TECHNICAL ISSUES PAPER

Import Risk Analysis (IRA) for the Importation of Fresh Mangosteen Fruit from Thailand

February 2003

AGRICULTURE, FISHERIES AND FORESTRY - AUSTRALIA

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GLOSSARY OF TERMS AND ABBREVIATIONS

AFFA	Commonwealth Department of Agriculture, Fisheries and Forestry - Australia
ALOP	appropriate level of protection
AQIS	Australian Quarantine and Inspection Service
Area	an officially defined country, part of a country or all or parts of several countries
Biosecurity Australia	an agency within the Commonwealth Department of Agriculture, Fisheries and Forestry - Australia. Biosecurity Australia protects consumers and animal and plant health, and facilitates trade, by providing sound scientifically based and cost-effective quarantine policy
Contaminating pest	a pest that is carried by a commodity and, in the case of plants and plant products, does not infest those plants or plant products
Control (of a pest)	suppression, containment or eradication of a pest population
Endangered area	an area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss
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
Entry potential	likelihood of the entry of a pest
Establishment	the perpetuation, for the foreseeable future, of a pest within an area after entry
Establishment potential	likelihood of the establishment of a pest
FAO	Food and Agriculture Organization of the United Nations
Fresh	not dried, deep-frozen or otherwise conserved
Hitchhiker pest	see contaminating pest import

ICA	Interstate Certification Assurance
ICON	AQIS Import Conditions database
Introduction	entry of a pest resulting in its establishment
Introduction potential	likelihood of the introduction of a pest
IPPC	International Plant Protection Convention, as deposited in 1951 with FAO in Rome and as subsequently amended
IRA	import risk analysis
ISPM	International Standard for Phytosanitary Measures
National Plant Protection Organisation	official service established by a government to discharge the functions specified by the IPPC
Non-quarantine pest	pest that is not a quarantine pest for an area
Official	established, authorised or performed by a National Plant Protection Organisation
Official control (of a regulated pest)	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
OIE	Office International des Epizooties
Pathway	any means that allows the entry or spread of a pest
PBPM	Plant Biosecurity Policy Memorandum
Pest	any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products
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
Pest free area	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

Pest risk analysis	the process of evaluating biological or other scientific evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it
Pest risk assessment	determination of whether a pest is a quarantine pest and evaluation of its introduction potential
Pest risk assessment (for quarantine pests)	evaluation of the probability of the introduction and spread of a pest and of the associated potential economic consequences
Pest risk management	the decision-making process of reducing the risk of introduction of a quarantine pest
Pest risk management (for quarantine pests)	evaluation and selection of options to reduce the risk of introduction and spread of a pest
Phytosanitary measure	any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests
Phytosanitary regulation	official rule to prevent the introduction and/or spread of quarantine pests, by regulating the production, movement or existence of commodities or other articles, or the normal activity of persons, and by establishing schemes for phytosanitary certification
PRA	pest risk analysis
PRA area	area in relation to which a pest risk analysis is conducted
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
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

SCU	Specific Commodity Understanding
Spread	expansion of the geographical distribution of a pest within an area
Spread potential	likelihood of the spread of a pest
SPS	sanitary and phytosanitary
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures
Stakeholders	Government agencies, individuals, community or industry groups or organisations, whether in Australia or overseas, with an interest in the subject matter of an IRA, including the proponent/applicant for a specific proposal
WTO	World Trade Organization

SUMMARY

The Commonwealth Department of Agriculture, Fisheries and Forestry - Australia (AFFA) is undertaking an import risk analysis (IRA) on fresh mangosteen fruit from Thailand.

This Technical Issues Paper contains the following sections:

- Biosecurity Australia's framework for quarantine policy and for IRA and the international framework for trade in animal- and plant-derived products
- Pest risk analysis (PRA) methodology
- Background to this IRA
- Issues raised at the stakeholder workshops in Cairns and Darwin
- Current quarantine policy for the importation of fresh mangosteen fruit
- Results of pest categorisation
- An outline of further steps in the IRA process.

The introductory sections provide information that is fundamental to understanding the national and international framework for considering import applications from other countries. Information specific to the mangosteen industry is covered in the section entitled "Proposal to import fresh mangosteen fruit from Thailand".

Biosecurity Australia will consult with stakeholders and relevant experts as necessary throughout the IRA process. Stakeholders are strongly encouraged to contribute to the IRA by providing relevant technical information and raising issues as early as possible, preferably while commenting on this Technical Issues Paper or during meetings with Biosecurity Australia.

To date, Biosecurity Australia has identified a total of 56 pests associated with mangosteen in Thailand. These pests include arthropods, nematodes, algae, fungi and weeds. Of these 56 pests, 35 are present in Australia and do not need to be considered further in the IRA. Of the remaining 21 pests not present in Australia (or present but under official control), four arthropod and four fungal pests are found on the import pathway (fresh fruit). These eight pests (and the one prohibited weed species) will need to be considered further in the IRA.

The next stage in the IRA will involve determining the potential of these pests to enter, establish or spread in Australia, and the potential economic consequences of their entry. This part of the risk assessment will be covered in the draft IRA paper. The draft IRA paper will also consider risk management measures to achieve Australia's appropriate level of protection (ALOP) and a preliminary position on the importation of fresh mangosteen fruit from Thailand.

After considering all technical issues, including stakeholder comments on the draft IRA paper, Biosecurity Australia will finalise the IRA recommendations consistent with Australia's ALOP and international rights and obligations under the SPS Agreement.

BIOSECURITY FRAMEWORK

AUSTRALIA'S BIOSECURITY POLICY

Legislative framework

AFFA's objective is to adopt biosecurity policies that provide the health safeguards required by government policy in the least trade-restrictive way and that are, where appropriate, based on international standards. In developing and reviewing quarantine (or biosecurity) policies, pest risks associated with importations may be analysed using import risk analysis – a structured, transparent and science-based process.

The *Quarantine Act 1908* (the Quarantine Act) and its subordinate legislation, including the *Quarantine Proclamation 1998* (the Quarantine Proclamation), are the legislative basis of human, animal and plant biosecurity in Australia.

Section 4 of the Quarantine Act defines the scope of quarantine as follows:

In this Act, quarantine includes, but is not limited to, measures:

- *for, or in relation to, the examination, exclusion, detention, observation, segregation, isolation, protection, treatment and regulation of vessels, installations, human beings, animals, plants or other goods or things*
- *having as their object the prevention or control of the introduction, establishment or spread of diseases or pests that will or could cause significant damage to human beings, animals, plants, other aspects of the environment or economic activities.*

Quarantine Risk

The concept of level of quarantine (or biosecurity) risk has been introduced as the basis of quarantine decision-making. When making decisions under the Quarantine Act, decision-makers must consider the level of quarantine risk and must take prescribed actions to manage the risk if it is unacceptably high. Section 5D of the Quarantine Act includes harm to the environment as a component of the level of quarantine risk.

Section 5D: level of quarantine risk

A reference in this Act to a level of quarantine risk is a reference to:

(a) the probability of:

(i) a disease or pest being introduced, established or spread in Australia or the Cocos Islands; and

(ii) the disease or pest causing harm to human beings, animals, plants, other aspects of the environment, or economic activities; and

(b) the probable extent of the harm.

Quarantine Proclamation

Subsection 13(1) of the Quarantine Act provides that the Governor-General in Executive Council may, by proclamation, prohibit the importation into Australia of any articles or things likely to introduce, establish or spread any disease or pest affecting people, animals or plants. The Governor-General may apply this power of prohibition generally or subject to any specified conditions or restrictions.

The Quarantine Proclamation is the principal legal instrument used to control the importation into Australia of goods of quarantine (or biosecurity) interest. A wide range of goods is specified in the Quarantine Proclamation including animals, plants, animal and plant products, micro-organisms, and certain other goods which carry a high risk if uncontrolled importation is allowed – e.g. soil, water, vaccines, feeds.

For articles or things prohibited by proclamation, the Director of Animal and Plant Quarantine may permit entry of products on an unrestricted basis or subject to compliance with conditions, which are normally specified on a permit. An import risk analysis provides the scientific and technical basis for biosecurity policies that determine whether an import may be permitted and, if so, the conditions to be applied.

The matters to be considered when deciding whether to issue a permit are set out in Section 70 of the Quarantine Proclamation as follows:

70 Things a Director of Quarantine must take into account when deciding whether to grant a permit for importation into Australia

(1) In deciding whether to grant a permit to import a thing into Australia or the Cocos Islands, or for the removal of a thing from the Protected Zone or the Torres Strait Special Quarantine Zone to the rest of Australia, a Director of Quarantine:

(a) must consider the level of quarantine risk if the permit were granted; and

(b) must consider whether, if the permit were granted, the imposition of conditions on it would be necessary to limit the level of quarantine risk to one that is acceptably low; and

(c) may take into account anything else that he or she knows that is relevant.

The matters include the level of quarantine risk (see above), whether the imposition of conditions would be necessary to limit the quarantine risk to a level that would be acceptably low, and anything else known to the decision maker to be relevant.

Environment

While protection of the natural and built environment has always been an objective of Australian quarantine policy and practice, recent amendments to the Quarantine Act make explicit the responsibility of quarantine officers to consider impact on the environment when making decisions. In particular, the scope of quarantine (as described in Section 4 of the Quarantine Act), and the level of quarantine risk (as described in Section 5D of the Quarantine Act), include explicit reference to the environment.

Environment is defined in Section 5 of the Quarantine Act as:

> *… all aspects of the surroundings of human beings, whether natural surroundings or surroundings created by human beings themselves, and whether affecting them as individuals or in social groupings.*

When undertaking an import risk analysis, Biosecurity Australia takes into account the risk of harm to the environment to ensure that the biosecurity policies developed reflect the Australian Government's approach to risk management. Environment Australia is involved in decisions on the import risk analysis work program and, for particular import risk analyses, discussions on the scope, the likely risks, and the expertise which may be required to address those risks. Environment Australia can also identify additional technical issues that it believes should be considered during an import risk analysis, and can nominate officers with relevant expertise to contribute to the import risk analysis.

Policy framework

The primary purpose of biosecurity is to protect Australia from the entry, establishment and spread of unwanted pests and diseases that may cause social, economic or environmental damage, while minimising the restrictions on the entry of agricultural commodities.

Successive Australian Governments have maintained an appropriate level of protection (ALOP) that reflects the value placed on Australia's unique and diverse flora and fauna and the value of its agricultural industries. However, at the same time they recognise that a zero-risk approach to the management of biosecurity risks is not tenable. This approach is evident in the strictness of all biosecurity-related activities, including policies on imported commodities, procedures at the border and operations against incursions of pests and diseases.

Recent inquiries into Australia's biosecurity regime have recognised that it is impossible in practice to operate a zero-risk biosecurity regime. In 1979, the Senate Standing Committee on Natural Resources stressed that there is no such thing as a zero-risk quarantine policy, and it believed that Australia's approach should be better described as '*scientific evaluation of acceptable risk*'. In 1988, the Lindsay Review of Australian quarantine concluded that '*a no risk policy is untenable and undesirable and should be formally rejected*'. In 1996, the Senate Rural and Regional Affairs and Transport Committee was of the view that a zero-risk approach was unrealistic and untenable, and that its currency only demonstrated that the concepts of risk assessment and risk management were widely misunderstood. These themes were repeated in the AQRC report (AQRC, 1996). In its 1997 response to that report, the Government confirmed a managed risk approach.

Import risk analysis provides the basis for considering import applications for the importation of animals and animal-derived products, and plants and plant-derived products. In keeping with the scope of the Quarantine Act and Australia's international obligations, only factors relevant to the evaluation of quarantine risk (i.e. the risk associated with the entry, establishment and spread of unwanted pests and diseases) are considered in the import risk analysis. The potential competitive economic impact of prospective imports is not within the scope of the import risk analysis process, and any discussion on industry support mechanisms would need to remain quite separate from the import risk analysis.

WTO AND IMPORT RISK ANALYSIS

One of the principal objectives in developing the administrative framework for import risk analysis was to ensure that it complied with Australia's international rights and obligations.

These derive principally from the WTO *Agreement on the Application of Sanitary and Phytosanitary Measures* (*SPS Agreement*), although other WTO Agreements (including the *Agreement on Technical Barriers to Trade* – the TBT Agreement) may be relevant in certain circumstances. Specific international guidelines on risk analysis developed under the International Plant Protection Convention (IPPC) and by the International Office of Epizootics (OIE) are also relevant.

The *SPS Agreement* applies to measures designed to protect human, animal and plant life and health from pests and diseases, or a country from pests, and which may directly or indirectly affect international trade. It also recognises the right of WTO Member countries to determine the level of protection they deem appropriate and to take the necessary measures to achieve that protection. Sanitary (human and animal health) and phytosanitary (plant health) measures apply to trade in or movement of animal and plant based products within or between countries.

In the *SPS Agreement*, SPS measures are defined as any measures applied:

- *to protect animal or plant life or health within the territory of the Member from risks arising from the entry, establishment or spread of pests, diseases, disease-carrying organisms or disease-causing organisms;*
- *to protect human or animal life or health within the territory of the Member from risks arising from additives, contaminants, toxins or disease-causing organisms in foods, beverages or feedstuffs;*
- *to protect human life or health within the territory of the Member from risks arising from diseases carried by animals, plants or products thereof, or from the entry, establishment or spread of pests; or*
- *to prevent or limit other damage within the territory of the Member from the entry, establishment or spread of pests.*

The key provisions of the *SPS Agreement* are as follows:

- An importing country has the sovereign right to adopt measures to achieve the level of protection it deems appropriate (its appropriate level of protection) to protect human, animal or plant life or health within its territory, but such a level of protection must be consistently applied in different situations.
- An SPS measure must be based on scientific principles and not be maintained without sufficient evidence.
- In applying SPS measures, an importing country must avoid arbitrary or unjustifiable distinctions in levels of protection, if such distinctions result in discrimination or a disguised restriction on international trade.
- An SPS measure must not be more trade restrictive than necessary to achieve an importing country's ALOP, taking into account technical and economic feasibility.
- An SPS measure should be based on an international standard, guideline or recommendation, where these exist, except to the extent that there is scientific justification for a more stringent measure which is necessary to achieve an importing country's ALOP.
- An SPS measure conforming to an international standard, guideline or recommendation is presumed to be necessary to protect human, animal or plant life or health, and to be consistent with the *SPS Agreement*.
- Where an international standard, guideline or recommendation does not exist or where, in order to meet an importing country's ALOP, a measure needs to provide a higher level of protection than accorded by the relevant international standard, such a measure must be based on a risk assessment; the risk assessment must take into account available scientific evidence and relevant economic factors.
- When there is insufficient scientific evidence to complete a risk assessment, an importing country may adopt a provisional measure(s) by taking into account available

pertinent information; additional information must be sought to allow a more objective assessment and the measure(s) reviewed within a reasonable period.

- An importing country must recognise the measures of other countries as equivalent, if it is objectively demonstrated that the measures meet the importing country's ALOP.

The rights and obligations in the *SPS Agreement* must be read as a whole. The articles must be interpreted in relation to each other. That is, the articles do not stand alone.

In many instances, the biosecurity policies Biosecurity Australia develops are based on the relevant international standards, guidelines and recommendations. In certain instances and in conformity with rights under the *SPS Agreement*, Australia has not adopted such international norms because to do so would result in an unacceptably high level of risk of disease or pest entry and establishment. Instead, the policies are based on a risk analysis.

The text of the *SPS Agreement* can be found at the WTO Internet site.[1]

The following issues are discussed in greater detail below:

- notification obligations;
- use of international standards;
- equivalence;
- risk assessment;
- appropriate level of protection; and
- consistency in risk management.

Notification Obligations

The WTO SPS Committee has been established to oversee the implementation of the *SPS Agreement*, and to provide a forum for the discussion of any trade issues related to biosecurity policies. Like other WTO committees, all WTO Members have the right to participate in the work and decision making of the SPS Committee; decisions are taken by consensus. The SPS Committee has accepted, as observers, the Codex Alimentarius Commission (Codex), OIE and IPPC, as well as other international and regional intergovernmental organisations with activities in food safety, animal health and plant protection to maximise knowledge of and participation in its work.

The SPS Committee normally meets three times a year at the WTO headquarters in Geneva, Switzerland.

In addition to considering any specific trade concerns raised by governments, the *SPS Agreement* has set specific tasks for the Committee. One of these is to monitor the extent to which governments are using internationally developed standards as the basis for their

[1] Available at http://www.wto.org/english/docs_e/docs_e.htm

requirements for imported products. Countries identify cases where the non-use, or non-existence, of an appropriate international standard is causing difficulties for international trade. After consideration by the SPS Committee, these concerns may be brought to the attention of the relevant standard-setting organisations.

Under the *SPS Agreement*, Members are required to notify WTO of new sanitary or phytosanitary regulations or modifications to existing regulations that are not substantially the same as the content of an international standard and that may have a significant effect on international trade. Australia notifies new measures and comments on draft policies proposed by other countries through the SPS Notification Point in AFFA.

Use of international standards

The *SPS Agreement* has conferred new responsibilities on three international organisations by requiring WTO Members to harmonise their sanitary and phytosanitary measures on the standards, guidelines and recommendations produced by those organisations unless there is scientific justification for a more stringent measure.

The three international organisations are referenced in Annex A of the *SPS Agreement* as follows:

- *for food safety, the standards, guidelines and recommendations established by the Codex Alimentarius Commission relating to food additives, veterinary drug and pesticide residues, contaminants, methods of analysis and sampling, and codes and guidelines of hygienic practice;*
- *for animal health and zoonoses, the standards, guidelines and recommendations developed under the auspices of the International Office of Epizootics;*
- *for plant health, the international standards, guidelines and recommendations developed under the auspices of the Secretariat of the International Plant Protection Convention in cooperation with regional organizations operating within the framework of the International Plant Protection Convention.*

International Plant Protection Convention

IPPC is a multilateral treaty deposited with the Director-General of the Food and Agriculture Organization of the United Nations. IPPC provides a framework and forum for international cooperation, standards harmonisation and information exchange on plant health in collaboration with regional and national plant protection organisations (RPPOs and NPPOs). Its prime purpose is to secure common and effective action to prevent the spread and introduction of pests of plants and plant products and to promote measures for their control.

Currently, 120 governments are contracting parties to IPPC.

The New Revised Text of the IPPC enabled the establishment of an Interim Commission on Phytosanitary Measures to serve as the IPPC's new governing body. Membership in the Interim Commission is open to all contracting parties of IPPC. The Interim Commission meets annually to establish priorities for standard setting and harmonisation of phytosanitary measures in coordination with the IPPC Secretariat.

The functions of the Interim Commission are to provide direction to the work program of the IPPC Secretariat and promote the full implementation of the objectives of the Convention and, in particular, to:

- review the state of plant protection in the world and the need for action to control the international spread of pests and control their introduction into endangered areas;
- establish and keep under review the necessary institutional arrangements and procedures for the development and adoption of international standards, and to adopt international standards;
- establish rules and procedures for the resolution of disputes; and
- cooperate with other relevant international organisations.

The new IPPC and ISPM Pub. No. 11 *Pest Risk Analysis for Quarantine pests* adopt a similar approach to that of the OIE and note the importance of documenting all steps in the risk analysis process.

Equivalence

Article 4 of the *SPS Agreement* states that:

> *Members shall accept the sanitary or phytosanitary measures of other Members as equivalent, even if these measures differ from their own or from those used by other Members trading in the same product, if the exporting Member objectively demonstrates to the importing Member that its measures achieve the importing Member's appropriate level of sanitary or phytosanitary protection.*

Members must accept the SPS measures of other Members as equivalent to their own if the latter can demonstrate objectively that their measures provide the level of protection required by the importing country.

Article 5.6 of the *SPS Agreement* states that:

> *Often there are several alternative measures that may either singly or in combination achieve ALOP. In choosing among such alternatives, a Member should apply measures that are not more trade-restrictive than necessary to achieve its ALOP, taking into account technical and economic feasibility.*

Risk assessment

Articles 5.1 to 5.3 of the *SPS Agreement* outline the requirements that Members should follow when carrying out a risk assessment.

Article 5.1 provides a basic statement of the obligation:

> *Members shall ensure that their sanitary or phytosanitary measures are based on an assessment, as appropriate to the circumstances, of the risks to human, animal or plant life or health, taking into account risk assessment techniques developed by the relevant international organizations.*

Annex A of the *SPS Agreement* contains two definitions of risk assessment; the following is the definition applicable to biosecurity assessments:

> *The evaluation of the likelihood of entry, establishment or spread of a pest or disease within the territory of an importing Member according to the sanitary or phytosanitary measures which might be applied, and of the associated potential biological and economic consequences.*

On the basis of this definition, the Appellate Body examining Australia's appeal against the dispute settlement panel's finding on Australia's prohibition of imports of Canadian salmon considered that a risk assessment within the meaning of Article 5.1 must:

- identify the hazards whose entry, establishment or spread within its territory a Member wants to prevent, as well as the associated potential biological and economic consequences;
- evaluate the likelihood of entry, establishment or spread of these hazards, as well as the associated potential biological and economic consequences; and
- evaluate the likelihood of entry, establishment or spread of these hazards according to the SPS measures that might be applied; measures which might be applied are those which reduce the risks to the appropriate level, with the aim of being least trade restrictive.

The Appellate Body believed that, for a risk assessment to fall within the meaning of Article 5.1 and the first definition in paragraph 4 of Annex A of the Agreement, it is not sufficient that it conclude that there is a 'possibility' of entry, establishment or spread of pests and their associated biological and economic consequences. That is, an assessment must evaluate the 'likelihood' (the 'probability') of entry, establishment or spread of pests and their associated biological and economic consequences. Furthermore, likelihood should be evaluated without and then with any SPS measures that might be required.

Article 5.2 outlines factors that should be considered when assessing the risks associated with a proposed importation. Specifically, it states that:

> *In the assessment of risks Members shall take into account available scientific evidence; relevant processes and production methods; relevant inspection,*

> *sampling and testing methods; prevalence of specific diseases or pests; existence of pest- or disease-free areas; relevant ecological or environmental conditions; and quarantine or other treatment.*

This paragraph emphasises the need to consider a wide range of 'factors' in both the importing and exporting country.

Article 5.3 describes the need to include a consequence assessment in a risk assessment, and lists dimensions that should be considered when assessing 'potential damage' arising from a disease or pest incursion. Specifically, it states that:

> *Members shall take into account as relevant economic factors; the potential damage in terms of loss of production or sales in the event of the entry, establishment or spread of a pest or disease; the cost of control or eradication in the territory of the importing Member*

This list of 'relevant economic factors' may be viewed as the bare minimum that must be considered if an analysis is to comply with the terms of the *SPS Agreement*. In addition, both the *OIE Code* and IPPC standards for risk analysis have outlined factors that should be considered when assessing consequences. These two standards also stress the need to consider the 'likely magnitude' of consequences - that is, to base an assessment of consequences on the likelihood of various levels of damage in the importing country. Finally, Article 5.3 states that Members should consider '*... the relative cost-effectiveness of alternative approaches to limiting risks ...*'. This is an issue that should be explored during risk management. Among factors that may not be taken into account are those relating to import competition.

The environmental and ecological consequences of pest or disease introduction are legitimate considerations in a risk assessment. The *SPS Agreement* provides a basic right to take measures to protect animal or plant life or health (Article 2). In Annex A, 'animal' is defined to include fish and wild fauna; and 'plant' to include forests and wild flora.

Additional to the economic factors identified in Article 5.3, the definition of risk assessment in Annex A, paragraph 4 (' *... evaluation of the likelihood of entry, establishment or spread of a pest or disease … and of the associated potential biological and economic consequences ...*') provides for general consideration of the biological consequences, including those for the environment. The environment is included in paragraph 1(d), which states that an SPS measure is one that is applied to ' *... prevent or limit other damage to a country from the entry, establishment or spread of pests ...*'.

Appropriate level of protection

The *SPS Agreement* defines '*appropriate level of sanitary or phytosanitary protection'* as 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. The *SPS Agreement* notes that many Members also refer to this concept as the '*acceptable level of risk*'. In setting their ALOP, Members are to take into account the objective of minimising negative trade effects (Article 5.4).

Determination of Australia's ALOP is an issue for government in consultation with the community. ALOP reflects government policy that is affected by community expectations; it is a societal value judgement to which AFFA contributes by providing technical information and advice. The *SPS Agreement* does not require a Member to have a scientific basis for its ALOP determination.

ALOP can be illustrated using a *risk estimation matrix* (Table 1). The cells of this matrix describe the product of likelihood and consequences – termed 'risk'.

When interpreting the risk estimation matrix it should be remembered that although the descriptors for each axis are similar ('low', 'moderate', 'high', etc.), the vertical axis refers to *likelihood* and the horizontal axis refers to *consequences.*

One implication of this is that a 'negligible' probability combined with 'extreme' consequences, is not the same as an 'extreme' probability combined with 'negligible' consequences – that is, that the matrix is *not symmetrical*. Another implication is that 'risk' is expressed in the same units as are used to estimate consequences – that is, risk is *not* a likelihood.

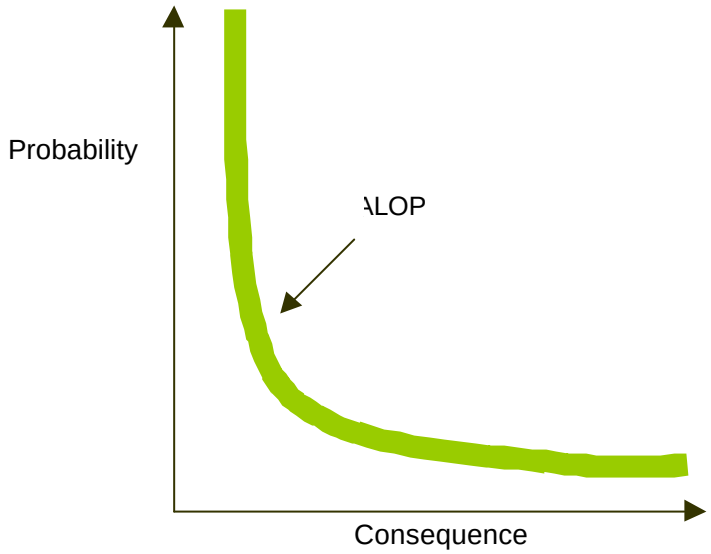
Table 1. Risk estimation matrix

Likelihood of entry, establishment and spread	Negligible impact	Very low	Low	Moderate	High	Extreme impact
High likelihood	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 likelihood	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Very low risk

Consequences of entry, establishment and spread

The band of cells in the table marked ‘very low’ represents Australia's ALOP, or tolerance of loss. This band of cells represents an approximation of a continuous ‘iso-risk curve’ - a curve that will be asymptotic at the minimum level of consequences considered to be ‘acceptable’ (which, in Australia's case, is ‘very low’) and at a likelihood that tends toward zero. The principle of an iso-risk curve is illustrated in Figure 1.

Figure 1. Theoretical iso-risk curve



Consistency in risk management

Article 5.5 states:

> *With the objective of achieving consistency in the application of the concept of appropriate level of sanitary or phytosanitary protection against risks to human life or health, or to animal and plant life or health, each Member shall avoid arbitrary or unjustifiable distinctions in the levels it considers to be appropriate in different situations, if such distinctions result in discrimination or a disguised restriction on international trade.*

Members are obliged to avoid arbitrary or unjustifiable distinctions in the levels of protection applied in different situations, if such distinctions result in discrimination or a disguised restriction on international trade. This obligation reflects the objective of consistency in applying the concept of ALOP against risks to human, animal and plant life or health – that is, consistency in risk management. In other words, it is not open to a Member to arbitrarily vary its attitude to the acceptance of risk from one situation to another.

Consistency in risk management is achieved in Biosecurity Australia's IRA process by using the risk estimation matrix (Table 1).

METHOD FOR PEST RISK ANALYSIS

The technical component of an IRA for plants or plant products is termed a 'pest risk analysis', or PRA. In accordance with ISPM Pub. No. 11 *Pest Risk Analysis for Quarantine Pests*[2], a PRA comprises three discrete stages:

- Stage 1: initiation of the PRA
- Stage 2: risk assessment
- Stage 3: risk management

The *initiation* of a risk analysis involves the identification of the pest(s) and pathways of concern that should be considered for analysis. *Risk assessment* comprises pest categorisation, assessment of the probability of introduction and spread, and assessment of the potential economic consequences (including environmental impacts). *Risk management* describes the evaluation and selection of options to reduce the risk of introduction and spread of a pest. Because the key objective of this *Technical Issues Paper* is to document the approach to and preliminary results of pest categorisation, this component of the PRA is discussed in further detail.

Under ISPM Pub. No. 11 *Pest Risk Analysis for Quarantine Pests*, pest categorisation describes 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. The objective of pest categorisation is thus to screen an exhaustive pest list to identify those that require an in-depth examination of the likelihood and consequences of introduction and spread.

ELEMENTS OF PEST CATEGORISATION

In accordance with ISPM Pub. No. 11 pest categorisation is based on the following elements or steps:

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

[2] PRA is used throughout this document as an abbreviation of Pest Risk Analysis. AFFA uses the term PRA to describe the technical component of an import risk analysis.

A description of these elements of pest categorisation from ISPM Pub. No. 11 is given below.

Identity of the pest

The identity of the pest should be clearly defined to ensure that the assessment is being performed on a distinct organism, and that biological and other information used in the assessment is relevant to the organism in question. If this is not possible because the causal agent of particular symptoms has not yet been fully identified, then it should have been shown to produce consistent symptoms and to be transmissible.

The taxonomic unit for the pest is generally species level. The use of a higher or lower taxonomic level should be supported by scientifically sound rationale. In the case of levels below the species, this should include evidence demonstrating that factors such as differences in virulence, host range or vector relationships are significant enough to affect phytosanitary status.

In cases where a vector is involved, the vector may also be considered a pest to the extent that it is associated with the causal organism and is required for transmission of the pest.

Presence or absence in the PRA area

The pest should be absent from all or a defined part of the PRA area.

Regulatory status

If the pest is present but not widely distributed in the PRA area, it should be under official control or expected to be under official control in the near future.

Potential for establishment and spread in the PRA area

Evidence should be available to support the conclusion that the pest could become established or spread in the PRA area. The PRA area should have ecological/climatic conditions including those in protected conditions suitable for the establishment and spread of the pest and where relevant, host species (or near relatives), alternate hosts and vectors should be present in the PRA area.

Potential for economic consequences in the PRA area

There should be clear indication that the pest is likely to have an unacceptable economic impact (including environmental impact) in the PRA area.

PROPOSAL TO IMPORT FRESH MANGOSTEEN FRUIT FROM THAILAND

BACKGROUND

Thailand first expressed interest in exporting several fruits and vegetables, including mangosteens, to Australia at the 11th Australia–Thailand Joint Technical Committee (JTC) meeting in 1991. In July 1993, Thailand indicated to the Plant Quarantine sub-group at the Thailand–Australia Joint Technical Working Group (JTWG) on Quarantine and Food Inspection meeting in Canberra that it would continue to develop its fruit-fly disinfestation treatment, and would submit pest and disease information for Australia to undertake a pest risk analysis for mangosteen.

At the 2nd Thailand–Australia JTWG meeting in August 1994, Thailand informed Australia that recent research showed that vapour heat treatment affected the quality of the mangosteen flesh. At that meeting, Australia requested information on pests and diseases of mangosteen to conduct a pest risk analysis, including data supporting non-fruit-fly host status.

At the informal mid-term review of activities arising from the 1994 JTWG meeting, representatives from Thailand indicated that they wished to pursue access for durian ahead of other tropical fruits. Since 1994, on advice from Thailand, AQIS/Biosecurity Australia has given priority to conducting an IRA on durians with the analysis on mangosteens put on hold.

At the 4th Thailand–Australia JTWG meeting in Bangkok in August 1999, Thailand indicated that, after the completion of the durian IRA, its next priority for horticulture product access was mangosteen. AQIS informed Thailand that, before AQIS could initiate an IRA, Thailand would need to provide a market access submission detailing pests and diseases of mangosteen, and statistics on production areas, crop volume and anticipated trade volume.

In July 2000, at the 20th Australia–Thailand JTC meeting in Canberra, the Thai authorities handed pest lists for mangosteens, lychees and longans in Thailand to AQIS and indicated that mangosteen was the next priority for market access to Australia. On 27 February 2001, Biosecurity Australia received a letter from Jabiru Tropical Orchards in the Northern Territory indicating an interest in importing mangosteens from Thailand.

Biosecurity Australia issued a Plant Biosecurity Policy Memorandum (PBPM) 2002/06 advising stakeholders that the mangosteen IRA had commenced on 18 February 2002.

On 5 April 2002, Biosecurity Australia held initial consultations in an informal workshop with scientists from Environment Australia and from the Queensland Department of Primary Industries.

Biosecurity Australia issued PBPM 2002/14 advising stakeholders of the outcome of the first round of consultation on the mangosteen IRA on 23 April 2002.

In June 2002, two scientists, one from Biosecurity Australia and one from the New South Wales Department of Agriculture travelled to Thailand to review agronomic practices, including pest and disease control in mangosteen orchards, and packhouse procedures. They also observed disinfestation trials for insects of potential quarantine concern associated with Thai mangosteen fruit (trip reports are detailed in Appendix 1).

On 9 July 2002, Biosecurity Australia issued PBPM 2002/32, giving stakeholders information on public meetings and workshops on the mangosteen IRA.

Responses of Biosecurity Australia to the series of questions raised by Alan Zappala on 18 July 2002 and by other stakeholders at other times are detailed in Appendix 3.

On 29 and 30 July 2002, Biosecurity Australia held stakeholder workshops in Cairns and Darwin, respectively. Topics presented at the workshops included: international standards, and rights and obligations; Biosecurity Australia's revised IRA process; the global, Thai and Australian mangosteen industry; and the preliminary pest list (including weeds). At both meetings, stakeholders raised various issues. These issues were summarised in a list of action items and sent to all registered stakeholders via PBPM 2002/36 on 21 August 2002.

In September 2002, a scientist from Biosecurity Australia travelled again to Thailand to observe orchard production, and review agronomic and packhouse procedures for mangosteen in southern Thailand (see Appendix 2 for trip report).

ADMINISTRATION

Timetable

Further steps in the IRA process are outlined in the last section of this paper. This IRA will consider quarantine risks associated with pests and diseases of fresh mangosteen fruit from Thailand. If there are no unforeseen difficulties, the IRA is expected be completed within 18 months. Throughout the process, stakeholders will be advised in a timely manner of key forthcoming events.

Scope

This IRA considers quarantine risks that may be associated with the importation of fresh mangosteen fruit from Thailand into Australia (for human consumption). The produce will have been cultivated, harvested, packed and transported to Australia under commercial conditions in Thailand. This IRA will also consider possible management measures to address those risks.

In this IRA, fresh mangosteen fruit is defined as the harvested fresh fruit of *Garcinia mangostana* L. from Thailand.

AUSTRALIA'S CURRENT QUARANTINE POLICY FOR IMPORTS OF MANGOSTEEN

International arrangements

Fresh fruit ¾ Imports of fresh mangosteen fruit into Australia for human consumption is currently prohibited. Under *AQIS Import Condition C6066*, any consignment of fresh mangosteen fruit that arrives in Australia must be re-exported or destroyed. A pest risk analysis is required to assess the risks of importing this commodity.

Non-tissue culture nursery stock — In vivo mangosteen nursery stock (e.g. whole plants, cuttings) may be imported from any country subject to requirements that include an import permit, new packaging, that the packages are labelled with the correct scientific name and that the specimens are free from soil, disease symptoms and other extraneous contamination, and subject to inspection on arrival, methyl bromide fumigation and a minimum of nine months growth in a post-entry quarantine facility for visual disease screening.

Tissue culture nursery stock — In vitro mangosteen material may be imported from any country subject to requirements that include an import permit, inspection on arrival and a minimum of nine months growth (out of tissue culture) in closed quarantine at a post-entry quarantine facility with disease screening.

Seed — Mangosteen (*Garcinia* spp.) seeds for sowing may be imported from any country subject to inspection on arrival and other requirements that include freedom from soil, live insects, plant material (e.g. fruit pulp, leaf or stem material), and contamination with prohibited seeds. Seeds must be packed in new containers that are clearly labelled with the scientific name.

Details of the importation requirements for mangosteen seeds are available in the AQIS Import Conditions database (ICON)[3].

Domestic arrangements

The Commonwealth Government is responsible for regulating the movement of plants and their products into and out of Australia, but the State and Territory Governments have primary responsibility for plant health controls within Australia. 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.

THE MANGOSTEEN INDUSTRY

Production of mangosteens in Australia

Production of mangosteen (*Garcinia mangostana* L.) from the Clusiaceae family is an emerging tropical fruit industry in Australia. Grown in the Northern Territory and tropical Queensland, most of the market supply comes from 15–20 growers in north Queensland (Moody, 2000).

Table 2. Australian mangosteen industry statistics

Statistics	Mangosteen
Tree numbers	15,000
Farm numbers	60
Area of trees (ha)	72
Average number of trees per farm	250
Median number of trees per farm	80
Range of tree numbers per farm	6–1800

Source: O'Connor (2000)

There are approximately 15,000 trees planted in the Northern Territory and far north Queensland (Table 2) (O'Connor, 2000). Currently, there are approximately 40 growers (RTELPA and NTHA, 1997), with about 72 hectares planted (O'Connor, 2000). The

[3] Available at http://www.aqis.gov.au/icon/

fruiting season for each of the production areas is slightly different. The Northern Territory's season is from mid-October to mid-January (RTELPA and NTHA, 1997) and the Queensland season is from November to the end of January. In some years, two crops may be produced in north Queensland with further fruiting in April and May (Chay-Prove, 2001).

Export of Australian mangosteens

Currently, Australia does not export mangosteen fruit. The Australian mangosteen industry is currently seeking market access to New Zealand, the USA, the European Union and several other countries.

The global mangosteen industry

The mangosteen is a very popular tropical fruit in Asia. From its native home in the Sunda Islands of Indonesia and the Malay Peninsula in south-east Asia, the crop has spread to the New World and is now being grown in other tropical countries, including Sri Lanka, southern India, Madagascar, Ivory Coast, Puerto Rico, Trinidad, Brazil, Central America and Australia (Northern Territory and north Queensland) (Verheij and Coronel, 1991). Small mangosteen orchards have also been established in Hawaii, USA.

The major producing and exporting countries are Thailand, Malaysia, the Philippines and Indonesia. Most of the fruit in those markets comes from backyard trees or from trees planted as a component of mixed fruit orchards. Currently, the major producing countries are Thailand (130,000 t from 15,000 ha in 1995), Malaysia (27,000 t from 2,200 ha in 1987), the Philippines (2,270 t from 1,130 ha in 1987) and Indonesia (2,500 t in 1975) (Downton & Chacko, 1998).

Thailand is the major exporter of mangosteen fruit to international markets ($US5m). In other south-east Asian countries, the crop is becoming more important. The crop is mostly grown for domestic consumption although very small quantities may be exported, for example by Vietnam.

Producing areas in Thailand are in the south and south-east, from the eastern province of Chanthaburi, south to the Malaysian border. The fruiting season is Thailand is from May to September.

The mangosteen is strictly tropical. It cannot tolerate temperatures below 5°C nor temperatures above 38°C. Young seedlings are killed by temperatures of 7°C. The crop thrives bests in high atmospheric humidity, above 80%, and in areas with an annual rainfall of 1270 mm with short periods of drought. The crop thrives best in deep rich organic soils, sandy loam or laterite soils, and does best under shade or with good windbreaks.

Depending on the region where the crop is being grown, mangosteen can have two fruiting seasons a year, for example in Malaysia, Ivory Coast, Madagascar, Indonesia, Puerto Rico and Australia. In other countries, there is only one major fruiting season. Table 3 summarises the fruiting seasons in mangosteen producing countries.

Table 3. Summary of fruiting seasons in mangosteen producing countries

Country	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Ref
Australia – NT	■																			■	■	■	■	■	RTELPA and NTHA, 1997
Australia – North Qld	■	■					■	■	■	■											■	■	■	■	Chay-Prove, 2001
Brazil															■	■	■	■							RTELPA and NTHA, 1997
Côte d'Ivoire											■	■	■	■						■	■	■	■	■	Bordeaut & Moreuil, 1970
India (south)	■	■	■	■	■	■							■	■	■	■	■	■	■	■					Krishnamurthi *et al*., 1964
Indonesia	■	■									■	■	■	■									■	■	Reza *et al*., 1994
Madagascar			■	■	■	■	■	■	■										■	■	■	■	■	■	Bordeaut & Moreuil, 1970
Malaysia	■	■	■	■						■	■	■	■	■	■	■					■	■	■	■	Mohd Khalid & Rukayah, 1993
Myanmar (Burma)								■	■	■	■	■	■	■											Reza *et al*., 1994
Papua New Guinea	■	■	■	■	■																■	■	■	■	Wiles, 1996
Philippines															■	■	■	■	■	■	■	■			DA-AMAS, 2000
Puerto Rico													■	■	■	■					■	■	■	■	Almeyda & Martin, 1976; Morton, 1987
Sri Lanka										■	■	■	■	■	■	■	■								Morton, 1987
Thailand									■	■	■	■	■	■	■	■	■	■							DAET, 1987
Trinidad													■	■					■	■					Bailey, 1963
Vietnam												■	■	■	■										Nguyen, 1998

PRELIMINARY RESULTS OF PEST CATEGORISATION

PRESENCE OR ABSENCE, REGULATORY STATUS AND ASSOCIATION OF PESTS WITH THE PATHWAY

Pest categorisation involves the following elements: identity of the pest; presence or absence in the PRA area; regulatory status; potential for establishment or spread in the PRA area; and potential for economic consequences (including environmental consequences) in the PRA area. These are discussed in the Elements of Pest Categorisation section. The first three elements of pest categorisation have been carried out in this Technical Issues Paper. Appendix 4 lists the range of pests associated with mangosteen trees in Thailand and their presence or absence in Australia (or present but not widely distributed and under official control). A total of 56 potential pests were determined to be associated with mangosteen crops (Table 4). Appendix 5 lists the potential pests that occur on the fruit pathway. Appendix 6 lists the potential pests that are to be considered further in the second stage of the IRA. A number of pests were eliminated from the pathway association stage because they are associated with the branches, flowers, leaves, and stems of mangosteen trees.

Table 4 provides for each category of organism (arthropods, nematodes, algae, fungi and weeds), a summary of the number known to be associated with mangosteens in Thailand, the number present in Australia and the number potentially associated with the import pathway (that is, they occur on mangosteen fruit). Many of the pests associated with mangosteens in Thailand also occur in Australia or are not present on the import pathway. These pests do not need to be considered further in the IRA.

Table 4. Summary of potential pests associated with mangosteens in Thailand and in Australia

Organism type	Present in Thailand	Present in Australia	Present in Australia but under official control	Consider further
Arthropods	34	19	0	15
Nematodes	1	1	0	0
Algae	1	1	0	0
Fungi	10	5	0	5
Weeds	10	9	0	1
Total	**56**	**35**	**0**	**21**

Arthropods

Of the 34 arthropod species known on mangosteens in Thailand, 19 also occur in Australia. Of the remaining 15 potential arthropod pests of mangosteens not present in Australia, 4 species are associated with the import pathway and will be considered further in the risk analysis.

The Oriental fruit fly, *Bactrocera dorsalis*, will not be considered further in the analysis because the mangosteen is now recognised as a non-preferred host based on the study by Leach (1997). Leach conducted his study on *B. papayae*, which is part of the *B. dorsalis* species complex. The *B. dorsalis* species complex comprises a large number of species from the Oriental region and Australasia (CAB International, 2002).

Nematodes

The one nematode species known on mangosteens in Thailand also occurs in Australia and infests only roots. Therefore, it will not be considered further in the risk analysis.

Algae

The one algal species reported on mangosteens affects the fruit, leaves and twigs. This species occurs in both Thailand and Australia, so will not be considered further in the risk analysis.

Fungi

Of the ten fungal species known on mangosteens in Thailand, five are also present in Australia. Of the remaining five potential pests, four species are associated with the pathway and will be considered further in the risk analysis.

Weeds

Of the ten weed species reported in mangosteen orchards in Thailand, nine are present in Australia. The one species that does not occur in Australia, *Chromolaena odorata*, is classified as a prohibited species. This species is not associated with the fruit pathway, but can occur as a contaminant, so will be considered further in the risk analysis.

SUMMARY OF PRELIMINARY PEST CATEGORISATION

To date, Biosecurity Australia has identified four arthropod and four fungal pests that are likely to be associated with mangosteen fruit imported into Australia from Thailand (Table 5). These eight pests (and the one prohibited weed species) will be considered further in the next stage of the IRA. The remaining elements of pest categorisation, the potential for

establishment and spread in the PRA area and the potential for economic consequences (including environmental consequences) in the PRA area, will be included in the draft IRA paper. The draft IRA paper will also consider risk management measures to achieve Australia's appropriate level of protection (ALOP).

Table 5. Summary of potential pests on the import pathway (fruit) for further consideration

Organism type	Number of potential species	On fruit	Consider further
Arthropods	15	4	4
Nematodes	0	0	0
Algae	0	0	0
Fungi	5	4	4
Weeds	1	0	1
Total	**21**	**8**	**9**

FURTHER STEPS IN THE IMPORT RISK ANALYSIS PROCESS

The IRA process requires that the following steps be taken in an IRA:

- release of the draft IRA paper for stakeholder comment
  - comments to be received within 60 days
- consideration of stakeholder comment on the draft IRA paper
  - further stakeholder consultation as necessary
- preparation of the final IRA paper
- submission of IRA recommendations to the Director of Animal and Plant Quarantine
- consideration of recommendations by the Director of Animal and Plant Quarantine and final determination
- release of the final IRA paper
  - appeals to be received within 30 days
- consideration of all appeals, if any
- if there are no appeals, or if the appeals are rejected, adoption of the quarantine policy.

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

Biosecurity Australia is committed to a thorough risk analysis of the proposed importation of fresh mangosteen fruit from Thailand. This analysis requires technical information from a wide range of sources. If you have information relevant to this IRA for fresh mangosteen fruit from Thailand, please provide it as quickly as possible[4].

[4] Contact details for stakeholder contributions are provided in the accompanying Plant Biosecurity Policy Memorandum (PBPM).

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APPENDICES

APPENDIX 1A: BIOSECURITY AUSTRALIA TRIP REPORT ¾ THAILAND JUNE 2002

Report on travel to Thailand (13.6.02 to 21.6.02) to observe disinfestation trials for insects of quarantine concern associated with Thai mangosteen and to review agronomic and packhouse procedures.

PURPOSE

To report on travel to Thailand accompanied by a NSW Agriculture entomologist, to observe disinfestation trials for mangosteen and to review agronomic and packhouse procedures for mangosteen in Thailand.

OUTCOMES

Visit to mangosteen production areas and packhouses

Mangosteen fruit are harvested from late April in the northern provinces of Thailand and until the end of August in the southern provinces. We were escorted by Thai entomologists to Chanthaburi, a major fruit producing region 300 km southeast of Bangkok where mangosteen fruit were being harvested and prepared for local and international markets.

We had previously indicated to Thai Department of Agriculture officials that after a preliminary pest risk assessment of Thai mangosteen a species of mealybug and two species of thrips were of quarantine concern to Biosecurity Australia (BA). Thai officials had proposed a series of disinfestation trials consisting of fruit dipping in petroleum oil and systemic insecticide solutions for the control of insects of quarantine concern to BA.

Prior to inspecting mangosteen orchards we observed the implementation of the dipping trials conducted at the Chanthaburi Horticultural Research Institute. Thai Department of Agriculture officials will forward the results of the trials to BA when available.

We visited the mangosteen orchard at the Horticultural Research Station and two other commercial mangosteen orchards within the Chanthaburi area.

- In all cases the level of hygiene and the health of the trees were extremely good.

- Fruit sampling and searching for insect pests revealed very few insect pests.
- A species of small black ant was noted to occasionally nest under the calyx of some mangosteens. We requested that the Thai entomologists provide identification of the species.
- No species of mealybugs or thrips of quarantine concern were detected.
- Some fruit flies, probably *Bactrocera dorsalis* (Oriental fruit fly) were detected upon foliage, however, no fruit flies were detected within mangosteen fruit. BA considers mangosteen fruit not to be a preferred host for fruit flies unless the skin has been damaged.
- All fruit was harvested by hand using a large pole and catch net and then placed in a harvest basket. The fruit at no time came in contact with the ground during the harvest process.

Two mangosteen packhouses were visited whilst in Chanthaburi. Current export markets for Thai mangosteen include Taiwan, Japan and Hong Kong. Taiwan also apparently regards the same species of mealybug and thrips to be of quarantine concern for Thai mangosteen. Interestingly, two different approaches were used by different packhouses to treat mangosteen destined for Taiwan.

Air blast treatment for export to Taiwan

The mangosteen calyx is a large raised concave structure perfectly shaped to provide shelter to insect pests. To ensure the calyx is free from pests of quarantine concern the first packhouse we visited conducted one hundred percent inspection of calyxes. If pests were detected, blasts of compressed air were used to dislodge them. No dipping of fruit was conducted.

Fruit dipping for export to Taiwan

The second packhouse we visited dipped mangosteen fruit in an undetermined pesticide solution for one minute and then rinsed the fruit in fresh water prior to packing. This method appeared to be less labour intensive and no live insects were detected on treated fruit.

Unfortunately no efficacy data was immediately available from Thai officials for the air blast or dipping treatments.

CONSIDERATIONS

Mangosteen disinfestation

Thai mangosteen export markets include Taiwan, Japan and Hong Kong. Mangosteen exported to Taiwan from Thailand required disinfestation for species of mealybugs and thrips. Disinfestation for Taiwan is achieved by either dipping or inspection and air blasts as required. Should exports of mangosteen from Thailand to Australia be approved, currently established disinfestation methods in use for export of mangosteen to Taiwan may be suitable for Australia. Dipping trials conducted by Thai quarantine officials will supply efficacy data for dipping treatments and help with evaluation of the effectiveness of these methods as risk mitigation strategies for exports of Thai mangosteen.

The “hands on” intensive cultivation and harvesting methods for mangosteen in Thailand increases the likelihood that:

- export fruit quality is maintained at an extremely high level,
- the potential for post harvest contamination of mangosteens with soil and other plant debris (including weed seeds) is greatly reduced, and
- if dipping of the fruit was to used as a disinfestation measure this measure would provide the additional benefit of washing off any non-sedentary hitchhikers (including weed seeds) which may be present upon the fruit.

Biosecurity Australia will liaise with our Agricultural Counsellor in Seoul to try and determine Taiwanese import conditions for mangosteen from Thailand.

The visit provided an opportunity to liaise with Thai officials and source a wide range of agronomic information and references that will greatly assist in the development of the mangosteen IRA.

APPENDIX 1B: NSW AGRICULTURE TRIP REPORT ¾ THAILAND JUNE 2002

Report on travel to Thailand (13.6.02 to 21.6.02) to observe disinfestation trials for insects of quarantine concern associated with Thai mangosteen and to review agronomic and packing house procedures.

DIARY

14 June 2002

The Technical Group met with Dr Udorn Unahawutti, Chief of Plant Quarantine, Department of Agriculture, Bangkok, to discuss two mangosteen disinfestation trials against two insect pest species of quarantine concern to Australia. The insects are mangosteen thrips [*Scirtothrips oligochaetus*, Karny (syn. *Anaphothrips oligochaetus*)] and grey pineapple mealybug (*Dysmicoccus neobrevipes*, Beardsley). These trials were to be carried out by Thai scientists with the Biosecurity Australia officer and me as observers.

The trials, as described to us, were as follows:

Experiment A: Two replicates of 50 fruit in three treatments – Control (not dipped); 1 minute dip in Confidor® (a.i. is imidacloprid); 1 minute dip in pesticide oil.

Experiment B: Two replicates of 50 fruit in two treatments – Control (not air blasted); mangosteens air blasted under calyces.

It has been established that mangosteens, in sound, undamaged condition, will not host infestations by fruit flies.

17 June 2002

The delegation visited Dr Surmsuk Salakpetch, Director, Chanthaburi Horticultural Research Center, and her colleagues. Experiment A (see above) was carried out that day.

Research mangosteen orchard. Prior to the experiment being carried out we toured the Horticultural Research Center's extensive mangosteen orchard. We were told that little or no insecticides are applied to mangosteens commercially so we were pleasantly surprised to find very little evidence of infestations by any insects. No thrips or mealybugs of quarantine concern to Australia were discovered on the fruit or under the calyces of the mangosteens here at the Research Center.

Postharvest disinfestation treatment. Experiment A was carried out. The Thai scientists undertook to forward the results to Biosecurity Australia when available. Immediately

after the dipping the dip solutions were sieved through a very fine terylene sieve. No insects except ants were found in the dip solution after treatment. The Biosecurity Australia officer asked the Thai scientists to supply a list of ant species to Biosecurity Australia as soon as they could.

Visits to commercial mangosteen packing houses. The Thai technicians, the Biosecurity Australia officer and I visited two commercial packing houses which were packing mangosteens for export to Taiwan. (Note: Taiwan has strict quarantine restrictions against various insect pests. No major breakdown in the supply of quarantine secure mangosteens to Taiwan have been recorded as far as the technicians knew). Two postharvest procedures were viewed – one in each of the two packing houses.

> **Air blaster.** A gun/nozzle connected to the hose from an electrically-driven air compressor was used to blast air under the calyces of mangosteens found with insects present. This activity necessitates examination of every piece of fruit.
>
> This method appeared to be very successful in dislodging ants, thrips (these species were not those of quarantine concern to Australia) and mealybugs (these species were not those of quarantine concern to Australia). After careful examination we concluded that the air blast treatment was successful in removing these insects.
>
> **Insecticidal dip.** Fruit, packed in plastic mesh crates were dipped for 1 minute in a solution of insecticide water and then washed in another tank of fresh water for another 1 minute prior to packing in export cartons. As in the previous packing house all fruit were examined individually but in this case if insects were found each affected fruit was blasted under its calyx with a strong stream of water from a specially-designated hose with nozzle nearby.
>
> Examination of treated product failed to find any insect except for some ants which may die at a later stage in response to the insecticidal dip.
>
> **Conclusion.** It appears that the fruit from both postharvest treatments were not infested with significant numbers of pests. The air blast method dislodged ants.

18 June 2002

Visit to commercial mangosteen orchard. Mangosteen trees in this orchard were over 100 years old. Trees stood some 15m to 20m high. Fruit were harvested using a bag connected to the end of a pole long enough to reach the fruit while the operator stood on the ground. This technique allowed the fruit to be harvested without its touching the ground. Consequently there was no evidence of the fruit being contaminated with soil, weed seeds or ground-dwelling insects. In addition not many insects were found in this orchard and no thrips or mealybugs of quarantine concern to Australia.

We were told that fruit, upon hitting the ground, suffers skin damage which is readily noticed. Fruit that has fallen onto the ground is not picked up and packed for market.

CONCLUSIONS

Insect load. In both the research orchard and the commercial orchards visited there was little insect infestation to be found and no infestations with the thrips and mealybug species of quarantine concern to Australia.

Postharvest disinfestation treatment in commercial packing houses. Operations are in place for treating and packing mangosteens for export to Taiwan. These operations, either using air blasting or insecticidal dipping, appear to be sufficient for export to Taiwan.

Dipping trials. Trials carried out at the Chanthaburi Horticultural Research Center, when the results are made available, will be evaluated.

Orchard hygiene. Inspection failed to find any contamination of the fruit with soil, weeds, weed seeds or ground-dwelling insects consistent with the fruit touching the ground.

Ant species. The Thai officials promised to identify ant species found on the fruit and send a list of names to Biosecurity Australia.

APPENDIX 2: BIOSECURITY AUSTRALIA SECOND TRIP REPORT ¾ THAILAND SEPTEMBER 2002

Report on travel to Thailand (8.9.02 to 14.9.02) to observe orchard production and review agronomic and packhouse procedures for mangosteen in southern Thailand and to discuss additional disinfestation trials for insects of quarantine concern associated with mangosteen.

PURPOSE

To report on travel to Thailand to observe orchard production and review agronomic and packhouse procedures for mangosteen in southern Thailand and to discuss additional disinfestation trials for insects of quarantine concern associated with mangosteen.

OUTCOMES

Visit to mangosteen production areas and packhouses

I visited a total of seven mangosteen orchards during two days of touring in the southern Thailand provinces of Nakon Sri Thammarat, Surat Thani and Song Khla. Mangosteen production in these areas was tapering towards the end of the season. Outcomes from the orchard visits as follows:

- Trees inspected within the southern regions varied in age between 10 to 200 years old;
- Very old trees were essentially managed organically as the size of the trees did not facilitate the application of sprays. The older trees were in very good condition and still producing large volumes of high quality fruit;
- In all orchards visited the level of hygiene and the health of the trees were extremely good;
- Fruit sampling and searching for insect pests revealed very few insect pests;
- The numbers of mealybugs detected were extremely low (smaller numbers than previously detected within the eastern region of Chanthaburi);
- Several species of small black ants were noted to occasionally nest under the calyx of some mangosteens. Thai entomologists have provided identification of the species concerned (*Technomyrmex butteli* Forel and *Dolichoderus* sp.);

- No fruit flies were detected within mangosteen fruit. Biosecurity Australia considers mangosteen fruit not to be a preferred host for fruit flies unless the skin has been damaged;
- All mangosteen fruit is harvested by hand, the fruit at no time coming in contact with the ground during the harvest process thus reducing the risk of weed seed contamination;
- Harvested fruit was auctioned nightly and held in cold storage until transport to packhouse facilities; and
- Packhouse facilities were much smaller in southern Thailand as compared to the facilities in eastern Thailand. Fruit for export was usually transported to Chanthaburi to be processed. No dipping of fruit was encountered (very few pests were found on fruit).

CONSIDERATIONS

Mangosteen disinfestation

My previous report indicated that dipping of the fruit in an insecticide or petroleum oil solution may provide effective control against thrips and mealybugs of quarantine concern. Results of the preliminary trials and discussions with Thai entomologists have raised doubts as to the effectiveness of fruit dipping as an efficacious disinfestation procedure. The Department of Agriculture (DOA) officials have indicated that fumigation with methyl bromide may be their preferred disinfestation treatment for exports of mangosteen to Australia.

DOA officials indicated fumigation trials with methyl bromide have been conducted and proven effective against mealybugs and thrips without a detrimental effect to fruit quality. I have requested efficacy data for mangosteen methyl bromide fumigation trials.

Mangosteen pest loads

Discussions with DOA extension staff provided further information related to thrips and mealybug population dynamics within the orchards:

- Mealybugs were extremely uncommon in the southern regions upon mature mangosteen fruit. Population densities vary with the season, however, numbers are generally low.
- Thrips are only present within or upon mangosteens at flowering and immature fruit development stages. By the time fruit has matured thrips are not able to lay eggs within the thick skin of the mangosteen and are not considered a pest. I received copies of

three scientific papers examining thrips population dynamics within mangosteen orchards in Thailand, supporting these statements made by DOA officials.

- It would appear that after inspecting many mangosteens within orchards and packhouses pest and disease concerns for Thailand mangosteens to Australia are extremely low and would be adequately mitigated by the use of methyl bromide fumigation, if adopted as a disinfestation technique.

Restructuring within the Department of Agriculture

DOA officials indicated a major restructuring and merging of DOA and DOA extension staff was to occur during October 2002. DOA staff were unsure of the implications of the proposed changes, reduced funding and structural reorganisation were suggested as possible outcomes. These restructuring changes may lead to difficulties in progressing the mangosteen IRA.

APPENDIX 3: RESPONSES TO QUESTIONS RAISED BY ALAN ZAPPALA PRIOR TO MANGOSTEEN STAKEHOLDERS MEETING IN CAIRNS (29 JULY 2002)

1. What is the mangosteen industry structure in Thailand, including statistics concerning geographical distribution, production area, production, yield, marketing and export?

Mangosteen is produced from the eastern province of Chanthaburi south to the Malaysian border in areas suitable for production.

Recent national figures for mangosteen cultivation and production are not currently available. In 1995, 130 000 tonnes were produced from 15 000 ha. Chanthaburi is one of the main provinces producing mangosteen. The province currently has 11 000 ha of mangosteen orchards producing approximately 42 million kg of mangosteen fruit per year.

2. What are the major research organizations and the names of key scientists working on mangosteen in Thailand?

Department of Agriculture (DOA) and Kasetsart University.

Sarute Sudhi-Aromna (Entomologist – Fruit Trees, Herbs and Spice Crops Entomology Research Group DOA)

Surmsuk Salakpetch (Director – Chanthaburi Research Centre)

Suranant Subhadrabandhi (Chairman of Fruit and Research Development Committee – Faculty of Agriculture Kasetsart University)

3. What are the commonly used horticultural practices and procedures for mangosteen production in Thailand?

Seedling trees are produced in nurseries, planted in plantations, agronomic practices applied as required, fruit harvested as ready.

4. What are the cultural methods of managing pests, diseases and hitchhikers likely to occur in mangosteen?

There are very few pests and diseases of mangosteen in Thailand. Fruit grown for domestic consumption requires very little pest and disease management, hitchhikers are not a consideration.

5. What are the prevalence and distribution of pests, diseases and hitchhikers likely to occur on mangosteen?

Pests and diseases of mangosteen vary throughout the world. Thrips and mealybugs are the main pests of mangosteen in Thailand. They occur in relatively small numbers and do not compromise the productivity of trees.

Thrips and mealybugs are commonly dispersed throughout Thailand. The incidence of mealybugs is lower in the southern provinces as compared to the eastern production area of Chanthaburi.

6. What is the infrastructure in Thailand for pest surveillance, monitoring, recording and reporting of mangosteen pests, diseases and weeds, including the expertise of the personnel conducing these activities?

Daily orchard surveillance is conducted by producers. Periodic surveys of regional production areas are conducted by specialist scientific staff.

Producers receive guidance on pests, diseases and weeds through various agricultural extension programs, seminars and field days. The DOA extension officers are especially trained officers specialising in various areas of agricultural and horticultural production.

7. What are the pesticide schedules used in Thailand for managing arthropod pests, diseases, weeds and other pests?

Comments here apply only to mangosteen. Weeds are not a concern as the canopy of mangosteen trees excludes growth of most weed species. Some mechanical removal of weeds may be conducted as required.

Thrips may be sprayed in mangosteen orchards if numbers are considered excessive during the flowering and early fruiting growth periods. Recommended chemicals for thrips control on mangosteen in Thailand may include: Confidor® (active = imidacloprid), Ascend® (active = abermectin), Parzon® (active = cypermethrin), Posse® (active = carbosulfan).

8. Is "pesticide resistance" a problem in Thailand and, if so, what measures are used to minimise the development of pesticide resistant strains on mangosteen pests, diseases and weeds?

No.

9. What is the procedure for registering pesticides in Thailand?

Anyone who wishes to produce, import and export of any pesticides and its formulated products as well as to have hazardous substance in possession must apply for permits and licenses at the Department of Agriculture, Ministry of Agriculture and Cooperatives for pesticides used in agricultural sectors and at Food and Drug Administration, Ministry of Public Health for pesticides in the household products.

The registration requires information detailing the permit applicants, the trade name and types of formulations and active ingredients, labels, amount of pesticides to be handled per year, features of the production plants, storage, etc. To be granted the permits, features of the production plants and storage such as location, size of the building, safety equipments, and waste disposal must meet the standard requirements announced by the authorities under the Hazardous Substance Act 1992 and the Factory Act 1992. For example, the plants or storage must have enough empty space outside and enough space in the building for proper operation. The buildings must have proper air circulation and equipped with safety measures. The laws also require that the storage should be located properly in an isolated safe area that does not have access to canal, river or other public water sources, natural conservation and environment.

10. What regulations govern the use of registered pesticides in Thailand and how are these enforced?

Legislation

Any activities in handling or management of pesticides throughout its life cycle (from importation, production through storage and disposal) must follow the Hazardous Substance Act 1992 which authorizes (1) the Ministry of Public Health to be responsible for pesticides used for public health purposes and in consumer products and (2) the Ministry of Agriculture and Cooperatives to be responsible for pesticides used in agricultural sectors. The objectives of the Hazardous Substance Act 1992 are as follows:

(1) To control pesticide according to the need of the responsible authority.

(2) To select pesticides through registration process.

(3) To issue permits for production, import or having possession (sales, storage, transport) of pesticide with the purposes of preventing or minimizing danger inflicted upon human beings, animals, plants, property and environment.

(4) To control quality of pesticides available in the market.

According to the Hazardous Substance Act 1992, several pesticides such as aldrin, aminocarb, and DDT are banned or severely restricted for agricultural and public health uses. In addition, there are other laws or legal instruments enacted to protect the environment and human beings from detrimental effects of poor chemical management for example:

- Food Act 1979 which seeks to control pesticide residues in foods and food products;
- Factory Act 1992 which seeks to control factory operations;
- Notification of Ministry of Interior RE: Occupational Safety Related to Dangerous Substances 1991, which seeks to protect workers from hazards of chemical in every physical form (solid, liquid, and gas).

Labeling

According to the WHO Recommended Classification of Pesticide by Hazard and Guidelines to Classification 1996-1997, pesticides can be divided into 4 classes as follow.

Class 1a Extremely Hazardous

Class 1b Highly Hazardous

Class 2 Moderately Hazardous

Class 3 Slightly Hazardous

The Hazardous Substance Act 1992 requires the appropriate label for each class of pesticide and its permit intention. The size, colour, signs and statements on the label must meet the standard requirements for an approval from the authorities. For example, labels of the pesticides under the permit to import into or export out of the country are not required to show as much information as those under the permit to produce for sale or distribution.

Generally, pesticides for import or export must have a label indicating the trade name, common name, UN number or CAS number, caution or symbol or sign showing the danger and property of the contained materials, mixture ratio of active ingredient, name and address of manufacturer, and containing size. The label may be in Thai or English. The label for pesticides that are sold or distributed must be in Thai and have more information and statements about application, instruction, storage, usage cautions and

danger of the products, toxic symptoms, first aid, and suggestion for the physician, date for manufactured or expired, and registration number.

11. What are the post harvest chemical treatments used on mangosteen fruit in Thailand?

No post harvest chemical treatments are used domestically for mangosteens in Thailand.

12. Are pesticide residues a concern, and if so, what are these pesticides and what measures are used by Thailand and importing countries to monitor pesticide residues in or on export mangosteen?

Pesticide residues are not a concern for mangosteen in Thailand.

13. How much biological and pest management information is available for mangosteen pests, diseases and weeds in Thailand?

The Thailand Department of Agriculture has an extensive extension and awareness service for mangosteen and other tropical fruits. Research has been conducted and various scientific papers published regarding agronomic aspects, pests, diseases and weeds of mangosteen in Thailand.

14. What are the main sources of scientific and technical information on Thailand's mangosteen pests, diseases and weeds in Thailand?

Please see above.

15. Has Thailand prepared datasheets on pests, diseases and weeds of mangosteen in Thailand?

No.

16. What procedures are used, and how effective are they in ensuring that packed mangosteen are free from materials such as contaminated soil and other pests?

Mangosteens for domestic consumption are packaged in standard cardboard boxes and cling wrap. Export standard mangosteens are washed, rinsed and packaged in export grade boxes before being sealed in pest and dirt proof containers.

17. What are Thailand's quarantine conditions for movement within the country to exclude pests and diseases?

There are no internal quarantine conditions for movement of mangosteens within Thailand.

18. Does Thailand government and / or industry require certification and registration of mangosteen plantations and, if so, what are measures required for these purposes?

It is not a requirement by law for domestic mangosteen producers to certify or register mangosteen plantations.

19. Are Thailand's mangosteen growers/plantation managers required to keep records of pest and disease occurrences and pesticide applications?

It is not a requirement by law for domestic mangosteen producers to maintain records. Most growers/managers do keep records.

20. Are there any environmental concerns in Thailand associated with the production and consumption of mangosteen and, if so, what measures are used to address such concerns?

No environmental concerns.

21. Does the Thai government and / or industry has an environmental policy for addressing environmental concerns with mangosteen production?

No environmental concerns.

22. Does Thailand import mangosteen and if so what are Thailand's import conditions for mangosteen?

No.

23. What countries are destinations for Thailand exports of fresh or frozen mangosteen?

Japan, Hong Kong and Taiwan.

24. What are these importing countries (e.g. Japan) requirements /protocols for the importation of Thai mangosteen to address their quarantine concerns?

Hong Kong and Taiwan have no quarantine treatment requirements. Japan requires cutting of fruit to inspect for fruit fly and then freezing of the fruit prior to export.

25. What have been importing countries quarantine concerns with mangosteen imported from Thailand?

Japan has expressed concern about fruit flies.

26. How is Thailand meeting importing countries quarantine requirements?

See 24 re. Japanese requirements.

27. Does Thailand maintain records of non-compliance reports by importing countries?

Yes.

28. Does the Thai government operate any pre-clearance arrangements for mangosteen or other commodities to meet other countries import requirements?

Yes - see 24 for Japanese requirements for mangosteen.

29. What quality assurance systems are used in Thailand for mangosteen fruit, including harvesting, cleaning, packaging, storage, transport, identity preservation and trace back of produce to the farm?

Quality assurance varies with the region, target market and quality of the produce. Low-grade mangosteen for local markets has minimal quality assurance. High quality fruit may undergo washing, individual packaging and labelling (with producers name or logo) chilling etc.

APPENDIX 4: PEST CATEGORISATION FOR MANGOSTEENS (PRESENCE/ABSENCE) IN AUSTRALIA

Note: Biosecurity Australia will review these tables during the course of the IRA process

Scientific Name	Common name	Present in Thailand[1]	Reference	Present in Australia[2]	Reference	Consider further[3]
ARTHROPODA						
Acari [mites]						
Brevipalpus californicus (Banks, 1904) [Acarina: Tenuipalpidae]	citrus flat mite	Yes	CAB International (2002)	Yes	Astridge *et al*. (2000a); Halliday (1998)	No
Tetranychus urticae Koch [Acarina: Tetranychidae]	two-spotted spider mite	Yes	IIE (1996); Waterhouse (1993)	Yes	Astridge & Fay (2000); IIE (1996)	No
Diptera [flies]						
Bactrocera dorsalis (Hendel, 1912) [Diptera: Tephritidae]	Oriental fruit fly	Yes	Burikam *et al*. (1991); IIE (1994); Waterhouse (1993)	No	Evenhuis (1989)	Yes
Drosophila (*Sophophora*) *melanogaster* [Diptera: Drosophilidae]	vinegar fly	Yes	Okada (1977)	Yes	Anderson & Gibson (1985); Davidson (1990); Worthen (1996)	No
Hemiptera [aphids, leafhoppers, mealybugs, psyllids, scales, whiteflies]						
Aspidiotus destructor Signoret, 1869 [Hemiptera: Diaspididae]	coconut scale	Yes	APPPC (1987); CIE (1966); Waterhouse	Yes	Astridge & Fay (2000); Chacko *et*	No

Scientific Name	Common name	Present in Thailand[1]	Reference	Present in Australia[2]	Reference	Consider further[3]
			(1993)		*al*. (1995); CIE (1966)	
Coccus viridis (Green, 1889)	green coffee scale	Yes	Ben-Dov *et al*. (2001); Waterhouse (1993)	Yes	Ben-Dov (1994); Smith *et al*. (1997)	No
Dysmicoccus neobrevipes Beardsley, 1959 [Hemiptera: Pseudococcidae]	gray pineapple mealybug	Yes	Anon. (2000b); Waterhouse (1993)	No	Williams (1985)	Yes
Greenidea sp. [Hemiptera: Aphididae]	aphid	Yes	DOA (2000)	? – Genus is present in Australia	Carver (2002)	Yes
Icerya seychellarum (Westwood, 1855) [Hemiptera: Margarodidae]	Seychelles scale	Yes	CIE (1955); Waterhouse (1993)	Yes	CAB International (2002)	No
Planococcus citri (Risso, 1813) [Hemiptera: Pseudococcidae]	citrus mealybug	Yes	CABI/EPPO (1999); Waterhouse (1993)	Yes	Astridge (2000); Chay-Prove *et al*. (2000); Smith *et al*. (1997)	No
Planococcus minor (Maskell, 1897) [Hemiptera: Pseudococcidae]	Pacific mealybug	Yes	Anon. (2000b)	Yes	Williams (1985)	No
Pseudococcus cryptus Hempel, 1918 [Hemiptera: Pseudococcidae]	cryptic mealybug	Yes	Anon. (2000b)	No	Ben Dov (1994)	Yes
Toxoptera aurantii (Boyer de Fonscolombe, 1841)	camellia aphid	Yes	APPPC (1987); Waterhouse (1993)	Yes	CIE (1961); Halliday (1998); Smith *et al*. (1997)	No

Scientific Name	Common name	Present in Thailand[1]	Reference	Present in Australia[2]	Reference	Consider further[3]
Hymenoptera [ants, bees]						
Dolichoderus sp.	black ant	Yes	Sudhi-Aromna (2002)	? – Genus is present in Australia	Shattuck & Barnett (2001)	Yes
Technomyrmex butteli Forel	black ant	Yes	Sudhi-Aromna (2002)	No	Shattuck & Barnett (2001)	Yes
Lepidoptera [butterflies, moths]						
Acrocercops sp. [Lepidoptera: Gracillariidae]	leafminer	Yes	Anon. (2000a)	? – Genus is present in Australia	Nielsen *et al*. (1996)	Yes
Adoxophyes privatana Walker [Lepidoptera: Tortricidae]	apple leaf-curling moth	Yes	DOA (2000)	No	Nielsen *et al*. (1996)	Yes
Aetholix flavibasalis (Guenée, 1854) [Lepidoptera: Pyralidae]	leaf roller	Yes	DOA (2000)	Yes	Nielsen *et al*. (1996)	No
Archips micaceanus (Walker) [Lepidoptera: Tortricidae]	soyabean leafroller	Yes	DOA (2000); Waterhouse (1993)	No	Nielsen *et al*. (1996)	Yes
Dudua aprobola (Meyrick, 1886) [Lepidoptera: Tortricidae]	leaf roller	Yes	DOA (2000)	Yes	Nielsen *et al*. (1996)	No
Eudocima fullonia (Clerck, 1764) [Lepidoptera: Noctuidae]	fruit-piercing moth	Yes	Anon. (2000b)	Yes	Nielsen *et al*. (1996)	No
Gatesclarkeana idia Diakonoff, 1973 [Lepidoptera: Tortricidae]	moth	Yes	DOA (2000)	No	Nielsen *et al*. (1996)	Yes
Homona difficilis Meyrick [Lepidoptera: Tortricidae]	leaf roller	Yes	DOA (2000)	No	Nielsen *et al*. (1996)	Yes

Scientific Name	Common name	Present in Thailand[1]	Reference	Present in Australia[2]	Reference	Consider further[3]
Hyposidra talaca (Walker, 1860) [Lepidoptera: Geometridae]	leaf-eating looper	Yes	DOA (2000)	Yes	Nielsen *et al*. (1996)	No
Lobesia genialis Meyrick [Lepidoptera: Tortricidae]	moth	Yes	DOA (2000)	No	Nielsen *et al*. (1996)	Yes
Orgyia postica (Walker, 1855)	cocoa tussock moth	Yes	CAB International (2002); Waterhouse (1993)	No	CAB International (2002)	Yes
Phyllocnistis citrella Stainton, 1856 [Lepidoptera: Gracillariidae]	citrus leafminer	Yes	IIE (1995); Waterhouse (1993)	Yes	Smith *et al*. (1997); Wilson (1991)	No
Stictoptera columba (Walker) [Lepidoptera: Noctuidae]	leaf eating caterpillar	Yes	Anon. (2000a); DOA (2000); Jumroenma *et al*. (2000)	Yes	Nielsen *et al*. (1996)	No
Stictoptera cucullioides Guenée,. 1852 [Lepidoptera: Noctuidae]	leaf eating caterpillar	Yes	Anon. (2000a); Jumroenma *et al*. (2000)	Yes	Nielsen *et al*. (1996)	No
Stictoptera signifera Walker [Lepidoptera: Noctuidae]	leaf eating caterpillar	Yes	Anon. (2000a); Jumroenma *et al*. (2000)	No	Nielsen *et al*. (1996)	Yes
Thysanoptera [thrips]						
Megalurothrips usitatus (Bagnall, 1913) [Thysanoptera: Thripidae]	bean flower thrips	Yes	Reyes (1994); Waterhouse (1993)	Yes	Miyasaki *et al*. (1984); Mound (1996)	No
Scirtothrips dorsalis Hood, 1919 [Thysanoptera: Thripidae]	castor thrips	Yes	DOA (2000); IIE (1986); Waterhouse (1993)	Yes	Mound (1996)	No

Scientific Name	Common name	Present in Thailand[1]	Reference	Present in Australia[2]	Reference	Consider further[3]
Scirtothrips oligochaetus Kamy [Thysanoptera: Thripidae]	mangosteen thrips	Yes	DOA (2000)	No	Mound (1996)	Yes
Selenothrips rubrocinctus Giard, 1901 [Thysanoptera: Thripidae]	red-banded thrips	Yes	Strassen & Harten (1984)	Yes	Astridge (2000); Astridge *et al*. (2000b); Mound (1996)	No
NEMATODA						
Tylenchulus semipenetrans Cobb, 1913 [Tylenchida: Tylenchulidae]	citrus root nematode	Yes	Chunram (1972)	Yes	Anderson (1965), Colbran (1955); Meagher (1969)	No
ALGAE						
Cephaleuros virescens Künze [Protista]	algal leaf spot	Yes	Lim & Sangchote (2000)	Yes	Lim & Sangchote (2000)	No
FUNGI						
Botryodiplodia theobromae Pat. [Mitosporic fungi: Coelomycetes]	fruit rot	Yes	Banjerdcherdchu & Shana (1991); Lim & Sangchote (2000); Wisalthanon & Jermsiri (1998)	Yes	CMI (1985)	No
Colletotrichum gloeosporioides (Penz.) Penz. & Sacc. [Phyllachorales: Phyllachoraceae]	anthracnose	Yes	Giatgong (1980); Khanmalee (1965); Lim & Sangchote (2000); Wisalthanon & Jermsiri (1998)	Yes	Cameron *et al*. (1989); Chakraborty *et al*. (1996); Sweetingham *et al*. (1995)	No

Scientific Name	Common name	Present in Thailand[1]	Reference	Present in Australia[2]	Reference	Consider further[3]
Colletotrichum sp. [Phyllachorales: Phyllachoraceae]	anthracnose; leaf blight	Yes	Khanmalee (1965); Wisalthanon & Jermsiri (1998)	? – Genus is present in Australia	CAB International (2002)	Yes
Corticium koleroga (Cooke) Höhnel [Polyporales: Corticiaceae]	thread blight	Yes	Wisalthanon & Jermsiri (1998)	Yes	Chacko *et al*. (1995)	No
Corticium salmonicolor (Berk. & Broome) [Polyporales: Corticiaceae]	pink disease	Yes	IMI (1996)	Yes	IMI (1996)	No
Gliocephalotrichum bulbilium Ellis & Hesseltine [Hypocreales: Nectriaceae]	fruit rot	Yes	Sangchote & Pongpisutta (1998)	No	APDD (2002)	Yes
Graphium sp. [Mitosporic fungi: Deuteromycetes]	fruit rot	Yes	Pienpuck & Choobumroong (1988)	? – Genus is present in Australia	CAB International (2002)	Yes
Helminthosporium quaciniae [Mitosporic fungi: Hyphomycetes]	leaf spot	Yes	Wisalthanon & Jermsiri (1998)	Yes	Chacko *et al*. (1995)	No
Pestalotiopsis flagisetulai Guba [Mitosporic fungi]	leaf spot	Yes	Giatgong (1980); Lim & Sangchote (2000); Wisalthanon & Jermsiri (1998)	No	APDD (2002)	Yes
Phomopsis sp. [Mitosporic fungi]	white pulp rot	Yes	Banjerdcherdchu & Shana (1991); Lim & Sangchote (2000)	? – Genus is present in Australia	CAB International (2002)	Yes
WEEDS						
Brachiaria mutica (Forsk.) Stapf. [Poaceae]	Para grass; buffalo grass	Yes	DOA (2000)	Yes	APNI (2001)	No

Scientific Name	Common name	Present in Thailand[1]	Reference	Present in Australia[2]	Reference	Consider further[3]
Chromolaena odorata (L.) R.M. King & H. Robbins [Asteraceae]	Siam weed; bitter-bush	Yes	DOA (2000)	No – Incursion eradicated	APNI (2001); Hnatiuk (1990); Holm *et al*. (1979)	Yes
Commelina benghalensis L. [Commelinaceae]	Benghal dayflower; tropical spider wort	Yes	DOA (2000)	Yes	APNI (2001); Hnatiuk (1990); Holm *et al*. (1997)	No
Cynodon dactylon (L.) Pers. [Poaceae]	Bahama grass; Bermuda grass; couch grass; devil grass; dog's tooth grass; quick grass; star grass	Yes	DOA (2000)	Yes	APNI (2001); Hnatiuk (1990)	No
Cyperus rotundus L. [Cyperaceae]	purple nutsedge; coco sedge; nut grass	Yes	DOA (2000)	Yes	APNI (2001); Hnatiuk (1990); Holm *et al*. (1979)	No
Digitaria ciliaris (Retz.) Koeler [Poaceae]	finger grass; southern crabgrass; tropical crab grass	Yes	DOA (2000)	Yes	APNI (2001); Hnatiuk (1990)	No
Echinochloa colona (L.) Link [Poaceae]	awnless barnyard grass; birds rice; jungle rice grass	Yes	DOA (2000)	Yes	APNI (2001); Hnatiuk (1990); Swain (1973)	No
Imperata cylindrica (L.) P. Beauv. [Poaceae]	bedding grass; blady grass; cogon grass; silver spike; spear grass; sword grass; thatch grass	Yes	DOA (2000)	Yes	APNI (2001)	No
Paspalum conjugatum Berg. [Poaceae]	Hilo grass; sour grass	Yes	DOA (2000)	Yes	APNI (2001)	No

Scientific Name	Common name	Present in Thailand[1]	Reference	Present in Australia[2]	Reference	Consider further[3]
Pennisetum polystachyon Schult. [Poaceae]	feather pennisetum; mission grass; thin napier grass	Yes	DOA (2000)	Yes	APNI (2001)	No

[1] This list contains all species known to be associated with the mangosteen plant from which the fresh individual mangosteens are derived from in Thailand.

[2] Pests are classified as not present in Australia, present in Australia, or present in Australia, but not widely distributed and under official control.

[3] Pests that are either not present in Australia or present but not widely distributed and under official control are considered further for whether they are associated with the pathway.

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APPENDIX 5: PEST CATEGORISATION FOR MANGOSTEENS (PATHWAY ASSOCIATION)

Note: Biosecurity Australia will review these tables during the course of the IRA process

Scientific name	Common name	Associated with fresh mangosteen fruit[4]	Reference	Consider further[5]
ARTHROPODA (arthropods)				
Diptera [flies]				
Bactrocera dorsalis (Hendel, 1912) [Diptera: Tephritidae]	Oriental fruit fly	No – Mangosteen non-preferred host; only on damaged and overripe fruit	Leach (1997)	No
Hemiptera [aphids, leafhoppers, mealybugs, psyllids, scales, whiteflies]				
Dysmicoccus neobrevipes Beardsley, 1959 [Hemiptera: Pseudococcidae]	gray pineapple mealybug	?No	Anon. (2000b)	Yes
Greenidea sp. [Hemiptera: Aphididae]	aphid	No	DOA (2000)	No
Pseudococcus cryptus Hempel, 1918 [Hemiptera: Pseudococcidae]	cryptic mealybug	Yes	Anon. (2000b)	Yes
Hymenoptera [ants, bees]				
Dolichoderus sp.	black ant	Yes	Sudhi-Aromna (2002)	Yes
Technomyrmex butteli Forel	black ant	Yes	Sudhi-Aromna (2002)	Yes
Lepidoptera [butterflies, moths]				
Acrocercops sp. [Lepidoptera: Gracillariidae]	leafminer	No	Anon. (2000a)	No
Adoxophyes privatana Walker [Lepidoptera: Tortricidae]	apple leaf-curling moth	No	DOA (2000)	No

Scientific name	Common name	Associated with fresh mangosteen fruit[4]	Reference	Consider further[5]
Archips micaceanus (Walker) [Lepidoptera: Tortricidae]	soyabean leafroller	No	CAB International (2002); DOA (2000)	No
Gatesclarkeana idia Diakonoff, 1973 [Lepidoptera: Tortricidae]	moth	No	DOA (2000)	No
Homona difficilis Meyrick [Lepidoptera: Tortricidae]	leaf roller	No	DOA (2000)	No
Lobesia genialis Meyrick [Lepidoptera: Tortricidae]	moth	No	DOA (2000)	No
Orgyia postica (Walker, 1855)	cocoa tussock moth	No	CAB International (2002); Waterhouse (1993)	No
Stictoptera signifera Walker [Lepidoptera: Noctuidae]	leaf eating caterpillar	No	Anon. (2000a); Jumroenma *et al*. (2000)	No
Thysanoptera [thrips]				
Scirtothrips oligochaetus Karny [Thysanoptera: Thripidae]	mangosteen thrips	No – immature fruit	DOA (2000)	No
FUNGI				
Colletotrichum sp. [Phyllachorales: Phyllachoraceae]	anthracnose; leaf blight	No	DOA (2000)	No
Gliocephalotrichum bulbilium Ellis & Hesseltine [Hypocreales: Nectriaceae]	fruit rot	Yes	Sangchote & Pongpisutta (1998)	Yes
Graphium sp. [Mitosporic fungi: Deuteromycetes]	fruit rot	Yes	DOA (2000)	Yes

Scientific name	Common name	Associated with fresh mangosteen fruit[4]	Reference	Consider further[5]
Pestalotiopsis flagisetulai Guba [Mitosporic fungi]	leaf spot	Yes	Wisalthanon & Jermsiri, 1998	Yes
Phomopsis sp. [Mitosporic fungi]	white pulp rot	Yes	DOA (2000)	Yes
WEEDS				
Chromolaena odorata (L.) R.M. King & H. Robbins [Asteraceae]	Siam weed; bitter-bush	No	DOA (2000)	Yes (prohibited weed)

[4] Describes whether the pest is associated with the pathway. The host relevant arthropod is listed for the biological control agents.

[5] Pests that are known to be associated with mangosteen fruit and either not present in Australia or present but not widely distributed and under official control, are to be considered further in the risk analysis.

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APPENDIX 6: PESTS THAT WILL REQUIRE FURTHER CONSIDERATION IN THE IRA

Scientific name	Common name
ARTHROPODA	
Dolichoderus sp.	black ant
Dysmicoccus neobrevipes	gray pineapple mealybug
Pseudococcus cryptus	cryptic mealybug
Technomyrmex butteli Forel	black ant
FUNGI	
Gliocephalotrichum bulbilium	fruit rot
Graphium sp.	fruit rot
Pestalotiopsis flagisetulai	leaf spot
Phomopsis sp.	white pulp rot
WEEDS	
Chromolaena odorata	Siam weed; bitter-bush