CARICOM MODEL HANDBOOK

GUIDELINES FOR PEST RISK ANALYSIS OF IMPORTED PLANTS AND PLANT PRODUCTS

2016

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The "Guidelines for Plant Risk Analysis of Imported Plants and Plant Products" were developed by the Caribbean Agricultural Health and Food Safety Agency (CAHFSA) and reviewed by the Caribbean Plant Health Directors (CPHD) and several CARICOM Member States.

The "Guidelines for Plant Risk Analysis of Imported Plants and Plant Products" was approved by the Sixty Second Special Meeting of the Council for Trade and Economic Development - Agriculture, 28 October 2016.

The guidelines are in compliance with Articles 56 and 57 of the Revised Treaty of Chaguaramas which assert that for the achievement of the goal of the Community Agriculture Policy, the Community shall, through competent Community Organs and Bodies promote, *inter alia*, the establishment of an effective regime of sanitary and phytosanitary measures.

The guidelines are also consistent with the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures (WTO-SPS Agreement; WTO, 1994), to which Member States participating in the Caribbean Single Market and Economy (CSME) are party and which sets out the rights and obligations of WTO members regarding the manner in which sanitary and phytosanitary measures to protect human, animal and plant health can be applied.

The National Plant Protection Organizations of Member States of CARICOM are encouraged to make full use of these model guidelines in the conduct of PRAs and to seek the services of CAHFSA, as necessary, in implementing the guidelines.

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DEFINITIONS USED

The use of biological and phytosanitary terms conforms to the (ISPM) No. 5, *Glossary of Phytosanitary Terms* (IPPC, 2016).

Commodity	A type of plant, plant product, or other article being moved for trade or other purpose
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 consignment)	Movement through a point of entry into an area
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
Establishment	Perpetuation, for the foreseeable future, of a pest within an area after entry
Host Range	Species capable, under natural conditions, of sustaining a specific pest or other organism
Introduction	The entry of a pest resulting in its establishment
Official Control	The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests
Pathway	Any means that allows the entry or spread of a pest
Pest	Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products
Pest categorization	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 risk analysis	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it
Pest risk assessment	Evaluation of the probability of the introduction and spread of a pest and of the associated potential economic consequences
Pest risk management	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, or to limit the economic impact of regulated non-quarantine pests
Plant products	Unmanufactured material of plant origin (including grain) and those manufactured products that, by their nature or that of their processing, may create a risk for the introduction and spread of pests
Plants	Living plants and parts thereof, including seeds and germplasm
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

INTRODUCTION

This document contains procedures that have been developed for use in the conduct of plant import risk analysis by Member States of CARICOM. The aim is to harmonise regional pest risk analysis procedures with guidelines provided by the International Plant Protection Convention (IPPC). The International Standard for Phytosanitary Measures (ISPMs) 2 and 11 explicitly identifies two different generalised approaches to conducting pest risk analysis (PRA). **Pest initiated PRA** focuses on an individual potential quarantine pest, considering all possible routes of entry into the PRA area. **Pathway initiated PRA** is based on a specific route by which one or more quarantine pest species may be introduced. This guideline addresses the conduct of pathway initiated PRA and is specific to one pathway: import route for commodities (plant and plant products) from other countries or regions.

Within CARICOM, the Member States use pest risk analyses to assist in considering the level of quarantine risk that may be associated with the importation or proposed importation of plants or plant products. In conducting a commodity import risk analysis, the risk analyst:

- identifies the pest (s) of quarantine concern that may accompany the commodity,
- assesses the likelihood that an identified pest would enter, establish or spread, and
- assesses the probable consequence (s) that would result.

If the assessed level of quarantine risk exceeds the Member's acceptable level of risk the country will consider whether there are any risk management measures that will reduce quarantine risk to acceptable levels. If there are no risk management measures that reduce the risk to that level, trade may not be allowed.

1. LEGAL FRAMEWORK FOR PRA

1.1 International Agreements and Standards

1.1.1 World Trade Organisation Agreement on Sanitary and Phytosanitary Measures

The World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures (WTO-SPS Agreement; WTO, 1994) is an agreement on how governments can apply food safety, animal health and plant health measures without then becoming unnecessary obstacles to trade. With respect to plant health, the Agreement aims to prevent the use of plant protection measures as disguised barriers to trade. As such, it requires that phytosanitary measures be based on an assessment of the risk to plant health and that the measures be based on scientific principles and sufficient scientific evidence. Where WTO Members apply phytosanitary measures as a condition for import of plant and plant products, the SPS Agreement requires that these do not to arbitrarily or unjustifiably discriminate between countries where identical or similar conditions prevail.

WTO members have the right to determine the level of SPS protection they deem appropriate for their country and have the sovereign right to take measures to achieve the level of protection it deems appropriate to protect plant life and health. In determining applicable measures, the SPS Agreement encourages Members to use international standards, guidelines and recommendations where they exist. When an international standard, guideline or recommendation does not exist or when a Member needs a measure to provide a higher level of protection than the relevant international standard would provide, such a measure must be based on a risk assessment. The risk assessment must consider available scientific evidence and relevant economic factors.

1.1.2 International Plant Protection Convention (IPPC)

The International Plant Protection Convention (IPPC) is a multilateral treaty whose main purpose is to "secure common and effective action to prevent the spread and introduction of pests of plants and plant products and promote appropriate measures for their control" (IPPC, 1997). It applies to both cultivated and natural flora, includes seeds and germplasm and covers conveyances, containers, storage places, soil and other objects or material capable of harbouring plant pests. The Convention extends to the potential impact of plant pests on the environment and addresses the import of living modified organisms and includes both direct and indirect damage by pests (including weeds).

The WTO recognises the IPPC as the relevant international standard setting body for plant health. Standards established by the Convention, the International Standards for Phytosanitary Measures (ISPMs) provide countries with a basis for their national phytosanitary measures. Harmonization of measures at the regional and international levels will substantially reduce the burden of countries to justify their own measures and to meet the measures of their trade partners. Where standards do not exist or are deemed inappropriate, risk assessment is needed to provide justification for measures.

The IPPC provides standards for performing risk assessment. Although ISPMs are internationally agreed to and adopted, they are meant to be guidelines and their use is not mandatory within the framework of the IPPC. In addition, their interpretation and application on a national level varies from country to country.

ISPMs are designed to be a framework and countries use this framework as a basis for their own national systems that may arrange the guidelines into a protocol or similar system, often adding additional elements to meet their needs. Using the framework provided by the ISPMs related to pest risk analysis, this document, which provides guidelines for the conduct of commodity pest risk analysis was prepared.

IPPC Standards Related to Pest Risk Analysis

ISPM No. 2, Framework for Pest Risk Analysis (2007), was originally adopted by the IPPC in 1995 as Guidelines for Pest Risk Analysis and was revised in 2007. This standard provides basic background regarding risk analysis for phytosanitary purposes and outlines a three-stage process for conducting risk analysis.

ISPM No. 3, Guidelines for the export, shipment, import and release of biological control agents and other beneficial organisms, (2005) provides guidelines for risk management related to the export, shipment, import and release of biological control agents and other beneficial organisms, and contains a section on PRA for these types of organisms.

ISPM No. 11, Pest Risk Analysis for Quarantine Pests (2013), was first adopted in 2001. In 2003, the Interim Commission on Phytosanitary Measures (now the Commission on Phytosanitary Measures (CPM)), the governing body of the IPPC, adopted a supplement on environmental risks (with annex 1), and in 2004, a supplement on genetically modified organisms was added (with annexes 2 &3). In 2013, annex 4 to ISPM 11 was adopted by CPM 8. This standard describes the factors to consider when conducting a PRA to determine if a pest is a quarantine pest. The emphasis in ISPM No. 11 is on the pest risk assessment and risk management components of PRA, although the full PRA process is covered.

ISPM No. 21, Pest Risk Analysis for Regulated Non-Quarantine Pests (2004). This standard provides guidelines for conducting PRAs on regulated non-quarantine pests.

1.2 National Legislative Framework

1.2.1 Plant Quarantine Regulations

The draft Regional Plant Quarantine Bill makes provision for the effective control of the importation of plants, plant products and articles which pose a threat of introducing injurious plant pests into the region, as well as the course of action to be taken when these are discovered within the Member States.

The following provisions of the draft Bill are important in relation to pest risk analysis associated with importations of plants and plant products:

13.— (*1) Any person intending to import a plant, plant product or other regulated article shall require an import permit issued by the NPPO in the following cases—*

(f) Where so determined by the NPPO on the basis of a pest risk analysis

(3) In evaluating an application for an import permit, the NPPO shall apply existing international standards, conduct a pest risk analysis or risk assessment, and shall

(a) approve the application where it meets prescribed requirements; or

(b) deny the application where it fails to meet prescribed requirements, informing the applicant in writing of the decision.

17. In order to protect plant resources, human and animal health or the environment, the Minister may, on the advice of the Director of the NPPO—

(a) allow the entry into [insert name of State] of any plant, plant product or other regulated article for scientific or experimental purposes after a pest risk analysis or in the case of a natural disaster for humanitarian purposes, subject to such terms and conditions that the Minister, on the advice of the NPPO, considers appropriate;

24.— (1) The NPPO may declare a pest to be—

(a) a regulated pest or a regulated non-quarantine pest, based on pest risk analysis;

1.3 Appropriate Level of Protection

The WTO-SPS agreement defines the concept of an Appropriate Level of Protection (ALOP) as the level of protection deemed appropriate by a WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory. The ALOP, (sometimes referred to as the acceptable level of risk) is determined by the WTO Member who should consider the objective of minimising negative trade effects in setting its ALOP.

2. *PEST RISK ANALYSIS (PRA) METHOD: General Overview*

Pest Risk Analysis is conducted in CARICOM to provide technical justification for phytosanitary measures and is done in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: Framework for Pest Risk Analysis (FAO, 2007) and ISPM 11: Pest Risk Analysis for Quarantine Pests (FAO, 2013). The process evaluates technical, scientific and economic evidence to determine whether an organism is a potential pest of plants and, if so, how it should be managed. It requires a risk assessment to characterize the risk and risk management to determine appropriate measures.

Under the IPPC, the term plant pest refers to all organisms harmful to plants or plant products including other plants, bacteria, fungi, insects and other animals, mites, molluscs, nematodes, and viruses. Pests can be either regulated or not, and the IPPC recognizes and defines two categories of regulated pests of plants: quarantine pests and regulated, non-quarantine pests. PRA assists with determining whether a particular pest fits either of these two categories and the strength of phytosanitary measures, if any, that should be taken.

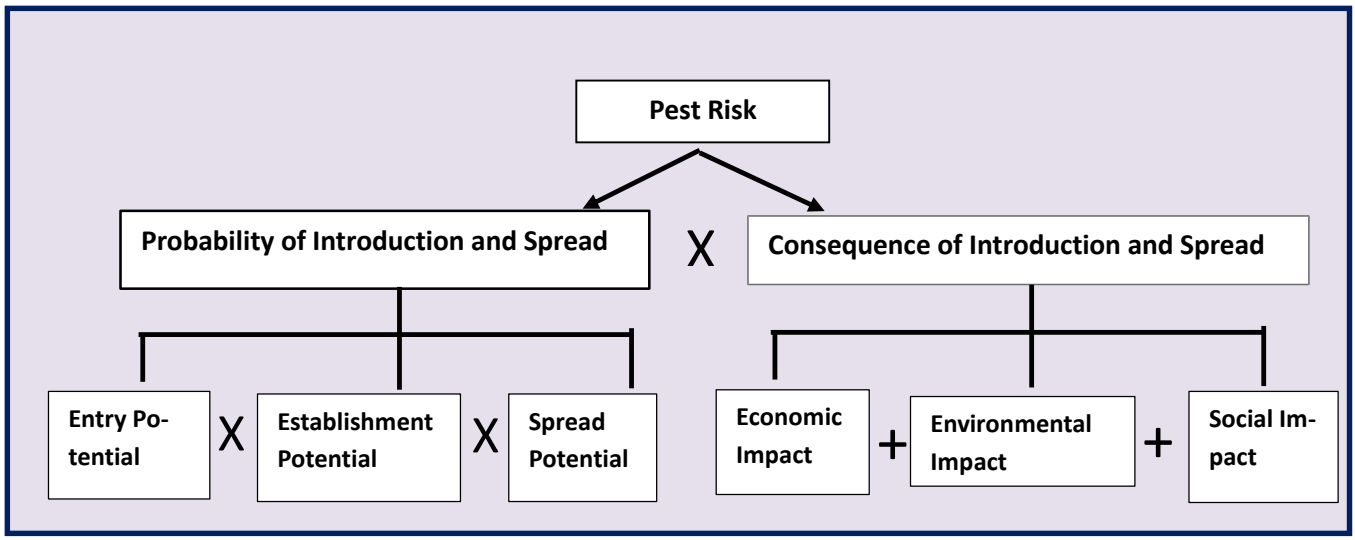
If it is determined that the organism is a potential quarantine pest of plants, the probability of introduction and spread and the magnitude of potential consequences is evaluated using scientific, technical and economic evidence. If the pest risk is deemed unacceptable, the analysis may continue by suggesting management options that will reduce the pest risk to an acceptable level. These pest risk management options may be used to establish phytosanitary regulations.

Quarantine risk consists of two major components: the probability of a pest entering, establishing and spreading and the consequences should this happen. These two components are combined to give an overall estimate of the risk to the Member State from pest introduction. However, before the major components can be combined, their component parts (the risk elements -probability of entry, establishment and spread; and the resulting consequence) must be considered. Each of these elements has an associated rating and these ratings are combined at various stages of the assessment to eventually produce an overall pest risk potential.

The risk factors for the likelihood of introduction and spread are interdependent and the model used in assessing the pest risk is therefore multiplicative (Box 1). Thus, if any of the risk ratings are ranked as negligible (numerical value of 0), then the overall likelihood of introduction and spread becomes negligible. If a pest is highly unlikely to enter a PRA area, it is also unlikely that it will establish and spread.

The risk factors for consequence of introduction and spread, however, are independent of each other and the model is correspondingly additive. The absence of an environmental impact, for example, does not negate the probability of an economic or social impact

Box 1 Elements of Risk Assessment



2.1 ASSIGNING QUALITATIVE RATINGS

Probability is the likelihood of an event occurring. This may be expressed quantitatively such as 0.000001 or qualitatively such as "negligible". There are also semi-quantitative measurements of probability that incorporates aspects of both the quantitative and qualitative methods.

A PRA is conducted by CARICOM Member States using a qualitative method. Qualitative risk analysis methods use subjective information and judgements, based on evidence, experience and expert judgement, to provide a description of risks. The estimates of risk are expressed in qualitative terms such as high, medium and low, rather than numerical terms such as probabilities or frequencies.

A qualitative likelihood is assigned to each step of the estimates of a pest's risk potential. Four verbal descriptors of the likelihood of pest entry, establishment and spread are used (high, medium, low and negligible). In addition, the verbal descriptors are assigned numerical values of 3, 2, 1 and 0 respectively. The definitions of these descriptors and their assigned numerical values are given in Table 1.

Table 1 Nomenclature for qualitative probabilities

Likelihood	Descriptive Definitions	Numerical Value
High	The event is highly likely to occur	3
Moderate	There is some likelihood that the event would occur	2
Low	The event is unlikely to occur	1
Negligible	The event will almost certainly not occur	0

2.1.1 Combining Ratings

To summarise the information for the audience and decision makers, the different ratings must be combined into an end result. Two methods of combining qualitative rating are used: the use of risk matrices (multiplicative) and adding scores (Table 1). The method used depends on the stage of the PRA being conducted as described below.

1. Using matrices

A matrix of rules is used to combine ratings for two different risk elements. Thus, If the probability of entry, for example, is assigned a likelihood of LOW and the probability of establishment is assigned a likelihood of MEDIUM, then combining the likelihood in the symmetrical risk matrix gives a likelihood of LOW for the probability of introduction (Table 2)

Table 2 Matrix of rules for combining qualitative likelihoods

E.g. Probability of Risk Element 1	Probability of Risk Element 2			
	Negligible risk	**Low risk**	**Medium risk**	**High**
Negligible risk	Negligible Risk	Negligible Risk	Negligible Risk	Negligible Risk
Low risk		Low Risk	Low Risk	Medium Risk
Medium risk			Medium Risk	Medium Risk
High risk				High Risk

Risk is the product of probability and consequence. In determining the risk of importing the commodity into [Member State], a risk estimation matrix (Table 3) is used to combine the estimates of the probability of introduction and spread and the overall consequence of pest introduction and spread. Unlike the matrix in Table 2, this matrix is not symmetrical. The consequence of introduction and spread is the weighted against the probability of introduction and spread as the introduction and spread of a pest is irrelevant if there were no consequences to that event.

Thus, if the probability of introduction and spread is assigned a likelihood of LOW and the consequence of introduction and spread is assigned a likelihood of MEDIUM, then combining the likelihood in Table 3 gives a likelihood of MEDIUM for the overall risk potential. If, however, the converse was true, with probability rated MEDIUM and consequence rated LOW, then using the matrix would produce a rating of LOW risk for the probability of introduction.

Table 3 Risk Estimation Matrix

Probability of Introduction and Spread	Consequence of Introduction and Spread			
	Negligible risk	**Low risk**	**Medium risk**	**High**
Negligible	Negligible Risk	Negligible Risk	Negligible Risk	Negligible Risk
Low	Negligible Risk	Low Risk	Medium	Medium Risk
Medium	Negligible Risk	Low Risk	Medium Risk	High Risk
High	Negligible Risk	Medium Risk	Medium Risk	High Risk

1.1.1 Adding Scores:

The ratings are added together to reach a numerical score or rank (Table 4). The scores are assigned using the numerical values given to the qualitative probabilities in Table 1. This method is used in determining the overall consequence rating. The ratings for economic, environmental and social impacts are added to reach a final rating for consequence of introduction and spread.

Table 4. Adding scores to give an overall consequence rating

Pest	Economic Impact Rating	Environmental Impact Rating	Social Impact Rating	Cumulative Rating for Consequence of impact
Species	N, L, M, H 0, 1, 2, 3	N, L, M, H 0, 1, 2, 3	N, L, M, H 0, 1, 2, 3	N, L, M, H 0-9

2. GUIDELINE FOR CONDUCTING A PEST RISK ANALYSIS

In accordance with *ISPM 11 Pest Risk Analysis for Quarantine Pests* a PRA follows a process defined by three discrete stages:

Stage1: Initiating the process

Stage 2: Risk assessment

Stage 3: Risk management

The initiation of a risk analysis involves the identification of pest(s) and pathways of concern that should be considered for analysis. Risk assessment comprises pest categorization, 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 measures to reduce the risk of introduction and spread of the pest to an acceptable level.

2.1 STAGE 1: INITIATION OF PRA

The initiation stage of the PRA defines the scope of the analysis, identifying the pest(s) of concern and that will be considered for a risk analysis. The initiating stage is completed in the following three stages:

Initiation point:

Document the reason(s) for initiating the PRA, whether:

- the importation of a new commodity,
- importation from a new area or new country of origin or
- revision of a phytosanitary policy or priority

Identify the PRA area:

The PRA area is defined in ISPM No. 5 (2016) as the area in relation to which the pest risk analysis is conducted. The PRA area should be defined as precisely as possible in order to identify the area for which information is needed.

Information

Identify previous PRAs from the same country/region and the same or related commodity. The pathway or a very similar one may have been subjected to the PRA process before, nationally or internationally. If a PRA exists, its validity should be checked. **If there is an existing assessment that adequately assesses the risks concerned, the PRA stops**.

Describe appropriate current importations (the same commodity from other countries, other commodities from the same country).

Report pertinent pest interception at ports of entry (if applicable)

Use information provided by the potential exporting country, to provide details on the commodity involved. Include background to PRA, industry details and any existing pest management practice(s).

Prepare a comprehensive list of potential pests known to occur in the exporting country and that are associated with the commodity. This may be presented in tabular form (Table 5).

Table 5. List of potential pests associated with the commodity

Scientific Name	**Taxonomic Position**	**Plant Part Affected**	**Present or absent in the importing country**	**Present or absent in the exporting country**	**Follows Pathway** Yes/No	**References**
Arthropods Bacteria Fungi Molluscs Nematodes Viruses						

2.2 STAGE 2: PEST RISK ASSESSMENT

Risk assessment describes the process of identifying pests of quarantine concern and estimating the risk (the probability of introduction and spread and the magnitude of the likely consequences) associated with each.

The IPPC divides risk assessment into three broad categories:

- pest categorization,
- assessment of the probability of introduction and spread and
- assessment of potential consequences

2.2.1 PEST CATEGORIZATION

Pest categorization identifies which of the pests identified during the initiation stage are quarantine pests for a given Member State and requires a PRA. For each pest, the categorization process examines whether the criteria in the definition of a quarantine pest are satisfied and allows for the elimination of an organism from consideration before in-depth examination is undertaken.

A quarantine pest is a "pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled' (ISPM#5, *Glossary of phytosanitary*

terms 2009). Thus, categorization briefly examines whether a pest occurs in the PRA area or not, whether it would survive in the PRA area and whether it has the potential to cause economic harm.

The categorization of an organism as a quarantine pest includes the following primary elements: pest identity, presence or absence in a PRA area, regulatory status, potential for introduction and spread and potential for economic consequence in the PRA area. Information must be collected and provided indicating how each organism satisfies these criteria.

Pest Identity:

Indicate the correct scientific name and taxonomic position. The most common unit for the taxonomic identification is the species (e.g. *Raoiella indica*). The use of a higher or lower taxonomic level should be supported by a scientifically sound rationale.

Determine whether the organism is considered a pest in its area of current distribution.

Presence or absence in the PRA area and regulatory status

Determine if the pest occur in the PRA area and if so the distribution. If the pest is present in the PRA area but not widely distributed, it should be under official control to be considered a quarantine pest.

Official control includes

- eradication or containment in the infested area
- surveillance in the endangered area(s)
- measures related to controls on movement into and within the protected area(s), including measures applied at the port of entry

Potential for introduction and spread in the PRA area

Seek to answer the following questions:

- Is the pest likely to be associated with the specific pathway?
- Does at least one host-plant species occur in the PRA area?
- If transmitted by vector(s), is a vector present in the PRA area?
- Are eco climatic conditions in the area of current distribution comparable with those of the PRA area or similar enough for the pest to survive?

Potential for economic consequences in PRA area

Assess whether the pest could cause damage or loss to plants or other negative economic impacts (on the environment, on society, on export markets) through the effect on plant health in the PRA area.

The results of the categorization process may be represented in tabular form (Table 6)

Table 6 Quarantine status of pests associated with (commodity) imports from (exporting country)

Pest	Present in [Country]	Under official control	Potential for introduction and spread	Potential economic impact	Quarantine Pest	Background Information
Arthropods, Bacteria Fungi Nematodes viruses	Yes/No	Yes/No	High Medium Low Negligible	High Medium Low Negligible	Yes/No	Give scientific reasons for assessments

Conclusion of pest categorization

If it has been determined that the pest(s) pose a phytosanitary risk to the PRA area, the PRA process should continue. If it does not fulfil all the criteria for a quarantine pest, the PRA process for that pest stops. If complete information is not available, the uncertainties should be documented and the PRA continues.

The quarantine pests identified during pest categorization are listed in a table and carried forward for further pest risk assessment.

For each quarantine pest selected for further analysis, the probability of introduction and spread as well as the consequences must be assessed.

2.2.2 PROBABILITY OF INTRODUCTION AND SPREAD

Introduction is defined in the Glossary of Phytosanitary terms (FAO) as the entry of a pest resulting in its establishment. Thus, probability of introduction is the probability of **entry** and **establishment**.

Probability of Introduction (Entry)

The probability of entry describes the likelihood that a quarantine pest will:

- enter [PRA area] as a result of trade in a given commodity
- be distributed in a viable state in the PRA area and
- is transferred to a suitable host.

For convenience, the entry potential is further divided into two components:

- Probability of **Exportation**: the probability that a pest will leave the exporting country on the commodity
- Probability of **Importation**: the probability that a pest will arrive in [PRA area] when a given commodity is imported

Probability of Exportation

The probability of exportation assesses the concentration of the pest on the pathway in the country of origin and the influence of plant protection practices applied in the field and at the packing facility. Two risk factors are considered in the probability of exportation: the pest prevalence on the harvested commodity and the probability that it will survive post- harvest treatments. For each risk factor, pests are assigned a rating of high, medium, low or negligible. A negligible rating is not possible for pest prevalence as only pests likely to be on the commodity for export were selected for analysis.

Pest prevalence on the harvested commodity

This factor rates the size of the pest population that may be associated with the harvested commodity for export. The risk ranking is assigned by deciding which of the criteria in **Box1** best apply to the pest under analysis.

Box 1. Criteria for ranking pest prevalence on the harvested commodity

The rating is considered **LOW** if any of the following applies:

- The export area is recognized as an area of low pest prevalence
- The commodity is not a preferred host for the pest
- Viable life stages are unlikely on the harvested commodity
- The pest is not usually associated with the plant part for export

The rating is **MEDIUM** if any of the following applies:

- The commodity is an occasional host for the pest
- The plant part for export is not the preferred feeding site for the pest
- Effective management practices are applied in the field prior to harvest

The rating is **HIGH** if both of the following conditions applies:

- The commodity (plant part) for export is a preferred host and a preferred feeding site for the pest
- No effective field management practices exist or are applied

Likelihood of surviving post-harvest treatment and handling

This factor examines the likelihood of the pest surviving post-harvest processing, packing and preparation for shipment. Post- harvest treatment refers to any manipulation, handling, or phytosanitary treatment to which the commodity is subjected. It considers the ease of detecting and removing the pest from the commodity at the packing-house through the various treatment and handling procedures (washing, brushing, dipping, culling, chemical treatment, cold storage etc.). Also important are the safe guarding methods applied to prevent re-infestation of the commodity from the packing facilities to shipping.

Box 2 provides guidance on the ranking of likelihood of surviving post-harvest treatment and handling.

Box 2. Criteria for ranking likelihood of surviving post-harvest treatment and handling

The rating is considered **NEGLIGIBLE** if

- It is highly likely, based on evidence, that the entire pest population will be killed or rendered inviable during the processing of the commodity

The rating is considered **LOW** if any of these apply:

- The pest or symptom of its presence is easily detected and can be readily removed during handling
- The post-harvest treatments are likely to significantly reduce pest prevalence on the commodity

The rating is **MEDIUM** if any of these apply

- Pest/ symptoms can be detected through visible inspection but only by destructive sampling (e.g. cutting) of the commodity
- Post-harvest treatment will have little effect on the pest population but the commodity is adequately protected to prevent re-infestation and any increase in the pest population between harvest and shipping

The rating is **HIGH** if both of these apply:

- Applied post-harvest treatments are insufficient to detect and remove the pest from the commodity
- Safeguards for the commodity are absent, leading to the risk of re-infestation of the commodity between harvest and shipping.

Note: Consider that if only one applies, the risk is medium

Conclusion of probability of exportation

The ratings for the two risk factors: pest prevalence on the harvested commodity and the probability that it will survive post-harvest treatments are combined following the matrix in Table 2 to determine the risk rating for probability of the pest being exported on the commodity.

Probability of Importation

The probability of importation assesses the likelihood that the pest will arrive in [*Member State*] when a given commodity is imported. The two risk factors considered are:

1. The likelihood that the pest will survive storage and shipment and
2. The likelihood of the pest avoiding detection during inspection at the port of entry

Likelihood of surviving storage and transport

This factor assesses the likelihood that the pest will survive and remain with the commodity from packing through arrival at the port of entry in the importing country. It requires knowledge of the biology of the pest and information on the conditions of storage and transport of the given commodity and examines the likelihood that the pest will multiply/increase in prevalence during transport and storage.

Consideration should be given to:

- speed and condition of transport
- vulnerability of life stages likely to be transported
- whether the life cycle is of sufficient duration to extend beyond time in transit
- commercial procedures (e.g. refrigeration) applied to consignment in transport or at destination.

The risk rating is assigned based on the criteria in **Box 3**

Box 3. Criteria for ranking likelihood of surviving storage and transport

The rating is considered **NEGLIGIBLE** if:

- It is highly likely, that the entire pest population will be killed or rendered inviable during storage and shipment

The rating is considered **LOW** if:

- The condition of storage and shipment would significantly reduce the pest population on the commodity

The rating is **MEDIUM** if:

- The conditions under which the commodity is stored and shipped will have little or no effect on the pest population.

The rating is **HIGH** if:

- The prevalence of the pest can significantly increase during storage and shipping

Likelihood of avoiding detection during inspection

This factor examines the probability that the pest will go undetected under current inspection procedures. The likelihood of detecting the pest during inspection or testing will depend on a number of factors including:

- ease of detection of life stages which are likely to be present
- location of pest on commodity
- symptom expression
- ability to be distinguished from other organisms

The criteria in Box 4 are used to rank the likelihood of avoiding detection during inspection

1 **Box 4. Criteria for ranking likelihood of avoiding detection during inspection**

The rating is considered **NEGLIGIBLE** if:

- The pest and or external damage caused to the commodity is highly visible to the naked eye

The rating is considered **LOW** if:

- The pest can be detected on the external surface with the aid of a hand lens or microscope

The rating is **MEDIUM** if:

- The pest is an internal feeder and is detected only through destructive sampling (cutting) of the commodity

The rating is **HIGH** if:

- The pest can only be detected using special diagnostic techniques (e.g. molecular methods, serological tests)

Conclusion of probability of exportation

The ratings for the two risk factors: The likelihood that the pest will survive storage and shipment and the likelihood of avoiding detection during inspection at the port of entry are combined to determine the risk rating for probability of the pest being exported on the commodity.

Conclusion of Probability of Entry

Combine the risk rankings for the probability of exportation and that for the probability of importation in a risk matrix (Table 2) to determine a ranking for the probability of entry

Probability of Introduction (Establishment)

In order to estimate the probability of establishment of a pest, reliable biological information (life cycle, host range, epidemiology) and other factors affecting its survival should be obtained from the area where the pest currently occurs. The situation in the PRA area can then be compared with that in the area where it currently occurs.

The opportunity for establishment is assessed based on two risk factors:

- The likelihood of the pest coming in contact with suitable host material
- The likelihood of it surviving existing climatic conditions.

Note: In small island states such as CARICOM Member States, the PRA area is considered the entire island. Commodities entering the country from any destination are transported across the entire Island, that is, throughout the PRA area. Likewise, all entry, transit and destination points are considered close to suitable hosts. In addition, CARICOM Member States lack seasonality, allowing for fairly consistent climatic conditions all year and at all locations.

Likelihood of coming in contact with suitable host material

In assessing the likelihood that the pest will find suitable hosts in the PRA area, the following should be considered:

- Distribution of the hosts in [*Member State*] (consider if the pest requires alternate hosts to complete its life cycle, and if those hosts are present in the PRA area).
- The presence of other plant species that could prove to be suitable hosts in the absence of the usual host species
- The pest life stage present on the commodity and the likelihood of it coming in contact with host material and infesting it.
- Presence of vectors needed for its dispersal

Box 5 provides guidance on determining the risk rating for likelihood of **coming in contact with suitable host material**

Box 5: Criteria for ranking likelihood of coming in contact with suitable host material

The rating is considered **NEGLIGIBLE** if any of the following applies:

- There are no suitable host available in the PRA area
- The pest life stage present is highly unlikely to move on its own from the commodity
- A vector or other agent necessary for contact with the host is absent from the area

The rating is considered **LOW** if any of these applies:

- Few natural hosts exist in the PRA area
- The life stages of the pest that is dispersed is limited in its ability to disperse naturally
- Vectors and other dispersal agents are present but the prevalence is low.

The rating is **MEDIUM** if any of the following applies:

- Suitable hosts are only available in select areas of the PRA area such as on commercial farms or botanical gardens
- The pest is capable of dispersal on its own or through widely prevalent vectors

The rating is **HIGH i**f all of these apply:

- Suitable hosts are widely distributed throughout the PRA area
- No alternate hosts are needed to complete development or, if needed, are widely available

The likelihood of the pest surviving existing climatic conditions

This factor assesses whether the climatic conditions in the country are suitable for the establishment of the pest.

When introduced into a new area, pests can be expected to behave as they do in their native areas if climates are similar. Thus, the climatic condition in the PRA area is compared with those of the area where the pest is established.

Box 6 provides guidance on determining the risk rating for likelihood of **surviving climatic conditions.**

Box 6: Criteria for ranking the likelihood of surviving existing climatic conditions

The rating is considered **NEGLIGIBLE** if:

- Evidence from the global distribution of the pest suggests that it cannot survive the climatic conditions in the PRA area.

The rating is considered **LOW** if:

- The climatic conditions for the successful establishment of the pest are present in the PRA area only occasionally and under extreme conditions (unusual rainfall, cold front etc.) or in select areas

The rating is considered **MEDIUM** if any of the following applies:

- Some of the climatic conditions for the successful establishment of the pest (e.g. temperature, humidity, rainfall) are present in the PRA area but others are not.

The rating is considered **HIGH i**f:

- All climatic conditions for the pest establishment on a suitable host are present in the PRA area

Conclusion of Probability of Establishment

The ratings for the two risk factors: the likelihood that the pest will come in contact with suitable host material and the likelihood that it will survive existing climatic conditions are combined as per Table 2 to determine the risk rating for probability of the pest becoming established in the PRA area.

Conclusion of the Probability of Introduction

The risk ratings for the risk elements, probability of entry and the probability of establishment are combined in a risk matrix (Table 2) to determine the risk rating for the probability of introduction.

Probability of Spread

Spread is defined as the expansion of the geographical distribution of a pest within an area. The assessment of spread concerns movement from the intended habitat or the intended use to an unintended habitat, where the pest may establish. In order to estimate the probability of spread of a pest, reliable biological information must be obtained from the area where the pest currently occurs and the situation carefully compared with that in the PRA area.

The spread potential is assessed based on two risk factors:

1. **Dispersal Potential of the pest**
2. **Intended use of the commodity**

Dispersal Potential of the Pest

Dispersal potential considers the reproductive patterns as well as the dispersal mechanism of the pest, including vectors, to allow movement from the pathway to a suitable host.

Box 7 provides guidance on determining the risk rating for **dispersal potential of the pest**

Box 7: Criteria for ranking dispersal potential of the pest

The rating is considered **NEGLIGIBLE** if any of the following applies:

- There is no evidence that the pest is spreading or has spread in other parts of the world
- The pest requires specific vectors for dispersal that are not present in the PRA area
- The dispersal stage of the pest requires special conditions that do not occur in the PRA area

The rating is considered **LOW** if any of these apply:

- The pest has low reproductive potential and/or limited natural dispersal capacity
- Vectors and other dispersal agents are present but the prevalence is low
- Spread of the pest in other parts of the world has been slow and limited

The rating is considered **MEDIUM** if any of the following applies:

- Pest has either high reproductive potential or the species is capable of rapid dispersal
- The pest is capable of dispersal on its own or through widely prevalent vectors

The rating is considered **HIGH** if both of these apply:

- Evidence exists that the pest is capable of rapid dispersal on its own, via natural forces (e.g. wind, water), by vectors or human assisted.
- Evidence exists that the pest is spreading or has spread in other parts of the world

Intended use of the commodity

End-use such as planting, processing or consumption will all affect the chances of the pest transferring to a suitable host and becoming established.

Box 8 is used to determine the risk rating for **intended use of the commodity**

Box 8 Criteria for ranking the risk posed by the intended use of the commodity

The rating is considered **NEGLIGIBLE** if:

- The commodity will be sent directly to a post entry quarantine facility where it will be used and subsequently destroyed.

The rating is considered **LOW** if:

- The commodity is intended for research purposes in a controlled environment or is intended for processing

The rating is considered **MEDIUM** if:

- The commodity is intended for consumption and will be distributed to special markets

The rating is considered **HIGH i**f:

The commodity is intended for planting and will be distributed to farms across the Island

Conclusion on probability of spread

The ratings for the two risk factors: the dispersal potential of the pest and the intended use of the commodity are combined (Table 2) to determine the risk rating for the probability of the pest spreading in the PRA area.

Conclusion on the probability of introduction and spread

The risk ratings for the probability of introduction and that for the probability of spread are combined in a risk matrix (Table 2) to determine the risk rating for the probability of introduction.

2.2.3 A*SSESSMENT OF POTENTIAL ECONOMIC CONSEQUENCE*

This section seeks to analyse the likely consequence should the pest enter, establish and spread in the PRA area.

In many instances, detailed analysis is unnecessary if sufficient evidence is already available or the risk presented by the pest is widely agreed.

The assessment considers direct and indirect pest effects and their economic, environmental and social consequences as listed in Table 7.

Table 7: Potential Consequences from Pest Introduction and Spread

	Economic Impact	**Environmental Impact**	**Social Impact**
Pest Effect	Reduction in yield of host crop (due to production losses or loss of marketable commodity)	Reduction of ecologically significant species by direct infestation	Loss of employment
	Reduction in value of host due to quality loss or diverted market	Impact on threatened or endangered species e.g. through habitat destruction	Loss of land use function (agriculture and living area)
	Loss of domestic or export market	Stimulate the use of biological or chemical control programmes	Contribution to wellbeing (aesthetic value, historical value)
	Increased production cost	Reduction in biodiversity	Production of services such as water quality, animal grazing and fishing
	Introduced regulatory cost (e.g. phytosanitary measure	Impact on plant communities	Impact on other industries e.g. tourism, energy

Each of the three risk factors (economic, environmental and social impact) is assessed, taking into consideration the associated pest effects and based on the criteria in Box 9.

In this section, the numerical values for the qualitative descriptors (Table 1) are also assigned to the risk ratings.

Box 9: Criteria for assessing each of the potential impacts

The rating is considered **NEGLIGIBLE (0)** if:

- The pest will have none of the listed pest effects

The rating is considered **LOW (1)** if:

- The pest is likely to cause only one of the listed pest effects

The rating is considered **MEDIUM (2)** if:

- The pest is likely to cause two of the listed pest effects

The rating is considered **HIGH (3)** if:

- The pest is likely to cause three or more of the listed pest effects

Conclusion on the likelihood of economic consequence

For each pest, sum the ratings for the three risk factors to produce a cumulative risk rating for consequence of introduction and spread (Table 8). The cumulative risk rating should be interpreted as follows:

Negligible: 0 points

Low: 1-2 points

Medium: 3-4 points

High: 5-9 point

Table 8: Risk Rating for Consequence of Introduction and Spread

Pest	Factor 1 Economic Impact	Factor 2 Environmental Impact	Factor 3 Social Impact	Cumulative Risk Ratings
Pest species	N, L, M, H 0, 1, 2, 3	N, L, M, H 0, 1, 2, 3	N, L, M, H 0, 1, 2, 3	N, L, M, H 0-9

2.2.4 OVERALL ASSESSMENT OF PEST RISK

The overall assessment of risk requires the combination of likelihood of pest introduction and spread and consequences of that introduction, if it occurs. This is determined by using a risk estimation matrix (Table 3) to combine the estimates of the probability of pest introduction and spread (Section 2.2.2) with the overall consequence of introduction and spread (Section 2.2.3).

3. STAGE 3 PEST RISK MANAGEMENT

The final stage in the PRA process is pest risk management. Pest risk management uses the conclusion from the pest risk assessment to decide whether risk management is required and if so, the appropriate measure to use. The guiding principle is to manage risk to achieve the required degree of safety that can be justified and is feasible within the limits of available options and resources.

If on completing the risk assessment stage, the risk is considered unacceptable, then the analytical process of risk management proceeds as follows:

1. Identification of potential phytosanitary measures to reduce the risk to or below an acceptable level
2. Evaluation of the identified measures for efficacy and feasibility
3. Selection of appropriate measures

3.1 Identification of potential phytosanitary measures

The first step in the risk management process is to identify management options that can be applied to reduce the identified risk(s) including, where available, measures set by international standard-setting bodies. These options can consist of existing measures or they may be new measures developed specifically to address the risk from the import under consideration. Measures can range from total prohibition to permitting import subject to visual inspection. In some cases, more than one measure may be required in order to reduce the pest risk to an acceptable level.

The measures that are most commonly applied to traded commodities can be classified into broad categories which relate to the pest status of the pathway in the country of origin (Table 9).

These include measures:

- Applied to prevent or reduce original infestation in the growing crop
- Applied to the consignment and commodities
- To ensure the area or place of production is free from pest
- Concerning the restriction or prohibition of commodities
- Applied during pre-and post-harvest handling
- Applied within the importing country

Table 9: Common measures applied to manage pest risk

Pathway points	Mitigation measures
Pre-harvest	• Pest-free areas or areas of low pest prevalence • Resistant cultivars • Healthy planting material • Sanitation and cultural controls • Certification schemes • Testing • Protected conditions
Harvest	• Harvesting at specific times or at specific stages of ripeness • Culling infested products • Field sanitation • Harvest techniques • In-field chemical treatments • Field surveillance
Post-Harvest Handling	• Post-harvest treatments (chemical, heat, waxing, washing, brushing, etc) • Testing • Culling • Packinghouse inspection • Processing (degree and type)
Shipping	• Treatment in transit (e.g., cold treatment) • Speed and type of transport • Pre-shipment inspection • Testing
Distribution	• Restriction on ports of entry • Post-entry quarantine • Post-entry inspection • Post-entry treatment • Packaging
End Use	• Restriction on end-use • Post-entry processing

3.2 Evaluation of identified measures for efficacy and feasibility

When all the risk management options have been identified for a particular risk or group of risks, they should each be evaluated to ensure they will mitigate the risk to the desired level either alone or in combination with other measures. At the same time, each option should also be evaluated to ensure they are feasible or applicable to the context in which they are to be applied.

For each option, then, that has been identified as a possible mitigation measure, the analyst must determine:

- Is it effective in reducing pest risk to an acceptable level?
- Is it efficient? Does the measure reduce pest risk with minimal waste and cost?

- Is it cost effective? That is, is the cost of the measure less than the cost of not mitigating?
- Is it feasible? Is it physically and practically possible to implement the requirement?
- It is reproducible? If the same measure is applied to the same or similar consignments, does it yield the same results each time?
- Will application of the treatment result in potential negative social, economic or environmental consequences?

Table 10 may be used to organize the information by answering yes or no for each criterion

Table 10. Assessment of the efficacy and feasibility of identified phytosanitary measures

Potential Management Options	Effective	Efficient	Feasible	Reproducible	Cost Effective	Potential adverse effect
Option 1	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No

3.3 Selection of appropriate measures

The most appropriate phytosanitary measures are those that are feasible, effective and provide reasonable benefits given the costs. An analysis of cost-effectiveness can help identify the least costly pest risk management option for meeting an identified goal. In general, the preferred pest risk management options will be those where adverse impacts are as low as reasonably feasible.

3.4 CONCLUSION OF PEST RISK MANAGEMENT

The pest risk management process results in either no appropriate measures being identified, or selection of one or more management options that have been found to lower the risk associated with the quarantine pest(s) to an acceptable level. It is useful to document the evaluation of pest risk management options and the reasons for selecting preferred options, as this information may prove useful in cases of disagreement, failure of options to achieve the desired results, or in future cases of a similar nature. These management options form the basis for phytosanitary regulations or requirements which may be developed by [*Member State*] in response to the risk presented by the pest.

The conclusion of the pest risk management stage marks the end of the PRA. As for other stages of the PRA, pest risk management is an iterative process; it is not necessary to complete each step sequentially. Continual review and revision is required as new information is obtained. Pest risk communication throughout the PRA process is helpful and will ensure complete information is acquired at each stage, that stakeholders understand the issues involved and that the Risk Analyst has all the necessary information to complete the PRA process adequately

4. APPENDIX 1 FURTHER READING AND RESOURCES

Search Tools

General Search Engines:

- Google: http://www.google.com
- AllSearchEngines: http://www.allsearchengines.com

Literature Searches:

- Agricola : http://agricola.nal.usda.gov
- E-Journals.org (http://www.e-journals.org/) :
- Pubmed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi
- Science Direct (http://www.sciencedirect.com/)
- Scirus (http://www.scirus.com/):
- Entomological journals on the web (http://www.medbioworld.com/bio/journals/insect.html)

Early Warning, Pest Alerts and Archives:

- Agriculture Network Information Center (AGNIC), Plant Diseases Announcements (http://www.agnic.org/pmp/)
- Center for Invasive Plant Management (http://www.weedcenter.org/)
- EPPO Pest Alerts (http://www.eppo.org/QUARANTINE/Alert_List/alert_list.htm):
- Invasive Species Emerging Issues (http://www.invasivespecies.gov/new/emerge.shtml
- NAPPO Phytosanitary Alert System (http://www.pestalert.org/): North American Plant Protection Organization
- National Agricultural Pest Information System (NAPIS) (http://ceris.purdue.edu/napis/)
- National Plant Board (NPB) Plant Pest Issues (http://nationalplantboard.org/issues.html)
- New Disease Reports (http://www.bspp.org.uk/ndr/):
- Pestnet (http://www.pestnet.org /)

- ProMed (http://www.fas.org/promed/):
- The Nature Conservancy (TNC) Invasives on the Web (http://tncweeds.ucdavis.edu/index.html)
- University of Florida Pest Alert (http://pestalert.ifas.ufl.edu/)

General Resources:

General Resources - Online:

- APHIS Raleigh Plant Protection Center: (http://www.invasivespecies.org/)
- APHIS Regulated Pest List (PPQ website) http://www.aphis.usda.gov/ppq/regpestlist/
- Australian Quarantine and Inspection Service (http://www.daff.gov.au/aqis)
- Biosecurity New Zealand Risk Analysis Procedures Version 1, Biosecurity New Zealand,
- 2006. 103 pp (http://www.biosecurity.govt.nz/
- CAB International (CABI) Bioscience (http://www.cabi.org/)
- CABI Crop Protection Compendium (http://www.cabi.org/cpc)
- CABI Invasive Species Compendium (http://www.cabi.org/isc)
- California Exotic Pest Plant Council (http://www.caleppc.org/)
- Canadian Forest Service (http://www.nrcan-rncan.gc.ca/
- CFIA Plant Pest Information (http://www.inspection.gc.ca/)
- COSAVE (http://www.cosave.org)
- Crop Knowledge Master (http://www.extento.hawaii.edu/):
- Department of Agriculture- Western Australia (http://www.agric.wa.gov.au /)
- Ecoport (http://www.ecoport.org/ep
- Featured Creatures (http://creatures.ifas.ufl.edu/)
- Florida Exotic Pest Plant Council (http://www.fleppc.org /)
- Great Lakes Information Network (http://www.great-lakes.net/)
- International Association for the Plant Protection Sciences (http://www.plantprotection.org /)
- International Survey of Herbicide Resistant Weeds http://www.weedscience.org/in.asp)
- IPPC 2006. International Plant Health Risk Analysis Workshop 24 - 28 October 2005, Niagara Falls, Canada http://phytosanitary.info/information/ippc-pest-risk-analysis-training-course

- Israel Journal of Plant Protection Sciences (http://www.phytoparasitica.org)
- Ministry of Agriculture and Forestry, New Zealand (http://www.maf.govt.nz/
- National Association of State Departments of Agriculture (http://www.nasda-hq.org/)
- New Pest Advisory Group (NPAG) (http://www.cphst.org/NPAG /)
- North American Exotic Forest Pest Information System (http://www.exoticforestpests.org/:
- Queensland Government (http://www.nrm.qld.gov.au /)
- RiskWorld (http://www.riskworld.com/):
- ScaleNet (http://www.sel.barc.usda.gov/
- Secretariat of the Pacific Community Plant Protection Service (http://www.spc.int/
- Systematic Entomology Laboratory (http://www.sel.barc.usda.gov/
- Texas Department of Agriculture-Alerts:(http://www.agr.state.tx.us/
- The World Conservation Union Invasive Species Specialist Group (http://www.issg.org/)

5. LITERATURE CITED

IPPC. 1997. International Plant Protection Convention. Rome, IPPC, FAO

WTO. 1994. Agreement on the Application of Sanitary and Phytosanitary Measures. Geneva, World Trade Organization.