Australian Government

Biosecurity Australia

Final Import Risk Analysis Report for the Importation of Cavendish Bananas from the Philippines

Part A

November 2008

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Postal address:

Biosecurity Australia
GPO Box 858
CANBERRA ACT 2601
AUSTRALIA

Internet: www.biosecurityaustralia.gov.au

Cover image: Emerging banana bunch showing bracts, flowers and fingers (Photo: D Peasley)

This import risk analysis has been released by the Chief Executive of Biosecurity Australia.

Stakeholders have 30 days from the publication of this document to lodge an appeal in writing with the Import Risk Analysis Appeals Panel – a body independent of Biosecurity Australia – on one or both of the following grounds:

> There was a significant deviation from the process set out in the *Import Risk Analysis Handbook* (BA 2003) that adversely affected the interests of a stakeholder.
>
> A significant body of scientific information relevant to the outcome of the IRA was not considered.

In lodging appeals, stakeholders must give reasons for their appeal.

Appeals should be submitted to:

> IRAAP Secretariat
> Corporate Policy Division
> Department of Agriculture, Fisheries and Forestry
> GPO Box 858
> CANBERRA ACT 2601

Facsimile: +61 2 6272 5926
E-mail: IRAAP@daff.gov.au

Further details of the appeal process are provided in the Handbook (BA 2003).

Foreword

This import risk analysis report is in three parts:

- Part A contains a summary of the import risk analysis (IRA).
- Part B contains background material, an explanation of the method used in the IRA, hazard identification, detailed risk assessments and proposed risk management measures.
- Part C contains technical details on the full range of pests[1] considered.

This document is Part A

It contains a brief background on risk analysis, a summary of the method used and the results and conclusions of the analysis. Part A is intended to assist stakeholders' understanding, but it does not contain the full details of the analysis and should not be relied on as such.

[1] The term 'pest' used throughout this report is the collective term used for insect pests, plant diseases, viruses, bacteria and fungi that could harm plants. The formal definition used is the one provided in the International Plant Protection Convention (IPPC): 'any species, strain, or biotype of plant, animal or pathogenic agent injurious to plants or plant products' (FAO 2006).

Contents

Part A (This document)

Part B

Part B contains background material, an explanation of the method used in the IRA, hazard identification, detailed risk assessments and proposed risk management measures as well as:

- Abbreviations and acronyms
- List of terms
- Reference list.

Part C

Part C contains technical details on the full range of pests considered.

1. Overview

Biosecurity Australia and a specialist import risk analysis team have prepared this import risk analysis (IRA) report assessing an application to import mature, hard green Cavendish bananas from the Philippines to Australia.

This report shows that under existing pest and disease management practices used in the Philippines, the unrestricted risk is too high (exceeds Australia's appropriate level of protection (ALOP)) to permit the importation of mature hard green bananas from the Philippines without the application of phytosanitary risk management measures.

Twenty one pest species have been identified that pose a quarantine risk that exceeds Australia's ALOP and therefore require risk management measures. The pest species include the pathogens that cause Moko, black Sigatoka and freckle; and arthropods that include seven species of armoured scale, four species of mealybug, five species of spider mite and two species of thrips.

In order to achieve Australia's ALOP, the Philippines authorities and industry must demonstrate through verifiable laboratory and/or field research trials and under commercial conditions that risk management measures, either alone or in combination, will reduce the pathogen levels to measurable thresholds. These disease thresholds are set out for each pathogen in this report. The management of arthropod pests can be achieved by the application of existing quarantine policy requiring inspection and remedial action if the pest is found.

The report proposes that the importation of mature, hard green bananas to Australia from the Philippines will require the Philippines to demonstrate, to the satisfaction of Australia, that the proposed measures will achieve Australia's ALOP for the risk management of all pests and diseases.

Mandatory pre-clearance arrangements will be required, with Australian Quarantine and Inspection Service (AQIS) officers involved in all risk management measures in the Philippines, and in auditing the systems and processes used by the Philippines to certify exports.

Failure to implement approved measures to the required standard may result in immediate suspension of exports to Australia.

The mandatory measures and procedures for each plantation/block and for stages of the export pathway are discussed in Sections 20.2 and 20.3 of Part B and include:

- registration of all plantations/blocks and packing stations
- approved documentation systems in packing stations
- AQIS audits of entire production cycle
- AQIS field audits
- application of standard commercial practices, including:
  - maintenance of disease control programs for quarantine pests (for example, fungicidal spray programs and the maintenance of spray diaries)
  - freedom from trash
  - labelling of lots
  - prevention of contamination
  - inspection
  - disinfestation.

Phytosanitary risk management measures that will reduce the risk for specific pests to an acceptable level are considered feasible. To reduce the risk to an acceptable level, any measure or combination of measures will be required to reduce the level of disease or the number of disease propagules to a threshold value that will achieve Australia's ALOP. In this report pest thresholds have been determined for Moko, black Sigatoka and freckle.

The phytosanitary risk management measures for specific pests include:

Moko

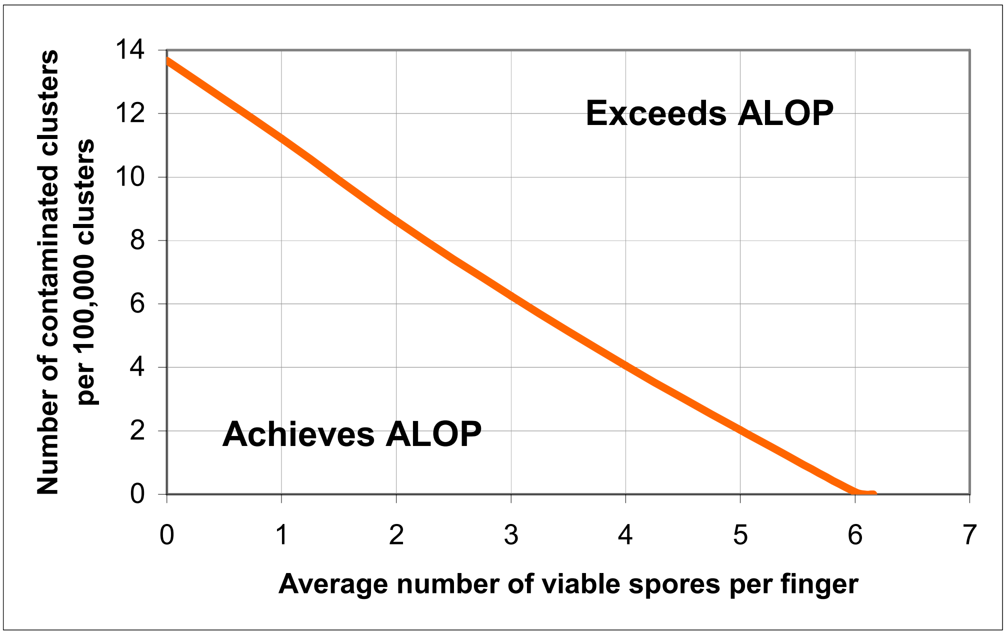
The pest threshold for Moko that would achieve Australia's ALOP is 2.5 infected clusters per million imported clusters. It is considered feasible that the following measures, either alone or in combination, would achieve this threshold level:

- areas of low pest prevalence
- visual inspection for discolouration of pseudostem and peduncle followed by corrective action.

Black Sigatoka

The IRA team considered that black Sigatoka can enter by two pathways (infected trash and spores on the skin of bananas) and therefore two pest thresholds are specified. As a result, there are a range of values for each pest threshold that, in combination, will achieve Australia's ALOP. Figure 1.1 shows the range of pest thresholds that would achieve Australia's ALOP.

Figure 1.1 Combination of required pest thresholds that achieves Australia's ALOP



It is considered feasible that the following measures, either alone or in combination, would achieve the pest threshold values within the acceptable range illustrated in Figure 1.1:

- areas of low pest prevalence
- trash minimisation
- post-harvest fungicide treatment.

Freckle

The pest threshold for freckle that would achieve Australia's ALOP is 7.5 infected clusters per 1000 clusters after the fruit has been processed in the packing shed. It is considered feasible that the following measures, either alone or in combination, would achieve this pest threshold level:

- areas of low pest prevalence
- fungicide bunch spray.

Arthropod pests – armoured scales, mealybugs, spider mites and thrips

- Specific risk management for all arthropod pests (armoured scales, mealybugs, spider mites and thrips) is required, comprising inspection, followed by corrective action (treatment or withdrawal of the lot) if any pests are detected.

Part B of the report contains full details of the analysis and the conclusions.

2. The import risk analysis (IRA) process

2.1 The process

The objective of Australia's biosecurity policies is to protect the nation from the risks of exotic pests entering, establishing and spreading, thereby threatening Australia's unique flora and fauna, and agricultural industries that are free from many serious pests.

The import risk analysis (IRA) process is an important part of Australia's biosecurity policies. It enables the Australian Government to consider formally the risks that could be associated with proposals to import new products. If the risks are found to exceed Australia’s appropriate level of protection (ALOP), risk management measures are proposed to reduce the risks to a level that achieves Australia’s ALOP. However, if it is not possible to reduce the risks to that level, trade will not be allowed.

Successive Australian Governments have maintained a conservative, but not a zero-risk, approach to the management of biosecurity risks. This approach is expressed in terms of Australia's ALOP. It reflects community expectations through government policy and is described as providing a high level of protection aimed at reducing risk to a very low level, but not to zero. This definition of ALOP, and its illustration by way of a risk estimation matrix, is shown in Table 4.1. The State and Territory governments agreed in 2002 that Australia’s needs are met by this definition of the ALOP.

Biosecurity Australia undertakes Australia’s import risk analyses, using teams of technical and scientific experts in relevant fields, and consulting stakeholders at various stages of the process. Biosecurity Australia’s recommendations are provided to the Director of Animal and Plant Quarantine, who is the Secretary of the Australian Government Department of Agriculture, Fisheries and Forestry (DAFF). The Director, or delegate, is responsible for determining whether or not an importation can be permitted under the *Quarantine Act 1908*, and if so, under what conditions. The Australian Quarantine and Inspection Service (AQIS) is responsible for implementing appropriate risk management measures.

Full details of the processes used by Biosecurity Australia are given in Part B of this report and the *Import Risk Analysis Handbook* (BA 2003), available on the website www.biosecurityaustralia.gov.au.

2.2 The IRA team

An import risk analysis team (IRA team), formerly referred to as a risk analysis panel, was established to assist Biosecurity Australia in preparing this IRA report. The IRA team included members with expertise in different areas, including quarantine risk analysis, plant pests and diseases, and the banana industry.

Under the terms of reference, the IRA team was required to consider scientific and other relevant information to identify quarantine pests that could be on the pathway associated with the importation of mature, hard green banana fruit from the Philippines. In particular, it was to assess the potential for these pests to enter, establish and spread in Australia and have direct and indirect consequences. The IRA team was also required to consider and recommend risk management measures for the identified quarantine risks that it considered necessary to meet Australia’s ALOP and to report to the Chief Executive of Biosecurity Australia.

The revised draft IRA report for the importation of Cavendish bananas from the Philippines (Biosecurity Australia 2007) included a minority view in Part A of that report. The minority view was provided by one member of the IRA team regarding the risk management measures for Moko as they were expressed in the revised draft IRA report. The IRA team, in considering all stakeholder comments provided on the 2007 revised draft report, further developed the risk management section for Moko noting the comments of stakeholders and the issues raised by the member of the IRA team. All members of the IRA team provided full endorsement to the contents of the draft final report with no qualifications.

During the analysis, many complex issues were considered where empirical data were not available and the IRA team was required to exercise expert judgement. To help with this process, the IRA team worked on various occasions with external experts. On other occasions, particular parameters in the analysis were allocated a range of values that took account of the members' differing views.

3. Scope

This report focuses on the importation from the Philippines of mature, hard green banana fruit of four Cavendish varieties, Extra Dwarf, Giant Cavendish, Grand Nain and Williams (referred to as mature, hard green bananas in this report) produced in specified areas of the Philippines. The specified areas are Davao (Davao del Sur, Davao del Norte and Davao Oriental), Cotabato (South Cotabato, North Cotabato and Sarangani) and Bukidnon, on the island of Mindanao.

The report contains details of the quarantine pests associated with Philippine bananas. It also includes recommendations on risk management measures to manage any pests for which the risk has been assessed as being higher than is acceptable for Australia.

A number of draft IRA reports have been published since June 2002. This has provided extensive opportunities for stakeholders to provide comprehensive submissions and comments. These submissions have been carefully considered in finalising the IRA.

This report has been prepared as part of the IRA process set out in the *Import Risk Analysis Handbook* (2003). Changes to the import risk analysis process announced by the Australian Government in late 2006 were implemented on 5 September 2007, when regulations that were made under the *Quarantine Act 1908* formally took effect. However, under transitional arrangements, announced in Biosecurity Australia Policy Memorandum 2007/20, a number of IRAs which were well underway or nearly completed including this IRA, are to be finished under the pre-regulated process as described in the *Import Risk Analysis Handbook* (BA 2003)[2].

[2] Available at http://www.biosecurityaustralia.gov.au

4. Import risk analysis – an overview

An import risk analysis (IRA) for plants or plant products has three key stages:

- **pest categorisation** (identifying pests that may be associated with the commodity in question)
- **risk assessment** (assessing the likelihood that the identified pests will enter, establish and spread, as well as the types and likely magnitude of consequences)
- **risk management** (assessing the measures that can be used to mitigate the assessed risks, if possible).

What is risk?

There are many concepts and definitions of risk and what constitutes risk. However, in an IRA, risk is considered to have two major components:

- the likelihood of a pest entering, establishing and spreading in Australia from imports
- the consequences or impact this may have.

The two components are combined to give an overall estimate of the risk.

4.1 Pest categorisation

Pest categorisation is the initial stage in the IRA process, and identifies pests that require a risk assessment. In this report, it identifies pests that:

- are known to be associated with Cavendish bananas in the Philippines
- are absent from Australia, or whose presence in Australia is uncertain, or which are present but are limited in distribution and under official control
- have the potential for being on the pathway (see 4.2.1)
- have the potential for entry, establishment and spread
- have the potential for unfavourable consequences.

4.2 Risk assessment

Risk assessment, the second stage, evaluates the risks associated with the plant or plant product. This process assesses the likelihood that the importation of bananas from the Philippines for an average year will result in the entry, establishment and spread of each pest. The reference to ‘average’ indicates that the likelihood estimate is based on an average or representative single year of trade. However, it does not mean the quarantine protection applies only to one year.

Each pest is also assessed individually following the procedure detailed in the international standard for phytosanitary measures (ISPM 11). In estimating the probability of entry, establishment and spread (PEES), the median of the values simulated by the model (referred to as the 50th percentile value) is used as a basis in formulating recommendations. This methodology, which is based on Australia’s policy for on-going quarantine protection, was followed by the IRA team. It combines this likelihood with an assessment of the magnitude of the potential consequences to provide an assessment of risk.

In this analysis, the risk of pathogens was assessed with the assistance of a risk simulation model. The risk of arthropod pests was assessed qualitatively, in line with existing policy.

4.2.1 Entry, establishment and spread

Pathways for pests

The entry, establishment and spread of a new pest in Australia resulting from trade in bananas require an unbroken chain of events from the exporting country to suitable host plants in Australia. Typically, this requires that:

- the pest is present in the plantation
- it remains on, or in, the banana fruit at harvest
- it survives packing, storage and transport to Australia
- it is not detected when subjected to on-arrival border procedures
- it survives distribution within Australia on, or in, the fruit and the waste that is subsequently generated
- the waste is disposed of close to suitable host plants, resulting in their exposure to the pest
- infestation or infection of a host plant by the pest occurs
- the pest population becomes self-perpetuating.

Importation steps

The initial part of the analysis focuses on the steps on the pathway in the exporting country. The first step is in the plantation where the bananas are growing. In some cases, pests may be completely absent from some plantations and bananas from these plantations will be free of the pests when harvested.

The next step considers the likelihood that the pest will be present on, or in, the bananas when they are harvested for export. It is important to note that the pest categorisation stage of the risk analysis eliminates pests that have such a small likelihood of being present on or in mature hard green bananas that they do not constitute a threat to Australia. Conversely, a number of the pests of concern for Philippine banana plantations are not primarily pests of bananas, but they may require further consideration because they are associated with banana fruit. This is further considered in Section 8.3 of Part B of this report dealing with contaminant pests.

During the harvesting and transport of bananas in bunches to packing stations, bananas that are not carrying pests may come into contact with contaminated objects, such as plant material, implements, clothing and equipment that could readily transfer pests. Frequent handling by workers also provides opportunities for further cross-contamination. The analysis allows for these possibilities.

At packing stations, bananas are subject to several operations, including high pressure and high volume washing, separation of bunches into hands and clusters, immersion in wash tanks and, in some instances, sponging, brushing, sorting and grading, before being packed in plastic-lined cartons. These operations may reduce the number of pests present or the number of bananas carrying a particular pest, but their effect will depend on the pest. A specific step in the analysis assesses the likelihood of this happening. The processes at packing stations may also increase the number of bananas carrying pests or the numbers of pests on individual bananas. For example, a wash tank where the water is contaminated with bacteria or fungal spores, may result in the contamination of clean bananas. The analysis allows for a possible increased rate of infection of pest-free bananas during processing at packing stations.

At the end of the packing line, bananas will be subjected to various operations related to their export and transport to Australia. This could include quality inspection, palletisation, containerisation and stages of transportation to the final port of destination in Australia. Bananas may also be stored for some time at this stage. Depending on the pest, some operations may reduce the number of bananas carrying pests or the number of pests present on individual bananas, and the analysis allows for this. Conversely, some operations could increase the number of bananas carrying pests, and the analysis considers this.

On-arrival procedures are the last step in the import process that may affect the number of bananas carrying pests. For example, if live insects are noticed when a container is opened to check that the contents comply with the documentation, action may be taken (such as treatment) that results in a reduction in the number of infested bananas. The analysis allows for this possibility.

Distribution of fruit and banana waste within Australia

The other steps in the pathway occur in Australia. The analysis takes the estimate for the likelihood of pest entry from the exporting country and continues by estimating where pests may end up after entering Australia, as well as the likelihood of a pest establishing and spreading at these locations.

The important elements for the on-shore analysis are the distribution pattern for bananas, the availability of suitable hosts for pests and the probability that a pest being carried on, or in, a banana will start a pest population.

The pathway analysis continues by looking at the distribution pattern for bananas (packaged as clusters in cartons) after quarantine authorities have released them at the border. The analysis follows the steps in the supply chain of imported clusters. It considers storage periods, ripening requirements, their distribution through wholesalers and retailers, and finally the production and disposal of waste. Allowance is made for the various end uses of banana fruit, and how and where waste will be generated and disposed of.

While domestic consumers are the main end user, the analysis recognises the importance of wholesalers, retailers, food processors and food services as significant end users generating and disposing of banana waste. The analysis also distinguishes between various types of waste, recognising that some waste disposal will be done through municipal garbage collection to municipal tips, some through home composting, and the rest will be discarded into the broader environment. Importantly, the analysis considers the various distribution pathways in commercial banana-growing areas, as distinct from other areas that may be climatically less suitable for plant species that could support introduced pests.

Exposure, establishment and spread within Australia

The pathway analysis then considers the likelihood that banana waste is discarded sufficiently close to a suitable host plant and whether, if the waste is either infected or infested with pests, pests then transfer to the plant.

It is recognised that different pests have different host ranges, so this part of the analysis is specific for each pest or group of pests with similar biology. Black Sigatoka, for example, has a narrow host range and is restricted to species of *Musa* and *Heliconia*, while many arthropod pests are polyphagous and can feed (and therefore establish) on a wide range of plant species. Pests not only have different host ranges, they also have different mechanisms for spread. This means waste carrying pests that have low mobility will need to be discarded relatively close to a suitable host plant compared with waste infected with pests that can disperse over substantial distances, such as black Sigatoka, which produces wind-dispersed spores.

The detail in this part of the analysis extends to considering the many factors that could affect a pest’s ability to transfer from the waste material. They include the time the pest remains viable in, or on, the discarded waste, whether the waste is buried, the density of the host plants in close proximity to the waste, whether biological (vectors or intermediate hosts), physical or mechanical means of transfer exist and any known behaviour of the pest in actively seeking host plants.

The final important element in the analysis considers the likelihood that a pest will establish and spread once it successfully transfers to a suitable host. Again, there are many factors that need to be considered. For example, with an insect pest being carried as a larva in a fruit, the larva must emerge, mature into an adult, find a mate and lay eggs. In turn, the eggs must hatch successfully and establish a pest population. The whole pathway must be continuous to result in pest establishment. However, there is much potential for breaks in the chain. Pest establishment may be possible only during relatively short periods, depending on climate and host plant development. There also may be only a short time for a mature insect to find a mate. Pests that emerge on different days may have little chance of finding a mate. In addition, many insects have a dispersal phase when they are searching for and selecting host plants before mating. If only a few insects emerge at one time, there is a strong chance they will disperse in different directions and not find a mate.

By contrast, other pests, such as Moko, that have no means of self-dispersal, rely on other mechanisms to establish and spread. The analysis evaluates various risk scenarios for Moko, including transfer by insects, leaching in free water, movement of machinery, vehicles and implements, and cutting, mowing and slashing. For each scenario, a specific sequence of events is considered.

At this point, it is worth noting the record of plant pest incursions in Australia. Although it is always difficult to draw firm conclusions about the pathway of entry, most incursions appear to be associated with the movement (often illegal) of planting material (e.g. cuttings and plants) or natural movement, particularly into northern Australia. There is little evidence that the regulated importation of agricultural commodities for human consumption (e.g. citrus, table grapes, kiwi fruit and cherries) is a significant pathway for the entry of pests.

There is, however, one case where it is suspected that unregulated importation of fruit resulted in a new pest becoming established in Australia. Papaya fruit fly became established in north Queensland in 1995, and it is thought that this resulted from the illegal importation of infested tropical fruit. This example illustrates that pest establishment from fruit is not impossible, and emphasises the need to rigorously analyse proposals to import fruit.

Probability of entry, establishment and spread

Combining the likelihoods of each of the component steps in the pathway provides an overall estimate of the probability of entry, establishment and spread for each pest.

4.2.2 Consequences

The other part of the risk assessment involves estimating the potential consequences or impact of a pest establishing in Australia. To determine an overall estimate, the consequences are considered under four headings – local, district, regional and national. The approach used allows for consideration of direct pest effects, such as potential production losses, control costs and quality loss. Indirect consequences, such as eradication costs, effects on domestic and international trade, and impacts on the environment and communities, are also assessed.

Scores for these impacts range from ‘unlikely to be discernible’ to ‘highly significant’, and are applied to direct and indirect criteria. The scores are then combined using a series of rules to provide an overall assessment of the consequences for each pest, ranging from ‘negligible’ to ‘extreme’.

4.2.3 Risk

The estimate of the annual likelihood of entry, establishment and spread is combined with the estimate of the consequences according to the matrix shown in Table 4.1 to provide an estimate of the risk for each pest. The reference to ‘annual’ indicates that the likelihood estimate is based on the estimated volume for one year of trade. However, it does not mean the quarantine protection applies only to one year. Clearly, the consequences of pest entry, establishment and spread can extend beyond a year, and the assessment of consequences is not restricted to a particular period. In addition, it is always possible to modify the quarantine measures in response to changes in pest status, scientific knowledge and new treatments.

Risk estimates of 'low', 'moderate', 'high' or 'extreme' are considered to exceed the level of risk Australia will accept. Estimates of 'very low' or 'negligible' are considered acceptable. If the risk estimate for a pest exceeds 'very low', risk management measures are required.

4.2.4 Unrestricted risk

The initial risk analysis for each pest assumes there are no risk management measures in place. This is called the 'unrestricted risk'. If the unrestricted risk estimate for a pest exceeds 'very low', risk management measures are required.

Table 4.1 Risk estimation matrix

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

*When this likelihood is assessed quantitatively, the qualitative descriptors on the vertical axis are replaced by numerical likelihood ranges as follows: *High* by 0.7–1; *Moderate* by 0.3–0.7; *Low* by 0.05–0.3; *Very low* by 0.001–0.05; *Extremely low* by 1.0E–06 to 0.001; and *Negligible* by 0 to 1.0E–06.

4.3 Risk management

Risk management is the third stage of the IRA process. Where the unrestricted risk estimate for an individual pest is unacceptable (that is, it exceeds 'very low') risk management measures would be required to manage the risks to an acceptable level. It is necessary to determine if there are risk management measures or pest limits that, if met, would reduce the risk estimate to a level that would achieve Australia's ALOP. Such pest limits are referred to in the report as pest thresholds. The 'restricted' risk is determined by repeating the risk analysis taking into account the effects of the proposed measures or the pest threshold. This is repeated for each proposed measure and/or combination of measures and the value is checked against the matrix to determine whether the proposed measure reduces the risk to a 'very low' or 'negligible' level.

Various risk management measures may be available, depending on the biology of individual pests. Some examples of risk management measures that can be applied up to the point of import include sourcing the fruit from areas free of a pest or areas where the pest is at a low level, and applying a treatment followed by inspection and rejection if pests are detected.

Risk management measures that can be applied at, or after, importation of the fruit are limited. However, some possibilities that could be considered include inspection and rejection if pests are found, and treatments such as fumigation. Several pests of bananas in eastern Australia are absent from Western Australia. Western Australia already has controls on the movement of bananas from eastern Australia, and these may be relevant to risk management for bananas from the Philippines moving into Western Australia.

The analysis for some pests may indicate there is no single risk management measure that will reduce the risk to ‘very low’ or ‘negligible’. In these cases, it may be possible to combine individual risk management measures to achieve a sufficient level of risk reduction. This is referred to as a ‘systems approach’ to risk management.

In developing final recommendations on risk management measures, consideration is given to the potential impact of the measures on potential trade. Where there are alternative and equivalent risk management measures that achieve the required degree of risk reduction, the final recommendations need to take into account Australia’s international obligations and propose the least trade-restrictive risk management measures available.

5. Results

5.1 Pest categorisation

The IRA process categorised 122 potential pests of mature, hard green bananas according to their presence or absence in Australia, including regulatory status where applicable, their potential for being on the pathway (association with banana fruit), their potential for establishment and spread in Australia, and the potential consequences of establishment and spread. Table 5.1 summarises the findings. Part C contains details of the categorisation.

Table 5.1 Outcome of the pest categorisation process

Groups	Associated with bananas in the Philippines	Not in Australia, uncertain or of regional concern	Potential for being on pathway (Likely)	Potential for establishment or spread (Feasible)	Potential for consequences (Significant)	No. of species to be considered further
Arthropods						
Insects	77	39	23	23	20	20
Mites	8	5	5	5	5	5
Pathogens						
Bacteria	2	1	1	1	1	1
Fungi	23	3	2	2	2	2
Viruses	6	3	3	3	3	3
Nematodes	6	0	0	0	0	0
Total	**122**	**51**	**34**	**34**	**31**	**31**

After all the pests were considered, 31 quarantine pest species were identified as requiring further consideration in detailed risk assessments, because of their likely potential for being on the pathway of entry, because of the potential to establish or spread, and because the potential consequences for Australia were judged to be significant. One bacterium, two fungi, three viruses, 13 insect pests and four species of spider mites were considered for the whole of Australia (Table 5.2). Seven additional insect pests and one species of spider mite were considered for Western Australia only (Table 5.3).

Table 5.2 Pests of mature, hard green bananas considered further for the whole of Australia

Pathogens	Scientific name
Bacteria	
Moko	*Ralstonia solanacearum* race 2 (Burkholderiales: Ralstoniaceae)
Fungi	
Black Sigatoka	*Mycosphaerella fijiensis* (Dothideales: Mycosphaerellaceae)
Freckle	*Guignardia musae* (Cavendish strain) (Dothideales: Mycosphaerellaceae)
Viruses	
Bract mosaic	*Banana bract mosaic virus* (Potyviridae)
Bunchy top	*Banana bunchy top virus* (Nanoviridae) Abaca bunchy top virus (Unassigned: Nanoviridae)
Arthropods	
Fruit flies	*Bactrocera occipitalis* (Diptera: Tephritidae) *Bactrocera philippinensis* (Diptera: Tephritidae)
Armoured scales	*Aspidiotus coryphae* (Hemiptera: Diaspididae) *Aspidiotus excisus* (Hemiptera: Diaspididae) *Pinnaspis musae* (Hemiptera: Diaspididae)
Mealybugs	*Dysmicoccus neobrevipes* (Hemiptera: Pseudococcidae)

Pathogens	Scientific name
	Nipaecoccus nipae (Hemiptera: Pseudococcidae) *Pseudococcus jackbeardsleyi* (Hemiptera: Pseudococcidae)
Spider mites	*Oligonychus orthius* (Prostigmata: Tetranychidae) *Oligonychus velascoi* (Prostigmata: Tetranychidae) *Raoiella indica* (Acari: Tenuipalpidae) *Tetranychus piercei* (Prostigmata: Tetranychidae)
Weevils	*Philicoptus demissus* (Coleoptera: Curculionidae) *Philicoptus iliganus* (Coleoptera: Curculionidae) *Philicoptus strigifrons* (Coleoptera: Curculionidae) *Philicoptus* sp.1 (Coleoptera: Curculionidae) *Philicoptus* sp.2 (Coleoptera: Curculionidae)

Table 5.3 Pests of mature, hard green bananas considered further for Western Australia only

Common name	Arthropods
Armoured scales	*Abgrallaspis cyanophylli* (Hemiptera: Diaspididae) *Hemiberlesia palmae* (Hemiptera: Diaspididae) *Pseudaulacaspis cockerelli* (Hemiptera: Diaspididae) *Selenaspidus articulatus* (Hemiptera: Diaspididae)
Mealybugs	*Planococcus minor* (Hemiptera: Pseudococcidae)
Spider mites	*Tetranychus marianae* (Prostigmata: Tetranychidae)
Thrips	*Chaetanaphothrips signipennis* (Thysanoptera: Thripidae) *Elixothrips brevisetis* (Thysanoptera: Thripidae)

5.2 Risk assessment

Detailed risk assessments were conducted on the 31 quarantine pests identified as requiring further assessment in the pest categorisation stage. Where the biology of pests was considered sufficiently similar, they were assessed as a group. The results are summarised in Table 5.4. The unrestricted risks posed by Moko, black Sigatoka, freckle, armoured scales (seven species), mealybugs (four species), spider mites (five species) and two species of thrips exceed Australia's appropriate level of protection (ALOP). Therefore, specific risk management measures for these pests are required to reduce the risks to a level consistent with Australia's ALOP. The unrestricted risk of each of the other pests assessed was within Australia's ALOP and risk management measures for those other pests are not required.

The IRA team used a banana cluster as the unit of analysis in all risk assessments. This recognises that a cluster is the basic unit derived from bunches in packing stations and essentially maintains its integrity throughout the marketing chain until it reaches the consumer. It was also considered likely that individual clusters could provide a pathway for the entry and establishment of pests without considering larger quantities of fruit.

The estimates of unrestricted risk also exclude practices considered common in the Philippines but not mandatory, such as the chlorination of flotation tanks. Where appropriate, some of these practices are considered as phytosanitary measures in sections dealing with risk management.

Table 5.4 Summary of the assessment of unrestricted risk of quarantine pests

Common name of pest	Probability of entry, establishment and spread (PEES)	Consequences	Unrestricted risk	Assessed for management measures:
Pests of concern to the whole of Australia				
Moko	1.60E–01	High	Exceeds ALOP	Yes
Black Sigatoka	6.84E–01	Moderate	Exceeds ALOP	Yes
Freckle	9.56E–01	Low	Exceeds ALOP	Yes
Bract mosaic	4.29E–03	Low	Achieves ALOP	No
Bunchy top	4.21E–08	Moderate	Achieves ALOP	No
Fruit flies	Negligible	High	Achieves ALOP	No
Armoured scales	Moderate	Low	Exceeds ALOP	Yes
Mealybugs	High	Low	Exceeds ALOP	Yes
Spider mites	High	Low	Exceeds ALOP	Yes
Weevils	Negligible	Low	Achieves ALOP	No
Pests of concern to Western Australia*				
Armoured scales	Moderate	Low	Exceeds ALOP	Yes
Mealybugs	High	Low	Exceeds ALOP	Yes
Thrips	High	Low	Exceeds ALOP	Yes
Spider mites	High	Low	Exceeds ALOP	Yes

*Western Australia has a pest and disease status that is different, in some respects, from other areas of Australia. This regional freedom from pests or diseases that may already be present in other locations in Australia is recognised in the risk assessment.

5.3 Risk management

The proposed risk management measures for the pests that had an unrestricted risk exceeding Australia's ALOP are summarised below.

The effectiveness of specific measures will need to be verified by laboratory and/or field trials and under commercial conditions before exports can begin.

5.3.1 Pests – Australia

Moko

The major entry, establishment and spread pathway identified for Moko was the potential for Moko bacteria to be present in the vascular tissue of banana fruit harvested in the Philippines and transported to Australia. Transfer of Moko to host plants in Australia could occur as a result of bacteria leaching from banana waste and colonising the roots of host plants in the general vicinity, or as a result of mechanical transfer by implements coming into contact with infected waste and subsequently making contact with susceptible hosts.

The proposed risk management measures (systems approach) for Moko are:

Areas of low pest prevalence

The IRA team considered that an area of low pest prevalence (ALPP) would be a risk mitigation measure that could be implemented and would be expected to reduce the number of infected banana fruit.

An ALPP could be established and maintained following the guidelines described in ISPM 22: *Requirements for the establishment of areas of low pest prevalence* (FAO 2005a) and ISPM 29:

Recognition of pest free areas and areas of low pest prevalence (FAO 2007). An area of low Moko disease prevalence could be a place of production (a banana plantation managed as a single unit) or a production site (a designated block within a plantation) for which low prevalence of Moko is established, maintained and verified by Philippine Bureau of Plant Industry (BPI) and audited by AQIS. This measure would reduce the values associated with several steps on the import pathway and thereby mitigate the risk.

When establishing an ALPP, the Philippines would have to meet a number of requirements, including:

- establishing the specified level of the relevant pest to sufficient precision
- recording and maintaining surveillance and control activities for a sufficient number of years
- identifying and demonstrating that potential infection/infestation pathways have been regulated to maintain the ALPP.

Visual inspection for discolouration of pseudostem and peduncle followed by corrective action

Inspection of harvested banana bunches for vascular discolouration of the pseudostem and peduncle, and for premature ripening of fruit, at either harvesting or processing could be used to identify Moko-infected fruit in the export pathway. Subsequent corrective action of immediately removing bunches showing visible signs of vascular discolouration would constitute a risk mitigation measure.

Moko infection causes vascular discolouration irrespective of whether external disease symptoms develop. However, the degree of discolouration varies from cream or yellow through to reddish-brown, brown and black. This colour variation is likely to depend on the time elapsed since infection and the severity of the infection. Consequently, there will be instances when there is no evident vascular discolouration of infected plants because of the ‘lag period’ between when infection with Moko occurs and when the first signs of vascular discolouration become evident. It is acknowledged that there are other diseases and physiological conditions that may cause similar discoloration. This could result in the rejection of some bunches that are not infected with Moko.

Examinations of the cut pseudostem and the cut peduncle of banana bunches when harvested for export to Australia would be a means of detecting at least a proportion of Moko-infected banana bunches that are not expressing externally visible symptoms, and thus be a means of reducing the likelihood of importing asymptomatic fruit. Inspection for internal Moko symptoms in freshly cut cross-sections of the pseudostem and peduncle could be conducted in the field at bunch harvest and for the peduncle again within the packing station. All bunches that show visible signs of vascular discolouration would be required to be immediately removed from the export pathway, either in the field or before de-handing. These inspections would be in addition to the routine quality assurance regime targeted at ensuring the removal of fruit with blemishes, obvious distortion in shape, premature ripening and visible splits.

Black Sigatoka

The major entry, establishment and spread pathway identified for black Sigatoka is the potential for fungal fruiting bodies to be on pieces of leaf and floral plant tissue (referred to as trash) adhering to banana fruit, and for spores to be released from fruiting bodies and contaminate fruit being processed at packing stations. Subsequent spore dispersal could lead to infection of host plants in Australia.

The proposed risk management measures for black Sigatoka are:

Areas of low pest prevalence

The IRA team considered that ALPP would be a risk mitigation measure that could be implemented and would reduce the level of pests. ALPP would be expected to reduce both the level of infected trash in exported clusters and the level of fertile spores on fruit.

Areas of low pest prevalence could be established and maintained following the guidelines described in ISPM 22: *Requirements for the establishment of areas of low pest prevalence* (FAO 2005a) and ISPM 29: *Recognition of pest free areas and areas of low pest prevalence* (FAO 2007). An area of low black Sigatoka prevalence could be a place of production (a banana plantation managed as a single unit) or a production site (a designated block within a plantation) for which low prevalence of black Sigatoka is established, maintained and verified by BPI and audited by AQIS. This measure would reduce the number of fertile pseudothecia and spores on the import pathway and thereby mitigate the risk.

Individual banana plantations in the Philippines could be maintained at very low disease prevalence for black Sigatoka disease symptoms through the use of various management practices, including regular fungicide applications and other horticultural practices, such as regular de-leafing as soon as initial fleck or streak symptoms of the disease are observed on leaves. Plantations where such measures are implemented are known to have lower black Sigatoka disease prevalence.

The IRA team acknowledges that the prevalence of black Sigatoka is lower in the drier areas of Mindanao than in wetter areas. It may be practical to establish areas of low pest prevalence in parts of Mindanao where the disease pressure is relatively low. Even in these areas, it would be necessary to avoid areas where ‘hot spots’ are likely to occur due to microclimatic factors or physical barriers to aerial fungicide application.

Trash minimisation

The IRA team considered that trash minimisation would be a risk mitigation measure that would reduce the level of pests. Trash minimisation procedures would reduce the level of leaf and floral material in export bananas and hence reduce the proportion of infected clusters. Trash minimisation procedures may be applied in the banana plantation and in the pack house.

Trash minimisation procedures in banana plantations may include:

- covering of bunches without placing the flag leaf in the bunch cover
- regularly replacing bunch covers showing tears
- rodent control
- rejecting bunches with rodent or bird nests or other visible trash
- rejecting bunches that fall on to the ground
- removing pruned leaves from a plantation used for growing export bananas.

Trash minimisation procedures at the pack house may include:

- high pressure washing
- removal of trash during de-handing
- brushing and/or wiping of clusters
- visual quality control systems including the removal of visible trash.

Post-harvest fungicide treatment

The IRA team considered that a post-harvest fungicide treatment would reduce fertile spore levels.

Post-harvest fungicide treatments are already used in packing stations in the Philippines (BPI 2000) and the principles and practices of application are well understood.

As development of fungicide resistance in black Sigatoka is a problem, this issue will need to be addressed by testing the sensitivity of spores from an export plantation to the nominated fungicide(s) prior to applying the post-harvest fungicide treatment.

While post-harvest fungicide treatment of export bananas in the packing station would reduce the level of spores on the fruit surface, it may not be sufficiently effective against fruiting bodies of black Sigatoka embedded in plant material. Consequently, the IRA team considered that this treatment alone will not achieve Australia’s ALOP.

Freckle

The major entry, establishment and spread pathway identified for freckle was the potential for fruiting bodies to develop on fruit infected either immediately before harvest or during processing at packing stations. Subsequent spore dispersal could lead to infection of host plants in Australia.

The proposed risk management measures for freckle are:

Areas of low pest prevalence

The IRA team considered that ALPP would be a risk mitigation measure that could be implemented and would reduce the level of pests. ALPP would be expected to reduce the proportion of infected clusters.

Areas of low pest prevalence could be established and maintained following the guidelines described in ISPM 22: *Requirements for the establishment of areas of low pest prevalence* (FAO 2005a) and ISPM 29: *Recognition of pest free areas and areas of low pest prevalence* (FAO 2007). An area of low freckle prevalence could be a place of production (a banana plantation managed as a single unit) or a production site (a designated block within a plantation) for which low prevalence of freckle is established, maintained and verified by BPI and audited by AQIS. This measure would reduce the proportion of infected fruit on the import pathway and thereby mitigate the risk.

Individual banana plantations in the Philippines could be maintained at a very low disease prevalence for freckle disease symptoms through the use of various management practices, including regular fungicide applications and other horticultural practices such as regular de-leafing, covering of banana bunches with polythene bunch covers, improving drainage to reduce build up of relative humidity, avoiding overlapping of leaves by maintaining appropriate plant density and the use of tissue cultured planting material. Plantations where such measures are implemented are known to have lower disease prevalence.

The IRA team acknowledges that prevalence of freckle is lower in the drier areas of Mindanao than in wetter areas. It would be more practical to establish areas of low pest prevalence in parts of Mindanao where the disease pressure is relatively low. Even in these areas, it would also be necessary to avoid areas where 'hot spots' are likely to occur due to microclimatic factors or physical barriers to aerial fungicide application.

The lower freckle incidence from ALPP would also reduce the likelihood that clean fruit is contaminated during processing in the packing shed.

Fungicide bunch spray

The IRA team considered that the use of fungicide bunch sprays to provide protection against freckle infection would reduce the level of pests.

Pesticide sprays are already used in banana plantations in the Philippines (BPI 2000, 2001, 2002b) including fungicide bunch sprays against fruit spots (BPI 2001) and therefore the principles and practices of application are well understood. Non-perforated bags would be required to be attached in a manner that would minimise the risk of pathogen entry into bagged bunches. Any damaged bags would be required to be replaced.

The level of symptomless infection of banana fruit would be reduced by regular fungicide bunch sprays and, as a consequence, the proportion of clean clusters that may be contaminated during processing in the packing station would be reduced.

Arthropod pests – armoured scales, mealybugs and spider mites

The major entry, establishment and spread pathway identified for armoured scales, mealybugs and spider mites is the presence of various life stages of the insects, including adults, nymphs and eggs that are protected in spaces between the fingers of harvested banana fruit.

The proposed risk management measure for all arthropod pests is:

- Inspection of 600 clusters of fruit drawn randomly from each lot or consignment of fruit presented for export. If any quarantine arthropod pests are found, the lot or consignment will be immediately withdrawn from export or treated to kill the pests.

5.3.2 Pests – regional

The pests of regional concern include arthropod pests (four species of armoured scales, one species of mealybug, one species of spider mite and two thrips species) that are absent from Western Australia. On-arrival inspections and corrective action will be performed by AQIS for regional quarantine pests only if consignments are first landed at an international port in that state.

Arthropod pests – armoured scales, mealybugs, spider mites and thrips

The major entry, establishment and spread pathway identified for armoured scales, mealybugs, spider mites and thrips is the presence of various life stages of the insects, including adults, nymphs and eggs that are protected in spaces between the fingers of harvested banana fruit.

The proposed risk management measure for all arthropod pests is:

- Inspection of 600 clusters of fruit drawn randomly from each lot or consignment of fruit presented for export. If any of the quarantine arthropod pests are found, the lot or consignment will be immediately withdrawn from export. If the rejected lot is treated to kill the pests, a re-inspection will be required.

5.3.3 Pre-clearance

It is proposed at least for the initial trade, that the quarantine measures will be undertaken through a standard pre-clearance arrangement directly involving AQIS officers. The need for pre-clearance will be reassessed after experience has been gained following significant trade.

AQIS officers will be involved in these arrangements in the plantation inspections for Moko, black Sigatoka and freckle, and direct verification of procedures at packing stations and during fruit inspection. The involvement of AQIS officers in pre-clearance will also facilitate a rigorous audit of other arrangements, including registration procedures, standard commercial practice, traceability and arrangements for the secure handling of export fruit.

Under the pre-clearance arrangement, on-arrival procedures will involve verifying that the consignment received is the pre-cleared consignment and the consignment's integrity has been maintained.

5.3.4 Operational arrangements

A range of operational arrangements for Philippine bananas entering Australia will supplement the specific risk management measures outlined above. The operational arrangements will ensure the risk management measures effectively mitigate the risks identified in the risk assessment. Part B of the report contains details of the operational arrangements.

A detailed operating manual and work plan will need to be developed to take account of the following issues:

- recognition of the competent authority
- registration of export plantations/blocks
- standard commercial agronomic practice
- inspection for Moko, black Sigatoka and freckle
- operational requirements for disease monitoring
- registration of packing stations
- disinfection treatment at packing stations and prevention of contamination after disinfection
- adequate labelling of lots
- freedom from trash
- prevention of contamination in storage, transport and handling
- phytosanitary inspection and certification
- notification of non-compliance
- import permits and notification of quarantine entry
- verification of documents on arrival in Australia
- audit arrangements
- review of import conditions.

As bananas have not previously been exported to Australia the Philippines banana production procedures and certification systems would be subject to a review by both AQIS and Biosecurity Australia, to ensure that the Philippines will meet Australia's requirements. This would include an on-ground assessment and an assessment of Philippine plant quarantine services.

Biosecurity Australia will perform the initial systems review of the country's plant quarantine services while AQIS will undertake the plantation and pack house inspections and preclearance inspections and would undertake subsequent audits of the Philippine plant quarantine service.

Fruit will be inspected in the Philippines by the Philippines Bureau of Plant Industry (BPI) before presentation to AQIS officers for pre-clearance inspection. BPI will be required to inspect a 3000 unit sample to ensure freedom from trash and other quarantine pests. Only lots found free of trash and other quarantine pests (through sampling) will be presented to AQIS officers for pre-clearance inspection. However, the detection of any quarantinable pests at on-arrival inspection will require the consignment to be treated, destroyed or re-exported under AQIS supervision.

6. Further steps in the IRA process

The administrative process adopted requires the following steps to be undertaken:

- consideration of appeals, if any
- if there are no appeals, or the appeals are rejected, the recommended policy will be submitted to the Director of Animal and Plant Quarantine for a policy determination
- if an appeal is allowed, the IRA Appeal Panel may advise the Chief Executive of Biosecurity Australia on how to overcome the identified deficiencies. When the process is completed, the recommended policy will be submitted to the Director of Animal and Plant Quarantine for a determination
- notification to the proponent/applicant, registered stakeholders, and the WTO of the policy determination.

Stakeholders will be advised of any significant variations to this process.

7. Acknowledgments

Biosecurity Australia wishes to acknowledge the extensive work of the IRA team on this IRA.

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