PEST RISK ASSESSMENT FOR USE IN INDUSTRY BIOSECURITY PLANS

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Plant Health AUSTRALIA

Introduction

The assessment of the risk posed by exotic pests listed in Industry Biosecurity Plans (IBPs) takes into account relevant international standards on risk assessment developed under the International Plant Protection Convention (IPPC) and is consistent with the International Standards for Phytosanitary Measures (ISPM) No. 2 and 11 [Food and Agriculture Organization of the United Nations (FAO), 2004; 2007]. This risk assessment processes is based on the Department of Agriculture, Fisheries and Forestry Pest Risk Analysis (IRA) process (DAFF 2011). Modifications of the DAFF IRA process have been made to suit the analysis required in the IBP process, including, but not limited to:

- **Entry potential:** The determination of entry potential in this IBP takes into account all potential pathways by which an exotic pest could enter Australia and subsequently be transferred to a suitable host. This includes the legal and illegal importation of plant material as well as contamination and the possibility of introduction through natural means such as wind. Therefore the scope is wider than that used by DAFF in their IRA process, which only considers legal importation of plants or plant commodities through regulated pathways.

- **Potential economic impact:** The consequences of pest establishment in this document only takes into account the impacts on the industry the IBP relates to. The DAFF IRA process has a wider scope, including the effects to all of Australia's plant industries, trade, the environment and public health.

- **Risk potentials and impacts:** The number of categories used in IBPs for describing the entry (Table 1), establishment (Table 2), spread (Table 3), and potential economic impact (see Table 5) differs in comparison to that used in the DAFF IRA process.

Therefore, while there are similarities in the ranking system used in this document and the IRA process followed by DAFF, there are differences in the underlying methodology and scope of consideration that may result in different outcomes between the two assessment systems. This includes different guidance to assignment of qualitative probabilities when compared with the DAFF IRA process.

The objective of risk assessment is to clearly identify and classify biosecurity risks and to provide data to assist in the evaluation and treatment of these risks. Risk assessment involves consideration of the sources of risk, their consequences, and the likelihood that those consequences may occur. Factors that affect the consequences and likelihood may be identified and addressed via risk mitigation strategies.

Risk assessment may be undertaken to various degrees of refinement, depending on the risk information and data available. Assessment may be qualitative, semi-quantitative, quantitative, or a combination of these. The complexity and cost of assessment increase with the production of more quantitative data. It is often more practical to first obtain a general indication of the level of risk through qualitative risk assessment, and if necessary, undertake more specific quantitative

assessment later [Australian Standard/New Zealand Standard (AS/NZS) ISO 31000, 2009].

Pest risk assessments carried out by Plant Health Australia involve a number of relevant experts from relevant governments, universities, research organisations and industry to access the technical expertise needed for a particular assessment. Scientific, peer-reviewed, publications should take precedence when gathering relevant pest information. However due to the range of variables that may influence how a pest may behave in Australian conditions, expert judgment based on a range of case histories, sometimes involving comparable pests, must also be considered when information is insufficient or inconclusive.

When a risk assessment is performed, it is important to document the level of confidence in the analysis, what available information or reasoning contributed to individual risk assessments and any areas where assumptions have been made or where information is limited or unavailable.

The outcomes and validity of information used for past pest risk assessment should be utilised yet re-assessed against current conditions as circumstances and available information may have changed. Information or assessment of a similar organism may also be investigated when available information on the specific organism is absent or incomplete.

When conducting a risk assessment of a pest that threatens multiple industries the entry, establishment and spread potential will need to consider all known factors across all host industries. This accurately reflects the ability of a pest to enter, establish and spread across Australia and ultimately results in similar ratings across industry groups. However the consequences of a pest becoming established are very specific to the industry and therefore the economic impact rating will always differ between industries.

Pest risk assessment process used in IBPs

Risk assessment is a process to evaluate the risk that a species will be transported and introduced, establish, increase in abundance, spread and cause impacts. Due to the scarcity of information that may exist on any particular pest and because the result of an incursion may be spatially and temporally context specific it is important to document any uncertainty so that these points can be prioritised for future research.

Step 1 – Clearly identify the pest

It is essential to clearly define the identity of the pest for which the risk assessment is being performed so that it is not confused with other pests. The generally accepted unit for defining a pest is its scientific species. A broader grouping may be used in some circumstances, for example when carrying out a risk assessment for a group of closely related species. Alternatively, the unit for defining a pest may be more narrowly defined, for example a sub-type within a species (e.g. subspecies, race, strain, pathovar). In such cases there must be evidence that factors, such as

differences in host range, pathogenicity (virulence) or vector relationship, make that sub-type distinct from others in terms of biosecurity significance.

Several invertebrate pests are also host to, and a vector of pathogens, typically, viruses, bacteria and fungi. Both the invertebrate vector and pathogen will require two separate risk assessments to account for the potential absence or presence of the vector and pathogen.

The following guidelines are used when identifying a pest:

- Generally pest is defined to species level
- Alternatively a group (e.g. family, genus level) can be used
- Sub-species level (e.g. race, pathovar, strain etc.) may be required
- Vector/pathogen relationships need to be accounted for

Step 2 – Assess the likelihood of entry

The probability of entry describes the likelihood that a pest will enter Australia and be transferred (alive) to a suitable host or suitable habitat. The below list is a range of factors that should be considered when assessing all potential pest entry pathways. Table 1 provides a definition for each entry potential rating which should be based on these factors and any other known variables.

- Current global pest distribution and prevalence of the pest in source countries
- Past pest interception data (where available)
- Is an invertebrate vector required for long term survival outside of a suitable host
- How known invertebrate vectors or host plant material may be managed at the border (quarantine practices, host material regulations, and pest detectability)
- The lifecycle and life stages of the pest and how these may influence pest prevalence and survival through different transit methods
- All potential pathways the pest, or pest vector, has available to reach a suitable host (E.g. soil or seed borne organisms or pests carried by wind).
- Volume, frequency, and seasonal timing of potential host material moving across the border.
- Geographical distribution of all potential host plants (or suitable vectors)
- Proximity of all pathways entry points to suitable hosts

Table 1. *Definitions of entry potential ratings*

Entry potential	Definition
Negligible	The probability of entry is extremely low given the combination of all known factors including the geographic distribution of the pest, quarantine practices applied, probability of pest survival in transit and pathways for pest entry and distribution to a suitable host.
Low	The probability of entry is low, but clearly possible given the expected combination of factors described above.
Medium	Pest entry is likely given the combination of factors described above.
High	Pest entry is very likely and potentially frequent given the combination of factors described above.
Unknown	The pest entry potential is unknown or very little of value is known.

Step 3 – Assess the likelihood of establishment

Establishment can be considered as the ability of a pest to have self-perpetuating populations into the foreseeable future. The probability of establishment is driven by a number of factors one of which is population dynamics which will differ between species and be influenced by different environments. By having reliable information on the pest's lifecycle, host range, epidemiology, and survival mechanisms will allow for a more accurate risk assessment. The below list is a range of factors that should be considered when assessing a pests establishment potential. Table 2 provides a definition for each establishment potential rating which should be based on these factors and any other known variables.

- The continued survival and reproduction ability of the pest (with or without vector) within all potential climatic and environmental conditions of Australia
- Temperature and humidity thresholds of pests
- Seasonal timing of host imports
- Distribution of natural enemies
- Host competition with established organisms
- The availability, quantity, and distribution of all known hosts, alternative hosts, and vectors
- All available control methods (pesticides, biological controls, readily available resistant varieties)
- Reproduction strategies and potential for adaptation to a wider host or climatic range.
- Minimum population requirements
- How existing cultural practices (current best practice IPM) may impact pest establishment

***Table 2**. Definitions of establishment potential ratings*

Establishment potential	Definition
Negligible	The pest has limited potential to survive and become established within Australia given the combination of all known factors.
Low	The pest has the potential to survive and become established in approximately one-third or less of the range of hosts. The pest could have a low probability of contact with susceptible hosts.
Medium	The pest has the potential to survive and become established in between approximately one-third and two-thirds of the range of hosts.
High	The pest has potential to survive and become established throughout most or all of the range of hosts. Distribution is not limited by environmental conditions that prevail in Australia. Based upon its current world distribution, and known conditions of survival, it is likely to survive in Australia wherever major hosts are grown.
Unknown	The establishment potential of the pest is unknown or very little of value is known.

Step 4 – Assess the likelihood of spread

Spread can be considered as the expansion of the geographical distribution of a pest. The probability of spread needs to consider all factors that contribute to pest movement between susceptible hosts after establishment. The below list is a range of factors that should be considered when assessing a pests spread potential. Table 3 provides a definition for each spread potential rating which should be based on these factors and any other known variables.

- The availability (distribution) of all know hosts
- All known natural dispersal methods (ability for active flight, wind borne life-stages, vectors)
- Existing presence of potential vectors and whether a vector is required for long distance spread
- All host industries ability to mechanical spread the pest through movement of host material (propagation and waste material)
- Natural/geographical barriers (mountain ranges, climatic extremes)
- The potential for spread through contamination of alternative hosts or farming machinery

Table 3. *Definitions of spread potential ratings*

Spread potential	Definition
Negligible	The pest has very limited potential for spread in Australia given the combination of dispersal mechanisms, availability of hosts, vector presence, industry practices and geographic and climatic barriers.
Low	The pest has the potential for natural or assisted spread to susceptible hosts within Australia yet is hindered by a number of the above factors
Medium	The pest has an increased likelihood of spread due to the above factors
High	The natural spread of the pest to most production areas is largely unhindered and assisted spread within Australia is also difficult to manage
Unknown	The spread potential is unknown or very little of value is known.

Step 5 – Combining the potentials for entry, establishment and spread

After each risk area has been rated individually, a combined risk rating should be determined using a qualitative risk analysis matrix. This is achieved by combining the likelihoods of entry, establishment, and spread using a matrix of rules (Table 4). This matrix is used to combine the likelihood of entry and establishment, and then this result is combined with the likelihood of spread to determine the overall likelihood of entry, establishment and spread.

Table 4. *A matrix of 'rules' for combining descriptive likelihoods*

Combine in order of entry, establishment and spread				
Likelihood	**High**	**Medium**	**Low**	**Negligible**
High	High	Medium	Low	Negligible
Medium	Medium	Low	Low	Negligible
Low	Low	Low	Extremely Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Adapted from DAFF (2011)

Step 6 – Assess the likely consequences

The most obvious consequence of a pest introduction is the economic impact on the Industry (producers). In addition, exotic pests may also impact industry service providers, stakeholders involved in the supply chain, local communities, and have environmental and social consequences. However, the IBP risk assessment process is based primarily on the economic consequences of the pest to the industry. The below list is a range of factors that should be considered when assessing a pests potential impact on a specific industry. Table 5 provides a definition for each potential impact rating which should be based on these factors and any other known variables.

- Likely impact on productivity - Industry yield and host longevity (extrapolated from comparable overseas examples).
- Types, amount and frequency of damage to all stages of growth
- Increases in production costs and/or storage costs
- Pest impacts on crop quality and flow on effects this may have on post-harvest costs and consumer demand.
- Impact of local quarantine measures (availability of service providers and contractors)
- Domestic and export market access issues (phytosanitary regulations imposed)
- Seasonal timing, including what stage of plant/bee maturity is most affected by the pest
- Costs involved with meeting ongoing control and surveillance requirements
- Impacts of control measures on the host or beneficial organisms (including pollinators if applicable).
- Pests affecting industry production through effects on other organisms (i.e. competition with beneficial organisms)
- Pests acting as vectors for other existing industry pests
- The effectiveness of current or available chemical treatments and pest management procedures

Table 5. *Definitions of economic impact ratings of a pest to an industry*

Economic impact	Definition
Negligible	There are very minor, often undetectable, impacts on production with insignificant changes to host longevity, crop quality, production costs or storage ability. There are no restrictions to market access.
Very Low	There are minor, yet measurable, impacts on production including either host longevity, crop quality, production costs or storage ability. There are no restrictions to market access.
Low	There are measurable impacts to production including either host mortality, reduction in yield, production costs, crop quality, storage losses, and/or minimal impacts on market access.
Medium	There are significant impacts on production with either host mortality, reduction in yield, production costs, crop quality, storage losses, and/or moderate impacts on market access.
High	There are severe impacts on production including host mortality and significant impacts on either crop quality or storage losses, and/or severe impacts on market access.
Extreme	There is extreme impact on standing crop at all stages of maturity, with high host mortality or unmanageable impacts to crop production and quality, and /or extreme, long term, impacts on market access.
Unknown	The economic potential of the pest is unknown or very little of value is known.

Step 7 – Derive an overall risk estimate by combining the likelihood and consequence ratings

Once the probabilities of entry, establishment and spread have been estimated for the pest, and an assessment of the likely economic consequences has been made, this information can be combined to achieve an overall risk rating. This may be done mathematically for numerical data, however a set of 'decision rules' are required in order to combine qualitative rankings (DAFF, 2011). Table 6 summarises decision rules for combining the qualitative likelihood and consequence ratings described in this document.

Where the values for entry, establishment and spread potentials, or the economic impact, are represented by a probability range, an overall risk should be derived by using all discrete values within that range. For example, a pest with an economic impact of low-high would have an overall risk score calculated separately using an economic impact of low, medium and high. The overall risk will then be described as a range limited by the upper and lower values produced from the combinations.

Table 6. *Risk estimation matrix*

Combine the result of the above 'entry, establishment, spread' matrix (Table 4) with the economic impact rating using this table to obtain the overall risk rating.

		Combined likelihood rating				
		High	**Medium**	**Low**	**Extremely low**	**Negligible**
Economic consequence rating	**Extreme**	Extreme risk	Extreme risk	High risk	Medium risk	Low risk
	High	High risk	High risk	Medium risk	Low risk	Very low risk
	Medium	Medium risk	Medium risk	Low risk	Very low risk	Negligible risk
	Low	Low risk	Low risk	Very low risk	Negligible risk	Negligible risk
	Very low	Very low risk	Very low risk	Negligible risk	Negligible risk	Negligible risk
	Negligible	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk

Adapted from DAFF (2011)

Step 8 – Review the risks

Risks will change over time and may become more or less relevant based on changing technology, practices, legislation and policy. A process to identify new threats and to reassess the risk of existing threats facing the industry will be undertaken regularly as part of the IBP review process.

References

AS/NZS ISO 31000:2009, Risk management - Principles and guidelines. Standards Australia, Sydney, and Standards New Zealand, Wellington.

DAFF (2011) Final pest risk analysis report for '*Candidatus* Liberibacter species' and their vectors associated with Rutaceae. Department of Agriculture, Fisheries and Forestry, Canberra.

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