are known to be able to affect germination, growth and crop productivity (Bertolini et al. 2015; Khare, Tiwari & Sharma 2014; Koike, Gladders & Paulus 2007; Ménard et al. 2014).

The introduction and spread in Australia of pests with wide host ranges would affect both the imported hosts and alternate hosts. When a pest gains entry into a new region or crop it may establish and spread quickly, requiring the implementation of costly and/or environmentally-damaging control measures. New control measures to minimise economic impacts may result in changes to the supply and production chain.

The establishment of new quarantine pests in Australia could also result in phytosanitary regulations being imposed by foreign or domestic trading partners. Trade restrictions on affected commodities could lead to loss of markets.

This section examines the potential consequences of '*Candidatus Liberibacter solanacearum*', *Cercospora foeniculi*, *Diaporthe angelicae*, *Fusarium oxysporum* f. sp. *cumini*, *Passalora malkoffii*, *Phomopsis diachenii* and SLRSV were they to enter, establish and spread in Australia.

Consequences of '*Candidatus Liberibacter solanacearum*'

Based on the department's final PRA for '*Candidatus Liberibacter solanacearum*' (DAWR 2017), the potential consequences of the introduction and spread of '*Candidatus Liberibacter solanacearum*' in Australia are estimated to be **Moderate**.

Consequences of *Cercospora foeniculi*

The consequences of entry, establishment and spread of *Cercospora foeniculi* in Australia have been estimated according to the methods described in Table 2.3.

Based on the decision rules described in Table 2.4, that is, where the potential consequences of a pest with respect to one or more (but not all) criteria have an impact of 'D', the overall consequences are estimated to be **Low**.

The supporting evidence for this assessment is provided.

Criterion	Estimated impact score and rationale
Direct	
Plant life or health	<p>D—Significant at the district level</p> <p>The direct impact of <i>Cercospora foeniculi</i> on plant life or health would be of major significance at the local level, significant at the district level, and of minor significance at the regional level, which has an impact score of 'D'.</p> <ul style="list-style-type: none"> <i>Cercospora foeniculi</i> infects all parts of the fennel plant, including leaves, stems, and petioles (Khare, Tiwari & Sharma 2014). Damage on host plants includes destruction of foliage, yield loss and reduced seed production (Khare, Tiwari & Sharma 2014; Mishra 2005). Under severe conditions, foliage becomes blighted and yield is highly reduced. If the crop becomes infected early in the growing season, lack of seed formation results in higher yield losses (Khare, Tiwari & Sharma 2014). In the 2018-19 financial year, Australia produced 1,449 tonnes of fennel with a total value of \$2.9 million (Horticulture Innovation Australia 2020). Additionally, fennel seed is one of the five spice crops being trialled as part of the Australian Government's initiative to develop domestic spice production in northern

Criterion	Estimated impact score and rationale
	Australia (Ministers for the Department of Industry, Science, Energy and Resources 2019). <i>Cercospora foeniculi</i> has the potential to significantly damage this industry.
Other aspects of the environment	<p>A—Indiscernible at the local level</p> <p>The direct impact of <i>Cercospora foeniculi</i> on other aspects of the environment would be indiscernible at the local, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> No impact of <i>Cercospora foeniculi</i> has been reported on the environment internationally or domestically. <i>Cercospora foeniculi</i> is host specific and infects only fennel (Khare, Tiwari & Sharma 2014). There is no evidence of this fungus infecting native or endangered flora.
Indirect	
Eradication, control, etc.	<p>A—Indiscernible at the local level</p> <p>The indirect impact of <i>Cercospora foeniculi</i> on eradication and control would be indiscernible at the local level, district, regional, and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> Containment or eradication of <i>Cercospora foeniculi</i> (which is host specific) would be easily achieved through cultural practices such as crop rotation and fungicidal seed treatment. Existing management measures to control other <i>Cercospora</i> species in Australia are likely to be effective for control of this fungus.
Domestic trade	<p>C—Significant at the local level</p> <p>The indirect impact of <i>Cercospora foeniculi</i> on domestic trade would be of significance at the local level, minor significance at the district level, and indiscernible at the regional level, which has an impact score of 'C'.</p> <ul style="list-style-type: none"> The presence of <i>Cercospora foeniculi</i> could threaten economic viability through reduced trade or loss of domestic markets at the local level. Biosecurity measures to prevent the movement of plant material out of the initial incursion area would affect plant industries and business at the local level. The introduction of <i>Cercospora foeniculi</i> into a state or territory would disrupt interstate trade due to the biosecurity restrictions on the domestic movement of fennel seeds and propagative material within Australia. Interstate restrictions on these commodities may lead to a loss of markets, which could threaten economic viability.
International trade	<p>A—Indiscernible at the local level</p> <p>The indirect impact of <i>Cercospora foeniculi</i> on international trade would be indiscernible at the local, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> <i>Cercospora foeniculi</i> is not currently regulated by Australia's trading partners. Therefore, it is estimated that the introduction and spread of this pathogen in Australia will not result in restrictions on Australian exports of fennel seeds and propagative material.
Environmental and non-commercial	<p>B—Minor significance at the local level</p> <p>The indirect impact of <i>Cercospora foeniculi</i> on the environment would be of minor significance at the local level, and indiscernible at the district, regional and national levels, which has an impact score of 'B'.</p> <ul style="list-style-type: none"> Introduction of <i>Cercospora foeniculi</i> may result in additional fungicide use that causes minor damage to the local environment. For example, copper-based fungicide residues in the soil can be lethal or inhibit growth and reproduction of

Criterion	Estimated impact score and rationale
	soil invertebrates, in turn affecting soil processes such as the breakdown of plant litter (Wightwick et al. 2008).

Consequences of *Diaporthe angelicae*

The potential consequences of the entry, establishment and spread of *Diaporthe angelicae* in Australia have been estimated according to the methods described in Table 2.3.

Based on the decision rules described in Table 2.4, that is, where the potential consequences of a pest with respect to one or more (but not all) criteria have an impact of 'D', the overall consequences are estimated to be **Low**.

The supporting evidence for this assessment is provided.

Criterion	Estimated impact score and rationale
Direct	
Plant life or health	<p>D—Significant at the district level</p> <p>The direct impact of <i>Diaporthe angelicae</i> on plant life or health would be of major significance at the local level, significant at the district level, and of minor significance at the regional level, which has an impact score of 'D'.</p> <ul style="list-style-type: none"> • <i>Diaporthe angelicae</i> is a known pathogen of carrot (<i>Daucus carota</i>), causing umbel (inflorescence) browning, and is also known to have caused lesions on parsley stems (Bastide et al. 2017). However, no significant economic yield loss has been reported for either carrot or parsley crops grown for consumption. • A reduction in carrot seed production yield of 8% due to <i>Diaporthe angelicae</i> infection has however been reported (Bastide et al. 2017; Ménard et al. 2014). • The carrot seed production industry in Australia is well-developed and has expanded considerably in recent years (Gracie 2011). The available carrot seed production data for Australia is centred in Tasmanian production, which has been estimated to be at least \$8.5 million to \$10 million per annum, although this figure is likely to fluctuate significantly year-on-year (seeds production sector, personal communication). <i>Diaporthe angelicae</i> has the potential to damage this industry.
Other aspects of the environment	<p>A—Indiscernible at the local level</p> <p>The direct impact of <i>Diaporthe angelicae</i> on other aspects of the environment would be indiscernible at the local, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> • No impact of <i>Diaporthe angelicae</i> has been reported on the environment internationally or domestically. • <i>Diaporthe angelicae</i> can occur on a wide range of apiaceous hosts (Farr & Rossman 2020), with no evidence of them infecting native or endangered flora.
Indirect	
Eradication, control, etc.	<p>A—Indiscernible at the local level</p> <p>The indirect impact of <i>Diaporthe angelicae</i> on eradication and control would be indiscernible at the local level, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> • Eradication or containment of <i>Diaporthe angelicae</i> would be easily achieved through cultural practices such as crop rotation and fungicidal seed treatment. • Existing management measures to control other <i>Diaporthe</i> species in Australia are likely to be effective for control of this fungus.
Domestic trade	C—Significant at the district level

Criterion	Estimated impact score and rationale
	<p>The indirect impact of <i>Diaporthe angelicae</i> on domestic trade would be significant at the local level, of minor significance at the district level, and indiscernible at the regional and national levels, which has an impact score of 'C'.</p> <ul style="list-style-type: none"> The presence of <i>Diaporthe angelicae</i> could threaten economic viability at the local level through reduced commodity trade or loss of domestic markets. Biosecurity measures to prevent the movement of plant material out of the initial incursion area would affect plant industries and business at the district level. The introduction of <i>Diaporthe angelicae</i> into a state or territory would disrupt interstate trade due to the biosecurity restrictions on the domestic movement of seeds and planting materials of host species within Australia. Interstate restrictions on these commodities may lead to a loss of markets, which could threaten economic viability.
International trade	<p>A—Indiscernible at the local level</p> <p>The indirect impact of <i>Diaporthe angelicae</i> on international trade would be indiscernible at the local, district, regional and national level, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> <i>Diaporthe angelicae</i> is not currently regulated by Australia's trading partners, and is already widespread globally (Farr & Rossman 2020). Therefore, it is estimated that the introduction and spread of this pathogen in Australia would not result in restrictions on Australian exports of apiaceous seeds and propagative material.
Environmental and non-commercial	<p>B—Minor significance at the local level</p> <p>The indirect impact of <i>Diaporthe angelicae</i> on the environment would be of minor significance at the local level, and indiscernible at the district, regional and national levels, which has an impact score of 'B'.</p> <ul style="list-style-type: none"> Introduction of <i>Diaporthe angelicae</i> may result in additional fungicide use that causes minor damage to the local environment. For example, copper-based fungicide residues in the soil can be lethal to or inhibit growth and reproduction of soil invertebrates in turn affecting soil processes such as the breakdown of plant litter (Wightwick et al. 2008).

Consequences of *Fusarium oxysporum* f. sp. *cumini*

The potential consequences of entry, establishment and spread of *Fusarium oxysporum* f. sp. *cumini* in Australia have been estimated according to the methods described in Table 2.3.

Based on the decision rules described in Table 2.4, that is, where the potential consequences of a pest with respect to one or more (but not all) criteria have an impact of 'C', the overall consequences are estimated as **Very Low**.

The supporting evidence for this assessment is provided.

Criterion	Estimated impact score and rationale
Direct	
Plant life or health	<p>C—Significant at the local level</p> <p>The direct impact of <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> on plant life or health would be of significance at the local level, minor significance at the district level, and indiscernible at the regional level, which has an impact score of 'C'.</p> <ul style="list-style-type: none"> <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> is a key limiting factor in major cumin growing areas of the world (Mehta, Sharma & Prasad 2012; Pappas & Elena 1997; Sharma et al. 2015; Tawfik & Allam 2004).

Criterion	Estimated impact score and rationale
	<ul style="list-style-type: none"> The fungus infects all parts of the plant including root, foliage and seed (Özer & Bayraktar 2015) and survives in soil (Israel & Lodha 2004). Damage on cumin includes damping off, wilting, shrivelling of the foliage, and discolouration within the vascular tissue, growth retardation and plant death (Pappas & Elena 1997). In India, this fungus has caused cumin yield losses varying from 5% to 60% (Lodha & Mawar 2014). In Greece, a cumin yield reduction from 1500kg/ha to 500kg/ha was observed (Pappas & Elena 1997). Cumin is being researched as part of an Australian government initiative to develop a new spice production industry in Australia (Ministers for the Department of Industry, Science, Energy and Resources 2019). However, cumin is not presently produced in Australia in significant volumes. Therefore, the impact of <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> on plant life or health would be unlikely to be significant at more than a local level.
Other aspects of the environment	<p>A—Indiscernible at the local level</p> <p>The direct impact of <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> on other aspects of the environment would be indiscernible at the local, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> No impact of <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> has been reported on the environment internationally or domestically. <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> has only been reported to infect cumin (Pappas & Elena 1997). There is no evidence of this fungus infecting native or endangered flora.
Indirect	
Eradication, control, etc.	<p>C—Significant at the local level</p> <p>The indirect impact of <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> on eradication and control would be of significance at the local level, minor significance at the district level, and indiscernible at the regional level, which has an impact score of 'C'.</p> <ul style="list-style-type: none"> Containment and eradication is costly as the fungus is able to survive in soil and would also cause disruption to Australia's agribusiness and associated trades at the local level. The impact would be expected to threaten economic viability through a large increase in costs for containment, eradication and control (for instance, through the application of fungicides) at a local level.
Domestic trade	<p>C—Significant at the local level</p> <p>The indirect impact of <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> on domestic trade would be of significance at the local level, minor significance at the district level, and indiscernible at the regional level, which has an impact score of 'C'.</p> <ul style="list-style-type: none"> The presence of <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> could threaten economic viability through reduced trade or loss of domestic markets at the local level. Biosecurity measures to prevent the movement of plant material out of the initial incursion area would affect plant industries and business at the local level. The introduction of <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> into a state or territory would disrupt interstate trade due to the biosecurity restrictions on the domestic movement of seeds and propagative material.
International trade	<p>A—Indiscernible at the local level</p> <p>The indirect impact of <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> on international trade would be indiscernible at the local, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> is not currently regulated by Australia's trading partners. Therefore, it is estimated that the introduction and spread of this

Criterion	Estimated impact score and rationale
	pathogen in Australia would not result in restrictions on Australian exports of cumin seed and propagative material.
Environmental and non-commercial	<p>B—Minor significance at the local level</p> <p>The indirect impact of <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> on the environment would be of minor significance at the local level, and indiscernible at the district, regional and national levels, which has an impact score of 'B'.</p> <ul style="list-style-type: none"> • Introduction of <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> may result in additional fungicide use that causes minor damage to the local environment. For example, copper-based fungicide residues in the soil can be lethal to or inhibit growth and reproduction of soil invertebrates, in turn affecting soil processes such as the breakdown of plant litter (Wightwick et al. 2008).

Consequences of *Passalora malkoffii*

The potential consequences of the entry, establishment and spread of *Passalora malkoffii* in Australia have been estimated according to the methods described in Table 2.3.

Based on the decision rules described in Table 2.4, that is, where the potential consequences of a pest with respect to one or more (but not all) criteria have an impact of 'C', the overall consequences are estimated to be **Very Low**.

The supporting evidence for this assessment is provided.

Criterion	Estimated impact score and rationale
Direct	
Plant life or health	<p>C—Significant at the local level</p> <p>The direct impact of <i>Passalora malkoffii</i> on plant life or health would be significant at the local level, of minor significance at the district level, and indiscernible at the regional and national levels, which has an impact score of 'C'.</p> <ul style="list-style-type: none"> • <i>Passalora malkoffii</i> is recognised as a major pathogen of aniseed in Turkey, causing serious economic losses (Erzurum et al. 2005). • <i>Passalora malkoffii</i> infects all above-ground parts of the aniseed plant (Erzurum et al. 2005; Ullah et al. 2013). Infection starts at the basal parts of the plant and later spreads to leaves, stems, flowers and fruits (Ullah, Mahmood & Honermeier 2013). The disease causes light brown spots with dark veins on leaves, stems and flowers (Ullah, Mahmood & Honermeier 2013). • Aniseed is not presently produced in Australia in significant volumes. Therefore, the impact of <i>Passalora malkoffii</i> on plant life or health would be unlikely to be significant above a local level.
Other aspects of the environment	<p>A—Indiscernible at the local level</p> <p>The direct impact of <i>Passalora malkoffii</i> on other aspects of the environment would be indiscernible at the local, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> • No impact of <i>Passalora malkoffii</i> has been reported on the environment internationally or domestically. • <i>Passalora malkoffii</i> is host specific and infects only aniseed (Erzurum et al. 2005; Ullah, Mahmood & Honermeier 2013). There is no evidence of this fungus infecting native or endangered flora.

Criterion	Estimated impact score and rationale
Indirect	
Eradication, control, etc.	<p>A—Indiscernible at the local level</p> <p>The indirect impact of <i>Passalora malkoffii</i> on eradication and control would be indiscernible at the local level, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> • Eradication or containment of <i>Passalora malkoffii</i> which is host specific would be easily achieved through cultural practices such as crop rotation and fungicidal seed treatment. • Existing management measures to control other fungi in Australia are likely to be effective for control of this fungus.
Domestic trade	<p>C—Significant at the local level</p> <p>The indirect impact of <i>Passalora malkoffii</i> on domestic trade would be significant at the local level, of minor significance at the district level, and indiscernible at the regional level, which has an impact score of 'C'.</p> <ul style="list-style-type: none"> • The presence of <i>Passalora malkoffii</i> could threaten economic viability through reduced trade or loss of domestic markets at the local level. Biosecurity measures to prevent the movement of plant material out of the initial incursion area could affect plant industries and business at the local level. • Introduction of <i>Passalora malkoffii</i> into a state or territory could disrupt interstate trade due to biosecurity restrictions on the domestic movement of seeds and propagative material.
International trade	<p>A—Indiscernible at the local level</p> <p>The indirect impact of <i>Passalora malkoffii</i> on international trade would be indiscernible at the local, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> • <i>Passalora malkoffii</i> is not currently regulated by Australia's trading partners. Therefore, it is estimated that the introduction and spread of this pathogen in Australia would not result in restrictions on Australian exports of aniseed seeds and propagative material.
Environmental and non-commercial	<p>B—Minor significance at the local level</p> <p>The indirect impact of <i>Passalora malkoffii</i> on the environment would be of minor significance at the local level, and indiscernible at the district, regional and national levels, which has an impact score of 'B'.</p> <ul style="list-style-type: none"> • Introduction of <i>Passalora malkoffii</i> may result in additional fungicide use that causes minor damage to the local environment. For example, copper-based fungicide residues in the soil can be lethal to or inhibit growth and reproduction of soil invertebrates, in turn affecting soil processes such as the breakdown of plant litter (Wightwick et al. 2008).

Consequences of *Phomopsis diachenii*

The potential consequences of the entry, establishment and spread of *Phomopsis diachenii* in Australia have been estimated according to the methods described in Table 2.3.

Based on the decision rules described in Table 2.4, that is, where the potential consequences of a pest with respect to one or more (but not all) criteria have an impact of 'C', the overall consequences are estimated to be **Very Low**.

The supporting evidence for this assessment is provided.

Criterion	Estimated impact score and rationale
Direct	
Plant life or health	<p>C—Significant at the local level</p> <p>The direct impact of <i>Phomopsis diachenii</i> on plant life or health would be significant at the local level, of minor significance at the district level, and indiscernible at the regional and national levels, which has an impact score of 'C'.</p> <ul style="list-style-type: none"> • <i>Phomopsis diachenii</i> is an important pathogen of caraway in Germany (Gabler & Ehrig 2000). The fungus infects foliage and causes necrosis of above ground parts of caraway and parsnip, including umbels (inflorescences) (Gabler & Ehrig 2000), stems and fruit (Machowicz-Stefaniak, Zalewska & Król 2012). • Umbels infected at an early stage are partially discoloured and do not develop further resulting in sterile umbels (Gabler & Ehrig 2000). Infection of umbels at the later stage of development results in unripe fruits (seeds) (Gabler & Ehrig 2000). The germination of seeds sourced from infected fruit is significantly reduced (Gabler & Ehrig 2000). • No economic yield loss caused by <i>Phomopsis diachenii</i> has been reported for parsnip crops. • Caraway seed is not produced commercially in Australia, and the domestic market is entirely dependent on imported caraway seeds (Rahman et al. 2020).
Other aspects of the environment	<p>A—Indiscernible at the local level</p> <p>The direct impact of <i>Phomopsis diachenii</i> on other aspects of the environment would be indiscernible at the local, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> • No impact of <i>Phomopsis diachenii</i> has been reported on the environment internationally or domestically. • <i>Phomopsis diachenii</i> has a restricted host range and is only reported on caraway (Rodeva & Gabler 2004) and parsnip (Machowicz-Stefaniak, Zalewska & Król 2009). There is no evidence of this fungus infecting native or endangered flora.
Indirect	
Eradication, control, etc.	<p>A—Indiscernible at the local level</p> <p>The indirect impact of <i>Phomopsis diachenii</i> on eradication and control would be indiscernible at the local, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> • Eradication or containment of <i>Phomopsis diachenii</i> would be easily achieved through cultural practices such as crop rotation and fungicidal seed treatment. • Existing management measures to control other <i>Phomopsis</i> species in Australia are likely to be effective for control of this fungus.
Domestic trade	<p>C—Significant at the local level</p> <p>The indirect impact of <i>Phomopsis diachenii</i> on domestic trade would be significant at the local level, of minor significance at the district level, and indiscernible at the regional and national levels, which has an impact score of 'C'.</p> <ul style="list-style-type: none"> • The presence of <i>Phomopsis diachenii</i> could threaten economic viability through reduced trade or loss of domestic markets at the local level. Biosecurity measures to prevent the movement of plant material out of the initial incursion area could affect plant industries and business at the local level. • The introduction of <i>Phomopsis diachenii</i> into a state or territory could disrupt interstate trade due to biosecurity restrictions on the domestic movement of seeds and propagative material within Australia.
International trade	<p>A—Indiscernible at the local level</p>

Criterion	Estimated impact score and rationale
	<p>The indirect impact of <i>Phomopsis diachenii</i> on international trade would be indiscernible at the local, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> <i>Phomopsis diachenii</i> is not currently regulated by Australia's trading partners. Therefore, it is estimated that the introduction and spread of this pathogen in Australia would not result in restrictions on Australian exports of caraway seed and propagative material.
Environmental and non-commercial	<p>B—Minor significance at the local level</p> <p>The indirect impact of <i>Phomopsis diachenii</i> on the environment would be of minor significance at the local level, and indiscernible at the district, regional and national levels, which has an impact score of 'B'.</p> <ul style="list-style-type: none"> Introduction of <i>Phomopsis diachenii</i> may result in additional fungicide use that causes minor damage to the local environment. For example, copper-based fungicide residues in the soil can be lethal to or inhibit growth and reproduction of soil invertebrates, in turn affecting soil processes such as the breakdown of plant litter (Wightwick et al. 2008).

Consequences of *Strawberry latent ringspot virus*

The potential consequences of the entry, establishment and spread of *Strawberry latent ringspot virus* in Australia have been estimated according to the methods described in Table 2.3.

Based on the decision rules described in Table 2.4, that is, where the potential consequences of a pest with respect to one or more (but not all) criteria have an impact of 'E', the overall consequences are estimated to be **Moderate**.

The supporting evidence for this assessment is provided.

Criterion	Estimated impact score and rationale
Direct	
Plant life or health	<p>E—Major significance at the district level</p> <p>The direct impact of <i>Strawberry latent ringspot virus</i> (SLRSV) on plant life or health would be of major significance at the district level, significant at the regional level, and of minor significance at the national level, which has an impact score of 'E'.</p> <ul style="list-style-type: none"> SLRSV is an economically important virus that has an extensive host range and can cause significant yield losses (Tzanetakis et al. 2006). Symptoms caused by SLRSV include severe narrowing and twisting of leaves, bunchy growth, and deformed fruits in olive trees (Faggioli et al. 2002), 'shot-hole' leaf symptoms with chlorotic line patterns in cherry (Allen, Davidson & Briscoe 1970), mottling, yellowing, vein banding, and stunting in strawberry plants (El-Morsy et al. 2017), leafroll, reduced growth and mild foliar malformations in grapevine (Savino et al. 1987), smaller, crinkled leaves with incurved margins towards the centre of the plant in celery (Walkey & Mitchell 1969) and growth reduction, rosetting and dieback of peach trees (Smith et al. 1988). SLRSV may be symptomless in parsley (Bellardi & Bertaccini 1991) and parsnip (Hicks, Smith & Edwards 1986). Therefore, the presence of SLRSV in parsley and parsnip seed is a potential risk for crop production. The symptomless nature of SLRSV in parsley and parsnip may lead to these hosts serving as a reservoir for the spread of this virus to susceptible hosts. SLRSV can cause severe symptoms and economic losses in some crops (Murant 1987; Smith et al. 1988). Heavy yield losses associated with SLRSV infections

Criterion	Estimated impact score and rationale
Other aspects of the environment	<p>have been reported in grapevine (Martelli & Walter 1993; Rüdel 1985), and yield losses have also been reported for olive trees (Faggioli et al. 2002).</p> <p>C—Significant at the local level</p> <p>The direct impact of SLRSV on other aspects of the environment would be significant at the local level, of minor significance at the district level, and indiscernible at the regional level, which has an impact score of 'C'.</p> <ul style="list-style-type: none"> SLRSV has a very wide host range, including non-cultivated plant species (Smith et al. 1988). Therefore, it is possible this virus may infect native and/or endangered flora. However, no specific evidence of this has been found.
Indirect	
Eradication, control, etc.	<p>D—Significant at the district level</p> <p>The indirect impact of SLRSV on eradication and control would be of major significance at the local level, significant at the district level, and of minor significance at the regional level, which has an impact score of 'D'.</p> <ul style="list-style-type: none"> Impact of management activities could be expected to threaten economic viability through a large increase in costs for containment, destruction of infected crops, eradication and control at a district level. Containment and eradication is costly and would also cause disruption to Australia's agribusiness and associated trades at the district level. The absence of the nematode vectors of SLRSV (<i>Xiphinema diversicaudatum</i> and <i>Xiphinema coxi</i>) in Australia (CABI 2020; Plant Health Australia 2020) suggests adequate control can be achieved by the use of virus-free plants for propagation. However, SLRSV is also a mechanically transmissible virus (El-Morsy et al. 2017), which may increase the difficulty of controlling this virus. Virus control measures in the field are limited and eradication may not be feasible unless an outbreak is detected at an early stage. This virus may be symptomless in parsley and parsnip. Therefore, visual inspection and diagnosis of SLRSV-infected parsnip and parsley crops may not be effective (Bellardi & Bertaccini 1991; Hicks, Smith & Edwards 1986). Additionally, SLRSV is known to be capable of infecting a wide range of hosts, including but not limited to strawberry, raspberry, blackberry, blackcurrant, redcurrant, cherry, peach, plum, celery and asparagus (Tang, Ward & Clover 2013).
Domestic trade	<p>D—Significant at the district level</p> <p>The indirect impact of SLRSV on domestic trade would be of major significance at the local level, significant at the district level, and of minor significance at the regional level, which has an impact score of 'D'.</p> <ul style="list-style-type: none"> The presence of SLRSV could threaten economic viability through reduced trade or loss of domestic markets at the district level. Biosecurity measures to prevent the movement of plant material from the initial incursion area would affect plant industries and business at the district level. The introduction of SLRSV into a state or territory would disrupt interstate trade due to the biosecurity restrictions on the domestic movement for host vegetables, seeds and nursery stock.
International trade	<p>D—Significant at the district level</p> <p>The indirect impact of SLRSV on international trade would be of major significance at the local level, significant at the district level, and of minor significance at the regional level, which has an impact score of 'D'.</p> <ul style="list-style-type: none"> SLRSV is currently regulated by many of Australia's trading partners, including but not limited to China, Spain, South Africa and Vietnam, which require country freedom or other certification requirements to address the risk of SLRSV in imported host commodities (DAWE 2020b).

Criterion	Estimated impact score and rationale
	<ul style="list-style-type: none"> If SLRSV were to establish in Australia, trading partners may review their phytosanitary requirements to include additional measures such as testing of host plant commodities for freedom from SLRSV. This would add significant costs to nursery stock production in Australia.
Environmental and non-commercial	<p>A—Indiscernible at the local level</p> <p>The indirect impact of SLRSV on the environment would be indiscernible at the local, district, regional and national levels, which has an impact score of 'A'.</p> <ul style="list-style-type: none"> No evidence was found indicating environmental or non-commercial indirect effects.

3.2.1 Unrestricted risk estimate

Unrestricted risk is the result of combining the likelihood of entry, establishment and spread with the assessed outcome of consequences. Likelihoods and consequences are combined using the risk estimation matrix shown in Table 2.5. Table 3.2 summarises the unrestricted risk estimates for '*Candidatus Liberibacter solanacearum*', *Cercospora foeniculi*, *Diaporthe angelicae*, *Fusarium oxysporum* f. sp. *cumini*, *Passalora malkoffii*, *Phomopsis diachenii* and *Strawberry latent ringspot virus*.

Table 3.2 Unrestricted risk estimates for quarantine pests of apiaceous vegetable seeds for sowing

Pest name	Likelihood of			Consequences		URE
	Entry	Establishment	Spread	P[EES]		
Bacteria						
<i>'Candidatus Liberibacter solanacearum'</i> ^{EP}	High	High	High (Low)*	High (Low)*	Moderate	Moderate (Low)*
Fungi						
<i>Cercospora foeniculi</i>	High	High	Moderate	Moderate	Low	Low
<i>Diaporthe angelicae</i>	High	High	Moderate	Moderate	Low	Low
<i>Fusarium oxysporum</i> f. sp. <i>cumini</i>	High	High	Moderate	Moderate	Very Low	Very Low
<i>Passalora malkoffii</i>	High	High	Moderate	Moderate	Very Low	Very Low
<i>Phomopsis diachenii</i>	High	High	Moderate	Moderate	Very Low	Very Low
Viruses						
<i>Strawberry latent ringspot virus</i>	High	High	Moderate	Moderate	Moderate	Moderate

^{EP} Pests for which there is an existing policy.

* Estimates in brackets show assessed likelihoods in the absence of known vectors

3.2.2 Pest risk assessment conclusions

The unrestricted risk estimates for *Fusarium oxysporum* f. sp. *cumini*, *Passalora malkoffii* and *Phomopsis diachenii* achieve the ALOP for Australia. Accordingly, risk management measures are not required for these pests.

The unrestricted risk estimates for '*Candidatus Liberibacter solanacearum*', *Cercospora foeniculi*, *Diaporthe angelicae* and *Strawberry latent ringspot virus* do not achieve the ALOP for Australia. Accordingly, risk management measures are required for these pests.

4 Pest risk management

The quarantine pests (two fungi, one bacteria and one virus) identified in this review (see Table 3.1) present unrestricted risks that do not achieve the appropriate level of protection (ALOP) for Australia. Consequently, the department recommends risk management measures to reduce the risk posed by these pests to levels that achieve the ALOP for Australia.

The department has evaluated existing measures to determine whether alternative or additional measures are required to manage the risks associated with these seed-borne pathogens.

4.1 Existing import conditions for seeds for sowing

Standard conditions

Under Australia's existing policy, all seeds for sowing, including apiaceous vegetable seeds, are subject to the department's standard seeds for sowing import conditions.

These standard import conditions are:

- each shipment must be packed in clean, new packaging and be clearly labelled with the full botanical name of the species.
- where the seed lot is greater than 10 kilograms and contains seed of less than eight millimetres in diameter, mandatory International Seed Testing Association (ISTA) sampling of each consignment must be used to establish freedom from contamination including weed seeds. This testing may be performed at department approved ISTA laboratories overseas or on arrival in Australia. A biosecurity officer must conduct a visual inspection of each consignment on arrival in Australia to verify the results of the ISTA sampling, or collect a sample for analysis if testing was not conducted overseas.
- where the seed lot is less than or equal to 10 kilograms in weight, or contains seed of greater than eight millimetres in diameter, a biosecurity officer must conduct a visual inspection of each consignment on arrival in Australia for freedom from live insects, soil, disease symptoms, contaminant seed, other plant material (for example, leaf and stem material, fruit pulp, and/or pod material), animal material (for example, animal faeces and/or feathers) and any other extraneous contamination of biosecurity concern.

All consignments imported into Australia regardless of end-use (including seed for sowing) must meet departmental standards for seed contamination and tolerance.

Apiaceous vegetable seed other than *Anthriscus cerefolium*, *Apium graveolens*, *Daucus carota*, *Foeniculum vulgare*, *Pastinaca sativa* and *Petroselinum crispum* can be released from biosecurity control if these standard import conditions are met.

Specific measures

Seeds of *Anthriscus cerefolium*, *Apium graveolens*, *Daucus carota*, *Foeniculum vulgare*, *Pastinaca sativa* and *Petroselinum crispum* are subject to additional pest risk management measures (testing or treatment) for the presence of '*Candidatus Liberibacter solanacearum*'.

Each consignment of *Anthriscus cerefolium*, *Apium graveolens*, *Daucus carota*, *Foeniculum vulgare*, *Pastinaca sativa* and *Petroselinum crispum* must meet the following requirements:

- Polymerase Chain Reaction (PCR) testing on a sample of 20,000 seeds (or 20% of small seed lots) to verify freedom from detectable presence of '*Candidatus Liberibacter solanacearum*', OR
- hot water treatment (50°C for 20 minutes).

Seed lots tested or treated off-shore must be accompanied by an official government Phytosanitary Certificate endorsed with the additional declaration that the consignment has undergone mandatory treatment or testing in accordance with Australian import conditions.

Under the International Plant Protection Convention (IPPC) and World Trade Organisation (WTO) SPS Agreement, phytosanitary measures against the introduction of new pests must be technically justified. As part of this review, the department evaluated the appropriateness of the existing measures to determine if alternative or additional measures are required for the identified seed-borne pathogens.

4.2 Recommended risk management measures

This review recommends that apiaceous vegetable seeds for sowing should be subject to:

- the department's standard seeds for sowing import conditions, AND
- additional mandatory treatment and/or testing for quarantine pests identified as associated with apiaceous vegetable seeds, to manage the risk of their introduction.

The department recommends that where PCR testing is required, the seed sample should be drawn prior to any treatment of seeds.

4.2.1 Species that remain subject to standard seeds for sowing import conditions

Most apiaceous vegetable seeds species reviewed were not found to be hosts of quarantine pests for Australia and will therefore remain subject to the department's standard seeds for sowing import conditions.

The apiaceous species that will remain subject to standard seeds for sowing import conditions are *Anethum graveolens*, *Angelica archangelica*, *Angelica atropurpurea*, *Angelica dahurica*, *Angelica gigas*, *Angelica glauca*, *Angelica pachycarpa*, *Angelica pubescens*, *Angelica setchuenensis*, *Angelica sinensis*, *Angelica sylvestris*, *Angelica taiwaniana*, *Angelica triquinata*, *Angelica ursina*, *Anthriscus caucalis*, *Anthriscus sylvestris*, *Apium prostratum*, *Carum carvi*, *Carum copticum*, *Coriandrum sativum*, *Cuminum cyminum*, *Daucus glochidiatus*, *Pimpinella anisum*, *Pimpinella leptophylla* and *Pimpinella saxifraga*.

4.2.2 Species requiring additional measures

The department recommends testing and/or treatment to manage the risks posed by the identified quarantine pests associated with *Anthriscus cerefolium*, *Apium graveolens*, *Daucus carota*, *Foeniculum vulgare*, *Petroselinum crispum* and *Pastinaca sativa*, including their synonyms or subordinate taxa as listed in Table 1.1. These requirements are in addition to the standard seeds for sowing import conditions.

4.2.3 Testing or treatment options

Four quarantine pests were identified as associated with apiaceous vegetable seeds for sowing: '*Candidatus Liberibacter solanacearum*', *Cercospora foeniculi*, *Diaporthe angelicae* and *Strawberry latent ringspot virus* (SLRSV). Consequently, additional risk management measures against these pests are required to achieve the ALOP for Australia.

Three risk management options are recommended:

- Option 1. PCR test—an option that is applicable to all four identified quarantine pests.
 - PCR test using sample size of 20,000 seeds or 20% of small seed lots to verify freedom from detectable presence of '*Candidatus Liberibacter solanacearum*', *Cercospora foeniculi*, *Diaporthe angelicae* and SLRSV.
- Option 2. Broad-spectrum fungicidal treatment—an option that is applicable to *Cercospora foeniculi* and *Diaporthe angelicae*.
- Option 3. Hot water treatment—an option that is applicable to '*Candidatus Liberibacter solanacearum*'.
 - Directly immerse seed in hot water at 50°C for 20 minutes for '*Candidatus Liberibacter solanacearum*'.

4.2.4 Additional PCR testing protocols

PCR testing is recommended as an option to manage the risks posed by '*Candidatus Liberibacter solanacearum*', *Cercospora foeniculi*, *Diaporthe angelicae* and SLRSV.

PCR testing for '*Candidatus Liberibacter solanacearum*' is currently in place for apiaceous host seeds under existing policy. The department is in the process of validating the required PCR testing protocols for *Cercospora foeniculi*, *Diaporthe angelicae* and SLRSV. When this work is completed, the department will publish the approved protocols on its website. All stakeholders will be notified by a formal Biosecurity Import Conditions (BICON) alert before the required PCR testing for these pests (on-shore or off-shore) commences.

The department may consider other proposed PCR testing protocols on a case-by-case basis. NPPOs that propose other PCR testing protocols must provide the department with an appropriate submission with evidence of test efficacy for its consideration.

4.2.5 Phytosanitary certification

Off-shore tested seed lots

Seed lots of *Anthriscus cerefolium*, *Apium graveolens*, *Daucus carota*, *Foeniculum vulgare*, *Petroselinum crispum* and *Pastinaca sativa* that are tested off-shore must be accompanied by the laboratory test report and an official government Phytosanitary Certificate endorsed with the following additional declaration:

- 'The consignment of [*botanical name(s) (Genus species)*] comprises [*insert number of apiaceous vegetable seed lots*] seed lot(s); for each seed lot, seeds were tested by PCR [*insert laboratory name(s) and report number(s)*] on a sample size of [*insert sample size i.e. 20,000 seeds or 20% of small seed lots*] and found free from [*name of the pests*];

Off-shore treated seed lots

Seed lots of *Daucus carota* and *Foeniculum vulgare* that are treated with fungicide off-shore must be accompanied by an official government Phytosanitary Certificate endorsed with the following additional declarations:

- 'The consignment of [*botanical name(s) Genus species*] comprises [*insert seed lot numbers*] seed lot(s); for each seed lot, seed were treated with the broad-spectrum fungicide [*insert name and active ingredient and dosage*] for control of [*name of pests*].'

Seed lots of *Anthriscus cerefolium*, *Apium graveolens*, *Daucus carota*, *Foeniculum vulgare*, *Petroselinum crispum* and *Pastinaca sativa* that are treated with hot water off-shore must be accompanied by an official government Phytosanitary Certificate endorsed with the following additional declarations:

- 'The consignment of [*botanical name(s) Genus species*] comprises [*insert seed lot numbers*] seed lot(s); for each seed lot, seed were directly immersed in hot water at 50°C for 20 minutes for control of '*Candidatus Liberibacter solanacearum*'.

4.2.6 Summary of additional risk management measures

The additional pest risk management measures for apiaceous vegetable seeds that are associated with the identified quarantine pests are summarised in Table 4.1.

Table 4.1 Summary of additional pest risk management measures for hosts of identified quarantine pests

Host species (a)	Pathogens	Option 1 (PCR test) (b)	Option 2 (Fungicide treatment) (c)	Option 3 (Hot water treatment) (b)
<i>Anthriscus cerefolium</i>	' <i>Candidatus Liberibacter solanacearum</i> '	Yes	–	Yes
<i>Apium graveolens</i>	' <i>Candidatus Liberibacter solanacearum</i> '	Yes	–	Yes
<i>Daucus carota</i>	' <i>Candidatus Liberibacter solanacearum</i> '	Yes	–	Yes
	<i>Diaporthe angelicae</i>	Yes	Yes	–
<i>Foeniculum vulgare</i>	' <i>Candidatus Liberibacter solanacearum</i> '	Yes	–	Yes
	<i>Cercospora foeniculi</i>	Yes	Yes	–
<i>Pastinaca sativa</i>	' <i>Candidatus Liberibacter solanacearum</i> '	Yes	–	Yes
	SLRSV	Yes	–	–
<i>Petroselinum crispum</i>	' <i>Candidatus Liberibacter solanacearum</i> '	Yes	–	Yes
	SLRSV	Yes	–	–

(a) Including hybrids of the species.

(b) Options 1 and 3 do not impact the organic status of seeds.

(c) For Option 2, the removal of fungicide from the seed prior to planting is not permitted.

4.3 Evaluation of recommended risk management measures

The recommended pest risk management measures (Table 4.2) are designed to reduce the pest risk for each identified quarantine pest to a very low level, which will achieve the ALOP for Australia.

Table 4.2 Evaluation of the recommended pest risk management measures impact on risk estimates

Recommended measure	Effect of the measure	Risk estimates after measures (restricted risk)
Option 1. PCR test	Testing to verify freedom from detectable presence of ' <i>Candidatus</i> Liberibacter solanacearum', <i>Cercospora foeniculi</i> , <i>Diaporthe angelicae</i> and SLRSV will reduce the risk of introducing these pests into Australia.	Very low
Option 2. Broad-spectrum fungicidal treatment	Treatment of seeds with an effective broad-spectrum fungicide will reduce the risk of introducing <i>Cercospora foeniculi</i> and <i>Diaporthe angelicae</i> into Australia.	Very low
Option 3. Hot water treatment	Treatment of seeds with hot water will reduce the risk of introducing ' <i>Candidatus</i> Liberibacter solanacearum' into Australia.	Very low

4.4 Seeds imported for sprouting or micro-greens production

Apiaceous vegetable seeds imported for the end-use of sprouting or micro-greens production for human consumption are currently subject to the department's standard seeds for sowing import conditions.

Anthriscus cerefolium, *Apium graveolens*, *Daucus carota*, *Foeniculum vulgare*, *Petroselinum crispum* and *Pastinaca sativa* seeds used for sprouting or micro-greens production are exempt from the additional measures for seeds for sowing if imported directly for germination at a production facility operated under an Approved Arrangement.

Facilities that operate under an Approved Arrangement will be required to demonstrate the existence of processes to ensure that seeds imported for the intended end-use of sprouting or micro-greens production will not be diverted for other purposes, and that other biosecurity risks are managed appropriately. Details of the requirements for registration and operation of an Approved Arrangement for the importation of apiaceous vegetable seeds for sprouting or micro-greens production are available on the department's website:

<http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/import/arrival/approved-arrangements/3.0-requirements.pdf>.

Departmental approval of an Approved Arrangement is subject to a range of requirements that include assessment of standard operating procedures, and pre-approval audit and verification processes.

Anthriscus cerefolium, *Apium graveolens*, *Daucus carota*, *Foeniculum vulgare*, *Petroselinum crispum* and *Pastinaca sativa* seeds that are not directly imported to be germinated at a production facility operated under an Approved Arrangement will require additional measures as specified in Section 4.2.

4.5 Alternative measures for seeds for sowing

Australia recognises the principle of equivalence as defined in ISPM 5, namely, '*the situation where, for a specified pest risk, different phytosanitary measures achieve a contracting party's appropriate level of protection*' (FAO 2019b). ISPM 24 (FAO 2017d) provides guidelines for the determination and recognition of equivalence of phytosanitary measures.

Where formal recognition of equivalence is required, the NPPO of the exporting country must provide a technical submission detailing relevant evidence for the proposed measures for consideration by the department.

Several ISPMs provide further guidance on alternative pest risk management options that may be appropriate to achieve the objective of freedom from the quarantine pests identified in this review. These include:

- ISPM 4: *Requirements for the establishment of pest free areas* (FAO 2017b)
- ISPM 10: *Requirements for the establishment of pest free places of production and pest free production sites* (FAO 2016c)
- ISPM 14: *The use of integrated measures in a systems approach for pest risk management* (FAO 2019d).

These alternative pest risk management options are discussed in the following sections.

4.5.1 Sourcing seeds from pest free areas

The establishment and use of a pest free area (PFA) by an NPPO provides assurance that specific pests are not present in a delimited geographic area. The delimitation of a PFA should be relevant to the biology of the pest concerned.

The requirements for establishing PFAs are set out in ISPM 4 (FAO 2017b). This ISPM defines a PFA as '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'. A PFA may concern all or part of several countries and is managed by the NPPO of the exporting country. The establishment and use of a PFA by an NPPO allows an exporting country to export plants and other regulated articles to an importing country without having to apply additional phytosanitary measures providing certain requirements are met.

Requirements for an NPPO to establish and maintain a PFA include:

- systems to establish freedom (general surveillance and specific surveys)
- phytosanitary measures to maintain freedom (regulatory actions, routine monitoring, and extension advice to producers)
- checks to verify freedom has been maintained.

NPPOs that propose to use area freedom as a measure for managing risks posed by the quarantine pests identified in this review must provide the Department of Agriculture, Water and the Environment with an appropriate submission demonstrating area freedom for its consideration.

4.5.2 Sourcing seeds from pest free places of production

Requirements for establishing pest free places of production are set out in ISPM 10 (FAO 2016c). The concept of ‘pest freedom’ allows exporting countries to provide assurance to importing countries that plants, plant products and other regulated articles are free from a specific pest or pests and meet the phytosanitary requirements of the importing country. Where a defined portion of a place of production is managed as a separate unit and can be maintained pest free, it may be regarded as a pest free production site.

Requirements for an NPPO to establish and maintain a pest free place of production or a pest free production site as a phytosanitary measure include:

- systems to establish pest freedom
- systems to maintain pest freedom
- verification that pest freedom has been attained or maintained
- product identity, consignment integrity and phytosanitary security.

Where necessary, a pest free place of production or a pest free production site must also establish and maintain an appropriate buffer zone.

Administrative activities required to support a pest free place of production or a pest free production site include documentation of the system and maintenance of adequate records about the measures taken. Review and audit procedures undertaken by an NPPO are essential to support assurance of pest freedom and for system appraisal. Bilateral agreements or arrangements may also be needed.

NPPOs that propose to use pest free places of production as a measure for managing risks posed by the quarantine pests identified in this review must provide the Department of Agriculture, Water and the Environment with an appropriate submission demonstrating pest free place of production status, for its consideration.

4.5.3 Sourcing seeds produced under a systems approach

ISPM 14 (FAO 2019d) provides guidelines on the use of systems approaches to manage pest risk. According to ISPM 14 (FAO 2019d), ‘a systems approach requires the integration of different measures, at least two of which act independently, with a cumulative effect’ to achieve the appropriate level of protection.

A systems approach could provide an alternative to relying on a single measure to achieve the ALOP of an importing country or could be used where no single measure is available. A systems approach is often tailored to specific commodity–pest–origin combinations and may be developed and implemented collaboratively by exporting and importing countries. The importing country specifies the appropriate approach after considering technical requirements, minimal impact, transparency, non-discrimination, equivalence and operational feasibility.

NPPOs that propose to use a systems approach as a measure for managing risks posed by the quarantine pests identified in this review must provide the Department of Agriculture, Water and the Environment with an appropriate submission describing their preferred systems approach and rationale, for its consideration.

4.5.4 Consideration of additional potential alternative options raised by stakeholders

After the release of the *Draft review of import conditions for apiaceous crop seeds for sowing into Australia*, the department received several responses from stakeholders, including from the organic sector, about potential alternative risk mitigation measures to the proposed mandatory fungicidal treatment. In preparing this final report, consideration has been given to a broad range of these potential alternative options, details of which are provided in Appendix C.

4.6 Review of import conditions

The department reserves the right to review these import conditions if there is reason to believe that the pest or phytosanitary status of these organisms has changed or is likely to change. Similarly, a review may be required, for example, where scientific evidence or other information subsequently becomes available which improves knowledge of, or decreases uncertainty in treatment efficacy and/or the equivalence of measures.

Since publication of *Final pest risk analysis for 'Candidatus Liberibacter solanacearum' associated with apiaceous crops* in September 2017, there have been conflicting reports as to whether this bacterium is seed transmissible. The department is currently co-sponsoring a globally distributed multi-laboratory research investigation into the potential for transmission of 'Candidatus Liberibacter solanacearum' from contaminated carrot seeds to progeny seedlings. When the results of that investigation are available, the department anticipates making a further examination of the relevant import conditions.

5 Conclusion

The findings of this review of import conditions for apiaceous vegetable seeds are based on a comprehensive scientific analysis of relevant literature.

The Department of Agriculture, Water and the Environment considers that the risk management measures recommended in this report will provide an appropriate level of protection against the identified quarantine pests associated with apiaceous vegetable seeds intended for sowing.

Appendix A: Pest categorisation of pathogens associated with Apiaceae species in scope

Pest categorisation determines whether the formal criteria for classification of a pest organism as a quarantine pest are satisfied. The process is based on the identity of the pest, its presence or absence in the pest risk analysis (PRA) area, regulatory status, potential for entry, establishment and spread in the PRA area, and potential for economic (including environmental) consequences in the PRA area (FAO 2019c).

Appendix A identifies pests that affect the apiaceous vegetables under review from a worldwide perspective, and considers their status in Australia. It also identifies any region in Australia in which legislation governing that region lists the pest as prohibited. Regional pests are considered further if they are absent from the region, or present and under official control in the region as defined by the International Plant Protection Convention (FAO 2019b).

Estimates of each pest's potential for creating economic consequences is based on the assessment of its likelihood of meeting the ISPM 5 definition of a quarantine pest.

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Bacteria						
' <i>Candidatus</i> Liberibacter solanacearum' Liefting et al. 2009 (haplotypes C, D & E) (' <i>Ca. L. solanacearum</i> ') [Rhizobiales: Phyllobacteriaceae]	<i>Anthriscus</i> , <i>Apium</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Not known to occur	Yes: seeds provide a pathway for this bacterium, which has been reported as seed-borne in <i>Apium graveolens</i> , (Monger & Jeffries 2018), <i>Daucus carota</i> (Bertolini et al. 2015), <i>Foeniculum vulgare</i> (Monger & Jeffries 2018), <i>Petroselinum crispum</i> (Monger & Jeffries 2016) and <i>Pastinaca sativa</i> (Monger & Jeffries 2018). This bacterium has also been reported naturally occurring on <i>Anthriscus</i> sp. (Hajri et al. 2017).	Yes: if introduced via the seed pathway, ' <i>Ca. L. solanacearum</i> ' could establish and spread in Australia. ' <i>Ca. L. solanacearum</i> ' associated with apiaceous crops has established in areas with a wide range of climatic conditions (Haapalainen 2014). Additionally, ' <i>Ca. L. solanacearum</i> ' is known to be transmitted by multiple psyllid vectors (DAWR 2017). Spread of this bacterium from the seed pathway could occur via human-mediated transport of infected planting material or psyllid vectors.	Yes: ' <i>Candidatus</i> Liberibacter solanacearum' is an economically important pathogen of apiaceous crops (Haapalainen 2014) and has the potential for economic consequences in Australia. Vegetative disorders associated with ' <i>Ca. L. solanacearum</i> ' in Spain have caused severe economic losses in carrot production for the fresh vegetable market (Bertolini et al. 2015). Additionally, ' <i>Ca. L. solanacearum</i> ' haplotype C is known to cause curling of stems and yellowing in celery, with severely affected plants becoming unmarketable (Teresani et al. 2014).	Yes (EP)

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Dickeya chrysanthemi</i> (Burkholder et al. 1953) Samson et al. 2005 [Enterobacterales: Enterobacteriaceae] (synonym: <i>Erwinia chrysanthemi</i> Burkholder et al. 1953)	<i>Daucus</i>	Yes (Stirling 2002)	Assessment not required	Assessment not required	Assessment not required	No
<i>Dickeya parthenii</i> Samson et al. 2005 [Enterobacterales: Enterobacteriaceae] (synonym: <i>Erwinia chrysanthemi</i> pv. <i>parthenii</i> (Starr) Dye)	<i>Apium</i>	Not known to occur	No: this bacterium has been reported occurring on <i>Apium</i> species (Bradbury 1986), but no published evidence was found indicating this bacterium is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this bacterium.	Assessment not required	Assessment not required	No
<i>Erwinia persicina</i> Hao et al. 1990 [Enterobacterales: Erwiniaceae]	<i>Petroselinum</i>	Not known to occur	No: this bacterium has been reported occurring on <i>Petroselinum crispum</i> (Nechwatal & Theil 2019), but no published evidence was found indicating this bacterium is seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this bacterium.	Assessment not required	Assessment not required	No
<i>Klebsiella variicola</i> Rosenblueth et al. 2004 [Enterobacterales: Enterobacteriaceae]	<i>Daucus</i>	Yes (Barrios-Camacho et al. 2019)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Pectobacterium carotovorum</i> subsp. <i>carotovorum</i> (Jones 1901) Gardan et al. 2003 [Enterobacterales: Enterobacteriaceae] (synonym: <i>Erwinia carotovora</i> subsp. <i>carotovora</i> (Jones 1901) Bergey et al. 1923)	<i>Apium</i> , <i>Daucus</i> , <i>Pastinaca</i>	Yes (Peltzer & Sivasithamparam 1985)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pseudomonas cichorii</i> (Swingle 1925) Stapp 1928 [Pseudomonadales: Pseudomonadaceae]	<i>Apium</i> , <i>Daucus</i>	Yes (Bradbury 1986; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pseudomonas marginalis</i> (Brown 1918) [Pseudomonadales: Pseudomonadaceae]	<i>Daucus</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020; Wimalajeewa, Hayward & Price 1985)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pseudomonas syringae</i> pv. <i>apii</i> (Jagger 1921) Young et al. 1978 [Pseudomonadales: Pseudomonadaceae] (synonym: <i>Pseudomonas apii</i> Jagger 1921)	<i>Apium</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Persley, Cooke & House 2010). The <i>Biosecurity and Agriculture Management (BAM) Act 2007</i> of Western Australia prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Pseudomonas syringae</i> pv. <i>coriandricola</i> Toben & Rudolph 1996 [Pseudomonadales: Pseudomonadaceae]	<i>Coriandrum</i> , <i>Daucus</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No
<i>Pseudomonas viridiflava</i> (Burkholder 1930) Dowson 1939 [Pseudomonadales: Pseudomonadaceae]	<i>Anethum</i> , <i>Apium</i> , <i>Pastinaca</i>	Yes (Persley, Cooke & House 2010)	Assessment not required	Assessment not required	Assessment not required	No
<i>Rhizobium radiobacter</i> (Beijerinck & van Delden 1902) Young et al. 2001 [Rhizobiales: Rhizobiaceae] (synonym: <i>Agrobacterium tumefaciens</i> (Smith & Townsend 1907) Conn 1942)	<i>Anthriscus</i> , <i>Apium</i> , <i>Carum</i> , <i>Daucus</i> , <i>Pastinaca</i>	Yes (Ophel et al. 1988; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Rhizobium rhizogenes</i> (Riker et al. 1930) Young et al., 2001 [Rhizobiales: Rhizobiaceae] (synonym: <i>Agrobacterium rhizogenes</i> (Riker et al. 1930) Conn 1942)	<i>Daucus</i>	Yes (Bradbury 1986)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Spiroplasma citri</i> Saglio et al. 1973 [Entomoplasmatales: Spiroplasmataceae]	<i>Apium</i> , <i>Daucus</i> , <i>Petroselinum</i>	Not known to occur	No: this bacterium has been reported occurring on <i>Apium</i> , and <i>Petroselinum</i> species (Gera et al. 2011; Nejat, Vadamalai & Dickinson 2011). It is reported to be seed transmitted in <i>Daucus carota</i> (Alfaro-Fernández et al. 2017), but since publication of this paper, no verified evidence was found indicating this bacterium is seed-borne in any hosts including <i>Daucus carota</i> . Seeds of apiaceous vegetables are not considered to provide a pathway for this bacterium.	Assessment not required	Assessment not required	No
<i>Streptomyces scabiei</i> (ex Thaxter 1891) Lambert and Loria 1989[Actinomycetales: Streptomycetaceae]	<i>Daucus</i> , <i>Pastinaca</i>	Yes (Horne, de Boer & Crawford 2002)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Xanthomonas campestris</i> pv. <i>coriandri</i> (Srinivasan et al.) Dye [Xanthomonadales: Xanthomonadaceae]	<i>Coriandrum</i>	Not known to occur	No: this bacterium has been reported occurring on <i>Coriandrum</i> species and causes leaf spot (Bradbury 1986), but no published evidence was found indicating this bacterium is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this bacterium.	Assessment not required	Assessment not required	No
<i>Xanthomonas hortorum</i> pv. <i>carotae</i> (Kendrick) Vauterin et al. 1995 [Xanthomonadales: Xanthomonadaceae] (synonym: <i>Xanthomonas campestris</i> pv. <i>carotae</i> (Kendrick 1934) Dye 1978)	<i>Coriandrum</i> , <i>Daucus</i>	Yes (EPPO 2020; Persley, Cooke & House 2010)	Assessment not required	Assessment not required	Assessment not required	No
Chromalveolata						
<i>Aphanomyces euteiches</i> Drechsler [Saprolegniales: Leptogleniaceae]	<i>Apium</i>	Yes (Watson 2011)	Assessment not required	Assessment not required	Assessment not required	No
<i>Globisporangium debaryanum</i> (Hesse) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium debaryanum</i> Hesse)	<i>Apium</i> , <i>Daucus</i> , <i>Petroselinum</i>	Yes (Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Globisporangium echinulatum</i> (Matthews) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium echinulatum</i> Matthews)	<i>Daucus</i>	Yes (Cook & Dubé 1989; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Globisporangium hypogynum</i> (Middleton) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium hypogynum</i> Middleton)	<i>Petroselinum</i>	Not known to occur	No: this chromalveolata has been reported occurring on <i>Petroselinum</i> species (Lévesque, Harlton & de Cock 1998), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this chromalveolata.	Assessment not required	Assessment not required	No
<i>Globisporangium recalcitrans</i> (Belbahri & Moralejo) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium recalcitrans</i> Belbahri & Moralejo)	<i>Daucus</i>	Not known to occur	No: this chromalveolata has been reported occurring on roots of <i>Daucus</i> species (Lu, Jiang & Hao 2013), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this chromalveolata.	Assessment not required	Assessment not required	No
<i>Globisporangium intermedium</i> (de Bary) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium intermedium</i> de Bary)	<i>Daucus</i>	Yes (Cook & Dubé 1989; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Globisporangium irregulare</i> (Buisman) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium irregulare</i> Buisman)	<i>Apium</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Davison et al. 2003)	Assessment not required	Assessment not required	Assessment not required	No
<i>Globisporangium mastophorum</i> (Drechsler) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium mastophorum</i> Drechsler)	<i>Apium</i> , <i>Petroselinum</i>	Yes (Davison & Bumbieris 1973). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No
<i>Globisporangium paroecandrum</i> (Drechsler) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium paroecandrum</i> Drechsler)	<i>Apium</i> , <i>Daucus</i>	Yes (Cook & Dubé 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Globisporangium rostratum</i> (Butler) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium rostratum</i> Butler)	<i>Daucus</i>	Yes (Cook & Dubé 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Globisporangium spinosum</i> (Sawada) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium spinosum</i> Sawada)	<i>Daucus</i>	Yes (Shivas 1989; Zahid et al. 2001)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Globisporangium sylvaticum</i> (Campb. & Hendrix) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium sylvaticum</i> Campb. & Hendrix)	<i>Apium</i> , <i>Daucus</i> , <i>Pastinaca</i>	Yes (Petkowski et al. 2013). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No
<i>Globisporangium ultimum</i> (Trow) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium ultimum</i> Trow)	<i>Apium</i> , <i>Coriandrum</i> , <i>Daucus</i>	Yes (Davison et al. 2003; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Globisporangium violae</i> (Chesters & Hickman) Uzuhashi, Tojo & Kakish [Peronosporales: Pythiaceae] (synonym: <i>Pythium violae</i> Chester & Hickman)	<i>Daucus</i>	Yes (Davison et al. 2003). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora cactorum</i> (Lebert & Cohn) Schröt. [Peronosporales: Peronosporaceae] (synonym: <i>Phytophthora omnivora</i> de Bary)	<i>Daucus</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora capsici</i> Leonian [Peronosporales: Peronosporaceae]	<i>Daucus</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Phytophthora cryptogea</i> Pethybr. & Laff. [Peronosporales: Peronosporaceae]	<i>Apium</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020; Zahid et al. 2001)	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora dauci</i> Bertier et al. [Peronosporales: Peronosporaceae]	<i>Daucus</i>	Yes (Bertier et al. 2013)	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora drechsleri</i> Tucker [Peronosporales: Peronosporaceae]	<i>Daucus</i> , <i>Pastinaca</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora megasperma</i> Drechsler [Peronosporales: Peronosporaceae]	<i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020; Zahid et al. 2001)	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora nicotianae</i> Breda de Haan [Peronosporales: Peronosporaceae] (synonym: <i>Phytophthora parasitica</i> Dastur)	<i>Coriandrum</i> , <i>Daucus</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora porri</i> Foister [Peronosporales: Peronosporaceae]	<i>Daucus</i>	Yes (Cook & Dubé 1989; Plant Health Australia 2020). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Phytophthora syringae</i> (Kleb.) Kleb. [Peronosporales: Peronosporaceae]	<i>Foeniculum</i>	Yes (Cook & Dubé 1989; Plant Health Australia 2020). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No
<i>Plasmopara anethi</i> Jermal. [Peronosporales: Peronosporaceae]	<i>Anethum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> species causing downy mildew disease (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Plasmopara apii</i> Săvul. & Săvul. [Peronosporales: Peronosporaceae]	<i>Apium</i>	Not known to occur	No: this fungus has been reported occurring on <i>Apium</i> species causing downy mildew disease (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Plasmopara archangelicae</i> Gapon. [Peronosporales: Peronosporaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species causing downy mildew disease (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Plasmopara dauci</i> Săvul. & Săvul. [Peronosporales: Peronosporaceae]	<i>Daucus</i> , <i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> and <i>Pastinaca</i> species (Farr & Rossman 2020; Watson 1971), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Plasmopara mei-foeniculi</i> Săvul. & Săvul. [Peronosporales: Peronosporaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species causing downy mildew disease (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Plasmopara nivea</i> (Unger) Schröt. [Peronosporales: Peronosporaceae] (synonyms: <i>Plasmopara angelicae</i> (Casp.) Trotter; <i>Plasmopara crustosa</i> (Fr.) Jørst; <i>Plasmopara umbelliferarum</i> (Casp.) Schröt. ex Wartenw.; <i>Plasmopara chaerophylli</i> (Casp.) Trotter; <i>Plasmopara pimpinellae</i> Trevis & Săvul.)	<i>Anethum</i> , <i>Angelica</i> , <i>Anthriscus</i> , <i>Apium</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Not known to occur	No: this chromalveolata has been reported occurring on <i>Angelica</i> , <i>Anthriscus</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i> and <i>Pimpinella</i> species causing downy mildew disease (Farr & Rossman 2020), but insufficient published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this chromalveolata.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Plasmopara pastinacae</i> Săvul. & Săvul. [Peronosporales: Peronosporaceae]	<i>Pastinaca</i>	Not known to occur	No: this chromalveolata has been reported occurring on <i>Pastinaca</i> species (Voglmayr et al. 2004), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this chromalveolata.	Assessment not required	Assessment not required	No
<i>Plasmopara petroselini</i> Săvul. & Săvul. [Peronosporales: Peronosporaceae]	<i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Petroselinum</i> species (Müller & Kokeš 2008), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Pythium afertile</i> Kanouse & Humphrey [Peronosporales: Pythiaceae]	<i>Daucus</i>	Yes (Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pythium aphanidermatum</i> (Edson) Fitzp. [Peronosporales: Pythiaceae]	<i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Pythium catenulatum</i> Matthews [Peronosporales: Pythiaceae] (synonym: <i>Globisporangium carolinianum</i> (Matthews) Uzuhashi et al.)	<i>Daucus</i>	Not known to occur	No: this chromalveolata has been reported occurring on <i>Daucus</i> species (Ho 2013), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this chromalveolata.	Assessment not required	Assessment not required	No
<i>Pythium coloratum</i> Vaartaja [Peronosporales: Pythiaceae]	<i>Apium</i> , <i>Daucus</i>	Yes (Davison et al. 2003; El-Tarabily, Hardy & Sivasithamparam 1997)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pythium oligandrum</i> Drechsler [Peronosporales: Pythiaceae]	<i>Daucus</i>	Yes (Cook & Dubé 1989; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pythium scleroteichum</i> Drechsler [Peronosporales: Pythiaceae]	<i>Daucus</i>	Yes (Cook & Dubé 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pythium sulcatum</i> Pratt & Mitch. [Peronosporales: Pythiaceae]	<i>Apium</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Davison & McKay 2003)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pythium torulosum</i> Coker & Patt. [Peronosporales: Pythiaceae]	<i>Daucus</i> , <i>Petroselinum</i>	Yes (Davison et al. 2003; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
Fungi						

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Absidia glauca</i> Hagem [Mucorales: Cunninghamellaceae]	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Absidia spinosa</i> Lendn. [Mucorales: Cunninghamellaceae]	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Acremonium apii</i> (Sm. & Ramsey) Gams [Hypocreales: Incertae sedis] (synonym: <i>Cephalosporium apii</i> Sm. & Ramsey)	<i>Apium</i>	Not known to occur	No: this soil-borne fungus has been reported occurring on <i>Apium</i> species (Davis & Raid 2002), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Acremoniella atra</i> (Corda) Sacc. [Incertae sedis: Incertae sedis]	<i>Anethum</i> , <i>Carum</i> , <i>Daucus</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Anethum graveolens</i> , <i>Carum carvi</i> and <i>Daucus carota</i> and is carried by the seeds of these hosts (Szopińska et al. 2012), (Mačkinitė 2011; Szopińska et al. 2008; Tyłkowska, Serbiak & Szopińska 2015).	Yes: if introduced via the seed pathway, this fungus could establish and spread in Australia. <i>Acremoniella atra</i> has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Acrostalagmus annulatus</i> (Berk. & Broome) Seifert [Incertae sedis: Incertae sedis] (synonym: <i>Stilbella annulate</i> (Berk. & Broome) Seifert)	<i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pastinaca</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Aecidium carotinum</i> Bubák [Pucciniales: Incertae sedis]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Duke 1993), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Aecidium distinctum</i> Arthur & Cummins [Pucciniales: Incertae sedis]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Arthur & Cummins 1933), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Aecidium foeniculi</i> Castagne [Pucciniales: Incertae sedis]	<i>Daucus</i> , <i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> and <i>Foeniculum</i> species (Farr & Rossman 2020; Strandberg 2000), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Aecidium petroselini-sativi</i> Săvul. [Pucciniales: Incertae sedis]	<i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Petroselinum</i> species causing spotting on leaves (Farr & Rossman 2020; Savulescu 1939), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Aegerita candida</i> Pers. [Polyporales: Meruliaceae] (synonym: <i>Bulbillomyces farinosus</i> (Bres.) Jülich)	<i>Coriandrum</i> , <i>Cuminum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Alternaria alternariae</i> (Cooke) Woudenb. & Crous [Pleosporales: Pleosporaceae] (synonym: <i>Sinomyces alternariae</i> (Cooke) Yong Wang et al.)	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Woudenberg et al. 2013), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Alternaria alternata</i> (Fr.) Keissl. [Pleosporales: Pleosporaceae] (synonyms: <i>Alternaria amaranthi</i> (Peck) Hook; <i>Alternaria daucifolii</i> Simmons; <i>Alternaria palandui</i> Ayyangar; <i>Alternaria tenuis</i> Nees; <i>Alternaria tenuissima</i> Nees & Nees)	<i>Anethum</i> , <i>Apium</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria atra</i> (Preuss) Woudenb. & Crous [Pleosporales: Pleosporaceae] (synonyms: <i>Ulocladium atrum</i> Preuss; <i>Stemphylium atrum</i> (Preuss) Sacc.)	<i>Daucus</i>	Yes (David 1995; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Alternaria atrocariis</i> Simmons [Pleosporales: Pleosporaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Simmons 2007), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Alternaria brassicae</i> (Berk.) Sacc. [Pleosporales: Pleosporaceae]	<i>Daucus</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria burnsii</i> Uppal et al. [Pleosporales: Pleosporaceae]	<i>Apium</i> , <i>Cuminum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Cuminum cyminum</i> (Özer & Bayraktar 2019). This fungus has also been reported occurring on <i>Apium</i> and <i>Cuminum</i> species (Farr & Rossman 2020).	Yes: if introduced via the seed pathway this fungus could establish and spread in Australia. <i>Alternaria burnsii</i> has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: <i>Alternaria burnsii</i> is a significant pest of cumin in India (Singh et al. 2018; Singh et al. 2016). However, <i>Alternaria burnsii</i> has previously been assessed and, considering the small size of the cumin industry in Australia, it was not considered to be of significant economic consequence for Australia (DAWE 2020a).	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Alternaria carotiincultae</i> Simmons [Pleosporales: Pleosporaceae] (synonym: <i>Alternaria daucicola</i> Zhang)	<i>Daucus</i>	Yes (Coles & Wicks 2011)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria carthami</i> Chowdhury [Pleosporales: Pleosporaceae]	<i>Cuminum</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria cheiranthi</i> (Lib.) Bolle [Pleosporales: Pleosporaceae]	<i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria consortialis</i> (Thüm.) Groves & Hughes [Pleosporales: Pleosporaceae] (synonym: <i>Ulocladium consortiale</i> (Thüm.) Simmons; <i>Stemphylium consortiale</i> (Thüm.) Groves & Skolko)	<i>Apium</i> , <i>Carum</i> , <i>Daucus</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria cucumerina</i> (Ellis & Everh.) Elliott [Pleosporales: Pleosporaceae]	<i>Coriandrum</i>	Yes (Persley, Cooke & House 2010; Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria cumini</i> Simmons [Pleosporales: Pleosporaceae]	<i>Cuminum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Cuminum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Alternaria dauci</i> (Kühn) Groves & Skolko [Pleosporales: Pleosporaceae] (synonyms: <i>Alternaria carotae</i> (Ellis & Langl.) Stev. & Wellman; <i>Macrosporium carotae</i> Ellis & Langl.; <i>Alternaria poonensis</i> Raghunath)	<i>Apium</i> , <i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria daucicaulis</i> Simmons [Pleosporales: Pleosporaceae] (synonym: <i>Lewia daucicaulis</i> Simmons)	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020; Simmons 2007), but no published evidence was found indicating it is seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Alternaria dianthicola</i> Neerg. [Pleosporales: Pleosporaceae]	<i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria infectoria</i> Simmons [Pleosporales: Pleosporaceae] (synonym: <i>Lewia infectoria</i> (Fuckel) Barr & Simmons)	<i>Coriandrum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria longipes</i> (Ellis & Everh.) Mason [Pleosporales: Pleosporaceae]	<i>Daucus</i>	Yes (Plant Health Australia 2020; Simmonds 1966)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria longissima</i> Deighton & MacGarvie [Pleosporales: Pleosporaceae]	<i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Alternaria novae-zelandiae</i> Simmons [Pleosporales: Pleosporaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Simmons 2007), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Alternaria oblongo-obovoidea</i> (Zhang & Zhang) Gannibal & Lawr. [Pleosporales: Pleosporaceae] (synonym: <i>Ulocladium oblongo-obovoideum</i> Zhang & Zhang)	<i>Coriandrum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Coriandrum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Alternaria petroselini</i> (Neerg.) Simmons [Pleosporales: Pleosporaceae] (synonym: <i>Stemphylium petroselini</i> Neerg.)	<i>Apium</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Cunnington et al. 2007; Davis & Raid 2002)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Alternaria preussii</i> Gannibal & Lawr. [Pleosporales: Pleosporaceae] (synonym: <i>Ulocladium dauci</i> Simmons)	<i>Daucus</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Daucus carota</i> (Simmons 1998).	Yes: if introduced via the seed pathway, <i>Alternaria preussii</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Biango-Daniels & Hodge 2018; Schmidt, Mitchell & Scow 2019).	No: no evidence was found indicating this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
<i>Alternaria porri</i> (Ellis) Cif. [Pleosporales: Pleosporaceae]	<i>Apium</i> , <i>Daucus</i>	Yes (Suheri & Price 2001). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria radicina</i> Meier et al. [Pleosporales: Pleosporaceae] (synonym: <i>Stemphylium radicinum</i> (Meier et al.) Neerg.)	<i>Anethum</i> , <i>Apium</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Alternaria ramulosa</i> (Sacc.) Joly [Pleosporales: Pleosporaceae] (synonyms: <i>Stemphylium ramulosum</i> Sacc.; <i>Macrosporium ramulosum</i> Sacc.)	<i>Anthriscus</i> , <i>Apium</i> , <i>Daucus</i> , <i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on dead stems of <i>Anthriscus</i> , <i>Apium</i> , <i>Daucus</i> and <i>Petroselinum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Alternaria ricini</i> (Yoshii) Hansf. [Pleosporales: Pleosporaceae]	<i>Coriandrum</i> , <i>Cuminum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Coriandrum sativum</i> and <i>Cuminum cyminum</i> and is carried by the seeds of these hosts (Ramesh & Jayagoudar 2013).	Yes: if introduced via the seed pathway, <i>Alternaria ricini</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating this fungus has an adverse impact. This fungus is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Alternaria selini</i> Simmons [Pleosporales: Pleosporaceae]	<i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Petroselinum</i> species causing leaf blight and pod deformation (Davis & Raid 2002), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Alternaria scrophulariae</i> (Desm.) Rossman & Crous [Pleosporales: Pleosporaceae] (synonyms: <i>Alternaria conjuncta</i> Simmons; <i>Lewia scrophulariae</i> (Desm.) Barr & Simmons)	<i>Daucus</i> , <i>Pastinaca</i> , <i>Pimpinella</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria solani</i> Sorauer [Pleosporales: Pleosporaceae] (synonym: <i>Macrosporium solani</i> Ellis & Martin)	<i>Apium</i> , <i>Foeniculum</i>	Yes (Horsfield et al. 2010; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Alternaria solani-nigri</i> Dubey, Singh & Kamal [Pleosporales: Pleosporaceae] (synonym: <i>Alternaria herbiculiniae</i> Simmons)	<i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Petroselinum</i> species causing lesions and spots on leaves (Farr & Rossman 2020; Woudenberg et al. 2014), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Alternaria umbellifericola</i> Raghunath [Pleosporales: Pleosporaceae]	<i>Carum</i> , <i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Carum</i> and <i>Foeniculum</i> species (Farr & Rossman 2020; Rao 1969), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Alternaria zhengzhouensis</i> Zhang [Pleosporales: Pleosporaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Zhang 2003; Zhuang 2005), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Amerosporium atrum</i> (Fuckel) Höhn [Chaetomellales: Chaetomellaceae] (synonym: <i>Chaetomella atra</i> Fuckel)	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Amerosporium concinnum</i> Petr. [Chaetomellales: Chaetomellaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Arxotrichum succineum</i> (Ames) Nováková & Kolařík [Sordariales: Chaetomiaceae] (synonym: <i>Chaetomium succineum</i> Ames)	<i>Apium</i> , <i>Petroselinum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Apium</i> and <i>Petroselinum</i> species (Farr & Rossman 2020). This fungus is seed-borne only in <i>Apium graveolens</i> (Farr & Rossman 2020).	Yes: if introduced via the seed pathway, <i>Arxotrichum succineum</i> could establish and spread in Australia. It has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
<i>Ascochyta anethicola</i> Sacc. [Pleosporales: Didymellaceae]	<i>Anethum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> species causing leaf spot (Weiss 2002), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Ascochyta biforae</i> Bond.-Mont. [Pleosporales: Didymellaceae]	<i>Carum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Carum carvi</i> and is carried by the seeds of this host (Mačkinaitė 2012).	Yes: if introduced via the seed pathway, <i>Ascochyta biforae</i> could establish and spread in Australia. It has established in areas with a wide range of climatic conditions (Mačkinaitė 2012; Ondřej 1983). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Ascochyta carvi</i> Ondřej [Pleosporales: Didymellaceae]	<i>Carum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Carum carvi</i> and is carried by the seeds of this host (Odstrčilová 2007; Ondřej 1983).	Yes: if introduced via the seed pathway, <i>Ascochyta carvi</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Odstrčilová 2007; Ondřej 1983). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: currently, there is no significant published evidence on the economic consequences of this fungus. It is not considered to have the potential for economic consequences in Australia.	No
<i>Ascochyta cretensis</i> Sutton [Pleosporales: Didymellaceae]	<i>Foeniculum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Foeniculum vulgare</i> and is carried by the seeds of this host (Nagy 2006).	Yes: if introduced via the seed pathway, <i>Ascochyta cretensis</i> could establish and spread in Australia. This fungus is established in Crete (Farr & Rossman 2020), and parts of Australia have similar climatic conditions. Spread of this fungus from the seed pathway could occur via air-borne spores.	No: currently, there is no significant published evidence on the economic consequences of this fungus. It is not considered to have the potential for economic consequences in Australia.	No
<i>Ascochyta foeniculina</i> McAlpine [Pleosporales: Didymellaceae] (synonym: <i>Ascochyta foeniculum</i> McAlpine)	<i>Foeniculum</i>	Yes (Khare, Tiwari & Sharma 2014; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Ascochyta grovei</i> Pisareva [Pleosporales: Didymellaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Ascochyta levistici</i> (Lebedeva) Melnik [Pleosporales: Didymellaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Ascochyta phomoides</i> Sacc. [Pleosporales: Didymellaceae]	<i>Angelica</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> , <i>Carum</i> , <i>Coriandrum</i> and <i>Foeniculum</i> species (Farr & Rossman 2020; Kozłowska & Mulenko 2005; Odstrčilová et al. 2002; Růžicková et al. 2011), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Ascospora himantia</i> (Pers.) Rehm [Incertae sedis: Incertae sedis]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Aspergillus alliaceus</i> Thom & Church [Eurotiales: Aspergillaceae]	<i>Coriandrum</i> , <i>Cuminum</i>	Yes (Bayman et al. 2002; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus alutaceus</i> Berk. & Curtis [Eurotiales: Aspergillaceae]	<i>Pimpinella</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Aspergillus amstelodami</i> Thom & Church [Eurotiales: Aspergillaceae] (synonym: <i>Eurotium amstelodami</i> Mangin)	<i>Daucus</i> , <i>Pimpinella</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus candidus</i> Link [Eurotiales: Aspergillaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Foeniculum</i>	Yes (Hocking 2003; Speare et al. 1994)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus chevalieri</i> Thom & Church [Eurotiales: Aspergillaceae]	<i>Coriandrum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus clavatus</i> Desm. 1834 [Eurotiales: Aspergillaceae]	<i>Cuminum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus deflectus</i> Fenell & Raper [Eurotiales: Aspergillaceae]	<i>Cuminum</i>	Yes (Robinson et al. 2000)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus flavipes</i> (Bainier & Sartory) Thom & Church [Eurotiales: Aspergillaceae]	<i>Coriandrum</i> , <i>Cuminum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Cuminum cyminum</i> and is carried by the seeds of this host (Dawar, Tariq & Ejaz 2014). This fungus has also been reported occurring on <i>Coriandrum</i> species (Pitt & Hocking 2009).	Yes: if introduced via the seed pathway, <i>Aspergillus flavipes</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Aspergillus flavus</i> Link [Eurotiales: Aspergillaceae] (synonym: <i>Aspergillus oryzae</i> (Ahlb.) Cohn)	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Yes (Hocking 2003; Plant Health Australia 2020; Simmonds 1966)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus foeniculicola</i> Udagawa [Eurotiales: Trichocomaceae] (synonym: <i>Emericella foeniculicola</i> Udagawa)	<i>Foeniculum</i>	Not known to occur	Yes: seeds do not provide a pathway for this fungus. It occurs on <i>Foeniculum vulgare</i> and is carried by the seeds of this host (Richardson 1990).	Yes: if introduced via the seed pathway, <i>Aspergillus foeniculicola</i> could establish and spread in Australia. This fungus is established in Japan (Farr & Rossman 2020), and parts of Australia have similar climatic conditions. Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
<i>Aspergillus fumigatus</i> Fresen. [Eurotiales: Aspergillaceae]	<i>Foeniculum</i> , <i>Pimpinella</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus nidulans</i> (Eidam) Winter [Eurotiales: Aspergillaceae] (synonyms: <i>Aspergillus nidulellus</i> Samson & Gams; <i>Emericella nidulans</i> (Eidam) Vuill.)	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020; Yip & Weste 1985)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus niger</i> Tiegh. [Eurotiales: Aspergillaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Yes (Leong, Hocking & Pitt 2004; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Aspergillus ochraceus</i> Wilh. [Eurotiales: Aspergillaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i>	Yes (Khondoker et al. 2018)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus parasiticus</i> Speare [Eurotiales: Aspergillaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus repens</i> (Corda) Sacc. [Eurotiales: Aspergillaceae]	<i>Cuminum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus sulphureus</i> Desm. [Eurotiales: Aspergillaceae]	<i>Pimpinella</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Pimpinella anisum</i> and is carried by the seeds of this host (Ahene, Odamtten & Owusu 2011).	Yes: if introduced via the seed pathway, <i>Aspergillus sulphureus</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
<i>Aspergillus sydowii</i> (Bainier & Sartory) Thom & Church [Eurotiales: Aspergillaceae]	<i>Foeniculum</i>	Yes (Rypien, Andras & Harvell 2008)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Aspergillus tamarii</i> Kita [Eurotiales: Aspergillaceae]	<i>Cuminum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Cuminum cyminum</i> and is carried by the seeds of this host (Dawar, Tariq & Ejaz 2014).	Yes: if introduced via the seed pathway, <i>Aspergillus tamarii</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence on the economic consequences of this fungus on plants. Therefore, this fungus is not considered to have the potential for economic consequences in Australia.	No
<i>Aspergillus terreus</i> Thom [Eurotiales: Aspergillaceae]	<i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus ustus</i> Thom & Church [Eurotiales: Aspergillaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i>	Yes (Gianni et al. 2017)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus versicolor</i> (Vuill.) Tirab. [Eurotiales: Aspergillaceae]	<i>Cuminum</i>	Yes (Gianni et al. 2017; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspergillus wentii</i> Wehmer 1896 [Eurotiales: Aspergillaceae]	<i>Cuminum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Asteroma robergii</i> Desm. [Diaporthales: Gnomoniaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Asteromella aegopodii</i> (Curr.) Petr. [Incertae sedis: Incertae sedis] (synonym: <i>Mycosphaerella podagrariae</i> (Roth) Petr.)	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Farr & Rossman 2020; Mulencko, Majewski & Ruskiewicz-Michalska 2008), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for these fungi.	Assessment not required	Assessment not required	No
<i>Asteromella huubii</i> Ruskiewicz-Michalska [Botryosphaerales: Phyllostictaceae] (synonyms: <i>Asteromella angelicae</i> (Sacc.) Moesz ex Bat. & Peres; <i>Phyllosticta angelicae</i> Sacc.)	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Ruskiewicz-Michalska 2016), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Asteromella tragii</i> (Bubák) Petr. [Incertae sedis: Incertae sedis] (synonym: <i>Phyllosticta tragii</i> Bubák)	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Berkeleyomyces basicola</i> (Berk. & Broome) Nel, de Beer, Duong & Wingf. [Microascales: Ceratocystidaceae] (synonym: <i>Thielaviopsis basicola</i> (Berk. & Broome) Ferraris)	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Bipolaris sorokiniana</i> (Sacc.) Shoemaker [Pleosporales: Pleosporaceae] (synonyms: <i>Drechslera sorokiniana</i> (Sacc.) Subram. & Jain; <i>Cochliobolus sativus</i> (Ito & Kurib.) Drechsler ex Dastur)	<i>Carum</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Petroselinum</i>	Yes (Jones 1971)	Assessment not required	Assessment not required	Assessment not required	No
<i>Bisufusarium dimerum</i> (Penz.) Lombard & Crous [Xylariales: Incertae sedis] (synonyms: <i>Microdochium dimerum</i> (Penz.) Arx; <i>Fusarium dimerum</i> Penz.)	<i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Botryosphaeria dothidea</i> (Moug.) Ces. & De Not. [Botryosphaeriales: Botryosphaeriaceae]	<i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Botryosphaeria obtusa</i> (Schwein.) Shoemaker [Pleosporales: Incertae sedis] (synonyms: <i>Diplodia seriata</i> De Not.; <i>Peyronellaea obtusa</i> (Fuckel) Aveskamp et al.; <i>Phoma obtuse</i> Fuckel)	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Botryotrichum murorum</i> (Corda) Wang & Samson [Sordariales: Chaetomiaceae] (synonym: <i>Chaetomium murorum</i> Corda)	<i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Cribb 1999)	Assessment not required	Assessment not required	Assessment not required	No
<i>Botrytis cinerea</i> Pers. [Heliales: Sclerotiniaceae] (synonym: <i>Botryotinia fuckeliana</i> (de Bary) Whetzel)	<i>Anethum</i> , <i>Apium</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Calloria oleosa</i> (Ellis) Sacc. [Helotiales: Dermateaceae] (synonym: <i>Peziza oleosa</i> Ellis)	<i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Petroselinum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Calonectria brassicae</i> (Panwar & Bohra) Lombard, et al. [Hypocreales: Nectriaceae] (synonym: <i>Cylindrocladium clavatum</i> Hodges & May; <i>Cylindrocladium gracile</i> (Bugnic.) Boesew.)	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Crous 2002; Farr & Rossman 2020; Mendes 1998), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Calonectria fimbriata</i> Seaver & Waterston [Hypocreales: Nectriaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Calonectria kyotensis</i> Terash. [Hypocreales: Nectriaceae]	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Calophoma complanata</i> (Tode) Chen & Cai [Pleosporales: Didymellaceae] (synonyms: <i>Leptosphaeria complanata</i> (Tode) Ces. & De Not.; <i>Phoma complanata</i> (Tode: Fr.) Desm.)	<i>Angelica</i> , <i>Apium</i> , <i>Daucus</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Not known to occur	No: the fungus has been reported occurring on <i>Angelica</i> , <i>Apium</i> , <i>Daucus</i> , <i>Pastinaca</i> and <i>Petroselinum</i> species (Farr & Rossman 2020; Koike, Gladders & Paulus 2007), but insufficient published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Calyptronectria argentinensis</i> Speg. [Pleosporales: Melanommataceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Cercospora angelicae</i> (Sacc. & Scalia) Chupp [Capnodiales: Mycosphaerellaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Cercospora apii</i> Fresen. [Capnodiales: Mycosphaerellaceae] (synonyms: <i>Cercospora apii</i> f. <i>dauci-carotae</i> Ellis & Everh.; <i>Cercospora apii</i> var. <i>petroselini</i> Sacc.; <i>Cercospora penicillata</i> var. <i>apii</i> Fuckel)	<i>Anethum</i> , <i>Apium</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Cercospora apiicola</i> Groenew. et al. [Capnodiales: Mycosphaerellaceae]	<i>Apium</i>	Not known to occur	No: this fungus has been reported occurring on <i>Apium</i> species (Groenewald et al. 2006), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Cercospora beticola</i> Sacc. [Capnodiales: Mycosphaerellaceae]	<i>Apium</i>	Yes (Persley, Cooke & House 2010; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Cercospora carotae</i> (Pass.) Kanz. & Siemaszko [Capnodiales: Mycosphaerellaceae]	<i>Daucus</i>	Yes (Persley, Cooke & House 2010; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Cercospora foeniculi</i> Magnus [Capnodiales: Mycosphaerellaceae]	<i>Foeniculum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Foeniculum vulgare</i> (Khare, Tiwari & Sharma 2014) and is carried by the seeds of this host (Dwivedi, Agrawal & Agrawal 2008).	Yes: if introduced via the seed pathway, <i>Cercospora foeniculi</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Khare, Tiwari & Sharma 2014). Spread of this fungus from the seed pathway could occur via air-borne spores.	Yes: <i>Cercospora foeniculi</i> is an economically important pathogen of <i>Foeniculum vulgare</i> (Khare, Tiwari & Sharma 2014; Mishra 2005) and has the potential for economic consequences in Australia. Destruction of foliage results in poorly developed fruit, yield loss and reduced seed production in India and Pakistan (Khare, Tiwari & Sharma 2014; Mishra 2005).	Yes
<i>Cercospora petroselini</i> Sacc. [Capnodiales: Mycosphaerellaceae]	<i>Petroselinum</i>	Not known to occur	No: Seeds do not provide a pathway for this fungus. The fungus occurs on <i>Petroselinum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Cercospora petroselini</i> f. <i>melitensis</i> Ferraris [Capnodiales: Mycosphaerellaceae]	<i>Petroselinum</i>	Not known to occur	No: Seeds do not provide a pathway for this fungus. The fungus occurs on <i>Petroselinum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Cercospora petroselinicola</i> Tosh. et al. [Capnodiales: Mycosphaerellaceae]	<i>Petroselinum</i>	Not known to occur	No: Seeds do not provide a pathway for this fungus. The fungus occurs on <i>Petroselinum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Chaetomium atrosporum</i> Skolko & Groves [Sordariales: Chaetomiaceae]	<i>Daucus</i> , <i>Foeniculum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Daucus carota</i> and <i>Foeniculum vulgare</i> and is carried by the seeds of these hosts (Dwivedi, Agrawal & Agrawal 2008; Farr & Rossman 2020).	Yes: if introduced via the seed pathway, <i>Chaetomium atrosporum</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Chaetomium cari-carvi</i> Pande & Rao [Sordariales: Chaetomiaceae]	<i>Carum</i>	Not known to occur	Yes. Seeds provide a pathway for this fungus. It occurs on <i>Carum carvi</i> and is carried by the seeds of this host (Pande 2008).	Yes. When introduced via the seed pathway, <i>Chaetomium cari-carvi</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Pande 2008). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
<i>Chaetomium cochliodes</i> Palliser [Sordariales: Chaetomiaceae]	<i>Pastinaca</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Chaetomium globosum</i> Kunze ex Fr. [Sordariales: Chaetomiaceae]	<i>Coriandrum</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020; Syed et al. 2009)	Assessment not required	Assessment not required	Assessment not required	No
<i>Chaetomium luteum</i> (Rai & Tewari) Cannon [Sordariales: Chaetomiaceae] (synonym: <i>Achaetomium luteum</i> Rai & Tewari)	<i>Anethum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Anethum graveolens</i> and is carried by the seeds of this host (Richardson 1990).	Yes: if introduced via the seed pathway, <i>Chaetomium luteum</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Chalastospora gossypii</i> (Jacz.) Braun & Crous [Pleosporales: Pleosporaceae]	<i>Anethum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> species (Crous et al. 2009), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Choanephora cucurbitarum</i> (Berk. & Ravenel) Thaxt. [Mucorales: Choanephoraceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i>	Yes (Conde & Diatloff 1991; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Chromelosporium ochraceum</i> Corda [Pezizales: Pezizaceae]	<i>Pastinaca</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Ciboria pastinacae</i> Velen. [Helotiales: Sclerotiniaceae]	<i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pastinaca</i> species (Mycobank 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Cilioplea coronata</i> (Niessl) Munk ex Crivelli [Pleosporales: Lophiostomataceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Circinella muscae</i> (Sorokīn) Berl. & De Toni [Mucorales: Syncephalastraceae]	<i>Daucus</i> , <i>Pimpinella</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. The fungus occurs on <i>Daucus</i> and <i>Pimpinella</i> species (El-Said & El-Hady 2014; Farr & Rossman 2020). This fungus is seed-borne only in <i>Pimpinella anisum</i> (El-Said & El-Hady 2014).	Yes: if introduced via the seed pathway, <i>Circinella muscae</i> could establish and spread in Australia. This fungus has established in areas with wide range of climatic conditions (El-Said & El-Hady 2014; Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
<i>Circinella simplex</i> Tiegh. [Mucorales: Syncephalastraceae]	<i>Coriandrum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Coriandrum sativum</i> and is carried by the seeds of this host (Ramesh & Jayagoudar 2013).	Yes: if introduced via the seed pathway, <i>Circinella simplex</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Cladosporium astroideum</i> var. <i>catalinense</i> Braun. [Capnodiales: Cladosporiaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on the dead stems of <i>Foeniculum</i> species (Bensch et al. 2012), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Cladosporium cladosporioides</i> (Fresen.) de Vries [Capnodiales: Cladosporiaceae]	<i>Angelica</i> , <i>Coriandrum</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Shipton & Chambers 1966)	Assessment not required	Assessment not required	Assessment not required	No
<i>Cladosporium colocasiae</i> Sawada [Capnodiales: Cladosporiaceae]	<i>Apium</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Cladosporium cucumerinum</i> Ellis & Arthur [Capnodiales: Cladosporiaceae]	<i>Cuminum</i>	Yes (Persley, Cooke & House 2010)	Assessment not required	Assessment not required	Assessment not required	No
<i>Cladosporium herbarum</i> (Pers.) Link [Capnodiales: Cladosporiaceae]	<i>Angelica</i> , <i>Anthriscus</i> , <i>Coriandrum</i> , <i>Cuminum</i> , <i>Foeniculum</i>	Yes (Barkat et al. 2016)	Assessment not required	Assessment not required	Assessment not required	No
<i>Cladosporium macrocarpum</i> Preuss [Capnodiales: Cladosporiaceae]	<i>Daucus</i> , <i>Pimpinella</i>	Yes (Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Cladosporium oxysporum</i> Berk. & Curtis [Capnodiales: Cladosporiaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Foeniculum</i>	Yes (Wilingham et al. 2002)	Assessment not required	Assessment not required	Assessment not required	No
<i>Cladosporium tenuissimum</i> Cooke [Capnodiales: Cladosporiaceae]	<i>Coriandrum</i> , <i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Cladosporium variabile</i> (Cooke) de Vries [Capnodiales: Cladosporiaceae] (synonyms: <i>Cladosporium subnodosum</i> Cooke, <i>Davidiella variabile</i> Crous, Schub & Braun; <i>Heterosporium variabile</i> Cooke)	<i>Coriandrum</i> , <i>Cuminum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Coriandrum sativum</i> and <i>Cuminum cyminum</i> and is carried by the seeds of this host (Ramesh & Jayagoudar 2013).	Yes: if introduced via the seed pathway, <i>Cladosporium variabile</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: this fungus is known to impact production of spinach seed crops (du Toit, Derie & Hernandez-Perez 2005). However, it is considered a pest of minor importance for spinach leaf production (Abu Al-qumboz & Abu-Naser 2019). No economic losses have been recorded on other hosts of this fungus. Therefore, it is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Clathrospora diplospora</i> (Ellis & Everh.) Sacc. & Traverso [Pleosporales: Diademaceae]	<i>Anthriscus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Clonostachys rosea</i> (Link) Schroers, Samuels, Seifert & Gams [Hypocreales: Hypocreaceae] (synonyms: <i>Gliocladium aureum</i> Rader; <i>Gliocladium roseum</i> Bainier)	<i>Cuminum</i> , <i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Curvularia eragrostidis</i> (Henn.) Mey [Pleosporales: Pleosporaceae] (synonyms: <i>Cochliobolus eragrostidis</i> (Tsuda & Ueyama) Sivan.; <i>Curvularia maculans</i> (Bancr.) Boedijn; <i>Pseudocochliobolus eragrostidis</i> Tsuda & Ueyama) Remember to re-alphabetise if name change is accepted.	<i>Cuminum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Cochliobolus geniculatus</i> Nelson [Pleosporales: Pleosporaceae]	<i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Collariella bostrychodes</i> (Zopf) Wei, Wang & Samson [Sordariales: Chaetomiaceae] (synonym: <i>Chaetomium bostrychodes</i> Zopf)	<i>Foeniculum</i>	No records found	Yes: seeds provide a pathway for this fungus. It occurs on <i>Foeniculum</i> species and is carried by the seeds of these hosts (Dwivedi, Agrawal & Agrawal 2008).	Yes: if introduced via the seed pathway, <i>Collariella bostrychodes</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
* <i>Colletotrichum</i> : the taxonomy of the <i>Colletotrichum</i> genus is undergoing significant revision (Damm et al. 2013; Damm et al. 2012a; Damm et al. 2012b; Damm et al. 2014; Damm et al. 2019; Damm et al. 2009; Weir, Johnston & Damm 2012).						
<i>Colletotrichum acutatum</i> Simmonds [Glomerellales: Glomerellaceae] (synonym: <i>Glomerella acutata</i> Guerber & Correll)	<i>Apium</i> , <i>Daucus</i>	Yes (Whitelaw-Weckert et al. 2007)	Assessment not required	Assessment not required	Assessment not required	No
<i>Colletotrichum anthrisci</i> Damm et al. [Glomerellales: Glomerellaceae]	<i>Anthriscus</i>	Not known to occur	No: this fungus has been reported occurring on the dead stems of <i>Anthriscus</i> species (Damm et al. 2009), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Colletotrichum circinans</i> (Berk.) Voglino [Glomerellales: Glomerellaceae]	<i>Anthriscus</i>	Yes (Shivas et al. 2016)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Colletotrichum coccodes</i> (Wallr.) Hughes [Glomerellales: Glomerellaceae]	<i>Daucus</i>	Yes (Shivas 1989; Shivas et al. 2016)	Assessment not required	Assessment not required	Assessment not required	No
<i>Colletotrichum dematium</i> (Pers.: Fr.) Grove [Glomerellales: Glomerellaceae]	<i>Angelica</i> , <i>Carum</i> , <i>Daucus</i> (There were multiple records in several apiaceous hosts prior to taxonomic changes* (Farr & Rossman 2020). Since then, records of this species on Apiaceae have been reported (Damm et al. 2009), but host plants of this species have not been identified to the species level.)	Yes (Damm et al. 2009)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Colletotrichum fioriniae</i> (Marcelino & Gouli) Shivas & Tan [Glomerellales: Glomerellaceae]	<i>Apium</i>	Yes (Damm et al. 2012a)	Assessment not required	Assessment not required	Assessment not required	No
<i>Colletotrichum gloeosporioides</i> (Penz.) Penz. & Sacc. [Glomerellales: Glomerellaceae]	<i>Carum</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i> (There were multiple records in several apiaceous hosts prior to taxonomic changes* (Farr & Rossman 2020). Since then, no reliable records of this species on Apiaceae have been reported.)	Yes (Weir, Johnston & Damm 2012)	Assessment not required	Assessment not required	Assessment not required	No
<i>Colletotrichum nymphaeae</i> (Pass.) Aa [Glomerellales: Glomerellaceae]	<i>Apium</i>	Yes (Damm et al. 2012a)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Colletotrichum orbiculare</i> (Berk.) Arx [Glomerellales: Glomerellaceae]	<i>Apium</i> (There were multiple records in several apiaceous hosts prior to taxonomic changes* (Farr & Rossman 2020). Since then, no records of this species on Apiaceae have been reported.)	Yes (Damm et al. 2013)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Colletotrichum truncatum</i> (Schwein.) Andreus & Moore [Glomerellales: Glomerellaceae] (synonym: <i>Colletotrichum capsici</i> (Syd. & Syd.) Butler & Bisby)	<i>Coriandrum</i> (There were multiple records in several apiaceous hosts prior to taxonomic changes* (Farr & Rossman 2020). Since then, no records of this species on Apiaceae have been reported.)	Yes (Damm et al. 2009)	Assessment not required	Assessment not required	Assessment not required	No
<i>Comoclathris permunda</i> (Cooke) Müller [Pleosporales: Pleosporaceae] (synonyms: <i>Clathrospora permunda</i> (Cooke) Berl.; <i>Pleospora permunda</i> (Cooke) Sacc.)	<i>Carum</i> , <i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Carum</i> and <i>Petroselinum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Coniothyrium conoideum</i> Sacc. [Pleosporales: Coniothyriaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Crocicreas cyathodeum</i> (Bull.) Carp. [Helotiales: Helotiaceae] (synonyms: <i>Cyathicula cyathodea</i> (Bull.) Thüm.; <i>Helotium cyathodeum</i> (Bull.) Karst.)	<i>Angelica</i> , <i>Anthriscus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Quijada et al. 2017), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Crocicreas nigrescens</i> (Cooke) Carp. [Helotiales: Helotiaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Cudoniella fructigena</i> Rostr. [Helotiales: Helotiaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Connors 1967), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Cunninghamella elegans</i> Lendn. [Mucorales: Cunninghamellaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Curvularia clavata</i> Jain [Pleosporales: Pleosporaceae]	<i>Foeniculum</i>	Yes (Pak et al. 2017; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Curvularia hexamera</i> Vegh & Benoit [Pleosporales: Pleosporaceae]	<i>Coriandrum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Coriandrum sativum</i> (HerbIMI 2020), but no published evidence was found indicating it is seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Curvularia inaequalis</i> (Shear) Boedijn [Pleosporales: Pleosporaceae]	<i>Cuminum</i>	Yes (Pimentel et al. 2005; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Curvularia lunata</i> (Wakker) Boedijn [Pleosporales: Pleosporaceae] (synonym: <i>Cochliobolus lunatus</i> Nelson & Haasis)	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Curvularia pallescens</i> Boedijn [Pleosporales: Pleosporaceae] (synonym: <i>Cochliobolus pallescens</i> (Tsuda & Ueyama) Sivan)	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Curvularia prasadii</i> Mathur & Mathur [Pleosporales: Pleosporaceae]	<i>Coriandrum</i>	Yes (Upsher & Upsher 1995)	Assessment not required	Assessment not required	Assessment not required	No
<i>Curvularia senegalensis</i> (Speg.) Subram. [Pleosporales: Pleosporaceae]	<i>Cuminum</i>	Yes (Upsher & Upsher 1995)	Assessment not required	Assessment not required	Assessment not required	No
<i>Curvularia spicifera</i> (Bainier) Boedijn [Pleosporales: Pleosporaceae] (synonyms: <i>Bipolaris spicifera</i> (Bainier) Subram.; <i>Cochliobolus spicifer</i> Nelson; <i>Drechslera tetramera</i> (McKinney) Subram & Jain; <i>Drechslera spicifera</i> (Bainier) Arx)	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Curvularia tuberculata</i> Jain [Pleosporales: Pleosporaceae] (synonym: <i>Cochliobolus tuberculatus</i> Sivan.)	<i>Foeniculum</i>	One record in the Torres Strait (ALA 2017); not known to occur on the Australian mainland or in Tas.	No: this fungus has been reported occurring on <i>Foeniculum vulgare</i> (Farr & Rossman 2020), but no published evidence was found indicating it seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Cyathicula cyathoidea</i> (Bull.: Fr.) Thüm. [Helotiales: Helotiaceae]	<i>Angelica</i> , <i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> and <i>Pastinaca</i> species (Dennis 1986; Farr & Rossman 2020), but no published evidence was found indicating it seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Cylindrocarpon destructans</i> (Zinssm.) Scholten [Hypocreales: Nectriaceae] (synonyms: <i>Ilyonectria destructans</i> (Zinssm.) Rossman et al.; <i>Ramularia destructans</i> Zinssm)	<i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i>	Yes (Plant Health Australia 2020; Summerell, Nixon & Burgess 1990)	Assessment not required	Assessment not required	Assessment not required	No
<i>Cylindrosporium crescentium</i> Barthol. [Helotiales: Ploettnerulaceae] (synonym: <i>Phloeospora crescentium</i> (Barthol.) Riley)	<i>Pastinaca</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Cylindrosporium pastinacae</i> Sacc. [Helotiales: Ploettnerulaceae]	<i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pastinaca</i> species causing leaf spot (Farr & Rossman 2020; Kobayashi 2007), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Cylindrosporium pimpinellae</i> Massal [Helotiales: Ploettnerulaceae]	<i>Angelica</i> , <i>Apium</i> , <i>Pastinaca</i> , <i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> , <i>Apium</i> , <i>Pastinaca</i> and <i>Pimpinella</i> species (Cain et al. 2010; Farr & Rossman 2020), but no published evidence was found indicating it seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Cyphellopycnis pastinacae</i> Tehon & Stout [Diaporthales: Diaporthaceae]	<i>Carum</i> , <i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Carum</i> and <i>Pastinaca</i> species (Cain et al. 2010; Farr & Rossmann 2020), but no published evidence was found indicating it seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Dactylella oxyspora</i> (Sacc. & Marchal) Matsush [Orbiliiales: Orbiliaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Chen et al. 2007), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Diaporthe ambigua</i> Nitschke [Diaporthales: Diaporthaceae]	<i>Foeniculum</i>	Yes (Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Diaporthe angelicae</i> (Berk.) Wehm. [Diaporthales: Diaporthaceae]	<i>Angelica</i> , <i>Anethum</i> , <i>Anthriscus</i> , <i>Carum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i>	Not known to occur	Yes: seeds provide a pathway for this fungus which has been reported occurring as seed-borne in <i>Daucus carota</i> , causing umbel browning and stem necrosis (Bastide et al. 2017). This fungus has also been reported on <i>Angelica</i> , <i>Anethum</i> , <i>Anthriscus</i> , <i>Carum</i> , <i>Daucus</i> , <i>Foeniculum</i> and <i>Pastinaca</i> species causing stem decay and leaf spot (Castlebury et al. 2003; Farr & Rossman 2020).	Yes: if introduced via the seed pathway, <i>Diaporthe angelicae</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	Yes: <i>Diaporthe angelicae</i> is known to cause umbel (inflorescence) browning in carrots plants, eventually leading to prematurely dried umbels. Carrot seed production was estimated to be reduced by 8% in affected areas in France (Ménard et al. 2014), which has the potential for economic consequences in Australia.	Yes
<i>Diaporthe arctii</i> (Lasch) Nitschke [Diaporthales: Diaporthaceae] (synonym: <i>Phomopsis arctii</i> (Lasch) Traverso)	<i>Daucus</i> , <i>Pastinaca</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Diaporthe eres</i> Nitschke [Diaporthales: Diaporthaceae]	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Diaporthe foeniculacea</i> Niessl [Diaporthales: Diaporthaceae]	<i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Diaporthe foeniculina</i> (Sacc.) Udayanga & Castlebury [Diaporthales: Diaporthaceae]	<i>Foeniculum</i>	Yes (Udayanga et al. 2014)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Diaporthe lusitanicae</i> Phillips & Santos [Diaporthales: Diaporthaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Dissanayake et al. 2017; Santos & Phillips 2009), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Diaporthe neotheicola</i> Phillips & Santos [Diaporthales: Diaporthaceae]	<i>Foeniculum</i>	Yes (Golzar et al. 2012)	Assessment not required	Assessment not required	Assessment not required	No
<i>Didymaria anethiana</i> Cooke [Capnodiales: Mycosphaerellaceae]	<i>Anethum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Didymella glomerata</i> (Corda) Chen & Cai [Pleosporales: Didymellaceae] (synonym: <i>Phoma glomerata</i> (Corda) Wollenw. & Hochapfel)	<i>Coriandrum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Didymella operosa</i> (Desm.) Sacc. [Pleosporales: Didymellaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Didymella superflua</i> (Fuckel) Sacc. [Pleosporales: Didymellaceae] (synonym: <i>Mycosphaerella superflua</i> (Fuckel) Petr.)	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Unamuno 1941), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Didymosphaeria conoidea</i> Niessl [Pleosporales: Didymosphaeriaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Dinemasporium hispidulum</i> (Schrad.) Sacc. [Incertae sedis: Incertae sedis] (synonym: <i>Pseudolachnea hispidula</i> (Schrad.) Sutton)	<i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Diplodia foeniculina</i> Thüm. [Botryosphaerales: Botryosphaeriaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Diplodina foeniculina</i> Speg. [Diaporthales: Gnomoniaceae]	<i>Foeniculum</i>	Not known to occur	No: these fungi have been reported occurring on <i>Foeniculum</i> species (Sulton 1996), but no published evidence was found indicating these fungi are seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for these fungi.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Diplodina mattioloana</i> Cif [Diaporthales: Gnomoniaceae] (synonym: <i>Diplodina mattiroliana</i> Cif)	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum vulgare</i> (Mycobank 2020), but no published evidence was found indicating it seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Discosia sampaioi</i> Gonz Frag [Xylariales: Amphisphaeriaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Dothidea collecta</i> (Schwein.) Ellis & Everh. [Dothideales: Dothideaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Dothidella angelicae</i> (Fr.) Rostr. [Incertae sedis: Polystomellaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Connors 1967), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Dothiorella dauci</i> Vala et al. [Botryosphaeriales: Botryosphaeriaceae]	<i>Daucus</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Daucus carota</i> and is carried by the seeds of this host (Richardson 1990; Vala, Kapoor & Chowdhry 1984).	Yes: if introduced via the seed pathway, <i>Dothiorella dauci</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
<i>Drechslera apii</i> (Göbelez) Richardson & Fraser [Pleosporales: Pleosporaceae] (synonym: <i>Helminthosporium apii</i> Göbelez)	<i>Apium</i> , <i>Daucus</i> , <i>Petroselinum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. The fungus occurs on <i>Apium</i> , <i>Daucus</i> and <i>Petroselinum</i> species (Farr & Rossman 2020; Watson 1971). It is seed-borne only in <i>Apium graveolens</i> (Richardson 1990).	Yes: if introduced via the seed pathway, <i>Drechslera apii</i> could establish and spread in Australia. This fungus is established in Turkey (Farr & Rossman 2020), and parts of Australia have similar climatic conditions. Spread of this fungus from the seed pathway could occur via air-borne spores.	No: Currently, there is no significant published evidence on the economic consequences of this fungus. Therefore, this fungus is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Ectophoma multirostrata</i> (Mathur, Menon & Thirum) Valenzuela-Lopez, Cano, Crous, Guarro & Stchigel [Pleosporales: Didymellaceae] (synonym: <i>Phoma multirostrata</i> (Mathur et al.) Dorenb. & Boerema)	<i>Coriandrum</i>	Yes (Golzar et al. 2015)	Assessment not required	Assessment not required	Assessment not required	No
<i>Entyloma helosciadii</i> Magnus [Entylomatales: Entylomataceae]	<i>Apium</i>	Not known to occur	No: this fungus has been reported occurring on <i>Apium</i> species (Turner 1971; Vánky 2011), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Entyloma pastinacae</i> Jaap [Entylomatales: Entylomataceae]	<i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pastinaca</i> species (Savchenko et al. 2015), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Epicoccum nigrum</i> Link [Pleosporales: Didymellaceae] (synonym: <i>Epicoccum purpurascens</i> Ehrenb.)	<i>Angelica</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i>	Yes (Brown, Hyde & Guest 1998; Fisher, Petrini & Sutton 1993; Langrell, Glen & Alfenas 2008)	Assessment not required	Assessment not required	Assessment not required	No
<i>Epicoccum plurivorum</i> (Johnst.) Chen & Cai [Pleosporales: Didymellaceae] (synonym: <i>Phoma plurivora</i> Johnst.)	<i>Daucus</i>	Yes (Aveskamp et al. 2010)	Assessment not required	Assessment not required	Assessment not required	No
<i>Erysiphe betae</i> (Vaňha) Weltzien [Erysiphales: Erysiphaceae]	<i>Daucus</i> , <i>Pastinaca</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Yes (Cunnington 2003)	Assessment not required	Assessment not required	Assessment not required	No
<i>Erysiphe heraclei</i> DC [Erysiphales: Erysiphaceae] (synonym: <i>Erysiphe umbelliferarum</i> f. <i>anthrisci</i> Jacz.)	<i>Anethum</i> , <i>Angelica</i> , <i>Anthriscus</i> , <i>Apium</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Yes (Cunnington 2003; Cunnington et al. 2008)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Erysiphe lichenoides</i> Trab & Sacc. [Erysiphales: Erysiphaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Erysiphe polygoni</i> DC [Erysiphales: Erysiphaceae]	<i>Angelica</i> , <i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Yes (Cook & Dubé 1989; Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Exserohilum rostratum</i> (Drechsler) Leonard & Suggs [Pleosporales: Pleosporaceae] (synonyms: <i>Drechslera rostrata</i> (Drechsler) Richardson & Fraser; <i>Setosphaeria rostrata</i> Leonard)	<i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Filiella pastinacae</i> (Karst.) Videira & Crous [Capnodiales: Mycosphaerellaceae] (synonyms: <i>Cercospora pastinacina</i> Solheim; <i>Cercospora pastinacae</i> Karst.; <i>Pseudocercospora pastinacae</i> (Karst.) Braun; <i>Ramularia pastinacae</i> (Karst.) Lindr. & Vestergr.)	<i>Angelica</i> , <i>Apium</i> , <i>Pastinaca</i>	Yes (Cook & Dubé 1989; Sampson & Walker 1982; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Fulvia fulva</i> (Cooke) Cif. [Capnodiales: Cladosporiaceae] (synonyms: <i>Cladosporium fulvum</i> Cooke, <i>Passalora fulva</i> (Cooke) Braun & Crous)	<i>Cuminum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusariella hughesii</i> Chab.-Frydm. [Incertae sedis: Incertae sedis]	<i>Anthriscus</i> , <i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus</i> and <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Fusarium acuminatum</i> Ellis & Everh. [Hypocreales: Nectriaceae] (synonym: <i>Gibberella acuminata</i> Wollenw.)	<i>Cuminum</i> , <i>Daucus</i> , <i>Pastinaca</i> , <i>Pimpinella</i>	Yes (Cook & Dubé 1989; Summerell et al. 2011)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium avenaceum</i> (Fr.: Fr.) Sacc. [Hypocreales: Nectriaceae] (synonym: <i>Gibberella avenacea</i> Cook)	<i>Apium</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Summerell et al. 2011)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium culmorum</i> (Sm.) Sacc. [Hypocreales: Nectriaceae]	<i>Carum</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Petroselinum</i>	Yes (Summerell et al. 2011)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Fusarium equiseti</i> (Corda) Sacc. [Hypocreales: Nectriaceae] (synonym: <i>Gibberella intricans</i> Wollenw.)	<i>Carum</i> , <i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Yes (Summerell et al. 2011)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium graminearum</i> Schwabe [Hypocerales: Nectriaceae] (synonym: <i>Gibberella zeae</i> (Schwein.) Petch)	<i>Carum</i> , <i>Coriandrum</i> , <i>Daucus</i>	Yes (Summerell et al. 2011)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium incarnatum</i> (Desm.) Sacc. [Hypocreales: Nectriaceae] (synonym: <i>Fusarium semitectum</i> Berk. & Ravenel)	<i>Anethum</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Foeniculum</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Yes (Summerell et al. 2011)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium moniliforme</i> Sheld. [Hypocreales: Nectriaceae] (synonym: <i>Gibberella fujikuroi</i> (Sawada) Wollenw.)	<i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i>	Yes (Petrovic et al. 2009; Summerell et al. 2011)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium oxysporum</i> f. sp. <i>apii</i> Snyder & Hansen [Hypocreales: Nectriaceae]	<i>Apium</i>	Not known to occur	No: this fungus has been reported occurring on <i>Apium</i> species (Schneider 1984), but insufficient published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Fusarium oxysporum</i> f. sp. <i>anethi</i> Gordon [Hypocreales: Nectriaceae]	<i>Anethum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> species (Royal Botanic Gardens Kew, Landcare Research NZ & Chinese Academy of Science 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Fusarium oxysporum</i> f. sp. <i>coriandrii</i> Kulkarni et al. [Hypocreales: Nectriaceae]	<i>Coriandrum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Coriandrum sativum</i> (Mishra 2005), but insufficient published evidence was found indicating it is seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Fusarium oxysporum</i> f. sp. <i>cumini</i> Prasad & Patel [Hypocreales: Nectriaceae]	<i>Cuminum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Cuminum cyminum</i> and is carried by the seeds of this host (Singh, Choudhary & Patel 1972).	Yes: if introduced via the seed pathway, <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Mishra 2005; Pappas & Elena 1997). Spread of this fungus from the seed pathway could occur via air-borne spores.	Yes: <i>Fusarium oxysporum</i> f. sp. <i>cumini</i> is an economically important pathogen of cumin (Mehta et al. 2012; Pappas & Elena 1997; Tawfik & Allam 2004) and has the potential for economic consequences in Australia.	Yes
<i>Fusarium poae</i> (Peck) Wollenw. [Hypocreales: Nectriaceae]	<i>Carum</i>	Yes (Summerell et al. 2011). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium proliferatum</i> (Matsush.) Nirenberg ex Gerlach & Nirenberg [Hypocreales: Nectriaceae]	<i>Foeniculum</i> , <i>Pimpinella</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium redolens</i> Wollenw. [Hypocreales: Nectriaceae] (synonym: <i>Fusarium oxysporum</i> var. <i>redolens</i> (Wollenw.) Gordon)	<i>Daucus</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Fusarium roseum</i> Link [Hypocreales: Nectriaceae] (synonym: <i>Gibberella pulicaris</i> (Kunze) Sacc.)	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium sporotrichioides</i> Sherb [Hypocreales: Nectriaceae]	<i>Coriandrum</i> , <i>Pimpinella</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium subglutinans</i> (Wollenw. & Reinking) Belson, Toussoun & Marasas [Hypocreales: Nectriaceae]	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium tricinctum</i> (Corda) Sacc. [Hypocreales: Nectriaceae]	<i>Pimpinella</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium udum</i> Butler [Hypocreales: Nectriaceae] (synonym: <i>Gibberella indica</i> Rai & Upadhyay)	<i>Coriandrum</i> , <i>Cuminum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Coriandrum sativum</i> and <i>Cuminum cyminum</i> (Ramesh & Jayagoudar 2013).	Yes: if introduced via the seed pathway, <i>Fusarium udum</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: currently, there is no significant published evidence on the economic consequences of this fungus. Therefore, this fungus is not considered to have the potential for economic consequences in Australia.	No
<i>Fusarium verticillioides</i> (Sacc.) Nirenberg [Hypocreales: Nectriaceae]	<i>Foeniculum</i> , <i>Pimpinella</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Fusicladiella pimpinellae</i> (Vestergr.) Deighton [Capnodiales: Mycosphaerellaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella major</i> (Scheuer 2019), but no published evidence was found indicating it seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Fusoidiella anethi</i> (Pers.) Videira & Crous [Capnodiales: Mycosphaerellaceae] (synonyms: <i>Dothidea anethi</i> (Pers.) Fr; <i>Phoma anethi</i> (Pers.) Sacc.; <i>Mycosphaerella anethi</i> (Pers.) Petr.)	<i>Anethum</i> , <i>Carum</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusoidiella depressa</i> (Berk. & Broome) Videira & Crous [Venturiaceae: Fusicladium] (synonyms: <i>Passalora depressa</i> (Berk.) Sacc.; <i>Cercospora depressa</i> (Berk. & Broome) Vassiljevsky)	<i>Anethum</i> , <i>Angelica</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> , <i>Angelica</i> , <i>Foeniculum</i> and <i>Petroselinum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Fusicolla merismoides</i> (Corda) Gräfenhan et al. [Hypocreales: Nectriaceae] (synonym: <i>Fusarium merismoides</i> Corda)	<i>Coriandrum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Geotrichum candidum</i> Link [Saccharomycetales: Dipodascaceae] (synonym: <i>Dipodascus geotrichum</i> (Butler & Petersen) Arx)	<i>Cuminum</i> , <i>Daucus</i>	Yes (Morris & Nicholls 1978)	Assessment not required	Assessment not required	Assessment not required	No
<i>Gibellulopsis nigrescens</i> (Pethybr.) Zare et al. [Incertae sedis: Plectosphaerellaceae] (synonym: <i>Verticillium nigrescens</i> Pethybr)	<i>Apium</i> , <i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Gloeosporium achaeniicola</i> Rostr. [Helotiales: Dermateaceae]	<i>Coriandrum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Coriandrum sativum</i> (Richardson 1990).	Yes: if introduced via the seed pathway, <i>Gloeosporium achaeniicola</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Richardson 1990; Stevenson 1926). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: currently, there is no significant published evidence on the economic consequences of this fungus. Therefore, this fungus is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Glomus aggregatum</i> Schenck & Sm. [Glomerales: Glomeraceae] (synonym: <i>Rhizophagus aggregatus</i> (Schenck & Sm.) Walker)	<i>Anthriscus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Glomus fuegianum</i> (Speg.) Trappe & Gerd. [Glomerales: Glomeraceae] (synonym: <i>Endogone fuegiana</i> Speg.)	<i>Anthriscus</i>	Yes (Gleason & McGee 2004)	Assessment not required	Assessment not required	Assessment not required	No
<i>Glomus heterosporum</i> Sm. & Schenck. [Glomerales: Glomeraceae]	<i>Anthriscus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus sylvestris</i> (Farr & Rossman 2020), but no published evidence was found indicating it seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Glomus macrocarpum</i> Tul. & Tul. [Glomerales: Glomeraceae] (synonym: <i>Endogone macrocarpa</i> (Tul. & Tul.) Tul. & Tul.)	<i>Anthriscus</i> , <i>Apium</i>	Yes (Antoniolli et al. 2002)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Glioniella perexigua</i> (Speg.) Sacc. [Hysteriales: Hysteriaceae] (synonym: <i>Hysterium perexiguum</i> Speg.)	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica sylvestris</i> (Farr & Rossman 2020), but no published evidence was found indicating it seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Golovinomyces orontii</i> (Castagne) Heluta [Erysiphales: Erysiphaceae] (synonym: <i>Erysiphe orontii</i> Castagne)	<i>Petroselinum</i>	Yes (Cunnington 2003; Liberato & Shivas 2012)	Assessment not required	Assessment not required	Assessment not required	No
<i>Gongronella butleri</i> (Lendn.) Peyronel & Dal Vesco [Mucorales: Cunninghamellaceae] (synonym: <i>Absidia butleri</i> Lendn.)	<i>Coriandrum</i> , <i>Cuminum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Helicobasidium mompa</i> Nobuj. Tanaka [Helicobasidiales: Helicobasidiaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020; Koike, Gladders & Paulus 2007), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Helicobasidium purpureum</i> (Tul) Pat [Helicobasidiales: Helicobasidiaceae] (synonyms: <i>Rhizoctonia crocorum</i> (Pers.) DC; <i>Tubercularia persicina</i> Ditmar)	<i>Angelica</i> , <i>Apium</i> , <i>Daucus</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Hendersonia foeniculi</i> Gonz Frag [Pleosporales: Phaeosphaeriaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Mycobank 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Heteropatella umbilicata</i> (Pers.: Fr.) Grove Jaap [Helotiales: Helotiaceae]	<i>Angelica</i> , <i>Daucus</i> , <i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Heterosphaeria linariae</i> (Rabenh.) Rehm [Helotiales: Helotiaceae] (synonyms: <i>Heteropatella lacera</i> Fuckel; <i>Heteropatella lacera</i> f. <i>dauci</i> Sacc.)	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on dry and decaying stems of <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Heterosphaeria patella</i> (Tode) Grev [Helotiales: Helotiaceae] (synonym: <i>Heteropatella bonordenii</i> (Hazsl) Lind)	<i>Anethum</i> , <i>Angelica</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> , <i>Angelica</i> , <i>Daucus</i> and <i>Pastinaca</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Humicola fuscoatra</i> Traaen [Sordariales: Chaetomiaceae]	<i>Foeniculum</i>	Yes (Beilharz, Parbery & Swart 1982)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Hyalopeziza archangelica</i> Olsen & Sivertsen [Helotiales: Hyaloscyphaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on the dead stems of <i>Angelica</i> species (Mycobank 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Hydropisphaera arenula</i> (Berk. & Broome) Rossman & Samuels [Hypocreales: Bionectriaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on the dead leaves and stems of <i>Foeniculum</i> species (HerbIMI 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Hydropisphaera erubescens</i> (Roberge ex Desm.) Rossman & Samuels [Hypocreales: Bionectriaceae] (synonym: <i>Calonectria umbelliferarum</i> Seaver)	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Itersonilia pastinacae</i> Channon [Cystofilobasidiales: Cystofilobasidiaceae]	<i>Anethum</i> , <i>Pastinaca</i>	Yes (Cook & Dubé 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Itersonilia perplexans</i> Derx [Cystofilobasidiales: Cystofilobasidiaceae]	<i>Anethum</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Pastinaca</i>	Yes (Aldaoud, Salib & Cunningham 2009)	Assessment not required	Assessment not required	Assessment not required	No
<i>Juxtiphoma eupyrena</i> (Sacc.) Valenzuela-Lopez, Cano, Crous, Guarro & Stchigel [Pleosporales: Didymellaceae] (synonym: <i>Phoma eupyrena</i> Sacc.)	<i>Daucus</i>	Yes (Lenne 1990; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Kalmusia clivensis</i> (Berk. & Broome) Barr [Pleosporales: Montagnulaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Huhndorf 1992), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Laestadia archangelicae</i> Rostr. [Diaporthales: Gnomoniaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Connors 1967), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Laetinaevia minutissima</i> (Rostr.) Nannf. ex Hein [Helotiales: Dermateaceae] (synonym: <i>Calloria minutissima</i> Rostr.)	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Connors 1967), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Lasiodiplodia theobromae</i> (Pat.) Griffon & Maubl. [Botryosphaerales: Botryosphaeriaceae] (synonym: <i>Botryodiplodia theobromae</i> Pat.)	<i>Cuminum</i> , <i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Leptosphaeria comatella</i> (Cooke & Ellis) Sacc. [Pleosporales: Leptosphaeriaceae]	<i>Daucus</i> , <i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> and <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Leptosphaeria conoidea</i> (De Not.) Sacc. [Pleosporales: Leptosphaeriaceae]	<i>Angelica</i> , <i>Daucus</i> , <i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> , <i>Daucus</i> and <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Leptosphaeria doliolum</i> (Pers.: Fr.) Ces. & De Not. [Pleosporales: Leptosphaeriaceae]	<i>Angelica</i> , <i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> and <i>Foeniculum</i> species (Farr & Rossman 2020; Stoykov 2004), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Leptosphaeria erigerontis</i> Berl. [Pleosporales: Leptosphaeriaceae]	<i>Carum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Carum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Leptosphaeria errabunda</i> (Desm.) Gruyter, Aveskamp & Verkley [Pleosporales: Didymellaceae] (synonym: <i>Phoma errabunda</i> Desm.)	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Leptosphaeria foeniculacea</i> Fabre [Pleosporales: Leptosphaeriaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Leptosphaeria foeniculi</i> Gonz Frag [Pleosporales: Leptosphaeriaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Leptosphaeria gloeospora</i> (Berk. & Curr) Sacc. [Pleosporales: Leptosphaeriaceae] (synonyms: <i>Massarina gloeospora</i> (Berk. & Curr.) Barr; <i>Trichometasphaeria gloeospora</i> (Berk. & Curr) Holm)	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Leptosphaeria longipedicellata</i> Mill & Burton [Pleosporales: Leptosphaeriaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Crane & Shearer 1991), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Leptosphaeria modesta</i> Rabenh. [Pleosporales: Leptosphaeriaceae] (synonyms: <i>Sphaeria modesta</i> Desm.; <i>Nodulosphaeria modesta</i> (Rabenh.) Munk ex Holm)	<i>Angelica</i> , <i>Anthriscus</i> , <i>Daucus</i> , <i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> , <i>Anthriscus</i> , <i>Daucus</i> and <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Leptosphaeria ogilviensis</i> (Berk. & Broome) Ces & De Not [Pleosporales: Leptosphaeriaceae]	<i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pastinaca</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Leptosphaeria rostrupii</i> Sacc. & Sacc. [Pleosporales: Leptosphaeriaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Leptosphaeria suffulta</i> (Nees) Niessel [Pleosporales: Leptosphaeriaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Leptospora rubella</i> (Pers.: Fr.) Rabenh. [Incertae sedis: Incertae sedis]	<i>Angelica</i> , <i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> and <i>Pastinaca</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Leveillula lanuginosa</i> (Fuckel) Golovin [Erysiphales: Erysiphaceae] (synonym: <i>Erysiphe lanuginosa</i> Fuckel)	<i>Anethum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> , <i>Daucus</i> , <i>Foeniculum</i> and <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Leveillula taurica</i> (Lév.) Arnaud [Erysiphales: Erysiphaceae]	<i>Anethum</i> , <i>Apium</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Yes (Glawe et al. 2005; Lenne 1990; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Lichtheimia corymbifera</i> (Coh) Vuill. [Mucorales, Cunninghamellaceae] (synonym: <i>Absidia corymbifera</i> (Cohn) Sacc & Trotter)	<i>Cuminum</i>	Yes (Kennedy et al. 2016)	Assessment not required	Assessment not required	Assessment not required	No
<i>Lophiostoma caulium</i> Fuckel [Pleosporales: Lophiostomataceae]	<i>Anthriscus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Macrophomina phaseolina</i> (Tassi) Goid. [Botryosphaeriales: Botryosphaeriaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Pastinaca</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Macrosporium cladosporioides</i> Desm. [Pleosporales: Pleosporaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Melanospora papillata</i> Hotson [Melanosporales: Ceratostomataceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Melanospora simplex</i> (Corda) Hawksw. [Melanosporales: Ceratostomataceae] (synonyms: <i>Melanospora damnosa</i> (Sacc.) Lindau; <i>Gonatobotrys simplex</i> Corda)	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Microdiplodia perpusilla</i> (Desm.) Allesch. [Botryosphaeriales: Botryosphaeriaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Mollisia atrata</i> Bres. [Helotiales: Dermateaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Monochaetia karstenii</i> (Sacc. & Syd.) Sutton [Xylariales: Amphisphaeriaceae] (synonym: <i>Pestalotiopsis karstenii</i> (Sacc. & Syd.) Steyaert)	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Monographella nivalis</i> (Schaffnit) Müll. [Xylariales: Amphisphaeriaceae] (synonym: <i>Fusarium nivale</i> Cesati; <i>Microdochium nivale</i> (Fr.) Samuels & I.C. Hallett)	<i>Coriandrum</i> , <i>Cuminum</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Mucor bacilliformis</i> Hesselt [Mucorales: Mucoraceae]	<i>Coriandrum</i> , <i>Cuminum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Coriandrum</i> and <i>Cuminum</i> species (Ramesh & Jayagoudar 2013).	Yes: if introduced via the seed pathway, <i>Mucor bacilliformis</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (NCBI 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
<i>Mucor circinelloides</i> Tiegh. [Mucorales: Mucoraceae]	<i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i>	Yes (Stewart, Munday & Hawkesford 1999)	Assessment not required	Assessment not required	Assessment not required	No
<i>Mucor fragilis</i> Bainier [Mucorales: Mucoraceae]	<i>Cuminum</i>	Yes (Connolly, Stodart & Ash 2010)	Assessment not required	Assessment not required	Assessment not required	No
<i>Mucor hiemalis</i> Wehmer [Mucorales: Mucoraceae]	<i>Angelica</i> , <i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Mucor racemosus</i> Bull. [Mucorales: Mucoraceae]	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Murispora rubicunda</i> (Niessl) Zhang et al. [Pleosporales: Amniculicolaceae] (synonym: <i>Massariosphaeria rubicunda</i> (Niessl) Crivelli)	<i>Anthriscus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Mycocentrospora acerina</i> (Hartig) Deighton [Pleosporales: Incertae sedis] (synonyms: <i>Centrospora acerina</i> (Hartig) Newhall; <i>Cercospora acerina</i> Hartig; <i>Cercospora cari</i> Westerd & Luigk)	<i>Anethum</i> , <i>Apium</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Pastinaca</i>	Yes (Plant Health Australia 2020; Sutton & Gibson 1977)	Assessment not required	Assessment not required	Assessment not required	No
<i>Mycosphaerella angelicae</i> (Fr.) Petr. [Capnodiales: Mycosphaerellaceae] (synonyms: <i>Sphaerella angelicae</i> Ellis & Everh.; <i>Phyllachora angelicae</i> (Fr.) Fuckel)	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring <i>Angelica</i> species (Stevenson 1926), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Mycosphaerella dolichospora</i> (Sacc. & Fautrey) Wehm. [Capnodiales: Mycosphaerellaceae]	<i>Carum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Carum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Mycosphaerella rubella</i> (Niessl & Schröt.) Magnus [Capnodiales: Mycosphaerellaceae] (synonym: <i>Sphaeria rubella</i> Niessl & Schröt.)	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Myrothecium leucotrichum</i> (Peck) Tulloch [Hypocreales: Incertae sedis] (synonym: <i>Xepicula leucotricha</i> (Peck) Nag Raj)	<i>Coriandrum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Nectria sylvana</i> Mouton [Hypocreales: Nectriaceae] (synonym: <i>Lasionectria sylvana</i> (Mouton) Rossman & Samuels)	<i>Angelica</i> , <i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on the decaying leaves and stems of <i>Angelica</i> and <i>Foeniculum</i> species (Samuels 1976), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Neocosmospora solani</i> (Mart.) Lombard & Crous [Hypocreales: Nectriaceae] (synonym: <i>Fusarium solani</i> (Mart) Sacc.)	<i>Apium</i> , <i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Summerell et al. 2011)	Assessment not required	Assessment not required	Assessment not required	No
<i>Nigrospora oryzae</i> (Berk. & Broome) Petch [Incertae sedis: Incertae sedis] (synonym: <i>Khuskia oryzae</i> Huds)	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Nigrospora sphaerica</i> (Sacc.) Mason [Incertae sedis: Incertae sedis]	<i>Cuminum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Nimbya gomphrenae</i> (Togashi) Simmons [Pleosporales: Pleosporaceae] (synonym: <i>Alternaria gomphrenae</i>)	<i>Cucumis</i> , <i>Coriandrum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Nodulosphaeria olivacea</i> (Ellis) Holm [Pleosporales: Phaeosphaeriaceae]	<i>Angelica</i> , <i>Carum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> and <i>Carum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Oidium coriandri</i> Hosag et al. [Erysiphales: Erysiphaceae]	<i>Coriandrum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Coriandrum</i> species (Thaung 2007), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Olpidium brassicae</i> (Woronin) Dang. [Olpidiales: Olpidiaceae] (synonym: <i>Olpidiaster brassicae</i> (Woronin) Doweld)	<i>Anethum</i> , <i>Apium</i> , <i>Daucus</i> , <i>Petroselinum</i>	Yes (Cook & Dubé 1989; Sampson & Walker 1982)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Ombrophila archangelicae</i> Rostr. [Helotiales: Helotiaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Conners 1967), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Ophiobolus anthrisci</i> (Holm) Holm [Pleosporales: Phaeosphaeriaceae] (synonym: <i>Ophiobolus nigromaculatus</i> f. <i>anthrisci</i> Holm)	<i>Anthriscus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Ophiobolus nigroclypeatus</i> Miller & Burton [Pleosporales: Phaeosphaeriaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Ophiobolus tenellus</i> (Auersw.) Sacc. [Pleosporales: Phaeosphaeriaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Pacispora scintillans</i> (Rose & Trappe) Sieverd. et al. [Diversisporales: Pacisporaceae] (synonym: <i>Glomus scintillans</i> Rose & Trappe)	<i>Anthriscus</i>	Yes (Tibbett et al. 2008)	Assessment not required	Assessment not required	Assessment not required	No
<i>Paecilomyces variotii</i> Baineir [Eurotiales: Trichocomaceae] (synonym: <i>Paecilomyces divaricatus</i> (Thom) Samson et al.)	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Papulaspora irregularis</i> Hotson [Incertae sedis: Incertae sedis]	<i>Coriandrum</i> , <i>Cuminum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Coriandrum sativum</i> and <i>Cuminum cyminum</i> (Ramesh & Jayagoudar 2013).	Yes: if introduced via the seed pathway, <i>Papulaspora irregularis</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Al-Dhabaan & Bakhali 2016; Jamiolkowska, Wagner & Sawicki 2000; Ramesh & Jayagoudar 2013). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
<i>Paraconiothyrium fuckelii</i> (Sacc.) Verkley & Gruyter [Pleosporales: Coniothyriaceae] (synonym: <i>Coniothyrium fuckelii</i> Sacc.)	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Paramyrothecium roridum</i> (Tode) Lombard & Crous [Hypocreales: Stachybotryaceae] (synonym: <i>Myrothecium roridum</i> Tode)	<i>Coriandrum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Paraphoma fimeti</i> (Brunaud) Gruyter et al. [Pleosporales: Incertae sedis] (synonym: <i>Phoma fimeti</i> Brunaud)	<i>Apium</i>	Yes (Crous, Know-Davies & Wingfield 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Passalora angelicae</i> (Ellis & Everh.) Braun [Capnodiales: Mycosphaerellaceae] (synonym: <i>Fusicladium angelicae</i> Ellis & Everh.)	<i>Angelica</i> , <i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> and <i>Petroselinum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for these fungi.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Passalora bupleuri</i> (Pass.) Braun [Capnodiales: Mycosphaerellaceae] (synonyms: <i>Cercospora bupleuri</i> Pass.; <i>Cercospora chaerophylli</i> Höhn.)	<i>Anthriscus</i> , <i>Coriandrum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus</i> and <i>Coriandrum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for these fungi.	Assessment not required	Assessment not required	No
<i>Passalora malkoffii</i> (Bubák) Braun [Capnodiales: Mycosphaerellaceae] (synonym: <i>Cercospora malkoffii</i> (Bubák) Braun)	<i>Pimpinella</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne on <i>Pimpinella</i> species and is seed-borne in <i>Pimpinella anisum</i> (Erzurum et al. 2005; Ullah et al. 2013).	Yes: if introduced via the seed pathway, <i>Passalora malkoffii</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Erzurum et al. 2005; Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	Yes: significant losses due to <i>Passalora malkoffii</i> have been reported (Erzurum et al. 2005) and it is an economically important pathogen of <i>Pimpinella anisum</i> (Ullah et al. 2013). Therefore, it has the potential for economic consequences in Australia.	Yes
<i>Passalora pastinacae</i> (Sacc.) Braun [Capnodiales: Mycosphaerellaceae] (synonyms: <i>Cercospora apii</i> var. <i>pastinacae</i> Sacc.; <i>Cercospora pastinacae</i> (Sacc.) Peck)	<i>Pastinaca</i>	Yes (Cook & Dubé 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Penicillium citrinum</i> Thom [Eurotiales: Aspergillaceae]	<i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Penicillium expansum</i> Link [Eurotiales: Aspergillaceae]	<i>Daucus</i>	Yes (Koffmann & Penrose 1987)	Assessment not required	Assessment not required	Assessment not required	No
<i>Penicillium simplicissimum</i> (Oudem.) Thom [Eurotiales: Aspergillaceae] (synonym: <i>Penicillium janthinellum</i> Biourge)	<i>Coriandrum</i>	Yes (Fisher, Petrini & Sutton 1993)	Assessment not required	Assessment not required	Assessment not required	No
<i>Periconia byssoides</i> Pers. [Pleosporales: Incertae sedis]	<i>Carum</i> , <i>Coriandrum</i> , <i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Periconia cookei</i> Mason & Ellis [Pleosporales: Incertae sedis]	<i>Coriandrum</i> , <i>Cuminum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Coriandrum sativum</i> and <i>Cuminum cyminum</i> (Ramesh & Jayagoudar 2013).	Yes: if introduced via the seed pathway, <i>Periconia cookei</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: currently, there is no significant published evidence on the economic consequences of this fungus. Therefore, this fungus is not considered to have the potential for economic consequences in Australia.	No
<i>Perisporiopsis melioides</i> Berk. & Curtis [Incertae sedis: Perisporiopsidaceae] (synonym: <i>Sphaeria melioides</i> Berk. & Curtis)	<i>Carum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Carum</i> species (Khalis, Reddy & Chary 1982).	Yes: if introduced via the seed pathway, <i>Perisporiopsis melioides</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Khalis, Reddy & Chary 1982; NCBI 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Phlyctema asparagi</i> Fautrey & Roum. [Helotiales: Dermateaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Phoma exigua</i> Desm. [Pleosporales: Didymellaceae] (synonym: <i>Boeremia exigua</i> (Desm.) Aveskamp et al.)	<i>Anethum</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Phoma herbarum</i> Westend. [Pleosporales: Didymellaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Phoma longissima</i> (Pers.) Westend. [Pleosporales: Didymellaceae]	<i>Anethum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> species (Farr & Rossman 2020), but no published evidence was found indicating fungus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Phomatodes nebulosa</i> (Pers.) Chen & Cai [Pleosporales: Didymellaceae] (synonyms: <i>Sphaeria nebulosa</i> Pers.; <i>Mycosphaerella nebulosa</i> (Pers.) Johanson ex Oudem.; <i>Phoma nebulosa</i> (Pers.) Mont.)	<i>Daucus</i> , <i>Pastinaca</i>	Yes (Zahid et al. 2001)	Assessment not required	Assessment not required	Assessment not required	No
<i>Phomatospora berkeleyi</i> Sacc. [Incertae sedis: Incertae sedis] (synonyms: <i>Sphaeria phomatospora</i> Berk. & Broome; <i>Phoma berkeleyi</i> Sacc.)	<i>Daucus</i>	Yes (Vijaykrishna & Hyde 2006)	Assessment not required	Assessment not required	Assessment not required	No
<i>Phomopsis brunaudiana</i> (Sacc.) Sutton [Diaporthales: Diaporthaceae] (synonyms: <i>Septoria brunaudiana</i> Sacc; <i>Rhabdospora brunaudiana</i> (Sacc.) Sacc.)	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Sutton 1996), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Phomopsis canadensis</i> Bubák & Dearn. [Diaporthales: Diaporthaceae]	<i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pastinaca</i> species (Cain et al. 2010), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Phomopsis diachenii</i> Sacc. [Diaporthales: Diaporthaceae]	<i>Carum</i> , <i>Pastinaca</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne on <i>Carum carvi</i> (Mačkinaitė 2011). Whilst this species has also been reported occurring on <i>Pastinaca sativa</i> (Udayanga et al. 2011), insufficient published evidence was found indicating it is seed-borne in this host.	Yes: if introduced via the seed pathway, <i>Phomopsis diachenii</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Machowicz-Stefaniak, Zalewska & Król 2009). Spread of this fungus from the seed pathway could occur via air-borne spores.	Yes: <i>Phomopsis diachenii</i> is an economically important pathogen (Machowicz-Stefaniak, Zalewska & Król 2009; Rodeva & Gabler 2004) and has the potential for economic consequences in Australia. Browning and dieback of caraway umbels (inflorescence) results in significant losses (Zalewska, Machowicz-Stefaniak & Król 2013b).	Yes
<i>Phyllosticta apii</i> Halst. [Botryosphaeriales: Phyllostictaceae]	<i>Apium</i>	Not known to occur	No: this fungus has been reported occurring on <i>Apium</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Phyllosticta coriandri</i> Khokhr. [Botryosphaerales: Phyllostictaceae]	<i>Coriandrum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Coriandrum</i> species (Mycobank 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Phyllosticta petroselini</i> Rothers [Botryosphaerales: Phyllostictaceae]	<i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Petroselinum</i> species (Mycobank 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Phyllosticta podagrariae</i> Oudem. [Botryosphaerales: Phyllostictaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Phymatotrichopsis omnivora</i> (Duggar) Hennebert [Pezizales: Rhiziniaceae] (synonym: <i>Phymatotrichum omnivorum</i> Duggar)	<i>Anethum</i> , <i>Angelica</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> , <i>Angelica</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i> and <i>Pimpinella</i> species (Alvarez 1976; Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Physarum cinereum</i> (Batsch) Pers. [Physarida: Physaraceae]	<i>Apium</i>	Yes (Cook & Dubé 1989; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Plasmodiophora brassicae</i> Woronin [Plasmodiophorida: Plasmodiophoridae]	<i>Petroselinum</i>	Yes (Plant Health Australia 2020; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Plectosphaerella cucumerina</i> Lindf.) Gams [Xylariales: Amphisphaeriaceae] (synonyms: <i>Fusarium tabacinum</i> (Beyma) Gams; <i>Monographella cucumerina</i> (Lindf.) Arx; <i>Plectosporium tabacinum</i> (Beyma) Palm et al.)	<i>Anthriscus</i> , <i>Apium</i> , <i>Coriandrum</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Pascoe, Nancarrow & Copes 1984)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Plectosphaerella pauciseptata</i> Phillips et al. [Glomerellales: Plectosphaerellaceae]	<i>Anthriscus</i> , <i>Coriandrum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus</i> , <i>Coriandrum</i> and <i>Petroselinum</i> species (Raimondo & Carlucci 2018; Usami et al. 2012), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Plectosphaerella plurivora</i> Phillips et al. [Glomerellales: Plectosphaerellaceae]	<i>Petroselinum</i>	Yes (Giraldo & Crous 2019)	Assessment not required	Assessment not required	Assessment not required	No
<i>Plectosphaerella ramiseptata</i> Phillips et al. [Glomerellales: Plectosphaerellaceae]	<i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Petroselinum sativum</i> (Raimondo & Carlucci 2018), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Plenodomus libanotidis</i> (Fuckel) Gruyter, Aveskamp & Verkley [Pleosporales: Didymellaceae] (synonyms: <i>Leptosphaeria libanotis</i> (Fuckel) Niessl; <i>Phoma rostrupii</i> Sacc.)	<i>Angelica</i> , <i>Daucus</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Daucus carota</i> and <i>Carum carvi</i> (Davis & Raid 2002; Mačkinaitė 2011; Richardson 1990). This fungus has been also reported on <i>Angelica</i> species (Davis & Raid 2002; Farr & Rossman 2020).	Yes: if introduced via the seed pathway, <i>Plenodomus libanotidis</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
<i>Plenodomus pimpinellae</i> (Lowen & Sivan) Gruyter, Aveskamp & Verkley [Pleosporales: Didymellaceae] (synonym: <i>Leptosphaeria pimpinellae</i> Lowen & Sivan)	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Mouchacca 2005), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Pleospora diaportheoides</i> Ellis & Everh. [Pleosporales: Pleosporaceae]	<i>Pastinaca</i> , <i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pastinaca</i> and <i>Petroselinum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Pleospora lithophilae</i> Gucevič [Pleosporales: Pleosporaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Kabaktepe, Mutlu & Karakus 2013), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Pleospora lusitanica</i> Pass. & Thüm. [Pleosporales: Pleosporaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Pleospora orbicularis</i> Auersw. [Pleosporales: Pleosporaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Pleospora papillata</i> Karst. [Pleosporales: Pleosporaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Pleospora penicillus</i> Fuckel [Pleosporales: Pleosporaceae] (synonym: <i>Pleospora media</i> Niessl)	<i>Anthriscus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pleospora phaeocomoides</i> (Berk. & Broome) Winter [Pleosporales: Pleosporaceae]	<i>Angelica</i> , <i>Daucus</i> , <i>Foeniculum</i>	Yes (Cook & Dubé 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Podosphaera fuliginea</i> (Schltldl.) Braun & Takam. [Erysiphales: Erysiphaceae] (synonym: <i>Oidium erysiphoides</i> Fr.)	<i>Angelica</i>	Yes (Plant Health Australia 2020; Simmonds 1966)	Assessment not required	Assessment not required	Assessment not required	No
<i>Protomyces macrosporus</i> Unger [Taphrinales: Taphrinaceae] (synonym: <i>Physoderma gibbosum</i> Wallr.)	<i>Angelica</i> , <i>Anthriscus</i> , <i>Carum</i> , <i>Coriandrum</i>	Yes (Cook & Dubé 1989)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Pseudocercospora daucicola</i> Goh & Hsieh [Capnodiales: Mycosphaerellaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020) No published evidence was found indicating this fungus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Pseudopithomyces chartarum</i> (Berk. & Curtis) Li, Ariyawansa & Hyde [Pleosporales: Didymellaceae] (synonym: <i>Pithomyces chartarum</i> (Berk. & Curtis) Ellis)	<i>Foeniculum</i>	Yes (Zahid et al. 2001)	Assessment not required	Assessment not required	Assessment not required	No
<i>Puccinia angelicae</i> (Schumach.) Fuckel [Pucciniales: Pucciniaceae] (synonym: <i>Puccinia bullata</i> (Pers.) Schröt.)	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Davis & Raid 2002; Dietrich 2005; Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Puccinia angelicae-mammillata</i> Kleb. [Pucciniales: Pucciniaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Puccinia anthriscicola</i> Gjaerum [Pucciniales: Pucciniaceae]	<i>Anthriscus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Puccinia apii</i> Desm. [Pucciniales: Pucciniaceae] (synonym: <i>Puccinia apii</i> Corda)	<i>Apium</i>	Yes (Davis & Raid 2002; Farr & Rossman 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Puccinia baicalensis</i> Tranzschel [Pucciniales: Pucciniaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Puccinia bistortae</i> (Strauss) DC. [Pucciniales: Pucciniaceae] (synonyms: <i>Puccinia caribistortae</i> Kleb.; <i>Puccinia polygonivivipari</i> Karst.)	<i>Angelica</i> , <i>Carum</i> , <i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> , <i>Carum</i> and <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Puccinia caricola</i> Zhuang [Pucciniales: Pucciniaceae]	<i>Carum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Carum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Puccinia chaerophylli</i> Purton [Pucciniales: Pucciniaceae]	<i>Anthriscus</i> , <i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus</i> and <i>Daucus</i> species (Davis & Raid 2002; Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Puccinia corvarensis</i> Bubák [Pucciniales: Pucciniaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Puccinia nanbuana</i> Henn. [Pucciniales: Pucciniaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Puccinia nitida</i> (Strauss) Barclay [Pucciniales: Pucciniaceae] (synonyms: <i>Puccinia aethusae</i> Mart; <i>Puccinia petroselini</i> (DC) Lindr.)	<i>Anethum</i> , <i>Angelica</i> , <i>Carum</i> , <i>Foeniculum</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> , <i>Angelica</i> , <i>Carum</i> , <i>Foeniculum</i> , <i>Petroselinum</i> and <i>Pimpinella</i> species (Davis & Raid 2002; Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Puccinia pimpinellae</i> (Strauss) Link [Pucciniales: Pucciniaceae]	<i>Angelica</i> , <i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> and <i>Pimpinella</i> species (Davis & Raid 2002; Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Puccinia pimpinellae-brachycarpae</i> Tranzschel & Erem. [Pucciniales: Pucciniaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Puccinia pulvillulata</i> Lindr. [Pucciniales: Pucciniaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Puccinia rubiginosa</i> Schröt. [Pucciniales: Pucciniaceae]	<i>Petroselinum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Petroselinum</i> species (Farr & Rossman 2020; Makinen 1964), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Puccinia thuemenii</i> McAlpine [Pucciniales: Pucciniaceae]	<i>Apium</i>	Yes (Cook & Dubé 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Puccinia tumida</i> Grev. [Pucciniales: Pucciniaceae]	<i>Angelica</i> , <i>Carum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> and <i>Carum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Pyrenopeziza angelicae</i> (Dearn.) Nannf. [Helotiales: Dermateaceae] (synonym: <i>Mollisia angelicae</i> Dearn.)	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on the leaves of <i>Angelica</i> species (Dearness 1924), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Pyrenopeziza pastinacae</i> (Nannf.) Gremmen [Helotiales: Dermateaceae]	<i>Angelica</i> , <i>Anthriscus</i> , <i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on dead stems of <i>Pastinaca</i> species (Gremmen 1958), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Pyrenopeziza plicata</i> (Rehm) Rehm [Helotiales: Dermateaceae] (synonym: <i>Pyrenopeziza plicata</i> f. <i>conicola</i> Bayl. Ellis)	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on dead stems of <i>Angelica</i> species (Elliott 1917; Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Pyrenophora biseptata</i> (Sacc. & Roum.) Crous [Pleosporales: Pleosporaceae] (synonym: <i>Drechslera biseptata</i> (Sacc. & Roum) Richardson & Fraser)	<i>Petroselinum</i>	Yes (Cunnington 2003)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pyrenophora pimpinellae</i> Gucevič [Pleosporales: Pleosporaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Mycobank 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Ramularia archangelicae</i> Lindr. [Capnodiales: Mycosphaerellaceae] (synonym: <i>Ramularia angelicae</i> Höhn.)	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Videira et al. 2016; Zalewska, Machowicz-Stefaniak & Król 2013a), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Ramularia chaerophylli</i> Ferraris [Capnodiales: Mycosphaerellaceae] (synonyms: <i>Ramularia anthrisci</i> Höhn.; <i>Ramularia chaerophylli</i> f. <i>aurei</i> Gonz. Frag.)	<i>Anthriscus</i>	Not known to occur	No: this fungus has been reported occurring on leaves of <i>Anthriscus</i> species (Jage & Braun 2004; Negrean 2004), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Ramularia endophylla</i> Verkley & Braun [Capnodiales: Mycosphaerellaceae] (synonym: <i>Mycosphaerella punctiformis</i> (Pers.: Fr.) Starbäck)	<i>Angelica</i> , <i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> and <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Ramularia foeniculi</i> Sibilis [Capnodiales: Mycosphaerellaceae]	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum vulgare</i> (Singh & Mathur 2004), but insufficient published evidence was found indicating it is seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Ramularia heraclei</i> (Oudem.) Sacc. [Capnodiales: Mycosphaerellaceae] (synonyms: <i>Ramularia coriandri</i> Moesz & Smarods; <i>Ramularia heraclei</i> var. <i>apii-graveolentis</i> Sacc. & Berl.; <i>Ramularia pastinacae</i> Bubák)	<i>Apium</i> , <i>Coriandrum</i> , <i>Pastinaca</i>	Yes (Braun et al. 2005)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Ramularia libanotidis</i> Bubák [Capnodiales: Mycosphaerellaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Wolczanska 2010), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Rhabdospora nebulosa</i> (Desm.) Sacc. [Capnodiales: Mycosphaerellaceae]	<i>Anethum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anethum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Rhabdospora pastinacina</i> (Sacc.) Allesch. [Capnodiales: Mycosphaerellaceae]	<i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pastinaca</i> species (Cain et al. 2010; Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Rhabdospora pleosporoides</i> (Sacc.) Sacc. [Capnodiales: Mycosphaerellaceae] (synonym: <i>Rhabdospora pleosporoides</i> var. <i>rubescens</i> (Karst.) Sacc.)	<i>Angelica</i> , <i>Anthriscus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> and <i>Anthriscus</i> species (Dennis 1990; Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Rhexocercosporidium carotae</i> (Årsvoll) Braun [Helotiales: Incertae sedis] (synonym: <i>Acrothecium carotae</i> Årsvoll)	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on the roots, leaves and petioles of <i>Daucus</i> species (Shoemaker et al. 2002), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Rhizoctonia ferruginea</i> Matz [Cantharellales: Ceratobasidiaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Rhizoctonia solani</i> Kühn [Cantharellales: Ceratobasidiaceae] (synonyms: <i>Corticium solani</i> (Prill. & Delacr.) Bourdot & Galzin; <i>Pellicularia filamentosa</i> (Pat.) Rogers; <i>Thanatephorus cucumeris</i> (Frank) Donk)	<i>Anethum</i> , <i>Apium</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Yes (Anderson et al. 2004; Neate & Warcup 1985)	Assessment not required	Assessment not required	Assessment not required	No
<i>Rhizoctonia zeae</i> Voorhees [Cantharellales: Ceratobasidiaceae] (synonym: <i>Waitea circinata</i> Warcup & Talbot)	<i>Daucus</i>	Yes (Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Rhizophagus fasciculatus</i> (Thaxt.) Walker & Schüßler [Glomerales: Glomeraceae] (synonym: <i>Glomus fasciculatum</i> (Thaxt.) Gerd. & Trappe)	<i>Anthriscus</i> , <i>Apium</i>	Not known to occur	No: this fungus has been reported occurring on <i>Anthriscus</i> and <i>Apium</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Rhizopus arrhizus</i> Fischer [Mucorales: Rhizopodaceae] (synonym: <i>Rhizopus oryzae</i> Went & Prins. Geerl.)	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i>	Yes (Plant Health Australia 2020; Simmonds 1966)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Rhizopus stolonifer</i> (Ehrenb.: Fr.) Vuill. [Mucorales: Rhizopodaceae] (synonym: <i>Rhizopus nigricans</i> Ehrenb.)	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Cook & Dubé 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Rhynchosporium secalis</i> (Oudem.) Davis [Helotiales: Incertae sedis]	<i>Coriandrum</i> , <i>Cuminum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Rosellinia nectrioides</i> Rehm [Xylariales: Xylariaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on <i>Angelica</i> species (Petrini, Petrini & Francis 1989), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Sarocladium kiliense</i> (Grütz) Summerb. [Hypocreales: Incertae sedis] (synonym: <i>Acremonium kiliense</i> Grütz)	<i>Cuminum</i> , <i>Foeniculum</i>	Yes (MacNish 1986)	Assessment not required	Assessment not required	Assessment not required	No
<i>Sarocladium strictum</i> (Gams) Summerb. [Hypocreales: Incertae sedis] (synonyms: <i>Acremonium strictum</i> Gams; <i>Cephalosporium acremonium</i> Corda)	<i>Apium</i> , <i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Schizothecium curvisporum</i> (Cain) Lundq. [Sordariales: Lasiosphaeriaceae] (synonym: <i>Sordaria curvispora</i> Cain)	<i>Apium</i> , <i>Daucus</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Apium graveolens</i> and <i>Daucus carota</i> (Cain & Groves 1948).	Yes: if introduced via the seed pathway, <i>Schizothecium curvisporum</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (NCBI 2020; Pieterse et al. 2018). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for significant economic consequences in Australia.	No
<i>Schizothecium inaequale</i> (Cain) Lundq. [Sordariales: Lasiosphaeriaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Cai, Jeewon & Hyde 2005), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Sclerotinia minor</i> Jagger [Helotiales: Sclerotiniaceae] (synonym: <i>Sclerotinia intermedia</i> Ramsey)	<i>Apium</i> , <i>Carum</i> , <i>Daucus</i> , <i>Petroselinum</i>	Yes (Sampson & Walker 1982)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Sclerotinia sclerotiorum</i> (Lib.) de Bary [Helotiales: Sclerotiniaceae]	<i>Anethum</i> , <i>Angelica</i> , <i>Anthriscus</i> , <i>Apium</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Yes (Li et al. 2006)	Assessment not required	Assessment not required	Assessment not required	No
<i>Sclerotinia trifoliorum</i> Erikss [Helotiales: Sclerotiniaceae]	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Sclerotium rolfsii</i> Sacc. [Incertae sedis: Incertae sedis] (synonyms: <i>Athelia rolfsii</i> (Curzi) Tu & Kimbr; <i>Corticium rolfsii</i> Curzi)	<i>Apium</i> , <i>Carum</i> , <i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Scutellospora calospora</i> (Nicolson & Gerd.) Walker & Sanders [Diversisporales: Gigasporaceae] (synonym: <i>Endogone calospora</i> Nicolson & Gerd.)	<i>Anthriscus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Septoria aegopodii</i> Desm. [Capnodiales: Mycosphaerellaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on the foliage of <i>Pimpinella</i> species (Verkley et al. 2013), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Septoria aegopodina</i> Sacc. [Capnodiales: Mycosphaerellaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on the foliage of <i>Pimpinella</i> species (Verkley et al. 2013), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Septoria anthrisci</i> Pass. & Brunaud [Capnodiales: Mycosphaerellaceae]	<i>Anthriscus</i> , <i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on the foliage of <i>Anthriscus</i> and <i>Angelica</i> species (Verkley et al. 2013; Wang et al. 2018), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Septoria apiicola</i> Speg. [Capnodiales: Mycosphaerellaceae] (synonyms: <i>Septoria apii</i> Chester; <i>Septoria apii-graveolentis</i> Dorogin)	<i>Anethum</i> , <i>Apium</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Septoria cari</i> Brezschnev [Capnodiales: Mycosphaerellaceae]	<i>Carum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Carum</i> species (Zalewska 2013), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Septoria carotae</i> Nagorny [Capnodiales: Mycosphaerellaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on foliage of <i>Daucus</i> species (Watson 1971), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Septoria carvi</i> Syd. [Capnodiales: Mycosphaerellaceae]	<i>Carum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Carum carvi</i> (Odstrčilová 2007).	Yes: if introduced via the seed pathway, <i>Septoria carvi</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Zalewska 2008). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: currently, there is no significant published evidence on the economic consequences of this fungus. Therefore, this fungus is not considered to have the potential for economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Septoria dauci</i> Nicolas & Agg�ry [Capnodiales: Mycosphaerellaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Mycobank 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Septoria daucina</i> Brunaud [Capnodiales: Mycosphaerellaceae]	<i>Daucus</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Daucus carota</i> (Richardson 1990).	Yes: if introduced via the seed pathway, <i>Septoria daucina</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: currently, there is no significant published evidence on the economic consequences of this fungus. Therefore, this fungus is not considered to have the potential for economic consequences in Australia.	No
<i>Septoria dearnessii</i> Ellis & Everh. [Capnodiales: Mycosphaerellaceae]	<i>Angelica</i>	Not known to occur	No: this fungus has been reported occurring on foliage of <i>Angelica</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Septoria heraclei</i> (Lib.) Desm. [Capnodiales: Mycosphaerellaceae]	<i>Pastinaca</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Septoria pastinacae</i> Westend. [Capnodiales: Mycosphaerellaceae]	<i>Pastinaca</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Septoria petroselini</i> Desm. [Capnodiales: Mycosphaerellaceae]	<i>Anethum</i> , <i>Apium</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Petroselinum</i>	Yes (Cunnington 2003)	Assessment not required	Assessment not required	Assessment not required	No
<i>Septoria pimpinellae</i> Hollós [Capnodiales: Mycosphaerellaceae] (synonyms: <i>Septoria laubertiana</i> Teterev.- Babajan, <i>Phomopsis pimpinellae</i> (Ellis) Greene)	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Septoria umbelliferarum</i> Kalchbr. [Capnodiales: Mycosphaerellaceae]	<i>Carum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Carum carvi</i> (Mačkinaitė 2011, 2012).	Yes: if introduced via the seed pathway, <i>Septoria umbelliferarum</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for significant economic consequences in Australia.	No
<i>Sphaerella foeniculina</i> Speg. [Capnodiales: Mycosphaerellaceae] (synonym: <i>Mycosphaerella foeniculina</i> (Speg.) Tomilin)	<i>Foeniculum</i>	Not known to occur	No: this fungus has been reported occurring on <i>Foeniculum</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Sphaerella sagedioides</i> Winter ex Sacc. [Capnodiales: Mycosphaerellaceae] (synonym: <i>Mycosphaerella sagedioides</i> (Winter ex Sacc.) Lindau)	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Sporobolomyces roseus</i> Kluver & Niel [Sporidiobolales: Incertae sedis]	<i>Pastinaca</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Stachybotrys chartarum</i> (Ehrenb.) Hughes [Hypocreales: Stachybotryaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Stachybotrys dichroa</i> Grove [Hypocreales: Stachybotryaceae] (synonym: <i>Memnoniella dichroa</i> (Grove) Lombard & Crous)	<i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Stachybotrys echinata</i> (Rivolta) Sm. [Hypocreales: Incertae sedis] (synonym: <i>Memnoniella echinata</i> (Rivolta) Galloway)	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Stachybotrys parvispora</i> Hughes [Hypocreales: Stachybotryaceae]	<i>Foeniculum</i>	No known to occur	Yes: seeds provide a pathway for this fungus. It occurs on <i>Foeniculum vulgare</i> and is carried by the seeds of this host (Dwivedi, Agrawal & Agrawal 2008).	Yes: if introduced via the seed pathway, <i>Stachybotrys parvispora</i> could establish and spread in Australia. This fungus has established in areas with a wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: no published evidence was found indicating that this fungus has an adverse impact. It is not considered to have the potential for significant economic consequences in Australia.	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Stagonospora polytaeniae</i> Greene [Pleosporales: Phaeosphaeriaceae]	<i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pastinaca</i> species (Cain et al. 2010), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Stemphylium botryosum</i> Wallr. [Pleosporales: Pleosporaceae] (synonym: <i>Pleospora tarda</i> Simmons)	<i>Apium</i> , <i>Daucus</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Stemphylium vesicarium</i> (Wallr.) Simmons [Pleosporales: Pleosporaceae] (synonyms: <i>Helminthosporium vesicarium</i> Wallr.; <i>Pleospora herbarum</i> (Pers.: Fr.) Rabenh.; <i>Sporidesmium putrefaciens</i> Fuckel; <i>Stemphylium herbarum</i> Simmons)	<i>Anethum</i> , <i>Angelica</i> , <i>Apium</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Cook & Dubé 1989; Woudenberg et al. 2017)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Stilbella flavescens</i> Estey [Incertae sedis: Incertae sedis] (synonym: <i>Stilbella aciculosa</i> (Ellis & Everh.) Seifert)	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Ginns 1986), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Subplenodomus apiicola</i> (Kleb.) Gruyter, Aveskamp & Verkley [Pleosporales: Didymellaceae] (synonym: <i>Phoma apiicola</i> Kleb.)	<i>Apium</i> , <i>Coriandrum</i> , <i>Foeniculum</i>	Not known to occur	Yes: seeds provide a pathway for this fungus, which has been reported as seed-borne in <i>Apium graveolens</i> only (Koike, Gladders & Paulus 2007; Richardson 1990). This fungus has been reported occurring on <i>Apium</i> , <i>Coriandrum</i> and <i>Foeniculum</i> species (Koike, Gladders & Paulus 2007).	Yes: if introduced via seed pathway, <i>Subplenodomus apiicola</i> could establish and spread in Australia. This fungus has established in areas with wide range of climatic conditions (Farr & Rossman 2020). Spread of this fungus from the seed pathway could occur via air-borne spores.	No: this fungus may occasionally cause losses of celery seedlings and may be a problem in direct-drilled crops (EPPO 2000). Overall, it is considered a minor disease (Koike, Gladders & Paulus 2007). It is not considered to have the potential for economic consequences in Australia.	No
<i>Syncephalastrum racemosum</i> Cohn ex Schröt. [Mucorales: Syncephalastraceae]	<i>Cuminum</i>	Yes (Cheong, Neumeister-Kemp & Kemp 2007)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Synchytrium aureum</i> Schröt. [Chytridiales: Synchytriaceae]	<i>Angelica</i> , <i>Anthriscus</i> , <i>Carum</i> , <i>Daucus</i> , <i>Pastinaca</i> , <i>Pimpinella</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Tetraploa aristata</i> Berk. & Broome [Pleosporales: Tetraplosphaeriaceae]	<i>Angelica</i>	Yes (Cook & Dubé 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Thecaphora pimpinellae</i> Juel [Urocystidales: Glomosporiaceae]	<i>Pimpinella</i>	Not known to occur	No: this fungus has been reported occurring on <i>Pimpinella</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Thielaviopsis paradoxa</i> (De Seynes) Höhn [Microascales: Ceratocystidaceae] (synonyms: <i>Ceratocystis paradoxa</i> (Dade) Moreau; <i>Chalara thielavioides</i> (Peyronel) Nag Raj & Kendr.)	<i>Daucus</i>	Yes (Girard & Rott 2000; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Thielaviopsis radicola</i> (Hennebert) Paulin et al. [Microascales: Ceratocystidaceae] (synonym: <i>Ceratocystis radicola</i> (Bliss) Moreau)	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Trichocladium asperum</i> Harz [Sordariales: Chaetomiaceae]	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Trichoderma harzianum</i> Rifai 1969 [Hypocreales: Hypocreaceae] (synonym: <i>Hypocrea lixii</i> Pat.)	<i>Cuminum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Trichoderma koningii</i> Oudem. [Hypocreales: Hypocreaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i>	Yes (Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
<i>Trichoderma viride</i> Pers.: Fr. [Hypocreales: Hypocreaceae]	<i>Coriandrum</i> , <i>Cuminum</i> , <i>Daucus</i> , <i>Foeniculum</i>	Yes (Paulus, Gadek & Hyde 2007)	Assessment not required	Assessment not required	Assessment not required	No
<i>Trichothecium roseum</i> (Pers.: Fr.) Link [Hypocreales: Incertae sedis] (synonym: <i>Trichoderma roseum</i> Pers.: Fr.)	<i>Angelica</i> , <i>Apium</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Typhula variabilis</i> Riess [Agaricales: Typhulaceae]	<i>Apium</i> , <i>Daucus</i>	Not known to occur	No: this fungus has been reported to be associated with storage rot of <i>Apium</i> and <i>Daucus</i> species (Farr & Rossman 2020), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Uredo cundinamarcensis</i> Mayor [Pucciniales: Incertae sedis]	<i>Apium</i>	Not known to occur	No: this fungus has been reported occurring on <i>Apium</i> species (Cline 2005), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Uromyces graminis</i> (Niessl) Dietel [Pucciniales: Pucciniaceae]	<i>Daucus</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> species (Koike, Gladders & Paulus 2007; Nunez & Davis 2016), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Uromyces lineolatus</i> (Desm.) Schröt. [Pucciniales: Pucciniaceae] (synonym: <i>Uromyces scirpi</i> Burrill)	<i>Daucus</i> , <i>Pastinaca</i>	Not known to occur	No: this fungus has been reported occurring on <i>Daucus</i> and <i>Pastinaca</i> species (Koike, Gladders & Paulus 2007; Nunez & Davis 2016), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
<i>Verticillium dahliae</i> Kleb. [Incertae sedis: Plectosphaerellaceae]	<i>Apium</i> , <i>Carum</i> , <i>Coriandrum</i> , <i>Cuminum</i>	Yes (Ramsay, Multani & Lyon 1996)	Assessment not required	Assessment not required	Assessment not required	No
<i>Verticillium nonalfalfae</i> Inderb et al. [Incertae sedis: Plectosphaerellaceae]	<i>Apium</i>	Not known to occur	No: this fungus has been reported occurring on <i>Apium</i> species (EFSA 2014), but no published evidence was found indicating it is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this fungus.	Assessment not required	Assessment not required	No
Nematodes						
<i>Belonolaimus longicaudatus</i> Rau 1958 [Panagrolaimida: Belonolaimidae]	<i>Daucus</i>	Yes (Nobbs 2003)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Ditylenchus dipsaci</i> (Kühn 1857) Filipjev 1936 [Panagrolaimida: Anguinidae]	<i>Apium</i> , <i>Daucus</i>	Yes (Ophel-Keller et al. 2008). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.(Stirling & Stanton 1997)	Assessment not required	Assessment not required	Assessment not required	No
<i>Dolichodorus heterocephalus</i> Cobb 1914 [Panagrolaimida: Dolichodoridae]	<i>Apium</i>	Not known to occur	No: this soil-borne nematode has been reported occurring on <i>Apium</i> species causing severe stunting and root damage (Davis & Raid 2002), but no published evidence was found indicating this nematode is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this nematode.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Heterodera carotae</i> Jones 1950 [Panagrolaimida: Heteroderidae]	<i>Daucus</i>	Not known to occur	No: this soil-borne nematode has been reported occurring on <i>Daucus</i> species (Davis & Raid 2002), but no published evidence was found indicating this nematode is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this nematode.	Assessment not required	Assessment not required	No
<i>Heterodera schachtii</i> Schmidt 1871 [Panagrolaimida: Heteroderidae]	<i>Daucus</i>	Yes (Nobbs 2003; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Meloidogyne arenaria</i> (Neal 1889) Chitwood 1949 [Panagrolaimida: Meloidogynidae]	<i>Apium</i> , <i>Daucus</i>	Yes (Hay & Pethybridge 2005; Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Meloidogyne fallax</i> Karssen 1996 [Panagrolaimida: Meloidogynidae]	<i>Daucus</i>	Yes (Government of Western Australia 2016; Nobbs et al. 2001; Vanstone & Nobbs 2007)	Assessment not required	Assessment not required	Assessment not required	No
<i>Meloidogyne hapla</i> Chitwood 1949 [Panagrolaimida: Meloidogynidae]	<i>Apium</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Nobbs 2003; Pullman & Berg 2010)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Meloidogyne incognita</i> (Kofoed & White 1919) Chitwood 1949 [Panagrolaimida: Meloidogynidae]	<i>Apium</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Stirling & Cirami 1984)	Assessment not required	Assessment not required	Assessment not required	No
<i>Meloidogyne javanica</i> (Treub 1885) Chitwood 1949 [Panagrolaimida: Meloidogynidae]	<i>Apium</i> , <i>Daucus</i>	Yes (Hay & Pethybridge 2005; Stirling & Cirami 1984)	Assessment not required	Assessment not required	Assessment not required	No
<i>Meloidogyne thamesi</i> Chitwood 1952 [Panagrolaimida: Meloidogynidae]	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Merlinius brevidens</i> (Allen 1955) Siddiqi 1970 [Panagrolaimida: Telotylenchidae]	<i>Daucus</i>	Yes (Hay & Pethybridge 2005)	Assessment not required	Assessment not required	Assessment not required	No
<i>Neodolichodorus australis</i> Hodda & Nambiar 2005 [Panagrolaimida: Dolichodoridae]	<i>Daucus</i>	Yes (Plant Health Australia 2020). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No
<i>Paratrachodorus minor</i> (Colbran 1956) Siddiqi 1974 [Triplonchida: Tylenchulidae]	<i>Apium</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Paratylenchus hamatus</i> Thorne & Allen 1950 [Panagrolaimida: Paratylenchidae]	<i>Apium</i>	Yes (Plant Health Australia 2020). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No
<i>Pratylenchus crenatus</i> Loof 1960 [Panagrolaimida: Paratylenchidae]	<i>Daucus</i>	Yes (Hay & Pethybridge 2005)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pratylenchus neglectus</i> (Rensch 1924) Filipjev & Schuurmans-Stekhoven 1941 [Panagrolaimida: Paratylenchidae]	<i>Daucus</i>	Yes (Riley & Kelly 2002)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pratylenchus penetrans</i> (Cobb 1917) Filipjev & Schuurmans-Stekhoven 1941 [Panagrolaimida: Paratylenchidae]	<i>Apium</i> , <i>Daucus</i> , <i>Pastinaca</i>	Yes (Riley & Kelly 2002)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pratylenchus thornei</i> Sher & Allen 1953 [Panagrolaimida: Paratylenchidae]	<i>Daucus</i>	Yes (Riley & Kelly 2002)	Assessment not required	Assessment not required	Assessment not required	No
<i>Rotylenchus robustus</i> (de Man 1876) Filipjev 1936 [Panagrolaimida: Hoplolaimidae]	<i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Phytoplasmas						
' <i>Candidatus</i> Phytoplasma asteris' [16SrI] (Aster yellows group)	<i>Anethum</i> , <i>Anthriscus</i> , <i>Apium</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> <i>Pastinaca</i> , <i>Petroselinum</i> , <i>Pimpinella</i>	Not known to occur	No: this phytoplasma has been reported occurring on <i>Anethum</i> , <i>Anthriscus</i> , <i>Apium</i> , <i>Coriandrum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i> and <i>Pimpinella</i> species (Khadhair & Evans 2000; Olivier, Lowery & Stobbs 2009; Rao et al. 2018), but no verified evidence was found indicating this phytoplasma is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this phytoplasma.	Assessment not required	Assessment not required	No
' <i>Candidatus</i> Phytoplasma australiense' [16SrXII-B] (Stolbur group)	<i>Apium</i>	Yes (Streten & Gibb 2005)	Assessment not required	Assessment not required	Assessment not required	No
' <i>Candidatus</i> Phytoplasma aurantifolia' [16SrII] (Peanut witches' broom group)	<i>Apium</i> , <i>Foeniculum</i>	Yes (Lee, Wylie & Jones 2010)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
' <i>Candidatus</i> Phytoplasma pruni' [16SrIII] (X-disease group)	<i>Daucus</i>	Not known to occur	No: this phytoplasma has been reported occurring on <i>Daucus</i> species (Olivier, Lowery & Stobbs 2009), but no published evidence was found indicating this phytoplasma is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this phytoplasma.	Assessment not required	Assessment not required	No
' <i>Candidatus</i> Phytoplasma solani' [16SrXII-A] (Stolbur group)	<i>Apium</i> , <i>Daucus</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Not known to occur	No: this phytoplasma has been reported occurring on <i>Apium</i> , <i>Daucus</i> , <i>Pastinaca</i> and <i>Petroselinum</i> species (Duduk et al. 2008; Medić Pap et al. 2018; Olivier, Lowery & Stobbs 2009), but no published evidence was found indicating this phytoplasma is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this phytoplasma.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
' <i>Candidatus</i> Phytoplasma trifolii' [16SrVI-A] (Clover proliferation group)	<i>Daucus</i>	Not known to occur	No: this phytoplasma has been reported occurring on <i>Daucus</i> species (Olivier, Lowery & Stobbs 2009), but no published evidence was found indicating this phytoplasma is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this phytoplasma.	Assessment not required	Assessment not required	No
' <i>Candidatus</i> Phytoplasma ulmi' [16SrV] (Elm yellows group)	<i>Daucus</i>	Not known to occur	No: this phytoplasma has been reported occurring on <i>Daucus</i> species (Olivier, Lowery & Stobbs 2009), but no published evidence was found indicating this phytoplasma is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this phytoplasma.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Viroids						
<i>Citrus exocortis viroid</i> [Pospiviroidae: Pospiviroid]	<i>Daucus</i>	Yes (Plant Health Australia 2020; van Brunschot et al. 2014). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No
Viruses						
<i>Ageratum enation virus</i> (AEV) [Geminiviridae: Begomovirus]	<i>Daucus</i>	Not known to occur	No: this virus has been reported occurring on <i>Daucus</i> species (Kumar et al. 2013), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Alfalfa mosaic virus</i> (AMV) [Bromoviridae: Alfamovirus]	<i>Apium</i>	Yes (Norton & Johnstone 1998)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Angelica virus Y</i> (AnVY) [Potyviridae: Potyvirus]	<i>Angelica</i>	Not known to occur	No: this virus has been reported occurring on <i>Angelica</i> species (Robertson 2007), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Anthriscus virus</i> (AntV)[Betaflexiviridae: Carlavirus]	<i>Angelica</i> , <i>Anthriscus</i> , <i>Carum</i>	Not known to occur	No: this virus has been reported occurring on <i>Angelica</i> , <i>Anthriscus</i> and <i>Carum</i> species (Muthaiyan 2009), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Anthriscus yellows virus</i> (AYV) [Sequiviridae: Waikavirus]	<i>Anthriscus</i>	Not known to occur	No: this virus has been reported occurring on <i>Anthriscus</i> species (Brunt et al. 1996; Murrant & Roberts 1977), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Apium virus Y</i> (AVY) [Potyviridae: Potyvirus]	<i>Apium</i> , <i>Coriandrum</i> , <i>Petroselinum</i>	Yes (Gibbs et al. 2008; Persley, Cooke & House 2010)	Assessment not required	Assessment not required	Assessment not required	No
<i>Arabis mosaic virus</i> (ArMV) [Secoviridae: Nepovirus]	<i>Apium</i> , <i>Daucus</i>	Yes (Sharkey, Hepworth & Whattam 1996). Western Australia's <i>BAM Act 2007</i> prohibits this pest (Government of Western Australia 2020), but official control could not be confirmed.	Assessment not required	Assessment not required	Assessment not required	No
<i>Artichoke yellow ringspot virus</i> (ARYSV) [Secoviridae: Nepovirus]	<i>Anethum</i> , <i>Foeniculum</i>	Not known to occur	No: this virus has been reported occurring on <i>Anethum</i> and <i>Foeniculum</i> species (Davis & Raid 2002), but insufficient published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Broad bean wilt virus</i> (BBWV) [Secoviridae: Fabavirus] (synonym: <i>Parsley virus 3</i>)	<i>Apium</i> , <i>Daucus</i> , <i>Petroselinum</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Caraway latent virus</i> (CawLV) [Betaflexiviridae: Carlavirus]	<i>Carum</i>	Not known to occur	No: this virus has been reported occurring on <i>Carum</i> species (van Dijk & Bos 1989), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Carrot latent virus</i> (CtLV) [Rhabdoviridae: Nucleorhabdovirus]	<i>Daucus</i>	Not known to occur	No: this virus has been reported occurring on <i>Daucus</i> species (Ohki, Doi & Yora 1978), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Carrot mosaic virus</i> (CtMV) [Unassigned: Potyvirus]	<i>Daucus</i>	Not known to occur	No: this virus has been reported occurring on <i>Daucus</i> species (Brunt et al. 1996), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Carrot mottle mimic virus</i> (CMoMV) [Tombusviridae: Umbravirus]	<i>Daucus</i>	Yes (Brunt et al. 1996)	Assessment not required	Assessment not required	Assessment not required	No
<i>Carrot mottle virus</i> (CMoV) [Tombusviridae: Umbravirus] (synonym: <i>Carrot motley dwarf virus</i>)	<i>Anethum</i> , <i>Anthriscus</i> , <i>Daucus</i>	Not known to occur—records prior to 1996 may be misidentifications of <i>Carrot mottle mimic virus</i> (Gibbs et al. 1996)	No: this virus has been reported occurring on <i>Anethum</i> , <i>Anthriscus</i> and <i>Daucus</i> species (Brunt et al. 1996), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Carrot red leaf virus</i> (CtRLV) [Luteoviridae: Polerovirus]	<i>Anethum</i> , <i>Anthriscus</i> , <i>Daucus</i>	Yes (Brunt et al. 1996; Persley, Cooke & House 2010)	Assessment not required	Assessment not required	Assessment not required	No
<i>Carrot temperate virus 1</i> (CTeV-1) [Partitiviridae: Alphacryptovirus]	<i>Daucus</i>	Not known to occur	Yes: seeds provide a pathway for these viruses, which have been reported as seed-borne in <i>Daucus carota</i> (Brunt et al. 1996).	Yes: if introduced via the seed pathway, these viruses could establish and spread in Australia. These viruses have established in Japan only (Brunt et al. 1996).	No: these viruses are symptomless in infected plants (Brunt et al. 1996). Currently, there is no published evidence on the economic consequences of these viruses. Therefore, these viruses do not have the potential for economic consequences in Australia.	No
<i>Carrot temperate virus 3</i> (CTeV-3) [Partitiviridae: Alphacryptovirus]	<i>Daucus</i>	Not known to occur				
<i>Carrot temperate virus 4</i> (CTeV-4) [Partitiviridae: Alphacryptovirus]	<i>Daucus</i>	Not known to occur				

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Carrot temperate virus 2</i> (CTeV-2) [Partitiviridae: Betacryptovirus]	<i>Daucus</i>	Not known to occur	Yes: seeds provide a pathway for these viruses, which have been reported as seed-borne in <i>Daucus carota</i> (Brunt et al. 1996).	Yes: if introduced via the seed pathway, these viruses could establish and spread in Australia. These viruses have established in Japan only (Brunt et al. 1996).	No: these viruses are symptomless in infected plants (Brunt et al. 1996). Currently, there is no published evidence on the economic consequences of these viruses. Therefore, these viruses do not have the potential for economic consequences in Australia.	No
<i>Carrot thin leaf virus</i> (CTLV) [Potyviridae: Potyvirus]	<i>Daucus</i> , <i>Petroselinum</i>	Not known to occur	No: this virus has been reported occurring on <i>Daucus</i> and <i>Petroselinum</i> species (Brunt et al. 1996; Mehle et al. 2019), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Carrot torradovirus 1</i> (CaTV1) [Secoviridae: Torradovirus]	<i>Daucus</i>	Not known to occur	No: this virus has been reported occurring on <i>Daucus</i> species (Rozado-Aguirre et al. 2017), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Carrot virus Y</i> (CarVY) [Potyviridae: Potyvirus]	<i>Daucus</i>	Yes (Persley, Cooke & House 2010)	Assessment not required	Assessment not required	Assessment not required	No
<i>Carrot yellow leaf virus</i> (CYLV) [Closteroviridae: Closterovirus] (synonyms: <i>Hogweed 6 virus</i> ; <i>Deracleum 6 capillovirus</i>)	<i>Anthriscus</i> , <i>Daucus</i>	Not known to occur	No: this virus has been reported occurring on <i>Daucus</i> species (van Dijk & Bos 1989), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Celery latent virus</i> (CeLV) [Potyviridae: Celavirus]	<i>Apium</i>	Not known to occur	Yes: seeds provide a pathway for this symptomless virus, which has been reported as seed-borne in <i>Apium graveolens</i> (Bos, Diaz-Ruiz & Maat 1978).	Yes: when introduced via the seed pathway, this virus could establish and spread in Australia. CeLV has established in Belgium, Italy and the Netherlands (Brunt et al. 1996). Spread of this virus from the seed pathway depends on human-mediated transport of infected seed.	No: CeLV has been reported to be seed transmitted causing yield losses in celery and celeriac crops (Bos, Diaz-Ruiz & Maat 1978). Since this initial report, this virus has not been reported again causing disease (Mink 1993). Therefore, this virus is not considered to have the potential for economic consequences in Australia.	No
<i>Celery mosaic virus</i> (CeMV) [Potyviridae: Potyvirus] (synonyms: <i>Apium virus 1</i> ; <i>Celery western mosaic virus</i> ; <i>Celery ringspot virus</i>)	<i>Anethum</i> , <i>Apium</i> , <i>Carum</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Yes (Persley, Cooke & House 2010)	Assessment not required	Assessment not required	Assessment not required	No
<i>Celery T virus</i> (CTV) [Rhabdoviridae: Cytorhabdovirus]	<i>Apium</i>	Not known to occur	No: this virus has been reported occurring on <i>Apium</i> species (Brunt et al. 1996), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Celery yellow mosaic virus</i> (CeYMV) [Potyviridae: Potyvirus]	<i>Apium</i>	Not known to occur	No: this virus has been reported occurring on <i>Apium</i> species (Brunt et al. 1996), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Celery yellow spot virus</i> (CeYSV) [Luteoviridae: Luteovirus]	<i>Apium</i> , <i>Pastinaca</i>	Not known to occur	No: this virus has been reported occurring on <i>Apium</i> and <i>Daucus</i> species (van Dijk & Bos 1989), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Chicory yellow mottle virus</i> (ChYMV) [Secoviridae: Nepovirus] (synonym: <i>Parsley carrot leaf virus</i>)	<i>Petroselinum</i>	Not known to occur	No: this virus has been reported occurring on <i>Petroselinum</i> species (Quacquarelli, Martelli & Vovlas 1974), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Chickpea chlorotic stunt virus</i> (CpCSV) [Luteoviridae: Polerovirus]	<i>Apium</i>	Not known to occur	No: this virus has been reported occurring on <i>Apium</i> species (Asaad et al. 2009), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Clover yellow vein virus</i> (CIYVV) [Potyviridae: Potyvirus]	<i>Coriandrum</i> , <i>Daucus</i>	Yes (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Coriander feathery red vein virus</i> (CFRVV) [Rhabdoviridae: Nucleorhabdovirus]	<i>Coriandrum</i> , <i>Pastinaca</i>	Not known to occur	No: this virus has been reported occurring on <i>Coriandrum</i> and <i>Pastinaca</i> species (Brunt et al. 1996), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Cucumber mosaic virus</i> (CMV) [Bromoviridae: Cucumovirus]	<i>Apium</i> , <i>Daucus</i> , <i>Petroselinum</i> , <i>Angelica</i>	Yes (Persley, Cooke & House 2010)	Assessment not required	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Gazar virus Y</i> (GVY) [Potyviridae: Potyvirus]	<i>Daucus</i>	Not known to occur	No: this virus has been reported occurring on <i>Daucus</i> species (Soliman et al. 2012), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Grapevine chrome mosaic virus</i> (GCMV) [Secoviridae: Nepovirus]	<i>Apium</i>	Not known to occur	No: this virus has been reported occurring on <i>Apium</i> species (Brunt et al. 1996), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Groundnut ringspot tospovirus</i> (GRSV) [Tospoviridae: Orthotospovirus]	<i>Coriandrum</i>	Not known to occur	No: this virus has been reported occurring on <i>Coriandrum</i> species (Lima et al. 1999), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Impatiens necrotic spot tospovirus</i> (INSV) [Tospoviridae: Orthotospovirus]	<i>Anthriscus</i>	Not known to occur	No: this virus has been reported occurring on <i>Anthriscus</i> species (Grausgruber-Gröger 2012), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Japanese hornwort mosaic virus</i> (JHMV) Dang Gui strain (DG strain) [Potyviridae: Potyvirus]	<i>Angelica</i>	Not known to occur	No: this virus has been reported occurring on <i>Angelica</i> species (Zhang et al. 2009), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Parsley 5 virus</i> (PaV-5) [Alphaflexiviridae: Potexvirus]	<i>Pastinaca</i>	Not known to occur	No: this virus has been reported occurring on <i>Petroselinum</i> species (Brunt et al. 1996), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Parsley green mottle virus</i> (PGMV) [Potyviridae: Potyvirus]	<i>Petroselinum</i>	Not known to occur	No: this virus has been reported occurring on <i>Petroselinum</i> species (Brunt et al. 1996), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Parsley latent virus</i> (PaLV) [Unassigned: Unassigned]	<i>Petroselinum</i>	Not known to occur	Yes: seeds provide a pathway for this symptomless virus, which has been reported as seed-borne in <i>Petroselinum crispum</i> (Bos, Huttinga & Maat 1979).	Yes: if introduced via the seed pathway, this virus could establish and spread in Australia. This virus has been detected in the Netherlands only (Bos, Huttinga & Maat 1979).	No: no published evidence was found indicating that this virus has an adverse impact. It is not considered to have the potential for economic consequences in Australia.	No
<i>Parsley severe stunt associated virus</i> (PSSaV) [Nanoviridae: Nanovirus]	<i>Petroselinum</i>	Not known to occur	No: this virus has been reported occurring on <i>Petroselinum crispum</i> (Vetten et al. 2019), but no published evidence was found indicating this virus is seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Parsnip 3 virus</i> (Par-3) [Unassigned: Potexvirus]	<i>Pastinaca</i>	Not known to occur	No: this virus has been reported occurring on <i>Pastinaca</i> species (Brunt et al. 1996), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Parsnip leafcurl virus</i> [Unassigned: Unassigned] (synonym: <i>Hogweed 4 virus</i>)	<i>Pastinaca</i>	Not known to occur	No: this virus has been reported occurring on <i>Pastinaca</i> species (Brunt et al. 1996), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Parsnip mosaic virus</i> (ParMV) [Potyviridae: Potyvirus]	<i>Pastinaca</i>	Not known to occur	No: this virus has been reported occurring on <i>Pastinaca</i> species (Murant 1972), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Parsnip mottle virus</i> (PMV) [Unassigned: Unassigned]	<i>Apium</i> , <i>Coriandrum</i> , <i>Pastinaca</i>	Not known to occur	No: this virus has been reported occurring on <i>Apium</i> , <i>Coriandrum</i> and <i>Pastinaca</i> species (Watson, Serjeant & Lennon 1964), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Parsnip yellow fleck virus</i> (PYFV) [Secoviridae: Sequivirus] (synonym: <i>Celery yellow net virus</i>)	<i>Apium</i> , <i>Pastinaca</i>	(Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
<i>Pedilanthus leaf curl virus</i> (PeLCV) [Geminiviridae: Begomovirus]	<i>Daucus</i>	Not known to occur	No: this virus has been reported occurring on <i>Daucus carota</i> (Saritha et al. 2017), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Strawberry latent ringspot virus</i> (SLRSV) [Secoviridae: Unassigned] (synonym: <i>Rhubarb virus 5</i>)	<i>Apium</i> , <i>Pastinaca</i> , <i>Petroselinum</i>	Not known to occur	Yes: seeds provide a pathway for this virus, which has been reported as seed-borne in <i>Pastinaca sativa</i> (Cooper 1981; Hicks, Smith & Edwards 1986) and <i>Petroselinum</i> species (Bellardi & Bertaccini 1991; Bos, Huttinga & Maat 1979; Hanson & Campbell 1979). SLRSV occurs on <i>Apium</i> species (Brunt et al. 1996). Seed transmission of SLRSV in <i>Apium graveolens</i> was reported from experimentally infected celery cultivars (Walkey & Whittingham-Jones 1970). It is not known to infect <i>Apium graveolens</i> seeds under natural conditions; therefore, <i>Apium graveolens</i> seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Yes: if introduced via the seed pathway, SLRSV could establish and spread in Australia. This virus has established in areas with a wide range of climatic conditions (Brunt et al. 1996; EPPO 2010; Murant 1983). SLRSV is symptomless in parsley (Bellardi & Bertaccini 1991) and was introduced into the US from Europe through this pathway (Hanson & Campbell 1979). SLRSV can be transmitted via nematode vectors, but its spread is not dependent on this (Tang, Ward & Clover 2013). It is also mechanically transmissible (El-Morsy et al. 2017).	Yes: SLRSV is an economically significant pathogen of horticultural crops, including grapes (Martelli & Walter 1993; Rüdel 1985) and has the potential for economic consequences in Australia. In some plant species, this virus induces severe decline in vigour causing significant losses in productivity (Murant 1987). Information on the economic consequences of this virus on apiaceous crops is almost non-existent.	Yes

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Tomato black ring virus</i> (TBRV) [Secoviridae: Nepovirus]	<i>Apium</i>	Not known to occur	No: this virus has been reported occurring on <i>Apium</i> species (Murant 1970), but insufficient published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Tomato chlorotic spot tospovirus</i> (TCSV) [Tospoviridae: Orthotospovirus]	<i>Apium</i>	Not known to occur	No: this virus has been reported occurring on <i>Apium</i> species (Gracia et al. 1999), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Tomato leaf curl New Delhi virus</i> (ToLCNDV) [Geminiviridae: Begomovirus]	<i>Daucus</i>	Not known to occur	No: this virus has been reported occurring on <i>Daucus carota</i> (Sivalingam, Sumiya & Malathi 2011), but no published evidence was found indicating this virus is seed-borne in this host. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No

Scientific name(s)	Host genera	Present in Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
<i>Tomato spotted wilt tospovirus</i> (TSWV) [Tospoviridae: Orthotospovirus]	<i>Apium</i>	Yes (Dietzgen et al. 2005)	Assessment not required	Assessment not required	Assessment not required	No
<i>Tomato zonate spot virus</i> (TZSV) [Tospoviridae: Orthotospovirus]	<i>Petroselinum</i>	Not known to occur	No: this virus has been reported occurring on <i>Petroselinum</i> species (Dong et al. 2010), but no published evidence was found indicating this virus is seed-borne in these hosts. Seeds of apiaceous vegetables are not considered to provide a pathway for this virus.	Assessment not required	Assessment not required	No
<i>Watermelon mosaic virus</i> (WMV) [Potyviridae: Potyvirus]	<i>Daucus</i>	Yes (Parry & Persley 2005)	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Issues raised on the draft review and responses

The Department of Agriculture, Water and the Environment circulated the *Draft review of import conditions for apiaceous crop seeds for sowing into Australia* in September 2017 for stakeholder consultation. A WTO SPS notification (G/SPS/N/AUS/436) was also issued at this time.

Comments were received on the draft review from stakeholders, including from industry representatives, trading partners and state and territory governments. A summary of the key issues raised, and the department's responses, is provided.

Issue 1: Recognition of pest free areas (PFAs)

Stakeholders suggested that instead of mandatory testing or treatment of apiaceous vegetable seeds, Australia should consider PFAs, and accept an alternative declaration on the Phytosanitary Certificate for the pathogens identified in the review.

The department acknowledges that, under the current international phytosanitary framework, the establishment of and use of a PFA by the National Plant Protection Organisation (NPPO) provides assurance that specific pests are not present in the production area of the plant products being exported. This facilitates entry into the importing country (in this case Australia), for the commodity (in this case apiaceous vegetable seeds), without the need for application of additional phytosanitary measures, when certain requirements are met.

Consistent with the principle of equivalence detailed in International Standard for Phytosanitary Measures (ISPM) 1 (FAO 2016a) and ISPM 11 (FAO 2016d), the department will consider a PFA proposed by an NPPO. ISPM 4 (FAO 2017b) states that a PFA is an area in which a specific pest does not occur, as demonstrated by scientific evidence and, where appropriate, this condition is officially maintained.

However, it is recognised that the distributions of seed-borne pathogens are expanding globally, and that new risks continually emerge. The vegetable seeds trade has become globalised and is evolving—seed lines are usually developed, commercially multiplied, and processed in multiple countries rather than at a single location. Therefore, in accordance with ISPM 4, pest free areas would need to be demonstrated and officially maintained for all locations/countries involved in the production chain.

NPPOs that propose use of pest free areas as a measure for managing risks posed by quarantine pests identified in this review must provide the Department of Agriculture, Water and the Environment with a submission demonstrating area freedom for its consideration. Requirements for an NPPO to establish and maintain a PFA are outlined in Section 4.5.1 of the final review.

Issue 2: Regional pest status

Stakeholders in Western Australia (WA) stated that *Alternaria alternata*, *Ditylenchus dipsaci*, *Itersonilia perplexans* and *Monographella nivalis* are listed under the *Biosecurity and Agriculture Management (BAM) Act 2007*, and suggested that entry of these organisms into WA is restricted or prohibited under that state's legislation.

However, these pathogens have been recorded as present in Australia, including in Western Australia (CABI 2019; EPPO 2019; Minchinton 2008; Nobbs 2003; Pleyrier et al. 2006; Shivas

1989). To justify implementation of phytosanitary regulations within a defined area, a pathogen must be under 'official control' as defined in ISPM 5 (FAO 2019b).

To meet the definition of 'official control', two major requirements need to be satisfied: active enforcement of mandatory phytosanitary regulations (that is, of official rules such as state/territory legislation) and the application of mandatory phytosanitary procedures (that is, of officially prescribed methods for implementing phytosanitary regulations) with the objective of pest eradication or containment. At a minimum, official control programs must demonstrate program evaluation and pest surveillance to determine the need for, and effect of, control.

It was also suggested that *Alternaria carotiincultae*, *Alternaria petroselini*, *Arabid mosaic virus*, *Broad bean wilt virus*, *Ascochyta foeniculina*, *Carrot red leaf virus*, *Citrus exocortis viroid*, *Fusarium oxysporum* f. sp. *apii*, *Mycocentrospora acerina*, *Passalora punctum*, *Periconia byssoides*, *Phoma plurivora*, *Protomyces macrosporus*, *Pseudomonas syringae* pv. *apii*, *Pseudomonas syringae* pv. *coriandricola*, *Sarocladium strictum* and *Septoria pastinacae* are absent from Western Australia. It was suggested these pests should be considered further in the pest categorisation process to establish their quarantine pest status and that, where appropriate, a risk assessment should be conducted.

The department was not provided with evidence that demonstrates controls are in place to prevent movement of host material of these pathogens, or to prevent the spread of these pathogens from known infested areas to other areas in the state. Consequently, these pathogens are not considered to be under 'official control' in Western Australia.

In accordance with ISPM 11 (FAO 2019c), to assess the probability of entry, an association of the pest with the import pathway is required. In this review, the pathogens must be recognised as seed-borne in one or more of the identified apiaceous vegetable species. However, the references provided by the stakeholders do not support the pathway association of these pathogens with seeds of the apiaceous vegetable species under review. Therefore, these pathogens have not been considered further in the pest categorisation process.

Issue 3: Particular pathogens should be highlighted in the group risk assessment

Stakeholders have acknowledged that the group risk assessment approach is appropriate for apiaceous vegetable seeds given the characteristics of the seed pathway. However, it has also been suggested that where any pathogen has attributes that differentiate it from a group assessment, these should be highlighted.

The draft review explained the rationale for group assessment (Section 3.1). Seeds for sowing are deliberately introduced, distributed and aided to establish. As a result, any pest that is associated with seed for sowing will consequently be aided in its entry, establishment and spread in Australia. Given the nature of the seed pathway, with respect to assessment of entry, establishment and spread, the department has largely taken a group risk assessment approach in the draft review.

In the preparation of this final report, the department has further reviewed this group risk assessment approach and included specific risk assessment sections for each pathogen group with common biological characteristics. Consequently, key factors that contribute to the likelihood of entry, establishment and spread have been highlighted in the risk assessment section. The department has also included specific risk assessments for individual pathogen groups to strengthen the pest risk assessment element of this report.

Issue 4: Pathway association

Stakeholders suggested that the pathway association of some pathogens requires reassessment and provided references to support their claims.

The department has undertaken a further assessment of these pathogens based on the available scientific literature, including the references provided by stakeholders. The department concludes that there is insufficient evidence for these pathogens to be considered on the pathway (in this case, apiaceous seeds for sowing). A summary of the department's assessment of the claims made by stakeholders on pathway association are:

- *Artichoke yellow ringspot nepovirus*—the reference provided by the stakeholder (bio-mirror.im.ac.cn/mirrors/pvo/vide/descr044.htm), in support of a claim of the seed-borne nature of this virus in dill (*Anethum graveolens*) and fennel (*Foeniculum vulgare*) is not considered to provide adequate evidence of this proposition. The reference states that this virus can be transmitted by seed to seedlings and transmitted by pollen to seed in *Datura* and *Nicotiana* species.
- *Chicory yellow mottle nepovirus*—the reference provided by the stakeholder (bio-mirror.im.ac.cn/mirrors/pvo/vide/descr207.htm), in support of a claim of the seed-borne nature of this virus in parsley (*Petroselinum crispum*) is not considered to provide adequate evidence of this proposition. The reference states that this virus is transmitted by seed but does not specify the hosts in which it is claimed to be seed-transmitted.
- *Grapevine chrome mosaic nepovirus*—the reference provided by the stakeholder (bio-mirror.im.ac.cn/mirrors/pvo/vide/descr366.htm), in support of a claim of the seed-borne nature of this virus in celery (*Apium graveolens*) is not considered to provide adequate evidence of this proposition. The reference did not mention the seed-borne nature of this virus in any of its known natural hosts, including celery.
- *Tomato black ring nepovirus*—the reference provided by the stakeholder (bio-mirror.im.ac.cn/mirrors/pvo/vide/descr823.htm), in support of a claim of the seed-borne nature of this virus in celery (*Apium graveolens*), states that this virus is seed-borne but does not specify the host(s) in which it is claimed to be seed-transmitted. Further research by the department indicates that this virus is transmitted through the seeds of about 34 plant species, but did not identify published evidence of seed transmission in celery (DAWE 2020a).
- *Xanthomonas campestris* pv. *coriandri*—the reference provided by the stakeholder (pnwhandbooks.org/node/18651/print), in support of a claim of the seed-borne nature of this pathogen in coriander is not considered to provide adequate evidence of this proposition. The reference states that 'leaf spot disease' can occur on the seed of parsley. 'Leaf spot disease' is a common name for bacterial diseases that can be caused by multiple species of bacteria.

Issue 5: Pathway analysis conducted at the genus level

Stakeholders have suggested that as the pathway analyses for hosts were conducted only at the genus level, seeds of other species from these genera may also have the potential to provide a pathway for seed-borne pathogens.

This review primarily focussed on highly traded apiaceous vegetable seeds for sowing. Although Appendix 1 of the draft report lists only host genera, the column for pathway association

mentions specific species where a pathogen is seed-borne. For example, '*Ca. L. solanacearum*' has been reported naturally occurring in apiaceous crops including *Anthriscus*, *Apium*, *Daucus*, *Foeniculum*, *Pastinaca* and *Petroselinum* species. '*Candidatus Liberibacter solanacearum*' is specified as being seed-borne in *Apium graveolens* (Monger & Jeffries 2018), *Daucus carota* (Bertolini et al. 2015), *Petroselinum crispum* (Monger & Jeffries 2016), *Foeniculum vulgare* and *Pastinaca sativa* (Monger & Jeffries 2018).

The department will continue to review the literature in relation to the seed-borne nature and pest status of pathogens of apiaceous crops, and may amend this policy accordingly.

Issue 6: Efficacy of fungicidal seed treatment for identified fungal pathogens

Stakeholders have sought clarification on the published scientific evidence used to justify the efficacy of the recommended fungicidal seed treatment for identified fungal pathogens in apiaceous vegetable seeds.

ISPM 38 (*International movement of seeds*) recommends that phytosanitary import requirements do not specify chemical products, active constituents or exact protocols (FAO 2017a). Therefore, consistent with ISPM 38, the department has not prescribed the names of specific fungicides for seed treatment.

Fungicidal seed treatment is an integral part of modern seed production systems and protects seedlings from both seed-borne and soil-borne pathogens. Vegetable seeds are generally treated with a broad-spectrum fungicide, such as Thiram or carboxin + Thiram, or another product with equivalent chemical constituents.

Historically, Australia has been importing apiaceous vegetable seeds treated with fungicide, and none of the identified fungal pathogens have been reported in Australian apiaceous vegetables. This empirical observation supports an assessment that fungicidal treatment is effective in managing the risk posed by these fungal pathogens.

Issue 7: Fungal pests of no quarantine significance

Stakeholders suggested that fungal pests such as *Cercospora* sp., *Fusarium* sp., *Phoma* sp. and *Ramularia* sp. are considered of low economic importance in the risk analysis and are of no quarantine significance and therefore, that there is no need for mandatory treatment for these pests.

The International Plant Protection Convention (IPPC) states that 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 2016b).

In the preparation of this final report, the department has further reviewed available evidence and reconsidered potential consequences of the quarantine pests identified in the draft report.

Following further assessment, the department revised the consequence ratings for three fungal pathogens, namely *Fusarium oxysporum* f. sp. *cumini*, *Passalora malkoffii* (formerly *Cercospora malkoffii*) and *Phomopsis diachenii*, from 'Low' to 'Very low'. Consequently, the unrestricted risks of these three pathogens were also changed from 'Low' to 'Very low' using the risk estimation matrix. As the unrestricted risk estimates for *Fusarium oxysporum* f. sp. *cumini*, *Passalora malkoffii* and *Phomopsis diachenii* achieve the appropriate level of protection (ALOP) for

Australia, risk management measures against these three fungal pathogens are no longer recommended.

However, the consequence ratings for two other fungal pathogens, *Cercospora foeniculi* and *Diaporthe angelicae*, are assessed as 'low'. Consequently, the unrestricted risks for these two pathogens are 'Low' using the risk estimation matrix. As the unrestricted risk estimates of these two fungal pathogens do not achieve the ALOP for Australia, risk management measures are required for these species to reduce risk to an acceptable level. Detailed justifications are provided in Section 3.1 of the final report.

Issue 8: Pest risk analysis of '*Candidatus Liberibacter solanacearum*' in apiaceous crops

Consequence rating for '*Candidatus Liberibacter solanacearum*'

Stakeholders have sought clarification on the consequence rating of '*Candidatus Liberibacter solanacearum*' ('*Ca. L. solanacearum*'). In the pest risk analysis (PRA) for '*Ca. L. solanacearum*' associated with apiaceous crops, the potential consequence of the introduction and spread of '*Ca. L. solanacearum*' was rated 'Moderate' (DAWR 2017). However, it was rated 'High' in the previous PRA that was published in 2009 (Biosecurity Australia 2009).

The department acknowledges that the consequence ratings of '*Ca. L. solanacearum*' differ between the PRA published in 2009 and that published in 2017. However, it should be noted that the haplotypes of this bacterium under assessment in the two reviews are different. The 2009 PRA assessed haplotypes A and B, which are associated with solanaceous crops, while the 2017 PRA assessed haplotypes C, D and E, which are associated with apiaceous crops.

The PRA published in 2009 assessed the quarantine risks of '*Ca. L. solanacearum*' (named '*Candidatus Liberibacter psyllae*' at the time) associated with solanaceous crops, including tomato, capsicum, eggplant, potato and tamarillo. In Australia, the value of solanaceous crops is substantial—the combined production value of potato, tomato and capsicum was approximately \$1.6 billion in 2018–2019. Therefore, the consequence rating of '*Ca. L. solanacearum*' for solanaceous crops was assessed as 'High'.

More recently, the department conducted a PRA for '*Ca. L. solanacearum*' associated with apiaceous crops including carrot, celery/celeriac, chervil, fennel, parsley and parsnip. Compared with solanaceous crops, the commercial value of apiaceous crops in Australia is substantially lower—the total production value of apiaceous crops was approximately \$400 million in year 2018–2019. Therefore, the consequence rating of '*Ca. L. solanacearum*' for apiaceous crops was assessed as 'Moderate'. All conditions recommended in the final PRA for '*Ca. L. solanacearum*' associated with apiaceous crops have been adopted in this final report.

Seed transmission of '*Ca. L. solanacearum*' in carrot

Stakeholders have questioned the scientific evidence that was used in the final PRA for '*Ca. L. solanacearum*' to support the existence of seed transmission of '*Ca. L. solanacearum*' in apiaceous crops.

'*Candidatus Liberibacter solanacearum*' is a high priority pathogen for Australia, and considered of high importance by many trading partners. Australia is free from all haplotypes of '*Ca. L. solanacearum*'.

The department acknowledges that seed transmission of phloem-restricted pathogens, such as '*Ca. L. solanacearum*', is a contentious issue for reasons that include consideration of the poor

connection of the embryo with the mother plant. Since the claimed detection of transmission of this bacterium in carrot seeds in 2015, there have been conflicting reports as to whether '*Ca. L. solanacearum*' is seed transmissible. A summary of these reports is provided below.

- Bertolini et al. (2015) reported that '*Ca. L. solanacearum*' is seed-borne and seed-transmissible in carrot. The authors reported that between 12% and 42% of the seedlings from '*Ca. L. solanacearum*' positive seed lots tested positive for the bacterium.
- Loiseau et al. (2017a; 2017b) twice tried to demonstrate seed to seedling transmission of the bacterium, but in each case failed to reproduce the results reported by Bertolini et al. (2015).
- Haapalainen et al. (2018) was not able to detect the bacterium in carrot crops grown from seed lots that were known to be infected with '*Ca. L. solanacearum*'.

Given the complexity of the available scientific evidence and the potential impact of '*Ca. L. solanacearum*' if it were to enter Australia, the department will undertake a separate review of the potential for this bacterium to be transmitted from contaminated seeds to seedling progeny.

Efficacy of hot water treatment for '*Ca. L. solanacearum*' in apiaceous seeds

Stakeholders have sought clarification on the scientific references used to justify the efficacy of the hot water treatment for '*Ca. L. solanacearum*' in apiaceous crop seeds.

Australia acknowledges there is no specific scientific publication indicating that hot water treatment at 50°C for 20 minutes is effective in eliminating '*Ca. L. solanacearum*' from apiaceous seeds. However, temperature has been shown to have a significant effect on the development of '*Ca. L. solanacearum*' (Munyaneza et al. 2012). Munyaneza et al. (2012) investigated the effects of temperature on '*Ca. L. solanacearum*', and their results indicated that temperatures above 32°C are detrimental to this '*Candidatus Liberibacter*' species. '*Candidatus Liberibacter*' species are considered to be heat sensitive with the exception of '*Ca. L. asiaticus*', which is able to cope with relatively higher temperatures (around 35°C) (Bové et al. 2008; DAWR 2017; Lopes et al. 2009).

ISPM 5 defines treatment as an 'official procedure for the killing, inactivation or removal of pests, or for rendering pests infertile or for devitalisation' (FAO 2019b). To remain consistent with ISPM 5, and using the available information regarding the heat sensitivity of '*Ca. L. solanacearum*', Australia recommended heat treatment of carrot seeds as an alternative measure to PCR testing.

Carrot seeds are generally treated by hot water at 50°C for 20 minutes to control a range of bacterial pathogens (Floyd & Melvin-Carter 2005), and this treatment has been recommended for control of bacterial pathogens (McGrath 2005). Based on this information, Australia recommends hot water treatment at a minimum temperature of 50°C for at least 20 minutes on apiaceous seeds to also manage the risk posed by '*Ca. L. solanacearum*'.

Alternatives to hot water treatment for '*Ca. L. solanacearum*'

Stakeholders have suggested that Australia considers other seed treatment options to mitigate the risk of '*Ca. L. solanacearum*'. The alternative seed treatments suggested by stakeholders

include dry heat treatment and various types of chemical treatment (for example, using difenoconazole, chloroiso-bromine cyanuric, kasugamycin, copper compounds, etc.).

Consistent with the SPS Agreement *Article 4 Equivalence*, Australia recognises that more than one SPS measure may be equally effective in meeting a country's ALOP. Therefore, in accordance with the SPS Agreement *Article 4 Equivalence*, Australia will consider all treatment options for which stakeholders can provide technical justification of effectiveness against '*Ca. L. solanacearum*' associated with apiaceous crop seeds.

The department is aware that dry heat treatment can be used to control some seed-borne bacterial pathogens. However, dry heat treatment usually requires a higher temperature and a longer treatment time (Kannan & Bastas 2015). For example, tomato seeds were recommended to be dry heat treated at 76 to 78°C for two days to control *Clavibacter michiganensis* subsp. *michiganensis* (Kannan & Bastas 2015). In December 2014, Japan introduced mandatory dry heat treatment (50°C for 72 hours) or hot water treatment (50°C for 20 minutes) to manage the risk of introduction of '*Ca. L. solanacearum*' associated with imported carrot seeds (G/SPS/N/JPN/383).

There appears to be no substantive information regarding chemical treatment against '*Ca. L. solanacearum*' in the peer-reviewed literature. The department is not aware of any technically justified demonstration of chemical treatment being effective to prevent the transmission of this bacterium. Therefore, the department does not currently consider chemical treatment to be an efficacious alternative treatment option for this pest.

Efficacy of PCR to detect 'Ca. L. solanacearum' in apiaceous vegetable seeds

Stakeholders have sought clarification on the scientific references used to justify the efficacy of the PCR test for the detection of '*Ca. L. solanacearum*' in apiaceous vegetable seeds.

The department considers that PCR testing is efficacious and notes that it has been consistently used to detect '*Ca. L. solanacearum*' in carrot, celery/celeriac and parsnip crops as well as in psyllid vectors (Cambra et al. 2015; Tahzima et al. 2014; Teresani et al. 2015; Teresani et al. 2014). Monger and Jeffries (2016) also used PCR to detect this bacterium in commercially available parsley seeds.

More recently in Australia, '*Ca. L. solanacearum*' was detected in imported carrot and parsley seeds during on-arrival seed testing using PCR, demonstrating that the PCR test can detect '*Ca. L. solanacearum*' in apiaceous seeds. Monger and Jeffries (2018) also used PCR to detect '*Ca. L. solanacearum*' in seeds from historical collections of carrot and related apiaceous species demonstrating that PCR can detect '*Ca. L. solanacearum*' in seeds.

Appendix C: Consideration of potential risk mitigation options

Introduction

The department is undertaking a series of seed reviews of the import conditions for four key vegetable families: Apiaceae, Cucurbitaceae, Brassicaceae and Solanaceae. This review of apiaceous vegetable seeds for sowing is the third in this series, following the release of the brassicaceous and cucurbitaceous vegetable seeds reports.

After the release of the *Draft review of import conditions for apiaceous crop seeds for sowing into Australia*, the department considered a broad range of potential alternative measures to minimise impacts on the organic seeds sector as well as non-organic producers. The purpose of this section is to provide supplementary details of these potential options.

Australia recognises the principle of equivalence, namely, '*the situation where, for a specified pest risk, different phytosanitary measures achieve a contracting party's appropriate level of protection*' (FAO 2017c). ISPM 24 (FAO 2017d) provides the principles and requirements that apply to the determination and recognition of equivalence of phytosanitary measures.

The department also notes that there may be a substantial distinction between an acceptable seed treatment for use in a primary production setting as compared to that required to be efficacious as a phytosanitary measure. For example, a pest management objective may be to suppress or reduce pest prevalence in the field to achieve an economically acceptable pest impact threshold. However, this would be unlikely to be a measure that would achieve an appropriate level of protection (ALOP) for Australia.

Seed testing

Diagnostic protocols are described in ISPM 27 (*Diagnostic protocols for regulated pests*) and adopted protocols are provided as annexures to ISPM 27 (FAO 2016e). Australia accepts validated on-shore or off-shore test protocols.

PCR testing is recommended as an option to manage the risks posed by all four quarantine pests identified as associated with apiaceous vegetable seeds. The department is in the process of validating published PCR testing protocols such as the protocol described by Bastide et al. (2017) for the detection of *Diaporthe angelicae*.

When validation of these PCR tests has been completed, the department will publish the approved protocols on its website. Registered stakeholders will be notified by a formal Biosecurity Import Conditions (BICON) alert before PCR testing (on-shore or off-shore) is required to commence.

Seed heat treatments

Heat treatments, including hot water treatments, have been applied to various seeds to mitigate the risk of seed-borne pathogens (Bang et al. 2011; Godefroid et al. 2017; McGrath, Wyenandt & Holmstrom 2016; Nega et al. 2003; Schmitt et al. 2009; Toporek & Hudelson 2017).

Dry heat treatment (DHT)—DHT has been applied to various vegetable seeds (Bang et al. 2011; Godefroid et al. 2017; Kubota, Hagiwara & Shirakawa 2012; Schmitt et al. 2009; Spadaro, Herforth-Rahmé & van der Wolf 2017). DHT of vegetable seeds (spinach, cucumber, lettuce,

Chinese cabbage, carrot and tomato) is routinely used by seed companies in Japan (Nakamura 1982).

Heat transfer in air is less efficient than in water, and dry heat treated seeds may require rehydration before sowing (Spadaro, Herforth-Rahmé & van der Wolf 2017). Long exposure periods or high temperatures are likely to be required to eliminate seed-borne pathogens, which may impact seed viability and vigour. Exposure periods at high temperatures (above 75°C) during DHT have also been shown to reduce seed viability and seedling vigour (Kubota, Hagiwara & Shirakawa 2012; Nakamura 1982; Shi et al. 2016).

There is no recognised scientific evidence that DHT is efficacious for the eradication of the quarantine pests identified as associated with apiaceous seeds in this review. Therefore, DHT is not recommended in this final report.

Hot water treatment (HWT)—HWT is effective against seed-contaminating pests that penetrate the seed coat, but less effective against embryo-borne pathogens (Godefroid et al. 2017; McGrath, Wyenandt & Holmstrom 2016; Toporek & Hudelson 2017). Precise control of the intensity and duration of the treatment is required. Seed lots can differ in sensitivity to HWT, depending on the cultivar, maturity of the seed, water content, or the seed storage period, even for seed lots of the same cultivar (Miller & Lewis Ivey 2018; Spadaro, Herforth-Rahmé & van der Wolf 2017; Toporek & Hudelson 2017).

HWT also has some practical constraints, including the requirements for treating and re-drying large seed volumes (Borgen 2004) and has potential to impact germination and post-treatment maturation (Borgen 2004; McGrath, Wyenandt & Holmstrom 2016; Nega et al. 2003). However, it may provide a viable option in some circumstances.

A hot water treatment schedule of 50°C for 20 minutes was proposed by the department (DAWR 2017) for eradication of '*Candidatus Liberibacter solanacearum*' in seeds, and is recommended in this final report (see Chapter 4).

There is no recognised scientific evidence that HWT is efficacious for the eradication of the other quarantine pests associated with apiaceous seeds in this review. Therefore, HWT is not recommended for other quarantine pests in this final report.

Other potential seed treatments

The department considered a broad range of potential alternative measures to minimise impacts on the organic seeds sector as well as non-organic producers. However, none of these were supported with efficacy data appropriate for phytosanitary measures.

Bleach or organic acids—Seed disinfectants have been used to manage some seed-borne infections or contamination by spores and other forms of disease organism on seeds. Disinfection may take place during various steps of seed production process (Mancini & Romanazzi 2014). Seed disinfection with sodium hypochlorite (bleach) is used in some conventional and organic agricultural production systems.

Bleach may be effective against some saprophytic fungi but is not generally effective in eliminating potentially internal seed-borne pathogens such as *Fusarium* spp. (Garibaldi et al.

2004; Gracia-Garza et al. 1999; Menzies & Jarvis 1994), and may be phytotoxic and/or impact germination (Cantliffe & Watkins 1983; Moutia & Dookun 1999; Sauer & Burroughs 1986).

Other disinfectants, such as acetic acid (CH_3COOH), hydrochloric acid (HCl) and hydrogen peroxide (H_2O_2) have been used to reduce bacteria on cabbage seed without affecting seed germination (Groot et al. 2004; van der Wolf et al. 2008).

However, these disinfectants rarely eliminate all of the microorganisms present, and there is no efficacy data to support the use of these substances as seed disinfectants against the fungal pathogens identified in this report.

Gaseous treatments—Ozone and chlorine dioxide (ClO_2) gases are strong oxidizing agents, with a broad antimicrobial spectrum, and therefore are used to decontaminate various fruits and vegetables, reduce produce decay and extend storage shelf-life (Trinetta et al. 2011). To date, these gases have been used mostly to inactivate food-borne pathogens on fruits, vegetables, sprouts and seeds intended for direct consumption (Gómez-López et al. 2009; Jin & Lee 2007; Paylan et al. 2014; Sharma et al. 2002). However, information on the application of these gases to manage seed-borne pathogens is limited. Trinetta et al. (2011) reported that ozone and ClO_2 gas treatments were able to significantly reduce the pathogenic bacterial contamination of tomato and lettuce seeds, but not eliminate the bacteria. However, there are no efficacy data to support the use of these gas treatments against the fungal pathogens identified in this report.

Biopesticides—Specific biopesticides including lecithin, copper (in various forms), lime, sulphur, calcium hydroxide and phosphates have been used to control a range of plant pathogens (EEC 1991). However, their application as seed treatments are rare (Spadaro, Herforth-Rahmé & van der Wolf 2017). In addition, there are no efficacy data to support the use of biopesticides against the fungal pathogens identified in this report.

Biocontrol agents—Several microbial formulations are commercially available for the control of seed-borne pathogens; these include strains of *Bacillus subtilis* (Kodiak), *Streptomyces grieseoviridis* (Mycostop), *S. lydicus* (Actinovate), *Gliocladium virens* (SoilGard) and *Trichoderma harzianum* (T-22 Planter Box) (Gatch 2016). For example, *B. subtilis* (Kodiak, Companion) has been used for many years to suppress plant pathogens, with varying degrees of success (Araújo, Henning & Hungria 2005; Asaka & Shoda 1996; Turner & Backman 1991; Utkhede & Rahe 1983). However, efficacy data on these formulations is limited and inconsistent (Gatch 2016). In addition, seed treatments with biocontrol agents have been shown to be less effective, and the protection effect often inconsistent in comparison to those achieved with chemical treatments (Gullino, Gilardi & Garibaldi 2014). It is considered that there are insufficient data to support the use of biocontrol agents against the fungal pathogens identified in this report.

Essential oils—Thyme oil has been tested for its ability to control seed-borne pathogens of several crops (Groot et al. 2004; Schmitt et al. 2009; Tinivella et al. 2009; van der Wolf et al. 2008). Thyme oil contains thymol and other antifungal compounds, which provide general antimicrobial activity against seed-borne pathogens. Van de Wolf et al. (2008) reported a significant reduction from 70% to less than 10% of seeds contaminated with two fungi. Batista de Lima et al. (2016) also reported that essential oils extracted from orange peel reduced the incidence of *Alternaria alternata* and *A. dauci* in carrot seeds. Similarly, Schmitt et al. (2009) demonstrated a reduction in infection of *Phoma valerianellae*, but not its eradication, from

lamb's lettuce seeds. However, there are insufficient efficacy data to support the use of essential oils against the specific fungal pathogens identified in this report.

In-field visual inspection

In-field visual inspection of crops may be an appropriate phytosanitary measure to detect pests that produce characteristic visible symptoms during the production cycle. However, in most cases it is impossible to discern a specific pest based on generic symptoms. For this reason, in-field visual inspection alone is not generally recommended as an appropriate phytosanitary measure for the detection of seed-borne pathogens.

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 2019b).
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.
Area	An officially defined country, part of a country or all or parts of several countries (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.
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 2019b).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 2019b).
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).
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).
Equivalence (of phytosanitary terms)	The situation where, for a specified pest, different phytosanitary measures achieve a contracting party's appropriate level of protection (FAO 2019b).
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2019b).
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.
Goods	The <i>Biosecurity Act 2015</i> defines goods as an animal, a plant (whether moveable or not), a sample or specimen of a disease agent, a pest, mail or any other article, substance or thing (including, but not limited to, any kind of moveable property).
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).
Import permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (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).
Intended use	Declared purpose for which plants, plant products, or other regulated articles are imported, produced or used (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).
Lot	A number of units of a single commodity, identified by its homogeneity of composition, origin etc., forming part of a consignment (FAO 2019b).
National Plant Protection Organization	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 (DAWR 2016).
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 2019b).
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 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 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 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 2019b).
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 2019b).

Term or abbreviation	Definition
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).
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).
PRA area	Area in relation to which a pest risk analysis is conducted (FAO 2019b).
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).
Regional pest	A pest of quarantine concern for a specified area, such as Western Australia.
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).
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	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.

Term or abbreviation	Definition
Soil	The loose surface material of the earth in which plants grow, in most cases consisting of disintegrated rock with an admixture of organic material (NAPPO 2003).
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.
Trash	Soil, splinters, twigs, leaves and other plant material, other than fruit as defined in the scope of this risk analysis. For example, stem and leaf material, seeds, soil, animal matter/parts or other extraneous material.
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.

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