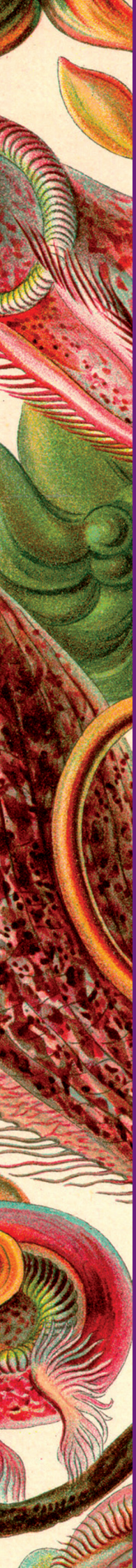

CAPACITY DEVELOPMENT

Food and Agriculture Organization of the United Nations

International Plant Protection Convention

MAR
2023

ENG

Emergency preparedness

A guide for developing contingency plans for outbreaks of quarantine pests

Funded by the European Union

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A guide for developing contingency plans for outbreaks of quarantine pests

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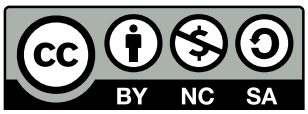

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2023-03 Version 1.0 Published to support implementation of ISPM 9 (*Guidelines for pest eradication programmes*) adopted by CPM-1 (1998).

Abstract

Contingency planning for quarantine pests is an essential activity for the effective operation of a national plant protection organization (NPPO). In this guide, generic and pest-specific contingency plans are defined, and the main components of these plans are outlined. For each of these components, guidance is provided on how NPPOs, in collaboration with relevant stakeholders, can effectively organize and allocate their resources to ensure that pests are eradicated quickly or are effectively contained. The guide also discusses the criteria to establish and maintain pest freedom, the reporting of outbreaks and recovery, and includes eight case studies around the world that illustrate various aspects of contingency planning for outbreaks of quarantine pests. The guide does not cover interceptions of quarantine pests in imported consignments or other regulatory incidents associated with traded commodities.

Contents

Acknowledgements

This document presents guidance to national plant protection organizations (NPPOs) and regional plant protection organizations (RPPOs) to support contingency planning for quarantine pests. It was created under the auspices of the Secretariat of the International Plant Protection Convention (IPPC) as a component of the *Strategic Framework for the IPPC (2020–2030): Protecting global plant resources and facilitating safe trade.* This work has been developed and peer-reviewed by selected experts all over the world under the coordination of the IPPC Secretariat with the oversight of the IPPC Implementation and Capacity Development Committee (IC).

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Abbreviations and acronyms

APHA	United Kingdom Animal and Plant Health Agency
CABI	Centre for Agriculture and Bioscience International
COMESA	Common Market for Southern and Eastern Africa
COP	common operating picture
CPM	Commission on Phytosanitary Measures
DEFRA	United Kingdom Department for Environment, Food and Rural Affairs
EPPO	European and Mediterranean Plant Protection Organization
EPPRD	Australian Emergency Plant Pest Response Deed
GIS	geographic information system
GPS	Global Positioning System
IAP	incident action plan
IICA	Inter-American Institute for Cooperation on Agriculture
IMS	incident management system
IMT	incident management team
IPM	integrated pest management
IPP	International Phytosanitary Portal
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
NGO	Non-governmental organization
NPPO	national plant protection organization
OIRSA	Organismo Internacional Regional de Sanidad Agropecuaria
PCR	polymerase chain reaction

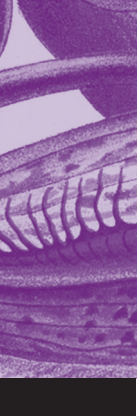
PFA	pest free area
PRA	pest risk assessment
RADA	Jamaica Rural Agricultural Development Authority
RPPO	regional plant protection organization
SIT	sterile insect technique
SOP	standard operating procedure
TAWG	*Tuta absoluta* Working Group
ToBRFV	Tomato brown rugose fruit virus
USDA	United States Department of Agriculture

About this guide

Section 1 introduces contingency planning and highlights the responsibilities of national plant protection organizations (NPPO) with respect to contingency planning for quarantine pests. It also covers the purpose and scope of generic and pest-specific contingency plans and the key principles of outbreak management. **Section 2** then explores the organization arrangements of an NPPO, including legislation and command structures. **Section 3** follows with outbreak-preparedness activities, such as training, outbreak exercises/simulations, and operational resources and guidance. **Section 4** considers the pest information required to respond to a particular pest and that should be included in a pest-specific contingency plan. The following three sections describe the outbreak management response. **Section 5** starts with the notification of an outbreak, triage and escalation, the containment measures and investigation into the outbreak; **Section 6** covers the main operational phase, including demarcation, surveillance and pest management measures; and **Section 7** considers the review and audit of the response in cases of prolonged official action. **Section 8** then covers the end of the outbreak management response and considers the criteria for pest freedom and measures to maintain this freedom. **Section 9** focuses on recovery, including de-escalation, stakeholder support and compensation arrangements. **Section 10** introduces a lessons learned exercise that can be applied after the outbreak management response has been completed. **Section 11** includes eight case studies from around the world that describe different successful eradication campaigns aligned with ISPM 9 (*Guidelines for pest eradication programmes*), outbreak responses (one of them based on a previously existing contingency plan) and preparation for an outbreak.

Users of the guide are encouraged to provide feedback on the guide to help strengthen future editions of the guide and other training resources.[1]

[1] Send email to ippc@fao.org



1. Introduction

1.1 CONTEXT

Rapid increases in overseas tourism, imports and exports, mail, changing transport procedures and new pathways are raising the risk of introducing and spreading plant pests. Climate change is also increasing the risk, as the climate of some regions becomes more suitable for the establishment and spread of non-native species, and new trade pathways open due to global changes in plant distribution and production. Outbreaks of plant pests are therefore increasingly likely.

Contingency planning is an essential activity for containment and eradication of quarantine pests and for the effective operation of an NPPO. Contingency planning is a forward-looking exercise in which plans are developed to address specific pests or pest groups that have a high potential for introduction, and for which an eradication plan is deemed to be both feasible and necessary, before the pest is found in an area.

One of the main activities of an NPPO is to conduct pest eradication programmes to eliminate a pest from an area. Within the IPPC context, ISPM 9 (*Guidelines for pest eradication programmes)* has been developed to provide guidance on these eradication programmes.

The need for contingency planning is recognized by the International Plant Protection Convention (IPPC) Strategic Framework 2020–2030, which supports NPPOs and the Commission on Phytosanitary Measures (CPM) in their work to overcome the emerging challenges linked to the growth and increasing diversity of global trade in food, agricultural and forestry products, and the increasing volume and speed of passenger and freight movements. The framework defines priorities and actions of the global plant health community for the next decade. This includes a willingness to strengthen pest outbreak alert and response systems, of which contingency plans are a part. (IPPC Strategic Framework, 2021).

The continued development of contingency plans for plant biosecurity risks and export-market access risks will provide NPPOs, as well as businesses, plant industries and sectors, with detailed information on improving readiness for a generic response and particular plant pest risks. Efforts should focus on improving the way contingency material is developed and delivered to increase functionality and better tailor the content to the needs of the NPPO and those involved in an outbreak response. Once developed, there is value in testing contingency plans through national simulation exercises in advance of an outbreak. (DAWE, 2021).

Developing contingency plans provides the opportunity to consider requirements for a response and to prepare for an outbreak by having agreed procedures, roles, responsibilities, budgets, treatments, etc. in place. It also provides additional time for deliberation, evaluation and research necessary to ensure that an eradication programme is well designed and can be executed quickly and effectively. Where cooperative programmes are anticipated, a contingency plan allows for the actions of cooperating parties to be specified and agreed upon before implementing the programme. Knowledge gained from previous successful eradication programmes can also be extremely useful for developing contingency plans or judging the feasibility of eradication programmes under consideration.

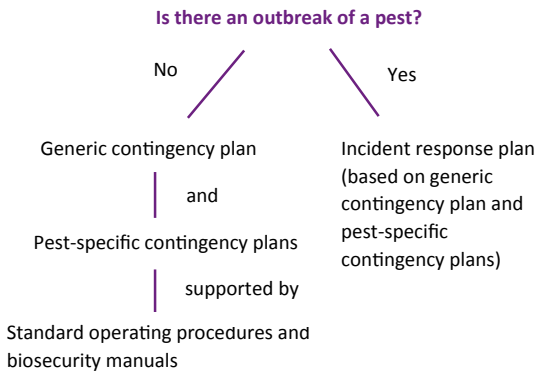
1.2 PURPOSE OF THE GUIDE

During the working group on development of the IPPC *Framework for Standards and Implementation* in August 2014, a gap was identified in guidance for contracting parties and NPPOs related to preparing for and responding to quarantine pest outbreaks. Although ISPM 9 provides guidelines for pest eradication programmes and emphasizes the importance of contingency planning – and there are specific guidelines for contingency plans for fall armyworm (IPPC, 2021) and for Fusarium tropical race 4 (TR4) banana wilt (IPPC, 2023) – there is little other guidance for contracting parties or NPPOs on developing and using contingency plans. This guide provides additional support to NPPOs in developing contingency plans for outbreaks of quarantine pests and organizing and allocating resources effectively.

1.3 SCOPE OF A CONTINGENCY PLAN

Contingency plans may have various names in different parts of the world, such as emergency response plans, emergency management (FAO, 2011), contingency plans, control strategies, etc. However, they all contain similar information and have a similar purpose, which is to prepare a management response to outbreaks of a plant pest. This guide provides detailed information on two types of contingency plans: generic contingency plans and pest-specific contingency plans. Plans are also developed at the onset of an outbreak, often called incident action plans (IAPs), but these will only be introduced and not elaborated on further in this guide. Contingency plans are generally supplemented with supporting material, including standard operating procedures (SOPs) and biosecurity manuals. As with IAPs, these will be introduced but will not be covered in detail in this guide.

Figure 1: Types of documents that should be developed before and at the beginning of an outbreak of a plant pest



Source: Author's own elaboration.

1.3.1 Generic and pest-specific contingency plans

Contingency plans can be either generic or specific, and the main differences between them are outlined below.

- A generic contingency plan describes how an NPPO will manage outbreaks of plant pests, regardless of species or situation. It covers the physical and human resources that are required for an emergency response and describes the outbreak management process.
  - A generic contingency plan should, as a minimum, identify the general rules, responsibilities, resources, skills and knowledge requirements needed during an outbreak response. It should provide the framework for detection, diagnosis, assessment, selection of control treatments, surveys, quarantine and movement controls, eradication and stand-down. Information on the organizational arrangements put in place to respond to a plant pest can be found in section 2 on organizational arrangements.
- Pest-specific contingency plans describe how an NPPO will respond to outbreaks of certain high-risk pests, and detail additional measures over and above those set out in a generic contingency plan. These plans may address individual species or groups of related species that have the potential to enter a country, establish and impact the economy, environment or society.
  - A pest-specific contingency plan should include important summary information on the specific pest and its biology and, in particular, on its introduction, detection and spread together with references to sources of further information. The plan will also provide pest-specific information for the outbreak management process and response covered in the generic contingency plan. For example, where a generic contingency plan will say that a quarantine area should be established, the pest-specific plan will specify the size of the area based on the biology of the pest and climatic conditions. Information on pest-specific information can be found in section 4 on background information on the pest.

1.3.2 Incident action plans (IAP)

The contingency plan can support the development of an IAP, a plan developed for a particular outbreak situation. IAPs are designed to move response operations from a reactive to proactive mode. It provides responders with direction on what to accomplish in a certain period of time (operational period) and the resources necessary to support the operations. Because the outbreak situation changes over time, IAPs must be revised on a regular basis (at least once per operational period) to maintain consistent, up-to-date guidance to outbreak responders.

The following should be considered for inclusion in an IAP:

- aim, objectives and goals;
- operational period objectives (major areas that must be addressed in the specified operational period to achieve the goals or control objectives);
- response strategies and tactics (priorities and the general approach to accomplish the short- and long-term objectives);
- health and safety plan (to prevent responder injury or illness);
- communication plan (how functional areas can exchange information);
- logistics plan (e.g. procedures to support operations with equipment, supplies, etc.);
- outbreak map (i.e. map of quarantine area);
- organization list, including primary roles, responsibilities and relationships (decision-making mechanism);
- assignment list with specific tasks;
- critical situation updates and assessments;
- liaison arrangements with stakeholders;
- equipment needs;
- accommodation arrangements; and
- risks.

1.3.3 Standard operating procedures (SOPs)

Other documents will support a contingency plan. These include SOPs, which provide a written list of responsibilities for a specific role or function and describe the tasks to be carried out under that role or function during an outbreak management response. These documents provide a platform for national consistency.

Each procedure contains a number of key features, as follows:

- *Purpose:* describes what the procedure is providing guidance on.
- *Application/scope:* identifies what is and is not covered by the procedure.
- *Resources/equipment:* lists the type and, where applicable, quantity of resources required to undertake the procedure.
- *Work health and safety:* describes any workplace health and safety risks.
- *Description of activities:* provides a step-by-step description of the tasks to be performed.
- *References:* lists relevant references, supporting material or related procedures that may assist in completing the procedure.
- *Checklists, forms and templates for this procedure:* lists identified documents referred to in the procedure.
- *Record-keeping:* identifies records that need to be kept and the method to complete, file and keep the records.

1.3.4 Development of industry biosecurity plans and industry biosecurity manuals

Biosecurity planning provides a mechanism for an agricultural industry, government and other relevant stakeholders to assess current biosecurity practices and future biosecurity needs. The participation of stakeholders in the development and implementation of eradication and contingency plans is highly desirable, especially when stakeholders have a role in operational aspects of the programmes. These roles are described in Appendix 5 of the 2015 IPPC guide on managing relationships with stakeholders.

Biosecurity planning identifies procedures that can be put in place to reduce the chance of pests reaching a country's borders or minimize the impact if a pest outbreak occurs.

Biosecurity manuals contain information to help producers implement biosecurity on-farm. Manuals could contain an overview of biosecurity, fact sheets to identify the high priority pests of a crop, tips on crop management, and how to manage people, vehicles and equipment to minimize biosecurity risks, and information on who to contact if a quarantine pest is found. Manuals could also contain a biosecurity self-assessment list and templates to record pest surveillance records and visitors.

1.4 KEY PRINCIPLES OF PLANT HEALTH OUTBREAK MANAGEMENT

When writing a contingency plan, the following principles should be taken into account.

1.4.1 A contingency plan should be effective

To be effective, a contingency plan should meet the following criteria:

- Realistic: the plan should be achievable within a predicted budget.
- Integrated/inclusive: the plan should utilize the skills and experience across the NPPO and other stakeholders (i.e. avoid silo working) and ensure the plan is acceptable for all. The plan should be made available to all NPPO personnel and key stakeholders once complete.

- Direct: the plan should be clear and understandable.
- Adaptable: the plan should be flexible depending on the situation.
- Concise: the plan should be to the point to avoid confusion.
- Relevant: the plan should be applicable to the outbreak situation.

1.4.2 Outbreak responses should be targeted at quarantine pests

A plant pest should be considered of national significance if it would likely have national impacts on either the environment; society, such as human infrastructure and social amenities, or the economy.

Assessments of quarantine status are based on pest risk analysis in line with ISPM 2 (*Framework for pest risk analysis*) and ISPM 11 (*Pest risk analysis for quarantine pests*) and consider issues such as previous history of successful establishment in new areas and pest characteristics.

For further detail about assessing the significance of a pest and the outbreak situation, refer to section 4 on background information of the pest.

1.4.3 Outbreak responses should be feasible and practical

Consideration should be given to the technical feasibility and practicality of eradication, given the information available. Where eradication is not possible, movement to containment or transition to stakeholder management may be necessary.

Even if an outbreak response ends up not being feasible or practical, it is important that a contingency plan considers response commitments that should be undertaken before a decision is made about technical feasibility and practicality. Activities such as imposing restrictions on trade, movement controls, delimitation, treatment and suppression, for example, should be covered to preserve the opportunity to carry out an outbreak management response if the assessment deems the outbreak response to be feasible and practical.

For further detail about assessing the feasibility and practicality of an outbreak response, refer to section 5 on official actions taken based on a suspect outbreak.

1.4.4 Response strategies and tactics should be based on accurate data

Data-gathering should be a continuous emergency management function; it is conducted before (detection), during (assessment and monitoring) and after (evaluation) the outbreak response to ensure that decision-making is based on the most up-to-date information.

Implementing effective data quality control will increase the value of data across an organization, both as a strategic and operational asset. Sharing trusted, high-quality data enable confident decision-making, inform policy development, promote data reuse and support service delivery.

Setting minimum data standards to all critical and shared data assets provides a solid foundation for a consistent approach to measure, communicate and improve the quality of data. These standards ensure the data generated can be easily verified, analysed and interpreted by participants in an emergency response.

The following points can be used to guide assessment of the quality of data:

- Completeness: How complete are the data? Are there known gaps?
- Representative: Is the dataset representative of the conditions or scenario to which it refers?
- Timeliness/currency: Are the timeliness and currency of the data appropriate?
- Fit for purpose: Are the data fit for purpose of their original or intended use?
- Consistency: Are the data consistent with related datasets, agreed standards and formats?
- Collection: What was the collection method, and was it consistent?
- Accuracy: Are the data accurate and valid, and to what level?

Minimum data standards support data being collated from multiple sources and in different formats. This permits information to be integrated to allow seamless mapping and searching for information about types of pests. Standardized data can be uploaded manually using preformatted spreadsheets, or automatically uploaded from pre-existing databases or systems via a programming interface.

Such a system could have a two-tiered permission system that allows users to restrict who can see their data. There may be unlimited access to some data,

while sensitive data, such as outbreak sites and contact information, can be restricted to particular user groups.

All information critical and relevant to a response must be recorded in a manner to satisfy an efficiency or financial audit. Information management systems and procedures for managing information must be in place to support this. The information management system selected for use should allow for the collection of:

- owner and location;
- case or reference number;
- area status;
- frequency of visits;
- statistics for surveillance and tracing activities;
- staff movement details;
- reports or information provided by the public or industry;
- records of expenditure;
- cost-sharing valuations; and
- market access status of the affected premises (Plant Health Australia, 2021).

Information management systems may also allow for:

- tracking of samples and diagnostic progress;
- generation of progress reports on destruction and decontamination;
- computerized tracing models;
- generation of forms for scheduled property visits (Plant Health Australia, 2021); and
- generation of maps.

While outbreaks should be based on accurate data as described, it is not always possible to obtain these data in an outbreak situation. Often, decisions have to be made based on incomplete data in time-limited circumstances. Where this is the case, uncertainties should be clearly described and justification for the decisions in the absence of data should be recorded.

1.4.5 Impacts to the environment, society and the economy should be minimized

A significant plant pest could cause serious production losses, jeopardize exports of plant and plant products, or have serious implications to the environment, amenity values or regional communities.

The goal of any contingency plan should be to minimize these impacts. If outbreak management is no longer achieving these aims, then the plan should be reviewed and adapted, or transition to management by industry and/or stakeholders over the long-term should be initiated.

1.4.6 Outbreaks should be coordinated between regions

In some countries, plant health is devolved between different regions. In these cases, it is important for the regions to come to an agreed arrangement to ensure there is a coordinated approach to outbreak management when outbreaks occur across regions, while also allowing each region to diverge where it is technically justified. Occasionally, outbreaks can occur across different countries (see case study 2). In such cases, the regional plant protection organizations (RPPO) shall function as the coordinating bodies in the areas covered.

2. Organizational arrangements

2.1 INTRODUCTION

This section summarizes the national legislation required for NPPOs to respond to pest outbreaks, describes the principles of an incident management system, command levels and how these could be structured within an NPPO, and explores options for funding outbreak response activities.

2.2 LEGISLATION

The NPPO should have national legislation in place that will give it the authority to carry out its functions as they relate to outbreak response activities. The national legislation should identify the NPPO as the sole national authority responsible for implementing the provisions of the IPPC and give the NPPO the mandate to carry out surveillance, determine pest status in an area, adopt appropriate phytosanitary measures, protect endangered areas, report outbreaks of plant pests and, when appropriate, confirm pest eradication.

More specifically, the national legislation should:

- Give legal authority to enable the officers of the NPPO and other authorized persons to enter premises, conveyances and other places where imported commodities, regulated pests or other regulated articles may be present, inspect or test imported commodities and other regulated articles, and take and remove samples from imported commodities or other regulated articles, or from places where regulated pests may be present.
- Define the roles and responsibilities of those stakeholders who support the NPPO in delivering its mandate related to the identification of pest status and the establishment and update of regulated pest lists.
- Provide the NPPO with the ability to declare an area as infested or subject to quarantine, and to adopt measures to eradicate or contain the spread of the pest.
- Describe regulatory controls to restrict the movement of certain plants, plant products and regulated articles within areas of the country, including within buffer zones.
- Provide the NPPO with the authority to implement emergency phytosanitary measures.
- Allow for diagnostic facilities to be established and maintained or give access to appropriate up-to-date diagnostic services to ensure that pests are properly identified.
- Ensure mandatory domestic reporting to the NPPO on the detection or suspected presence of regulated pests, and pests new to an area, host or pathway.
- Confirm and declare pest eradication.

2.3 MANAGEMENT SYSTEMS, COMMAND LEVEL AND STRUCTURE

2.3.1 Incident management systems (IMS)

The size, frequency and complexity of plant health outbreaks can mean that many agencies, departments and organizations are involved. This places a greater emphasis on the need for consistent, universally understood and applied processes. When these processes are not in place, a number of problems can arise, including:

- too many people reporting to one person;
- different organizational structures;
- lack of reliable outbreak information;
- inadequate and incompatible communications;
- lack of structure for coordinated planning among agencies;
- unclear lines of authority;
- terminology differences among agencies; and
- unclear or unspecified outbreak objectives.

To address these problems, it is advisable to consider the use of an incident management system (IMS) to achieve a more effective and efficient response. An IMS provides a consistent template to enable partners across agencies to work together to prevent, protect against, respond to, recover from and mitigate the effects of incidents, regardless of cause, size, location or complexity (FEMA, 2017).

There are many examples of IMS, e.g. the Australian Inter-Service Incident Management System (AIIMS) and the United States of America Federal

Emergency Management Agency (FEMA) National Incident Management System (NIMS), which provide detailed guidance and instructions.

www.afac.com.au/initiative.aiims

www.fema.gov/emergency-managers/nims

Generic plans such as these can be adopted and adapted to fit the needs of an NPPO, as has been done in the United Kingdom of Great Britain and Northern Ireland (https://planthealthportal.defra.gov.uk/pests-and-diseases/contingency-planning/).

2.3.2 Key principles and concepts

Whatever system is developed, it must take account of some key principles and concepts.

Management by objectives

Any response should be clear on what the desired outcome should be, and these objectives need to be communicated to everyone involved so that they know and understand the direction being undertaken.

Objectives need to be SMART:

- **S**pecific (so that it is clear what is expected);
- **M**easurable (to determine whether further action is required);
- **A**chievable (is it realistically possible);
- **R**elevant (look to achieve something consistent with policy); and
- **T**imed (to develop strategies, tactics and the resources needed).

Functions

It is important to ensure no activity is missed and, at the same time, that duplication does not occur. To achieve this, it is important that the following functions are allocated and may involve individuals or entire teams to carry them out:

- **Control:** The management of all activities necessary for the successful resolution of an outbreak.
- **Planning:** The task of preparing and delivering the plans and strategies required to help control the outbreak and assembling/maintaining/providing outbreak information.
- **Intelligence:** The task of collecting and analysing information or data, which is recorded and disseminated as intelligence to support decision-making and planning. This will include scientific and technical advice from specialists.
- **Communication:** Provide warnings, information and advice to the public and liaison with the media and affected communities/stakeholders. Communication helps to ensure that stakeholders and staff understand and support phytosanitary activities, requirements and systems, and have sufficient information to manage their own related activities. A communication strategy must be available to ensure that communication is handled as effectively as possible. A communication strategy should take into consideration: information needs of staff, stakeholders and affected parties; the urgency with which decisions need to be made; the extent to which engagement and communication will improve plant pest surveillance activities and the use of information provided by surveillance; and the costs of communication and engagement, both to the NPPO and to those engaged. Coordination of phytosanitary programmes requires timely and effective means of communication. The NPPO should ensure that communication provisions cover all parties involved. For further information on pest risk communication, see the IPPC Guide to Pest Risk Communication (FAO, 2019).
- **Operations:** Allocating and using resources to resolve an outbreak.
- **Logistics:** Acquiring and providing human and physical resources, facilities, services and materials to support the achievement of outbreak objectives.
- **Investigation:** The task of conducting investigations to determine the cause of an outbreak and/or to determine factors that contributed to the impact of the outbreak.
- **Finance:** Managing contracts, procurement, purchases, time records and the collection of cost data.

Adaptability and scalability

The size and structure of functional teams should reflect the size and complexity of the outbreak and the stage of the response and recovery.

Within functional teams, it is important to consider the span of control, which relates to the number of individuals, tasks or resources that one person can manage effectively. When the span of control is exceeded, consideration must be given to delegating responsibility to others. Conversely, where the span of control is lower, or the tasks fewer, responsibilities can be returned.

Clarity of structure, roles, responsibility and reporting

It is important to have a clearly defined and agreed management structure covering the functions described that is understood by all. Everyone involved should have clearly defined and agreed responsibilities within the management structure.

There should also be clear reporting lines within the management structure, with unity of command achieved by formal reporting going through one supervisor.

Uniform terminology

This enables effective communication between individuals, teams and agencies/organizations involved in the response.

Agreed understanding of the current position

A common operating picture (COP) is a description of the shared and consistent understanding NPPO staff and stakeholders have of the outbreak, gathered from a variety of sources to support decision-making. An example of a COP used in the United Kingdom summarizes the following areas: current situation, operational response, evidence obtained, policy considerations, communications and other key issues.

Flexibility

It is important to avoid over-rigid application of structures and process to the detriment of the response.

2.3.3 Command levels

There needs to be a clear understanding of roles and responsibilities. Within individual countries and NPPOs, command-level teams will go by many names, but any generic contingency plan needs to clearly describe the function and responsibilities of these teams.

Strategic command is accountable for the response, and as such sets the policy and makes the key decisions during the response, e.g. moving from eradication to containment or high-level resourcing or funding decisions.

Tactical command is responsible for: the planning, management and coordination of the response, ensuring that instructions are issued to implement actions; gathering, collating and assessing evidence and intelligence; maintaining communications up and down the command structure; and identifying and raising key decisions to strategic command.

Operational command is responsible for delivering the response in the field, e.g. inspection, survey, destruction and treatments.

Figure 2: Command levels

Source: Author's own elaboration.

2.3.4 Command, control and coordination structure

Depending on the significance of the pest and the size and scale of the response, a separate control structure may be set up, or the use of existing teams may be more appropriate.

- Various groups may need to be set up at the strategic, tactical and operational command levels covering their responsibilities (as outlined above).

One of the teams that can be set up at the tactical level is an incident management team (IMT), which is established to direct (but not deliver) operational activity. The role of the IMT is to ensure that the response is properly planned, adequately resourced, suitably implemented, provides for safety and welfare, informs and assists affected stakeholders, is effective and efficient, and minimizes impacts.

- Consequently, the tasks undertaken by an IMT are to:
- build a picture of what has happened, what is happening, and what is likely to happen;
- decide what needs to be done and how it will be done;
- prepare a plan that captures those decisions;
- gather the resources necessary;
- implement the plan and monitor its progress;
- keep people and organizations informed of all these actions;
- maintain records of their deliberations and decisions;
- manage the impacts and consequences of the response effort; and
- initiate and support the relief and recovery efforts for affected stakeholders.

2.3.5 Disaster management funds/ emergency fund

The ability of an NPPO to access extra funds will differ from country to country, as some NPPOs depend solely on government funding to undertake activities associated with their phytosanitary system/issues. The fund is often in response to eradication or containment of an introduced regulated pest or other pest outbreaks, compensating growers whose farms may be quarantined, crops that have to be destroyed and other emerging issues. In an ideal situation, a contingency plan will have associated funding allocated by the government and/or industry donors, as seen in some countries through the formulation of government–industry partnerships. If an NPPO does not have sufficient resources, it may be unable to respond to the spread of pests, thus making eradication or containment difficult or impossible.

3. Outbreak preparedness activities

3.1 INTRODUCTION

While every country will be different, there should be a system in place to ensure NPPOs are prepared to respond effectively and efficiently prior to an outbreak occurring, in addition to the development of contingency plans.

When a pest outbreak occurs, arrangements need to be in place to allow for a rapid, nationally coordinated response. A number of plans, processes and groups should come together to stage an effective response, but importantly, there should be one nationally agreed system used to respond to all pest outbreaks.

Industry and community involvement in preparedness activities is critical to ensuring a common understanding of the approach to biosecurity outbreak management, the role of industry and community groups, and actively undertaking necessary actions to ensure compliance. The ability of these stakeholders to effectively cooperate and collaborate requires well-developed preparedness and response arrangements across the biosecurity continuum encompassing pre-border, border and post-border activities. In response to specific outbreaks, they may have the opportunity to take part in decision-making processes, particularly if cost-sharing arrangements are in place.

3.2 GENERIC OUTBREAK PREPAREDNESS ACTIVITIES

To prepare for outbreak activities, an NPPO should:

- understand biosecurity risks: identify the high-likelihood and high-consequence risks together with an assessment of the capacity and capability needed to manage those risks;
- engage with the public: preparing for biosecurity outbreaks requires engaging and partnering with the entire community with clear articulation of responsibilities;
- collaborate with stakeholders: responsibilities are shared by both government and stakeholders to develop and maintain the capability and capacity to respond to, and to recover from, biosecurity outbreaks;
- strengthen field operations: resources are available and can be deployed in an outbreak;
- develop diagnostics: capacity and capability to diagnose pests in an outbreak;
- prepare surveillance and control measures: technical surveillance plans and control measures are in place to eradicate and contain pests, e.g. pesticide approvals;
- carry out training and exercises/simulations: ensure that everyone is trained in outbreak response and that this training is tested during outbreak exercises;
- produce communication plans: to provide clear accurate and targeted information to the appropriate target audiences; and
- learn from experience: build capability by reviewing biosecurity actions and applying lessons learned during biosecurity outbreaks and exercises to future preparedness and responses (DAWE, 2021).

An NPPO may have a committee structure in place for the governance of outbreak preparedness activities. This could include a main board which coordinates outbreak preparedness activities and subgroups to carry out the work.

3.3 PEST-SPECIFIC OUTBREAK PREPAREDNESS ACTIVITIES

The NPPO should develop a list of nationally significant plant pests that is legislated and provides legal backing to implement control and eradication measures. This will assist with rapid decision-making, as well as any cost-sharing where relevant, if there is an outbreak.

The NPPO should have an effective surveillance and inspection programme in place for these high-priority plant pests to detect them early and minimize the risk of pest outbreaks. See the IPPC Surveillance guide.

These nationally significant pests may be prioritized for the development of contingency plans. To address gaps in preparedness for these plant pests, an NPPO may develop a preparedness index or see for example Australia's national action plans to determine where the gaps in preparedness are.

The United Kingdom of Great Britain and Northern Ireland has developed a preparedness index, which covers 23 priority pests in the country. The index provides a repository of all the "preparedness" products for the priority pests, such as links to contingency plans and SOPs, but also shows the level of preparedness in different areas. This indicates where further effort is needed to prepare for particular pests.

The areas covered by the United Kingdom's preparedness index are:

- legislation
- contingency plans
- risk analysis
- standard operating procedures
- communication plans
- pest alerts
- fact sheets
- ministerial briefing documents
- survey work
- management methods
- contracts (e.g. spraying)
- diagnostics
- pathways
- major new developments.

National action plans for Australia's National Priority Plant Pests set out how Australia will prepare for the threat of high-priority pests. The Plans identify the capabilities to improve how Australia will prevent these pests from entering Australia, and to detect and respond to incursions if these pests were to enter.

Figure 3: Information considered in the Australian national action plan

Background information on pest	Impact assessment	Detection	Technical feasibility to eradicate	Cost-benefit analysis	Rsponse	Quarantine and movement controls
Organism information • Name • Synonyms/basionym • Common name • Strains • Description	Industry	Notification		Cost of biosecurity incident response outweighed by benefits	Pathways	Legislation
Biology and Ecology • Habitat • Seasonality • Life cycle • Dispersal • Vectors, if any	Human health	Triage and escalation			Emergency containment measures	Movement control targets
Organism description	Enviromental	Maintenance of trade			Standard operating procedures	Premises • Infected • Contact • Suspect
Geographic destribution	Social amenity				National response team	Zoning • Restricted area • Control area
Host list Symptoms					Minimum data standards Information management systems Command structure • Functions • Training/Exercises Stakeholder consultation	Permits International rights and obligations
					Establish trigger points in plan	
					Audits	
Survillance	**Diagnostics**	**Tracing**	**Control methods**	**Public information**	**Stand down**	**Transition to management**
Sampling	Protocols • For initial identification • Confirmation diagnostics • Ongoing diagnostics – Field diagnostics – High throughput diagnostics	Trace forward/ trace back	Treatments/permits	Target audiences	Market access	Where eradication not archieved, or pest controlled in specified area to prevent spread – movement to other management options
Design	Approved institutions	Targets	Disposal	Key messages	Stakeholder support	
Delimitation	Management of samples and recording of data		Disinfection	Taking points	Compensation arrangements	
Existing surveillance programmes	Laboratory standards		Fallow/host-free period	Images	How is success demonstrated?	
Proof of freedom				Information/references	Criteria for pest freedom	
					Measures to maintain pest freedom	
					Reporting	
					De-escalation procedures	

Source: Author's own elaboration.

3.4 TRAINING OF PERSONNEL

The need for on-going training is a prudent investment of an organization's resources and funds (Walters and Griffin, 2013) and is a requirement under Article IV of the IPPC (FAO, 2011). There are many ways that an organization can meet its training and development needs. Training may be done in person, online, via written materials or by using a combination of all three. There should be a training plan that will be able to identify the following: the type of training and assessment, who should be trained and the justification/reason for the training. Training gives employees a clear idea of their functions, defining their roles and responsibilities, improves productivity and performance, improves employee morale, improves knowledge and skills, and attracts and retains employees.

An organization can conduct different levels of in-house training for their staff by having experienced members of the organization serve as facilitators or by bringing an external trainer to help teach employees or managers specific knowledge, skills or abilities. This training will help staff members to stay up to date with phytosanitary information that is related to their function.

Different skills are required for the successful functioning of an outbreak response. For example:

- field staff need to be competent in pest and host identification, survey techniques, enforcement action, etc.;
- field staff and management need to be familiar with and competent in the agreed outbreak response process, their roles and responsibilities; and
- diagnostic staff need to be trained in diagnostic methodology.

The NPPO should strive to maintain the technical integrity of all phytosanitary activities and be responsive to emerging and new pest situations.

The IPPC has developed guides and training materials that can aid in enhancing staff skills related to contingency planning. These include the Surveillance and reporting obligations e-learning course, the Pest risk analysis e-learning course, the IPPC guide on Surveillance and recommendations for an effective pest outbreak and alert system.

3.5 TESTING/EXERCISING OF PERSONNEL

3.5.1 The value of simulation exercises

The key reason to carry out simulation exercises is to examine, test and validate incident response arrangements, including plans, policies, procedures and capabilities.

The value of exercises is greatest following training. Placing people in situations outside their normal work areas without the tools to deal with an unfolding scenario is unlikely to lead to success, and if there is failure you will be unable to tell if this is due to people/organizations not performing to expectation or if the plans were inadequate to start with.

Consequently, exercises need to be part of a process to improve incident response, allowing organizations to plan how they intend to respond, train their staff in that response, practice the response, learn from the practice, and use this information to change the response plan as shown by Figure 4.

Figure 4: Cycle of planning, training, exercising and learning

Source: Emergency Planning College. 2016. *Developing and Delivering Exercises.* Emergency Planning College Position Paper No. 3. United Kingdom, Emergency Planning College. www.epcresilience.com/application/files/6116/5227/8027/PP03-Exerercise-FEB-2016.pdf

The challenge of incident response is even greater when multiple organizations and teams are involved. The first time they meet should not be during an outbreak. Exercising helps to resolve common issues, e.g. communications, culture, risk appreciation and appetite, shared situational awareness and common language.

3.5.2 Types of exercise

Exercising is a very broad term and there are many types available. They vary in complexity, cost, time and purpose, with the decision on which type to use largely dependent on the aim of the exercise. Exercise types are known by a variety of names and the most common are in Table 1, but hybrid exercises combining elements are frequent.

Moving down the table, the exercises increase in realism, challenge, complexity and difficulty. However, the same order also tends to reflect increasing costs, organization, length of preparation and disruption to normal business.

Table 1: Types of exercise

Exercise type	Purpose	Why to use this exercise type
Drill	To practice a single specific operation, procedure or function that forms part of a wider response plan, e.g. setting up a public reporting system. It is a supervised activity following directions.	To develop and practice at the operational level.
Discussion/ walk-through exercise	Used to familiarize participants with a finished plan. *or* Used at the plan-development stage to answer "what if" scenarios, challenging assumptions, ideas and proposed actions.	To confirm knowledge and awareness of plans, process and procedures (other exercise types also do this but will be undermined if familiarity is lacking). To experiment with plans, process or response strategies.
Table-top exercise	To practice dealing with a scenario that develops over time and increases in complexity. The scenario may take place over days, weeks or months with set time jumps and pre-planned injects introduced to represent evolving events, incidents and problems that require participants to make decisions and respond to. Usually held in an informal classroom/meeting room setting with injects (prepared occurrences) often given through a variety of methods, e.g. paper, phone calls, video, email, etc.	To confirm knowledge and awareness of plans, process and procedures. To develop and practice information management and/or leadership teams (choice depends on the level of realism required).
Simulation/functional or command-post exercise	Tries to be as close to real life as possible but without "live play". Simulation exercises allow people to practice their role, and also provide a method of testing a response plan and identifying and addressing any area of weakness. It usually involves testing of only small components of the plan and their integration with other parts of the plan, rather than the whole plan at once. The exercise should be held in the room/building the team would use during an incident, e.g. some organizations have purpose-built command centres. Scenario-based, using the full range of forms and media which replicate the way information would flow in a real event.	To confirm knowledge and awareness of plans, process and procedures. To develop and practice information management and/or leadership teams (choice depends on the level of realism required). Validation of plans and readiness.
Full-scale/live exercise	Involving at least some elements of live rather than simulated play. Requires people and assets to be physically deployed.	To confirm knowledge and awareness of plans, process and procedures. To develop and practice at the operational level taking part in an unfolding scenario. To test communication and information flow.

Source: Author's own elaboration.

3.5.3 Planning and running an exercise

The exercise needs to take people out of their comfort zone without breaking them, but be grounded in realism with the scenario seen as credible by the participants. It is important that exercises are linked to training learning outcomes and assessment criteria, to ensure knowledge, skills and abilities can be consolidated in a positive and effective manner, as well as provide a structure for deeper learning and experience. This can include feedback from exercises and incidents improving training.

Outbreaks can be complex incidents and dealing with them may need creativity, so any exercise must be an event where there is no fear of being seen to fail, especially if solutions are experimental. The exercise must be seen as a safe environment to practice and learn. An example of an exercise is shown in Figure 5.

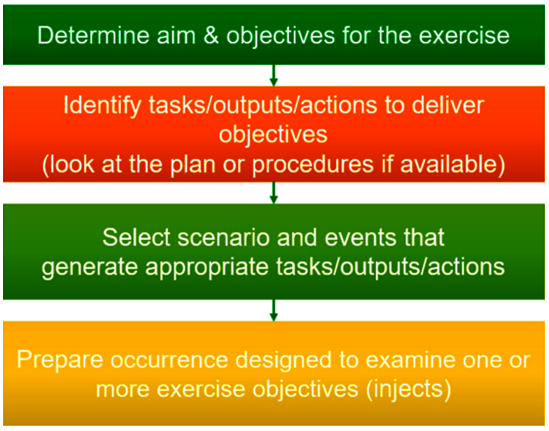
Figure 5: Outbreak exercise in the United Kingdom of Great Britain and Northern Ireland

© Derek McCann, APHA, United Kingdom

3.5.4 Planning sequence

The starting point of the planning process is to determine the exercise's aim and objectives. Is the aim to build confidence and competence (important when plans, procedures or systems are immature) or to validate and assure (to become part of the testing process for mature plans and guidance)? The scenario can then be selected, along with a number of injects to further develop the scenario and test the objectives, if appropriate. See Figure 6.

Figure 6: Planning sequence of exercises?



Source: Emergency Planning College. 2018. *Exercising Emergency Plans.* Emergency Planning College Training courses. United Kingdom, Emergency Planning College. www.epcresilience.com/book-a-course?show=20&categories=5;

Aim

Exercise professionals recommend that the strategic aim should be:

- always singular because it provides an overarching focus for activity by a diverse range of contributors;
- used to generate more specific objectives for teams and organizations, which express what they are to deliver in order to achieve the overall aim; and
- characterized by: "one sentence", "one verb" and no "ands".

A plant health example could be:

- To assess the capability of the NPPO in dealing with a major outbreak of (insert pest name).

Objective

These can be the key activities that need to be demonstrated and can be assessed by the exercise team as they support achievement of the aim.

They can either be activities that specific organizations/sections/departments need to do or the stages or actions that a team needs to go through.

It must be clear how the action/achievement will be evaluated and what is required to "pass".

Plant health examples could be that exercise participants:

- critically analysed the evolving outbreak situation;
- created and maintained shared situational awareness;

- set an appropriate strategy to deal with the outbreak; and
- made evidence-based decisions that were recorded.

Scenario

The initial scenario should include all the elements in Figure 7.

Figure 7: Scenario elements

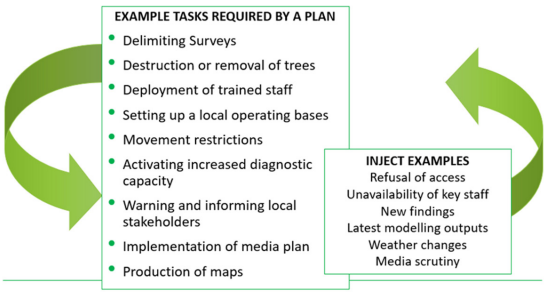
Source: Emergency Planning College. 2018. *Exercising Emergency Plans.* Emergency Planning College Training courses. United Kingdom, Emergency Planning College. www.epcresilience.com/book-a-course?show=20&categories=5;

Once the exercise is started, the scenario will unfold either in real time or as a series of time jumps where participants are taken to set points within the response and asked to take action from that point.

For certain exercise types, injects may be used. These are occurrences that are designed to examine one or more exercise objectives and drive the scenario in a phased and sequenced way.

Tasks are activities that participants may be asked or are required to perform, and these may be detailed in generic or pest-specific contingency plans (see Figure 8 for examples).

Figure 8: Examples of tasks required by a plan and examples of injects



Source: Emergency Planning College. 2018. *Exercising Emergency Plans.* Emergency Planning College Training courses. United Kingdom, Emergency Planning College. www.epcresilience.com/book-a-course?show=20&categories=5;

3.5.5 Reviewing an exercise

Section 10 provides detail on how to evaluate and review an exercise including lessons learned.

3.6 OPERATIONAL RESOURCES AND GUIDANCE

3.6.1 Equipment

When there is a new pest outbreak, resources such as human and financial resources should be available and allocated properly to address the outbreak of the new pest. This will differ from country to country. Equipment and supply resources may include vehicles, pest traps, lures, personal protective equipment and consumables. Data collection resources may include cameras, Global Positioning System (GPS) units, smartphones, tablets, notebooks, computer equipment and stationery. Public awareness resource materials refer to materials used to enhance or gain support for surveillance activities, and may include items such as brochures, posters, postcards and calendars.

Safety at work is important and should be considered by management. There should be adequate funding for things like protective equipment, personal security gear, first aid equipment, transport or vehicles for staff.

3.6.2 Guidance

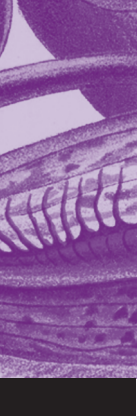
Operational guidance detailing how the requirements of a contingency plan are going to be put into practice should be drafted, e.g. SOPs, job cards, document templates and other guidance on specific aspects.

3.6.3 Information management systems

Information systems are required to ensure effective management of data as it moves from the field to record keeping and to reporting. The NPPO should select hardware and software in terms of short- and long-term programme goals. For example, in order to collect location data more efficiently, the geographic information system (GIS) software package in the office should be able to interact with the GPS units of field workers. The NPPO should consult with a database administrator and hardware and software solution providers.

General guidelines for information management include consideration of data standards by the NPPO (e.g. between surveillance programmes or between countries) as required. The NPPO is responsible for secure data storage and is the final authority for

approval of a security protocol. Data should be stored in safe and secure locations, and SOPs should be developed for security protocols, data storage and backup. The database should be validated and updated as needed. It is also important for the data to be accessible to all teams involved in the outbreak management response, and for all teams to be aware of where and how information should be stored.



4. Background information on the pest

4.1 INTRODUCTION

As detailed in section 1, pest-specific contingency plans describe how an NPPO will respond to outbreaks of certain high-risk pests and provide detail of measures that are required in addition to those set out in an overarching generic contingency plan. These measures are informed by the biology of the pest or group of pests concerned, and it is therefore advisable for this information to be provided in the plan to provide context and rationale for the measures being recommended.

4.2 PEST RISK ANALYSIS

Where available, pest risk analyses (PRAs) provide a wealth of information on a pest's biology and should be a priority when developing a contingency plan. A PRA provides the rationale for phytosanitary measures for a particular species or a group of species and evaluates scientific evidence to determine whether an organism is a quarantine pest. If so, the analysis evaluates the probability of introduction, establishment and spread of the pest and the magnitude of potential economic, environmental and social consequences in a defined area, using biological or other scientific and economic evidence (ISPM 2 and ISPM 11).

Information used for the PRA, including information on a pest's pathway of spread, its host range, its global distribution, its life cycle and the symptoms it causes, all provide the basis for recommending measures in an outbreak.

Further information can be sourced from data sheets (e.g. the CABI Crop Protection Compendium and the EPPO Global Database), scientific literature, and national and international experts.

4.3 BIOLOGY OF THE PEST IN PEST-SPECIFIC CONTINGENCY PLANS

The biological identity of the pest and other background information should be provided early in a pest-specific contingency plan to provide context for the action that follows in the rest of the plan. This information should include a summary of a pest's distribution, host range, symptoms, impacts and pathways of spread. Further context could be provided on the risk of the pest by including the conclusions of any pest risk analyses carried out on the pest and by describing the interceptions and outbreaks of the pest in the country concerned.

To supplement this information, a data sheet providing more detail could be included as an annex to the contingency plan, providing all the information in one place. Alternatively, a link to an existing data sheet or to other sources of information, such as the pest's distribution and host range, could be included instead, particularly in cases where the existing data sheet and/or information will be more regularly updated than the contingency plan.

5. Official actions taken based on a suspected outbreak

5.1 INTRODUCTION

A rapid response to an outbreak is necessary to prevent a pest spreading to a point where containment and eradication become impossible. A response should therefore start as soon as there is suspicion of an outbreak of a pest and not be delayed until the pest is confirmed. This is particularly the case for pests which require a long time to diagnose and confirm.

While there will be limitations on carrying out a full outbreak response before confirmation of a pest outbreak, in accordance with a country's legislation, there will still be some actions that can be taken. At the very least, the NPPO will be able to prepare for a response, so that it can act immediately upon confirmation of the pest.

This section will cover how suspected outbreaks are notified, assessed and escalated, and what official actions can be taken prior to the confirmation of a pest's identity. The official actions include those required to prevent the spread of the pest but, importantly, also include those required to uncover more information about the pest and outbreak situation.

5.2 NOTIFICATION

Notification of a suspected pest outbreak can either come through general surveillance or specific surveillance. General surveillance is defined as a process whereby information on pests of concern in an area is gathered from various sources (ISPM 6 (*Surveillance*)). The level of involvement by the NPPO in this process varies, ranging from very little involvement, such as where an outbreak is reported by a member of the public, an industry professional or commercial laboratory, to being quite considerable in cases where an NPPO will carry out horizon-scanning of the literature. Specific surveillance, on the other hand, is defined as a process whereby information on pests of concern in an area is obtained by the NPPO over a defined period (ISPM 6). This is a solely active process and includes inspection of plants and plant products by inspectors. In this instance, it may be the inspector that finds signs and symptoms of a pest.

In a contingency plan, the most likely sources of notifications to the NPPO should be specified. These will mark the initiation of the outbreak response.

5.3 INITIAL TRIAGE AND ESCALATION

5.3.1 Triage

The source of the outbreak notification will determine what team in the NPPO first hears about the outbreak. In the case of a report from an industry professional, it is likely that a plant health inspector will be first notified of the outbreak, whereas if an outbreak is reported by a member of the public, the report may be first received by government policy or communications staff. Each team that receives the notification should carry out an initial assessment as to the seriousness of the outbreak situation and determine whether it should be escalated up the organization. If a team is unable to carry out that initial assessment, it should send the notification on to a team that has the appropriate expertise. These teams should be set out in the generic contingency plan. The criteria used to assess an outbreak should also be set out in the plan. These criteria generally fall into three broad categories and are described below.

5.3.2 Pest risk

In accordance with ISPM 19 (*Guidelines on lists of regulated pests*), NPPOs should prepare, maintain and make available lists of regulated pests. These lists include quarantine pests, for which measures should be taken to prevent their introduction and spread. Quarantine pests are identified by performing a pest risk analysis in line with ISPM 2 and ISPM 11. In general, they should fulfil the following criteria:

- the identity of the pest is clearly defined;
- the pest is not present or widely distributed in the territory;

- the pest could enter, establish and spread within the territory;
- the pest could cause unacceptable economic, environmental and/or social impacts within the territory; and
- feasible and effective measures are available to prevent the entry, establishment and spread of the pest within the territory.

Quarantine pests can be further categorized into priority pests, which are defined as those that have the potential to cause the most severe economic, environmental and/or social impacts within the territory.

Lists of quarantine pests and priority pests provide a basis for taking action and escalating a plant pest outbreak when carrying out a triage assessment.

There will be times, however, when a certain pest is suspected but is not yet on a quarantine or priority pest list. In such cases, a short pest risk analysis should be carried out, which covers the quarantine pest criteria set out above. There may be a high degree of uncertainty in these cases and therefore a precautionary approach is advised before further information can be gathered.

5.3.3 Outbreak situation

When a quarantine pest or potential quarantine pest is suspected, an assessment of the outbreak situation should be carried out to provide further information on the seriousness of the outbreak. Some of the factors that may be considered include the:

- type of environment or business;
- extent of the outbreak;
- host distribution in the quarantine area;
- impact on the environment and business;
- suitability of the climate and environmental conditions for establishment and spread; and
- pathways of introduction into and out of the quarantine area.

The larger the scale of the outbreak and the more opportunity there is for spread of the pest, the more urgent it will be to escalate the finding up the organization and put in place containment measures.

5.3.4 Available plans and procedures

For quarantine pests in certain outbreak situations, SOPs may be available, which describe agreed containment and eradication measures. In these routine cases, outbreaks can be dealt with locally by the inspector or third-party entity supervised by the NPPO on the ground, and further escalation is not required. However, these cases still have the potential to grow in size and severity and should be monitored as to whether further resource is required. The level of resource required can be broadly split into three categories, as set out in Table 2.

5.3.5 Escalation

Where a decision has been made to escalate a plant pest outbreak, it should be clear who the outbreak should be escalated to and who should be made aware of the situation. In the contingency plan, it is important to lay out these lines of communication. Ideally, there should be a single reporting line to those who are responsible for making decisions about the outbreak and an agreed list of people who should be informed about the outbreak for awareness but are not expected to act. The roles and responsibilities of all these people should be clearly defined and agreed.

5.4 RESTRICTIONS AND MEASURES

If the pest and outbreak situation is assessed as being a significant risk, the inspector on the ground should carry out containment measures to prevent the spread of the pest. Containment measures that may be considered in a contingency plan are described below.

Table 2: Resource requirements for different levels of outbreak

Impact on resources	Criteria and guidance for resource allocation
Major (national)	A major deployment of resources, which results in a severe disruption to normal business and requires an immediate reorganization of priorities and reassignment of staff
Major (local)	A significant deployment of resources causing a significant disruption to normal business requiring a reorganization of priorities at a **local** and possibly **regional** level
Minor	The incident is not significantly disruptive to normal business and does not require the immediate reorganization of priorities

Source: Author's own elaboration.

5.4.1 Restrictions on movement of plants and plant products, material, equipment, machinery and people to and from the quarantine area

Where there is a risk of spread of the plant pest on plants and plant products, the plants and plant products should be prevented from leaving the quarantine area, and only moved for destruction or disinfection (under conditions that prevent escape during transit) in accordance with the country's legislation.

Certain plant pests, such as contaminating pests, may be associated with material, equipment and machinery, so these items may also need to be prevented from leaving the quarantine area. However, if movement is necessary, the material, equipment and machinery should be thoroughly cleaned at the designated outbreak site to remove any life stage of the plant pest (cleaning methods are described in ISPM 41 (*International movement of used vehicles, machinery and equipment*)).

Movement of people into the quarantine area should be severely restricted, especially while information is gathered on the risk of such movement. Personnel working at the outbreak site should be briefed on the importance of good hygiene practice to reduce the risk of carrying the plant pest to other areas of the site or to other sites.

5.4.2 Additional biosecurity measures

Where there is a significant risk of spread of the plant pest, even with the restrictions on movement, interim control and containment measures may be advised in the form of cultural, biological, chemical or physical controls.

5.4.3 Communication

The affected grower/landowner and, where appropriate, those in the local area and those associated with the quarantine area, should be made aware of the plant pest and its symptoms to encourage pest reporting and compliance with any restrictions put in place to contain the pest. The way in which awareness-raising is carried out will depend on the situation and location of the outbreak, but it may include the distribution of pest fact sheets and alerts, putting information on social media (e.g. Twitter), promotion over radio, and the dissemination of information through key stakeholders, such as universities and non-governmental organizations (NGOs).

5.5 INVESTIGATION

Information should be gathered on the pest biology and outbreak situation, and surveillance and tracing should be undertaken, to inform decision-making related to the outbreak response. This information will also be helpful in identifying any weaknesses in phytosanitary import measures that may have led to the introduction of the pest.

It should be noted that, while the investigation of the pest and outbreak will start upon the suspicion of a pest, it will continue for the duration of the outbreak response.

5.6 INFORMATION GATHERING

5.6.1 Pest biology

Pest biology information should be based on the information required for a pest risk assessment, in accordance with ISPM 11. Briefly, information that can be gathered on the pest includes its:

- taxonomic identity;
- global distribution;
- host range;
- establishment potential;
- methods of spread; and
- economic, environmental and social impacts (both existing and potential).

Pest risk assessments may already be available for the pest in the NPPO concerned or by other NPPOs, RPPOs and other bodies. These should be described or, at the very least, listed in pest-specific contingency plans. Other useful information can be drawn from pest fact sheets and published scientific literature.

5.6.2 Outbreak situation

The inspector should gather as much information as possible on the outbreak situation, in line with ISPM 6 and ISPM 9, and record this information for distribution to relevant people. This will be in addition to the information gathered in 3.1.2. Information should generally include:

- the location of the outbreak, including a grid reference where appropriate and any notable sites/areas nearby;
- the host or commodity affected and the quantity and value of those plants and/or plant products;
- the level of pest damage;
- the origin of affected plants;

- the known or suspected extent of the outbreak including premises and fields/crops/plants affected;
- background information on the type and nature of the business/area affected and its main activities, especially those relating to any trade in plants or plant products (including what impact any action may have);
- the likelihood of further spread;
- any initial action taken;
- the resources that would be needed to investigate further and over what timescale;
- any other factors that may influence containment or eradication;
- any intelligence on trade, public, media or political interest;
- past history of outbreaks at the site; and
- any connection with other countries, regions or states.

5.6.3 Surveillance

Further to information gathering, surveillance and sampling of other affected plants, plant products or material at the site or in the immediate vicinity should be carried out to confirm the extent of the outbreak. This initial survey should be used to determine if it is an isolated finding or an established outbreak.

5.6.4 Tracing

Where appropriate, information obtained regarding the origins of affected plants should be used to locate other related and therefore potentially affected plants. This may include contacting the NPPO of the exporting country to obtain delivery notes where consignments are involved. Information should also be obtained on the destination to which suspect plants have been sent.

In addition to tracing investigations relating to plants, trace forward/back investigations linked to material, equipment, machinery and people should also be made if the plant pest can be associated with these pathways.

5.6.5 Maintenance of trade

An outbreak of a plant pest may have an impact on trade with other nations. This should be investigated prior to confirmation of the pest.

5.7 SECONDARY TRIAGE AND ESCALATION

5.7.1 Triage and outbreak assessment

Where an outbreak of a plant pest has been initially assessed as being significant and has been escalated to senior managers and policy colleagues in line with section 3.2, a further in-depth assessment of the outbreak will likely be required to determine the level of action and scale of response.

The level of action that could be taken includes the following:

- eradication, requiring the complete elimination of the pest;
- containment, involving the prevention or minimization of spread;
- management by industry and/or landowners with government support; and
- no action at all.

Which of these should be taken will largely be determined by the pest and the outbreak situation. The former can be assessed in accordance with ISPM 11 using the information gathered in 5.1.1. If the assessment concludes that the pest meets the criteria of a quarantine pest, some form of action is likely to be recommended. However, whether any action is taken is also likely to be influenced by the outbreak situation using information gathered in 5.1.2, as, depending on the extent of the outbreak and the potential for spread and damage, it may not be feasible to eradicate or contain the pest concerned. This is particularly the case where a pest has likely spread to multiple destinations across the country.

The scale of response covers the level of governance, management, resources and funding that are required for an outbreak response. As with the level of action, this will be informed by the risk of the pest and the outbreak situation, with a more serious pest and a more extensive outbreak situation likely requiring a greater scale of response. The level of action itself will also inform the scale of response, with eradication and containment requiring more immediate action.

In some cases, the outbreak assessment may be straightforward and only require a discussion between a few people, while in other cases, it may require a formal group to be set up composed of people with experience across several disciplines (see section 2). Forms to assess the outbreaks, which cover key criteria, may also be used to improve the quality of information being assessed. The process for carrying out the

outbreak assessment should be described for generic and pest-specific contingency plans.

5.7.2 Alert levels

A tool that can be used to inform decision-making and present the outcome of the outbreak assessment is an alert level table. The alert level indicates the seriousness of the outbreak and ranges from an outbreak with the potential to cause little damage to an outbreak with the potential to cause catastrophic impacts over a short period of time. Alert levels can be accompanied by a description of the alert level and the scale of response required. An example of this is provided in Table 3.

5.8 ESCALATION

Having assessed the outbreak and decided on the level of action and scale of response, the outbreak should be escalated to the appropriate organization or team to manage the response.

5.8.1 Lead organization or team

Depending on the NPPO, there may be more than one organization or team that can manage an outbreak of a plant pest. The determining circumstances under which a particular organization or team would lead an outbreak response may be the sector (e.g. agriculture, horticulture or forestry), the location (e.g. state, province or country) or the scale of the outbreak (e.g. operational team or government department). These circumstances should be clearly defined and agreed, and they should be described in the contingency plan. An example of this is provided in Table 4.

With the control authority agreed, a lead person within that control authority should be nominated to take on overall responsibility for managing all activities relating to the outbreak of the plant pest.

5.8.2 Mobilization and deployment of staff

With the lead organization/team and person agreed, staff can be mobilized and deployed prior to the confirmation of the plant pest. Largely, activity at this stage will revolve around planning and investigation, as opposed to surveillance and control measures, and will be in line with the command structures described in section 2.

Table 3: Alert level table for plant pest outbreaks in England

ALERT	STATUS	RESPONSE
White	Plant pest which does not require statutory action or that can be managed as part of routine plant health activities (e.g., a pest with a management standard operating procedure) Example pest: *Bemisia tabaci* (tobacco whitefly)	Managed operationally, with advice from pest risk managers and diagnosticians, as appropriate
Black	Plant pest with potential for limited geographical spread leading to moderate economic, environmental or social impacts Example pest: *Anthonomus eugenii* (pepper weevil)	Initiation of an incident management team (IMT). Pest-specific response plans should be followed, where applicable.
Amber	Plant pest with potential for relatively slow but extensive geographical spread leading to host death and/or major economic, environmental or social impacts Example pest: *Anoplophora glabripennis* (Asian longhorned beetle)	Initiation of an IMT and strategic group of the leading government department. Pest-specific response plans should be followed, where applicable.
Red	Plant pest with potential for rapid and extensive geographical spread leading to host death and/or major economic, environmental or social impacts Example pest: *Agrilus planipennis* (emerald ash borer)	Initiation of the IMT, strategic group of the leading government department and, depending on the situation, central government response. Pest-specific response plans should be followed, where applicable.

Source: Department for Environment Food and Rural Affairs. 2022. *Generic Contingency Plan for Plant Health in England.* York, England. The United Kindom Plant Health Officer. https://planthealthportal.defra.gov.uk/assets/uploads/Generic-Contingency-Plan-for-Plant-Health-in-England-FINAL-2.pdf

Table 4: Scenarios under which a certain organization will lead a plant pest outbreak response in England

Scenario	Lead organization/team
Outbreak within a nursery/horticultural trade facility/orchard	Animal and Plant Health Agency (APHA)
Outbreak within a nursery, which has spread into the immediate surrounding environment	APHA
Outbreak in a domestic garden/allotment	APHA
Outbreak in the wider built-up environment, including street trees (including motorway plantings, verges and transport links, e.g. railway lines), public parks, etc. (may incorporate areas of woodland or situations where there is a direct threat to forests or woodland)	APHA or Forestry Commission to be decided on a case-by-case basis
Outbreak in a forest/woodland (may incorporate non-forest areas)	Forestry Commission
For outbreaks with an Amber or Red alert that require more extensive coordination	Department for Food, Environment and Rural Affairs
Other scenarios	To be decided on a case-by-case basis

Source: Department for Environment Food and Rural Affairs. 2022. *Generic Contingency Plan for Plant Health in England.* York, England. The United Kindom Plant Health Officer. https://planthealthportal.defra.gov.uk/assets/uploads/Generic-Contingency-Plan-for-Plant-Health-in-England-FINAL-2.pdf

6. Official actions to eradicate a confirmed pest outbreak

6.1 INTRODUCTION

After the final confirmation of the pest, there are official actions that need to be undertaken in order to eradicate a pest. Eradication is the "application of phytosanitary measures to eliminate a pest from an area" (ISPM 5 (*Glossary of phytosanitary terms*)). The NPPO may develop a pest eradication programme to prevent establishment or spread of a pest following its recent entry or as a measure to eliminate an established pest.

There are three main activities that are involved in an eradication process, namely containment, surveillance, and treatment and/or control measures (see ISPM 9).

6.2 CONTAINMENT

6.2.1 Demarcation

One of the functions of the NPPO is to have regulations in place that will be used to demarcate a quarantine area and the measures to be taken to prevent the spread of the pest. A quarantine area is "an area within which a quarantine pest is present and is being officially controlled". A quarantine area should be defined by the NPPO by using information from initial surveillance activities, the biology of the pest, the size and density of the pest population, the length of time the pest has been present, the local climatic, meteorological and environmental conditions, and the density of host plants. The early investigations will also provide data that is used to identify plants, plant products or other articles whose movement out of the quarantine area needs to be regulated to prevent the spread of the pest. The NPPO shall notify the owners of affected plants, plant products and other regulated articles of such measures.

The quarantine area consists of two main types of demarcation: an infested/infected zone and a buffer zone.

Infested/infected zone

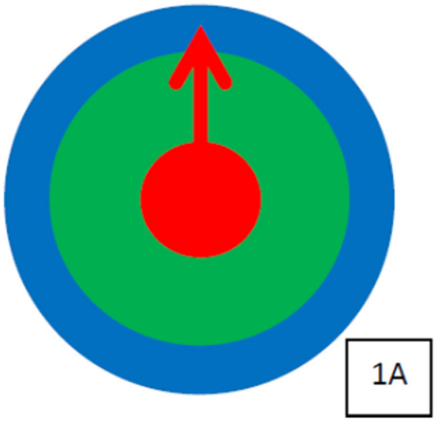
An infested/infected zone may cover the following:

- all plants known to be infested by the pest concerned.
- all plants showing signs or symptoms indicating possible infestation by the pest;
- all other plants liable to have been or become contaminated or infested by the pest, including plants liable to be infested due to their susceptibility to the pest and their close proximity to infested plants or common source of production with infested plants or plants grown from them; and
- land, soil, water courses or other elements infested, or liable to be infested, by the pest concerned.

Buffer zone

According to ISPM 5, a buffer zone is "an area surrounding or adjacent to an area officially delimited for phytosanitary purposes in order to minimize the probability of spread of the target pest into or out of the delimited area, and subject to phytosanitary or other control measures, if appropriate". The objective of a buffer zone in this case is to prevent pest spread from the quarantine area (Figure 9).

Figure 9: Goal of a buffer zone. 1A to prevent pest spread. Green area = buffer zone; red area = area where the pest of concern is present; blue area = protected area



Source: European Food Safety Authority Plant Health Panel 2018. *Guidance of the EFSA PLH Panel on quantitative pest risk assessment.* EFSA Journal 2018;16(7):5350, 94 pp. doi:10.2903/j.efsa.2018.5350

ISPM 4 (*Requirements for the establishment of pest free areas*), ISPM 10 (*Requirements for the establishment of pest free places of production and pest free production sites*), ISPM 22 (*Requirements for the establishment of areas of low pest prevalence*) and ISPM 26 (*Establishment of pest free areas for fruit flies (Tephritidae)*) provide some recommendations on the requirements related to buffer zones. According to ISPM 10, the extent of the buffer zone should be determined by the NPPO on the basis of the distance over which the pest is likely to spread naturally during the course of the growing season. Monitoring surveys should be conducted at adequate frequency over one or more growing seasons. Access for surveys or control measures should be verified in advance. If the pest is detected in the buffer zone, the demarcated area should be adjusted accordingly.

The following are constraints when establishing a buffer zone and situations where a buffer zone may not be justified (EPPO, 2021):

1. Technical limitations:

- If the natural dispersal capacity of the pest is very high (e.g. hundreds of kilometres by wind), establishing an effective buffer zone may not be feasible. This may also be the case in situations where hitchhiking is a major pathway and effective measures cannot be applied.
- If the generation time is very short, it may be very difficult to apply measures in time to prevent escape from the delimited area and therefore a buffer zone wider than the expected dispersal distance of the pest per generation will be required.
- If the delimiting surveys show that the pest is already widespread, establishing a buffer zone may not be feasible.

2. Other limitations:

- Regulatory limitations: the delimitation of the buffer zone may have to take into consideration whether protected species occur in the delimited area that would be adversely affected by the control measures.
- Economic, environmental and social limitations: the host plants grown in the buffer zone might be subjected to stringent measures; possible economic, environmental or social constraints should be identified and assessed.

When there is evidence that the pest was recently introduced into the area with the plants on which it was found, and it can be established that no spread has occurred, then the delimitation of regulated areas is not needed.

6.2.2 Continued area restrictions/ movement control

After the NPPO has demarcated a quarantine area, the movement of plants, plant products, machinery and tools, or other articles out of the quarantine area needs to be regulated to prevent the spread of the pest. The NPPO should notify owners of affected plants, plant products and other regulated articles of the regulations. Methods described in the eradication plan may be used to verify compliance. In order to release plants, plant products or other regulated articles from the quarantine area, arrangements should be put in place to prevent the spread of the pest, such as inspection or treatment.

6.3 SURVEILLANCE

Following the demarcation of a quarantine area, surveillance should be carried out to determine the presence and spread of the quarantine pest. There are two types of surveillance: general surveillance and specific surveillance.

I. General surveillance

General surveillance is defined as a process whereby information on particular pests that are of concern for an area is gathered from many sources, wherever it is available and provided for use by the NPPO (ISPM 6). Sources of information include scientific journals, research institutions and the general public. General surveillance provides a means for NPPOs to supplement pest information gathered by specific surveillance.

II. Specific surveillance

Specific surveillance provides the means for NPPOs to actively gather pest distribution information through structured programmes and is an important feature of the eradication process. ISPM 6 recognizes the three types of surveys based on the objectives of specific surveillance:

- detection surveys: conducted in an area to determine if pests are present;
- delimiting surveys: conducted to establish the boundaries of an area considered to be infested by or free from a pest; and

- monitoring surveys: ongoing survey to verify the characteristics of a pest population.

Of the three types of survey, delimiting surveys will be used for an eradication programme. The survey generally determines the extent and distribution of a pest outbreak and whether the pest can be eradicated. To delimit an outbreak, the area selection should be focused on the immediate surroundings of the known infested area and to sites of the same habitat type that, according to exercises of trace-forward and trace-back, may also have become infested. Table 5 provides a description of when each survey type should be used.

A wide variety of technical methods are available, but they generally fall into three fundamental types of surveillance: visual examination, trapping and sampling survey.

- Visual examination is when the host or habitat is examined for life stages, signs or symptoms associated with target pests.
- Sampling survey is when host material, target pests or soil are collected for identification and analysis.
- Trapping survey involves the use of e.g. chemical or physical traps to capture target pests in a given area.

The NPPO should have legislation in place that will support the surveillance activities. A surveillance system should be supported by phytosanitary legislation and policies to ensure that authority, responsibilities and financial resources are assigned to the appropriate administrative levels. Phytosanitary legislation or official procedures should provide legal power, process and protection for the NPPO officers or other authorized personnel to undertake surveillance activities, including entering premises or land to inspect plants, plant products or other articles that may be capable of harbouring pests, or to collect samples for testing.

For detailed information on surveys, see ISPM 6 and the IPPC surveillance guide (2021).

6.4 TRACE BACK AND FORWARD

If a quarantine pest is detected, the likely source of the pest should be investigated. Trace back actions may include pathway analysis to identify the source of the pest and its possible spread, inspection of host- or pathway-associated material, inspection of buildings and the historical movement of plants and plant products into the area through commercial trade, plant production and travellers.

The following steps should be taken in order to determine the spread and origin of the pest:

- Conduct a delimiting survey around the site of initial detection (as in 3.1). This will provide information about the spread of the pest.
- Assess the degree of damage (insignificant to severe), level of infestation (low to high) and, if possible, duration (old to recent) of the infestation

Table 5: Different circumstances under which certain types of survey are used

Specific surveillance	Pest situation				
	Pest present without control	Pest present under suppression	Pest present under eradication	Pest absent under exclusion	Pest transient, eradication of an outbreak
Monitoring	Uncontrolled pest subject to monitoring surveys	Pest under suppression subject to monitoring surveys	Pest under eradication subject to monitoring and verification surveys		
Detection				No pest; detection surveys including intensive trapping for exclusion in a pest free area	
Delimiting					Outbreak detected through ongoing detection surveys, therefore additional implementation of delimiting survey

Source: IPPC Secretariat. 2021. *Surveillance guide – A guide to understand the principal requirements of surveillance programmes for national plant protection organizations.* Second edition. Rome, FAO on behalf of the Secretariat of the International Plant Protection Convention. https://doi.org/10.4060/cb7139en

from the time of detection. During the delimiting survey, this information should be collected and mapped along with GIS information. This information could assist determination of the likely origin or location (foci) of the infestation.

- Consider the native region and current distribution of the pest. What commodities are currently imported that could be a source of the pest? How were these commodities moved and transported?
- Once the origin has been identified (trace-back), a follow-up of areas that could have also received a pest introduction (trace-forward) also needs to occur.

6.5 CONTINUED INVESTIGATION OF THE OUTBREAK

As described in section 5, information on the detection of a new pest in an area, the geographical origin of the pest and the pathway should continue to be gathered.

6.6 EXTERNAL COMMUNICATION

External communication is necessary to ensure that all parties directly engaged in the phytosanitary programme are kept informed. Pest risk communication is an interactive process allowing the exchange of information and opinions between an NPPO and stakeholders about the risks and risk-related factors associated with plant health. The NPPO must communicate information about pest outbreak internationally, to government, industry and to the general public. Sharing of pest risk information plays a crucial role in the successful implementation of a phytosanitary programme.

It is important when an outbreak of a pest is confirmed that there are effective, timely and accurate communications with stakeholders, trade, the public and the media. Various communication methods will be used to provide information relevant to the pest, to reduce its impact and spread, and to help with its eradication or control. The contingency plan must be able to clearly define the communication structure and the roles and responsibility. The NPPO should be the focal point for all communication with various stakeholders. A communication strategy must be able to explain how communication must be done internally, externally and with the media. Communication with stakeholders about the outbreak will reassure people in affected areas that the government is effectively dealing with the outbreak and will raise awareness of the outbreak among key stakeholders, industry and the general public.

The NPPO has the responsibility to share information about a pest outbreak in support of Article IV.3(a) of the IPPC, which states that contracting parties have the responsibility for the distribution of information within their territories regarding regulated pests. They are also required to the best of their ability to "conduct surveillance for pests and develop and maintain adequate information on pest status in order to support categorization of pests, and for the development of appropriate phytosanitary measures. This information shall be made available to contracting parties, on request" (Article VII.2(j)). NPPOs are required to "designate a contact point for the exchange of information connected with the implementation" of the IPPC (Article VIII.2).

With these systems in operation, contracting parties are able to fulfil the requirement under the IPPC to cooperate with one another to the fullest practicable extent in achieving the aims of the Convention (Article VIII.1), and in particular to "cooperate in the exchange of information on plant pests, particularly the reporting of the occurrence, outbreak or spread of pests that may be of immediate or potential danger, in accordance with such procedures as may be established by the Commission" (Article VIII.1(a)) (see ISPM 17 (*Pest reporting*) and the IPPC Pest risk communication guide (2019)).

There are four main stakeholders that need to be taken into account in any communications strategy: government, public/industry, international organizations/bodies and other countries.

Government

The relevant authority within the NPPO must communicate information about the outbreak of a pest and means of controlling it with other relevant government structures/departments. This will ensure that the necessary actions are taken by all the relevant structures within the relevant government departments as per the pest-specific plan or SOP. It will also ensure that all the necessary resources such as human resources, financial resources, etc., are released by government to support the eradication programme. NPPOs must conduct meetings with the relevant government officials to make sure that they understand their role and responsibility as may be outlined in a generic contingency plan or a SOP.

Public/industry

The NPPO has the obligation to share information about the outbreak of a pest, conduct outreach programmes for effective cooperation, notify of any restrictions on movement of plant material, where appropriate, and report relevant observations with the public. Informing the public about pest outbreaks will ease the execution of control measures and may contribute significantly to the success of the control measures as producers and the general public are often uncertain as to the extent and implications of such programmes. Communication can be done through different channels such as meetings, publishing of information on websites, pamphlets, radio, etc.

Communicating information about pest outbreaks with industry is crucial as industry may be able to assist the NPPO in carrying out some of the activities such as surveillance and awareness-raising, which may contribute to the successful eradication of the pest. Communication about potential impacts of the pest (if not eradicated/contained) and potential compensation could help to promote compliance and encourage reporting of sightings of the pest.

International organizations/bodies and other countries

Occurrence, outbreak or spread of pests that are known (on the basis of observation, previous experience, or pest risk analysis (PRA)) to be of immediate or potential danger should be reported to other countries, in particular to NPPOs of neighbouring countries and of trading partners. The NPPO must communicate the pest status to other contracting parties by means of a pest report (see Article VIII.1(a) and ISPM 17). NPPOs must send pest reports to the IPPC Secretariat for publishing on the International Phytosanitary Portal (IPP). The pest report should contain information that allows neighbouring countries or trading partners to adjust their phytosanitary import requirements and to take actions as a result of any changes in pest risk. It is the responsibility of an NPPO to provide pest records and other supporting evidence on pest status upon request from another NPPO. In order to promote harmonization and transparency, NPPOs should use the pest status categories outlined in ISPM 8 (*Determination of pest status in an area*) (and the associated pest status guide (IPPC Secretariat, 2021)) when making pest reports and exchanging pest status information with other NPPOs (see ISPM 17).

Pest reports should contain information on the identity of the pest, location, pest status and nature of the immediate or potential danger. They should be provided without undue delay, preferably through electronic means, through direct communication, openly available publication or the IPP. Reports of successful eradication, the establishment of pest free areas (PFAs) and other information may also be provided using the same reporting procedure. In addition, for pests of known and immediate danger (the danger could be due to trade links or geographic proximity) to other countries, direct communication to those countries, by mail or email, is recommended in any case. Countries may also address pest reports to regional plant protection organizations (RPPOs), to privately contracted reporting systems, through bilaterally agreed reporting systems, or in any other manner acceptable to the countries involved. Whatever reporting system is used, the NPPO should retain responsibility for the reports. For more information, please see ISPM 17 and the guide to national reporting obligations (2016) and the IPPC e-learning course on surveillance and reporting obligations.

6.7 TREATMENT INCLUDING CHEMICAL REGISTRATIONS AND PEST MANAGEMENT MEASURES

Phytosanitary measures are used by NPPOs to prevent the introduction and spread of regulated pests. Treatment or control measures may include host destruction, disinfestation of equipment and facilities, chemical or biopesticide treatment, soil sterilants, leaving land fallow, host-free periods, the use of cultivars that suppress or eliminate pest populations, restriction of subsequent cropping, trapping, lures or other physical control methods, inundative release of biological control agents, use of the sterile insect technique (SIT), and the processing or consumption of an infested crop. Normally more than one treatment option will be required to eradicate the pest. The selection of treatment and/or control options may be limited by legislative restrictions or other factors. In such situations, exceptions for emergency or limited use may be available to the NPPO (see ISPM 9).

Countries should have a legislation/protocol in place that allows for the emergency registration of chemicals in case of an outbreak of a new pest or in emergency situations. The emergency registration of chemicals will apply in cases where there are no registered chemicals in the country to control the outbreak of a new pest. The protocol for the emergency registration of chemicals should be able to show all the requirements or conditions that must be followed for the emergency registration of chemicals. It should also be able to state the pest situations that warrant the emergency registration of the chemical. It is also important for countries to have legislation for releasing non-native biocontrol agents and legislation for waste disposal.

7. Review of measures in cases of prolonged official actions

7.1 INTRODUCTION

Contingency plans may need to be updated at various stages of a response. Throughout the eradication programme, the contingency plan and the incident action plan should be subject to periodic review to analyse and assess information gathered, to check that objectives are being achieved and to determine if changes are required.

If continuing official action is required within the quarantine area over a prolonged period, a review of eradication and containment measures should be regularly undertaken to determine the success and cost-effectiveness of measures in the longer term. This review will involve consultation with stakeholders and should include:

- evaluation of the effectiveness of current measures;
- evaluation of the economic impact and cost-effectiveness of continuing existing measures;
- consideration of further measures to strengthen containment and eradication actions;
- consideration of statutory obligations and impact on import and export procedures; and
- consideration of alternative approaches, including pursuing measures to contain the pest rather than eradication, or even stopping statutory action (EPPO, 2009).

Depending on the outcome, a new contingency or specific eradication response plan may be developed or amended to become a pest suppression or ongoing pest management programme (IPPC, 2016). In circumstances where it is considered that the pest cannot be eradicated or contained, and official action is no longer considered appropriate, stakeholders should be consulted and a timetable and mechanism agreed for the removal of official measures and for the dissemination of pest management information as appropriate (EPPO, 2009). See section 8 for further details.

7.2 ESTABLISHMENT OF REVIEW POINTS

As with any contingency or response plan, there needs to be clear and robust review points of the response strategy and associated activities under the plan to effectively manage the uncertainty or unknowns in a response. Review points are used to monitor the effectiveness of the strategy and its delivery as well as to address any uncertainty and/or external factors that might suggest the response strategy will not achieve its objectives.

These review points can be broadly split into two categories:

- any time when circumstances are encountered that could affect the programme; and
- pre-set intervals.

In the case of the former, the review will be dependent on the type of outbreak, the individual pest's biology and the plan's aims/objectives. Each review point must be measurable and be monitored by the lead agency and relevant committees throughout the duration of the operational phase of the response (Plant Health Australia, 2021).

Potential review points under the first category include:

- key performance indicators or agreed milestones not being met;
- financial triggers such as the point when expenditure is projected to exceed the agreed budget;
- pest-related changes, such as:
  - new detections outside control areas or in another jurisdiction (where applicable),
  - change in expected pest behaviour,
  - change in pest impact,
  - new vector discovered;
- indicators of the effectiveness of the contingency plan's activities, for example, operational matters such as control methods not successful in achieving eradication;
- indicators that it may no longer be technically feasible to eradicate;

- maintenance of quarantine areas no longer possible due to legal/political/technical issues.

As the response progresses, the review points may be evaluated and amended as required (Plant Health Australia, 2021).

7.3 AUDITS OF THE PLAN

With prolonged official actions, efficiency, financial and scientific audits should be considered at the review points to ensure the plan continues to be well suited for its designated purpose. All information critical and relevant to a response should be recorded in a manner to satisfy an audit. Suitably experienced and/or qualified people should undertake these tasks. Information management systems and procedures for managing information should be in place to support this (Plant Health Australia, 2021).

7.3.1 Efficiency audit

Efficiency audit(s) may be considered during the course of the response. An efficiency audit should form a systematic and independent examination to determine whether eradication activities and any related activities comply with the contingency or response plan, and whether the plan is implemented effectively and is suitable to achieve its objectives. The efficiency advocate should consider the following:

- whether the response activities detailed in the plan are being implemented as described;
- whether the response activities of the lead agency are conducted in an effective and efficient manner;
- whether the expenditures made under the plan, and for which cost-sharing may be sought, are valid, accurate and in accordance with the cost-sharing arrangements; and
- to recommend on corrective action to modify the plan where necessary (Plant Health Australia, 2021).

7.3.2 Financial audit

A financial audit may be required if a financial trigger is met, such as the point when expenditure is projected to exceed the agreed budget in the plan. The plan may also require a financial audit at a particular phase of the response, for example, at completion.

A financial auditor should consider the following:

- attestation of financial data incorporated in prescribed financial statements prepared by the lead agency (and by other parties seeking cost-sharing), including the expression of an opinion as to whether the financial statements fairly present the financial position and the results of financial operations;
- examination of financial systems and transactions;
- reporting of observations or suggestions about any matters arising from audits that the auditor considers should be brought to the attention of the response parties;
- where they become apparent in the course of the audit, the identification of any potential claims or litigation matters which may involve any parties, and the extent of any exposure to such claims or litigation; and
- any other activities and issues that the response parties require to be reviewed (Plant Health Australia, 2021).

For the purpose of conducting any audit within the auditor's mandate, the auditor is entitled at all reasonable times to full and free access to all documents, records and property relevant to the audit and necessary cooperation from auditee personnel to aid in accomplishing the audit task (Plant Health Australia, 2021).

7.3.3 Scientific audit

If any of the specified technical trigger points for review (as agreed and outlined in the contingency/response plan) are met, there may be a need for expert review by an expert technical panel or other means.

A panel may also be engaged to provide validation of the current response strategy or to provide advice when key aspects of the response strategy are proposed for revision. A panel's membership should be based on skills and expertise, with each member engaged to provide their individual expertise and knowledge rather than presenting a view of their jurisdiction or industry.

The skills and expertise of nominated panel members must be relevant to the terms of reference. Roles may include:

- diagnostician(s);
- surveillance person(s) with local knowledge, preferably with experience in designing statistically sound surveillance strategies;
- a biometrician or modeller;

- a local and/or international pest expert(s) with knowledge in identification, biology, genetics and epidemiology of the pest or other similar pests;
- an agronomist who knows the host;
- an emergency response expert; and
- an economic expert (Plant Health Australia, 2021).

The expert technical panel will not be a decision-making body and will only provide technical advice on matters as defined in its terms of reference (Plant Health Australia, 2021).

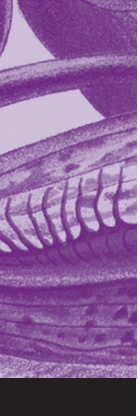
During the investigation and alert phase, the technical panel would likely be convened to:

- consider complex technical issues, as identified in a list of key priority questions from the decision-making committee. These phase-specific questions may include (but are not limited to):
  - pest biology,
  - potential pathways,
  - the biology and distribution of hosts,
  - establishment potential,
  - field and laboratory diagnostics,
  - surveillance methodologies and efficiencies,
  - impacts of environmental factors,
  - destruction;
- evaluate available pest/disease data (e.g. effectiveness of control measures) from other jurisdictions and or countries;
- consider if the proposed response strategy is technically appropriate and will achieve eradication (Plant Health Australia, 2021);
- evaluate proof of freedom surveillance operations and data; and
- evaluate biological or chemical control.

This panel may also recommend commissioning research projects where new information needs to be generated to inform the response.

7.4 CONCLUSION OF OFFICIAL ACTION

Following the conclusion of official action, a review should be undertaken to assess the effectiveness of the action taken and need for the contingency plan to be amended or for additional measures to prevent further outbreaks. See section 10 for further details.



8. Determining completion of official action

8.1 INTRODUCTION

At the beginning of an outbreak response, the level of action is agreed by the NPPO. This may constitute eradication, containment, long term management or no action at all. While this end goal may change as the outbreak develops and the situation is reviewed, at every stage it should be clear what a particular level of action looks like, how it is achieved, and ultimately how it will end or be transitioned into business-as-usual arrangements.

This section will cover the criteria required for pest freedom in the case of eradication, the measures for maintaining pest freedom, situations where eradication is no longer possible and reporting processes.

8.2 CRITERIA FOR PEST FREEDOM

The criteria for pest freedom should be agreed by the outbreak management team (e.g. the IMT), based on information on the pest's biology, the local climatic and meteorological conditions, and the ease of detection through surveillance and inspection activities.

Breaking this down further, it will be necessary to monitor the quarantine area for the minimum amount of time it will take for the pest or its symptoms to become apparent using the surveillance techniques available. Where surveillance is based on the trapping of adult insects, for example, monitoring should cover a period which includes adult emergence and flight. Whereas if surveillance is based on identifying symptoms on plants, monitoring should ideally cover the time when symptoms will be most apparent. Determining the appropriate time to survey for pest freedom therefore requires knowledge of the pest's biology (e.g. time of emergence and the length of life cycle) and the local conditions of the quarantine area (e.g. temperature).

It is also important to consider the ease of detection of the surveillance and inspection activities. If the likelihood of detection using a particular surveillance technique is low, monitoring may need to be carried out for longer or more intensely to provide confidence that the pest is no longer present. This is often the case for pests with cryptic life cycles, such as wood-boring beetles, where monitoring for more than one life cycle of the pest is required. It should also be noted that pests may change their behaviour when their prevalence is low or when they are subject to adverse conditions, altering the level of surveillance needed to declare pest freedom.

Guidance on what surveillance tools to use for the declaration of freedom are described in section 6 and can be found in ISPM 6, the IPPC surveillance guide and the IPPC guide for establishing and maintaining pest free areas. Briefly, these surveillance tools can be split into three main types:

- visual surveys to identify signs and symptoms of the pest;
- trapping using visual and olfactory cues; and
- sampling of pest and host material.

These surveillance tools may be used separately or in combination and may be used alongside other methods.

Once the criteria for pest freedom have been met, pest eradication can be declared and reported. However, it should be noted that monitoring and verification for several life cycles of the pest may be required to obtain recognition of pest freedom from trading partners, such as for PFA agreements.

8.3 MEASURES TO MAINTAIN PEST FREEDOM

It is important that the system used to achieve pest freedom be sustained and maintained. Based on information-gathering carried out during an outbreak response, areas of weakness in the phytosanitary import measures may have been identified for the pest concerned. This information should be used to review and amend the phytosanitary import measures to reduce the likelihood of the pest being introduced into the area. Determination of replacement or additional phytosanitary measures will depend on the pathway of entry, the biology of the pest and the availability, efficacy and feasibility of applying the measures.

General and specific surveillance activities are necessary for monitoring whether pest freedom is being maintained. Specific surveillance activities will usually be in the form of detection surveys, which are performed to determine if a pest is present. These activities will be similar to those used to declare pest freedom, but there would be differences in frequency, density and location depending on the level of risk of reintroduction of the pest. Regular survey reports that are publicly available are recommended so that they can be seen by trading partners and other relevant stakeholders.

8.4 MOVEMENT FROM ERADICATION TO OTHER MANAGEMENT OPTIONS

Where it becomes clear during the outbreak response that the criteria for pest freedom cannot be met because the pest is widely established, and eradication of the pest is neither feasible nor economically cost-efficient, the NPPO should determine whether the response should stand down and move from eradication to containment, move to long term management by industry, landowners and/or other stakeholders, or stopped completely. The decision to do this should be based on the review of the strategy and feasibility of eradication as described in section 7.

For transition to containment, the NPPO should amend their aims and action plans to reflect the change in scenario. The team should also define an endpoint for when containment is no longer appropriate and there should be a transition of responsibility from government to industry, landowners and/or other stakeholders. Pest freedom surveys should be considered for areas where the pest does not exist.

In cases where it is agreed for industry and/or landowners to take over responsibility from government for the management of the outbreak, consultation with the affected parties should be carried out to ensure it is acceptable for all parties and that there is a smooth transition of management.

When action is stopped completely, clear justification for this should be provided.

8.5 REPORTING

In all cases, whether eradication has been achieved or there is transition to containment, industry/landowner/stakeholder management, or no action at all, the outcome should be notified to the IPPC, the relevant RPPO(s) and affected trading partners, in accordance with ISPM 8 and ISPM 17.

In cases where eradication has been achieved, a scientific peer-reviewed paper discussing the actions taken is recommended to provide an example of a successful eradication campaign to other countries.

9. Relief, recovery and compensation

9.1 INTRODUCTION

A biosecurity emergency can have widespread impacts on affected industries and the general community. These impacts may include financial and emotional pressures on primary producers caused by destruction of crops or other primary produce, and trade and movement restrictions. There may also be flow-on effects to suppliers and consumers. More broadly, biosecurity emergencies may affect the wider community through the destruction of household produce, disruptions to household activities, restriction of and controls on affected areas, the potential limited availability of some consumer products, impacts on well-being and, where the natural environment or public assets are affected, the loss or negative impacts on social amenity (DPIPWE, 2020).

It is important that these impacts are managed through effective de-escalation procedures, stakeholder support and compensation arrangements (where applicable).

9.2 DE-ESCALATION PROCEDURES

Collected technical data from a response is analysed to predict rates of pest spread, impacts of the pest, and escalation or de-escalation of an outbreak. De-escalation activities will start before eradication is declared. This could be as soon as the eradication programme is completed and surveillance is being undertaken to ensure pest freedom. Once eradication has been declared (following surveillance), there will be further de-escalation to stand down. The decision to stand down monitoring, eradication and control operations is a trade-off between the costs of maintaining emergency operations, including ongoing surveys, and the cost of the pest escaping detection and control (including likely impacts) if de-escalation is carried out too soon. De-escalation will also occur following establishment of a containment regime or after transition to ongoing management, where eradication is not possible. Refer to section 8 for more information on declaring eradication and transitioning to other management approaches.

A demobilization plan should be implemented once the decision has been reached about the next phase for the response (the end of eradication activities, transition to programme management, etc.). The demobilization plan should include arrangements for physical repatriation and reconciliation of personnel, equipment goods and records used for the response, reviewing the need for quarantine arrangements within and between country regions, debrief/evaluation arrangements, and supporting relief and recovery.

9.2.1 Physical repatriation and reconciliation

As well as repatriating personnel, equipment goods and records, this will include handing over responsibilities for finalizing records, accounts and, where appropriate, coordinating national cost-sharing.

9.2.2 Review of intra- and inter-state/county/province quarantine arrangements

If the eradication campaign is unsuccessful or the response plan is terminated before completion, the most effective methods to support any trade within or between territorial divisions, such as a state or province, and international trade must be considered. If the pest is declared eradicated, then any in-country quarantine arrangements should be lifted and trading partners notified accordingly.

9.2.3 Debriefs

Debriefs are critical, as they provide an opportunity for participants to highlight any areas requiring improvement as well as any positive outcomes. Debriefs can be held at local, state/province and national levels following cessation of the outbreak response. For more information on debriefs, refer to section 10.

9.2.4 Relief and recovery

A coordinated approach is needed to support affected individuals and communities both during and following an emergency response. Relief and recovery activities should occur from the beginning of a response and continue throughout and following stand down of the outbreak (Plant Health Australia, 2021). All four elements of recovery are relevant – social, infrastructure, economic and environmental – in the context of biosecurity emergencies (DPIPWE, 2020). Relief and

recovery operations during the initiation, operational and stand-down phases of a response are outlined below. Note that different countries may use different terminology for the different phases of response.

Initiation phase of a response. Relief and recovery activities that may occur in the initiation phase of a response include providing access to social support and financial counselling and assistance services, providing information about the response and its potential impacts, and working with growers to develop options to support business continuity (Plant Health Australia, 2021).

Operational phase of a response. Relief and recovery activities in the eradication (operational) phase of a response will focus on supporting affected growers, businesses and the community. Specific issues such as availability of social support services and grower reimbursements (where relevant) should be identified in the response plan. Some of the relief and recovery activities that may occur in the operational phase include providing information on the response, any potential consequences and impacts and access to/availability of industry and government support services, and working with growers, industry and jurisdictions to support business continuity, including measures to permit trade to continue or resume, or transition to alternative activities where required (Plant Health Australia, 2021).

Stand-down phase of a response. Relief and recovery activities during and after the stand-down phase will depend on the specific circumstances and the outcome of the outbreak, including whether it occurred in a rural or urban environment and if the pest has been eradicated or not. Regardless of the outcome of the outbreak, recovery activities will occur through government and industry and will include continued engagement with stakeholders regarding access to and availability of support services.

Where the pest has been eradicated, recovery activities may also include a continuing focus on supporting growers and businesses to return to pre-outbreak levels of activity. Support provided to the community may include restoration of environmental and/or amenity values.

Where the pest is not able to be eradicated, recovery activities will change focus to supporting growers, businesses and the community to adjust to ongoing management of the pest. Communication and extension activities should focus on engaging with stakeholders to build awareness of the newly established pest and options to manage and mitigate its impact (Plant Health Australia, 2021).

9.3 STAKEHOLDER SUPPORT

9.3.1 Communication and public information

An effective communication strategy is essential and should keep stakeholders well informed through accurate, comprehensive and timely communication. The NPPO should solicit regular feedback and make provision for a constant flow of information between all parties. Communication can be passive (designed to inform stakeholders and sometimes receive information in response) and active (involving stakeholders in discussions and decision-making input) (IPPC, 2015).

Public awareness of the activities of an NPPO is an extension of the communication strategy. Significant pest outbreaks, pest eradication and control activities, and other activities that may lead to environmental disturbances are clearly issues of interest to the general public and may affect particular individuals or groups (IPPC, 2015).

Communication with stakeholders should consider the following, noting that communication will vary depending on whether the plant pest has been successfully eradicated or not:

- recognise that communication should be two-way, and that input and feedback should be encouraged;
- ensure that information is accessible to audiences in diverse situations, addresses a variety of communication needs and is provided through a range of communication channels and networks suitable for illiterate populations in the settings where this is relevant;
- establish mechanisms for coordinated and consistent communications between all jurisdictions (where applicable), service providers, organizations and individuals, and the community;
- ensure that all communication is relevant, timely, clear, accurate, targeted, credible and consistent; and
- identify trusted sources of information and repeat key recovery messages to enable greater community confidence and receptivity (Queensland Fire and Emergency Services, 2018).

Communication also involves trading partners. It may be necessary for the NPPO to negotiate arrangements to continue or reinstate international trade and

to notify impacted trading partners. In satisfying international reporting requirements, the NPPO will also report relevant changes in national pest status through the IPPC where necessary. Refer to section 8.

9.4 COMPENSATION ARRANGEMENTS

If increased trade and movement of people is increasing biosecurity risks, the cost of solving national problems and complying with international agreements is potentially large. All of these factors have generated considerable interest in who should pay for biosecurity. While governments may have a broad quarantine remit, historically investment has been focused on particular industries, often animal-based industries. In an environment of competition for limited biosecurity resources, specific investment will increasingly depend on strong economic and scientific justification, a holistic approach and risk analysis (Waage and Mumford, 2008).

To engage beneficiaries of response actions, some countries' governments have moved to engage industry in government–industry agreements, for example, Australia and New Zealand (see example of Australia's Emergency Plant Pest Response Deed below).

Government–industry agreements, also known as public–private partnerships, are usually based on a deed signed by industry and government representatives. A particularly important objective of these agreements is to deliver an agreed approach from government and industry to prepare for and effectively respond to phytosanitary risks. For example, they may cover one component of a phytosanitary system, such as cooperation with pest eradication programmes subsequent to a pest incursion. They may also cover several components or all facets of a national phytosanitary plan for a specific plant product or group of products (IPPC, 2015).

Emergency Plant Pest Response Deed (Plant Health Australia, 2022)

The Australian Emergency Plant Pest Response Deed (EPPRD) is a formal, legally binding agreement between Plant Health Australia (the national coordinator of the government–industry partnership for plant biosecurity in Australia), the Australian Government, all state and territory governments and national plant industry body signatories. The Deed covers the management and funding of responses to emergency plant pest incidents, including the potential for owner reimbursement costs for growers. It also formalizes the role of plant industries' participation in decision-making, as well as their contribution towards the costs related to approved responses. The key advantage of the EPPRD is more timely, effective and efficient response to plant pest incursions, while minimizing uncertainty over management and funding arrangements. Other significant benefits include:

- potential liabilities are known and funding mechanisms are agreed in advance;
- industry is directly involved in decision-making about mounting and managing an emergency plant pest response from the outset;
- a consistent and agreed national approach for managing incursions;
- wider commitment to risk mitigation by all parties through the development and implementation of biosecurity strategies and programmes;
- motivation and rationale to maintain a reserve of trained personnel and technical expertise; and
- provision of accountability and transparency to all parties.

Signatories to the EPPRD are committed to implement risk mitigation activities and promote reporting of suspected emergency plant pests. However, in relation to plant pest responses, the EPPRD operates only for the eradication of pests meeting the emergency plant pest criteria.

An emergency plant pest is a plant pest that has a nationally significant impact, either economic or environmental. An emergency plant pest must also be one of the following: a known exotic plant pest, a variant form of a plant pest already established in Australia, a previously unknown pest or an officially controlled pest.

Underpinning the EPPRD is PLANTPLAN (Plant Health Australia, 2021), the agreed technical response plan for an emergency plant pest incident. PLANTPLAN provides nationally consistent guidelines for response procedures, outlining the phases of an incursion, as well as the key roles and responsibilities of industry and government during each of the phases. It incorporates best practice in emergency plant pest responses and is updated regularly to incorporate new information or address gaps identified by the outcomes of incident reviews.

The National Environmental Biosecurity Response Agreement (NEBRA) (2022) establishes the national arrangements for responding to an outbreak of exotic emergency environmental pests and diseases of national significance where there are predominantly public benefits. Parties to this agreement are the national, state and territorial governments of Australia. National Environmental Biosecurity Response Agreement (NEBRA) – DAWE

10. Evaluating and maintaining contingency plans

10.1 INTRODUCTION

Any contingency plan will immediately, upon publication, start to become out of date. Plans will therefore need to be reviewed, either as part of a planned review process, after any significant changes to the outbreak process or following any use of the contingency plans for an outbreak or exercise.

When and how the plan is to be reviewed should be clearly stated in the contingency plan.

10.2 CONTINGENCY PLAN REVIEW

Contingency plans are subject to two types of regular review. A full-scale review, which includes an assessment of the whole outbreak management process and plan, and a light-touch review, which involves updating minor details such as acronyms, addresses, etc.

Full-scale reviews require more time and may occur every three to five years, with the time interval reflecting the maturity of the plan, available resources and the potential for significant change.

Significant changes include new legislation or new pest risk analysis following recent pest spread/interceptions, new trade pathways or new scientific research. Light-touch reviews, on the other hand, are much quicker and could be done more regularly, such as on an annual basis.

As at first publication, for any subsequent reviews it is advisable to seek external stakeholder comments beforehand to ensure that all implications are considered. For a review, this is more likely to be needed after a full-scale review than a light-touch review of minor details.

10.3 HOW TO CARRY OUT A LESSONS LEARNED REVIEW

In addition to the reviews mentioned above in section 10.2, a formal lessons learned review should be carried out once an outbreak is deemed finished or an outbreak exercise has been completed. A lessons learned review aims to assess an organization(s) response to a real or exercised outbreak, and this will include an assessment of the effectiveness of the contingency plan. The objective is to evaluate efficiency and learn from the experience gained to aid future planning, training and exercising.

This process can be best achieved by a series of debriefings at all levels within all agencies involved and concluding with a multi-agency debrief (if appropriate).

Within agencies, everyone involved, ranging from onsite operational teams to IMT personnel potentially based remotely from the area of operations, should be afforded the opportunity to contribute to a debriefing at some stage. The process may also benefit from additional debriefing sessions with those not directly involved, such as with advisory groups and interested external stakeholders.

The first debrief, often referred to as a "hot debrief", should take place immediately after the exercise or shortly after the outbreak and can be a useful way of capturing any early thoughts. The second debrief, often referred to as a "cold debrief", should take place after an appropriate interval to allow people to reflect on the situation and will be a more formal, considered process.

For both debriefs, three questions should be asked:

- What went well?
- What could have gone better?
- What would you have done differently?

In addition, a further three questions could be asked to approach the exercise from a different perspective:

- What was supposed to happen?
- What actually happened?
- Why were there any differences?

For both debriefs, it is important that a non-threatening atmosphere is created so that those involved are not afraid of being honest about their experiences and problems. The debriefs should be about improving processes and not about attributing blame to individuals. Organizations may wish to consider appointing a neutral debrief coordinator.

Any debriefing will be greatly improved if accurate issues/success logs are maintained during the outbreak response or exercise by all functional teams, which can be collated on an agency basis. An example log is provided in Figure 10.

As many lessons as needed can be added.

Failing to document and then learn from past events or exercises dooms organizations to repeat mistakes, especially as organizational memory declines over time.

Some lessons are more relevant to generic contingency plans, outlining organizational process in dealing with an outbreak, than pest specific plans. Table 6 provides examples of lessons for generic and pest-specific contingency plans.

10.4 IMPLEMENTATION OF PLANNED REVIEWS AND LESSONS LEARNED REVIEWS

Once completed, all feedback from the lessons learned debriefs should be collated, acknowledged and addressed.

The successes and issues need to be analysed to determine to what extent they contributed to the success of the response or hindered its conclusion. Following this analysis, mitigations and improvements can be recommended in the form of a report.

There is no specific format that an internal lessons learned report should take. The following is one possible format:

Figure 10: example log

	Date	Title	Category	Work area	Description	Outcome	Ownership
1							
2							
3							
Cont.							

- Date: provides context on when the issue arose.
- Title: a one-line title to identify the area of work associated with the lesson.
- Category: choice of "strategic", "tactical" and "operational". "Strategic" refers to lessons that are often longer term and are concerning large-impact changes. An example is a change in policy/legislation. "Tactical" refers to lessons regarding the management of an outbreak/incident and the processes/procedures involved. "Operational" refers to lessons that are predominantly field-based but could also be administrative/clerical changes, often short term and will be highly specific to a process or procedure.
- Work area: suggestions include operational and field issues, science and evidence, policy and legislation, communications, information technology and data management, training, administration issues and other key issues.
- Description: information on the specifics of the lesson, the who, what, where and why. This can include what went well and what did not.
- Outcome: make a recommendation of what to do next, including evidence needed to demonstrate action achieved.*
- Ownership: make a recommendation on assignment of the action to a person/team/group.*

* See 10.4: Implementation of planned reviews and lessons learned reviews.

Source: Author's own elaboration.

Table 6: Example issues discussed during debriefs for generic and pest-specific contingency plans

Type of plan	Example issues
Generic contingency plans	• Information both within and between organizations not being shared properly • Underdeveloped common understanding of the circumstances, immediate consequences and the longer-term implications of the outbreak, especially for ad hoc teams • Unwillingness of individual organizations to test their assumptions about the way their operational partners will respond in emergencies
Pest-specific contingency plans	• Size of survey zones • Speed of action • Treatment options • Diagnostic protocols • Compensation payments

Source: Author's own elaboration.

1. Executive summary
2. Core recommendations
3. Background
4. Subsections, e.g. data, operations, communications, policy and legislation, and governance, with each subsection including the following:
   - Overview
   - Aspects that went well
   - Key lessons learned
   - Recommendations
5. Future work
   - Update of contingency plans
   - Data sharing
   - Training
   - Communication.

Once completed, it is recommended that a process is put in place to ensure the recommendations from the lessons learned review are implemented. This process will include accepting the recommendations and prioritizing their implementation. This could be done by a group of individuals with experience across a range of disciplines to ensure that the recommendations are appropriate for all parties.

It is essential that all actions identified should be taken forward by a nominated person/agency and given a timescale for completion so that implementation can be tracked. A governance arrangement may be needed to ensure that any implementation programme is completed.

Lessons learned should be shared with all who may be required to respond to major outbreaks, even if they did not participate, and may include those who respond to outbreaks and emergencies other than plant health outbreaks.

11. Case studies

Case study 1

Eradication of the cactus moth (*Cactoblastis cactorum*) from two islands off the coast of the Yucatán Peninsula, Mexico

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Timeline of the case study

2006–2007

Content of the case study

Stakeholders involved:

- Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA), Mexico
- Joint FAO/IAEA Division International Atomic Energy Agency
- United States Department of Agriculture (USDA), Center for Plant Health Science and Technology (CPHST)
- North American Plant Protection Organization (NAPPO)

Cactus moth (*Cactoblastis cactorum* (Berg)) is an invasive species with the potential to cause devastating socioeconomic effects on the commercial production of prickly pear (*Opuntia*) as well as to arid ecosystems in Mexico.

An extended outbreak of the cactus moth was detected in 2006 in Isla Mujeres and Isla Contoy off the Yucatán Peninsula in Mexico. The national plant protection organization of Mexico, SENASICA, the state plant protection committee with the assistance of the United States Department of Agriculture Agricultural Research Services (USDA-ARS) and other collaborators including the Joint FAO/IAEA Division and NAPPO, reacted promptly to eradicate the outbreaks by delimiting the infestation and by population suppression using an integrated pest management (IPM) approach. With strategic and financial support from the federal government, SENASICA executed the eradication campaign. The campaign included pheromone traps, stripping of infested *Opuntia* cactus, removal of egg sticks and the limited use of insecticide. By intensifying these activities and integrating SIT, the outbreaks were officially declared eradicated in 2009. Sterile moths were shipped weekly from the rearing laboratory of USDA-ARS in Tifton, Georgia, and Gainesville, Florida, United States of America.

SENASICA maintains a surveillance system in strategic high-risk sites to provide early detection of any possible incursion of the cactus moth. Surveillance networks for early detection of invasive insect pests are critical for cost-effective eradication of outbreaks. Future plans are to maintain the cactus moth surveillance network operating at high-risk points of entry.

Eradication of the cactus moth from the two islands prevented spread of the pest to the mainland of the Yucatán Peninsula and further north to the commercial *Opuntia* cactus production areas and arid ecosystems where cactus is a major component of the ecosystem.

The following ISPMs were implemented successfully:

- ISPM 8 (*Determination of pest status in an area*)
- ISPM 9 (*Guidelines for pest eradication programmes*)
- ISPM 29 (*Recognition of pest free areas and areas of low pest prevalence*)

Additional resources

Bloem, K., Bloem, S., Carpenter, J., Hight, S., Floyd, J. & Zimmermann, H. 2007. Don't let cacto blast us: development of a bi-national plan to stop the spread of the cactus moth *Cactoblastis cactorum* in North America. In: M.J.B. Vreysen, A.S. Robinson & J. Hendrichs, eds. *Area-wide control of insect pests: from research to field implementation*, pp. 337–344. Dordrecht, The Netherlands, Springer.

Carpenter, J.E., Hight, S.D. & Bello, A. 2008. Eradication and containment of *Cactoblastis cactorum* in Mexico and the United States. Abstract 1286. 23rd International Congress of Entomology. Durban, South Africa, 6–12 July 2008. Durban, South Africa.

Heath, R.R., Teal, P.E.A., Epsky, N.D., Dueben, B.D., Hight, S.D., Bloem, S., Carpenter, J.E., Weissling, T.J., Kendra, P.E., Cibrián-Tovar, J. & Bloem, K.A. 2006. Pheromone-based attractant for males of *Cactoblastis cactorum* (Lepidoptera: Pyralidae). *Environmental Entomology*, 35: 1469–1476.

Hernández, J., Sánchez, H.M., Bello, A. & González, G. 2007. Preventive programme against the cactus moth *Cactoblastis cactorum* in Mexico. In: M.J.B. Vreysen, A.S. Robinson & J. Hendrichs, eds. *Area-wide control of insect pests: from research to field implementation*, pp. 345–350. Springer, Dordrecht, The Netherlands.

Hight, S.D., Carpenter, J.E., Bloem, S. & Bloem, K.A. 2005. Developing a sterile insect release program for *Cactoblastis cactorum* (Berg) (Lepidoptera: Pyralidae): effective overflooding ratios and release-recapture field studies. *Environmental Entomology* 34: 850–856.

Zimmermann H.G., Bloem, S. & Klein, H. 2004. *Biology, history, threat, surveillance and control of the cactus moth,* Cactoblastis cactorum. IAEA/FAO-BSC/CM. Vienna, IAEA.

Figure 11: Cactus moth outbreaks in Isla Mujeres and Isla Contoy, Yucatán Peninsula, Mexico

© A. Bello, SENASICA SAGARPA Mexico

Figure 12: Cactus moth (*Cactoblastis cactorum*) on its prickly pear (*Opuntia*) cactus host

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Case study 2

Guatemala, Mexico, United States of America – Moscamed Programme for the eradication and containment of the Mediterranean fruit fly (*Ceratitis capitata*)

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Timeline of the case study

1977–2018

Content of the case study

In 1975–1978, the invasion of Mediterranean fruit fly (*Ceratitis capitata* (Wiedemann)) in Guatemala and in Chiapas, Mexico, threatened the horticultural industry of the region (Guatemala, Mexico and United States of America), and lead to the establishment and implementation of a joint programme operated by the national plant protection organizations (NPPOs) of Guatemala (Ministerio de Agricultura, Ganadería y Alimentación (MAGA)), Mexico (Secretaria de Agricultura, Ganadería, Desarollo Rural, Pesca y Alimentación (SAGARPA)) and the United States of America (USDA). Between 1975 and 1977, cooperative agreements were signed between these countries to eradicate and contain Mediterranean fruit fly using an area-wide approach based on the sterile insect technique (SIT). The eradication activities of Mediterranean fruit fly in Mexico were undertaken in 1977–1982. The containment barrier with a buffer zone in Guatemala, set in 1982, is still maintained. FAO and IAEA had a fundamental role in capacity building and technology transfer through technical cooperation projects.

The case proved that area-wide eradication and containment of an invasive insect pest using an IPM approach, including SIT, is technically and economically feasible.

Stakeholders involved aim to:

- continue protecting the PFA north of the containment barrier in Guatemala by maintaining a solid containment barrier;
- incorporate state-of-the-art technology to the programme to improve its cost-effectiveness.

The following ISPMs were implemented successfully:

- ISPM 4 (*Requirements for the establishment of pest free areas*)
- ISPM 9 (*Guidelines for pest eradication programmes*)
- ISPM 26 (*Establishment of pest free areas for fruit flies (Tephritidae)*)

Additional resources

Enkerlin W.R., Gutiérrez Ruelas, J.M., Pantaleón, R., Soto-Litera, C., Villaseñor-Cortés, A., Zavala López, J.L., Orozco Dávila, D., *et al.* 2017. The Moscamed Regional Programme: A Success Story of Area-Wide Sterile Insect Technique Application. *Entomologia experimentalis et applicata*, 164: 327–339.

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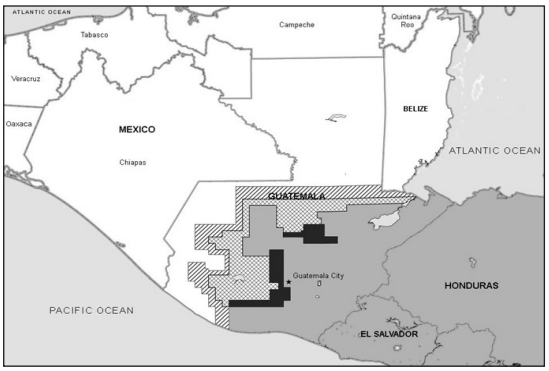
Orozco, D., Enkerlin, W. & Reyes, R. 1994. The Moscamed Program: practical achievements and contributions to science. In: C.O. Calkins, W. Klassen & P. Liedo, eds. *Fruit Flies and the Sterile Insect Technique*, pp. 209–222. Boca Raton, United States of America, CRC Press.

Ortiz, G., Liedo, P., Reyes, J., Schwarz, A. & Hendrichs, J. 1986. Mediterranean fruit fly *Ceratitis capitata*. Present status of the eradication program in southern Mexico. In: R. Cavalloro, ed. Proceeding CEC/IOBC Meeting, Hamburg, West Germany, 23 August 1984, pp. 101–111. Rotterdam, Netherlands, A.A. Balkema.

Patton, P. 1980. Mediterranean fruit fly eradication trial in Mexico. In: Proceedings of Symposium on Fruit Fly Problems, XIV International Congress on Entomology, pp. 81–83. Kyoto, Japan, ICE.

Figure 13: Mediterranean fruit fly mass rearing and sterilization facility, Metapa de Domínguez, Chiapas, Mexico

Figure 14: Location of the Mediterranean fruit fly containment barrier in Guatemala in 2015



Case study 3

Patagonia, Argentina – a Mediterranean fruit fly (*Ceratitis capitata*) PFA

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Timeline of the case study

2001–2004

Content of the case study

A programme to eradicate Mediterranean fruit fly (*Ceratitis capitata*) from Patagonia, Argentina, known as PROCEM SENASA, was launched by Argentina's NPPO (Servicio Nacional de Sanidad y Calidad Agroalimentaria (SENASA)) and the Fundación Barrera Zoofitosanitaria Patagonica (FUNBAPA).

Mediterranean fruit fly eradication actions started in 2001. Patagonia was officially declared a Mediterranean fruit fly PFA in 2004. Trading partners, including the United States of America and Mexico, recognized Patagonia as a Mediterranean fruit fly free area. FAO and IAEA had a fundamental role in capacity building and technology transfer through technical cooperation projects.

The eradication of Mediterranean fruit fly allowed for the elimination of costly quarantine treatments to most of the 3 million boxes of quality pears and apples that the region exports annually. Eradication was achieved through an intensive area-wide programme using SIT. Strategic alliances between federal and state governments, as well as with the private sector, are fundamental to achieve success in large-scale pest interventions that apply an integrated approach including SIT.

Sterile flies were shipped from the mass-rearing and sterilization facility located in the Province of Mendoza. Of fundamental importance to protect the PFA was the extensive quarantine barrier effectively managed by FUNBAPA.

The following ISPMs were implemented successfully:

- ISPM 4 (*Requirements for the establishment of pest free areas*)
- ISPM 9 (*Guidelines for pest eradication programmes implementation*)
- ISPM 26 (*Establishment of pest free areas for fruit flies (Tephritidae)*)

Additional resources

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Figure 15: Medfly mass rearing and sterilization facility in Mendoza, Argentina

© G. Taret, PROCEM Argentina

Figure 16: Inspection at the FUNBAPA quarantine road station in Patagonia, Argentina

© Esteban Rial, PROCEM, Patagonia Argentina

Case study 4

A fruit fly-free country in Chile

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Timeline of the case study

1994–2018

Content of the case study

In 1980, the Government of Chile, through the Agriculture and Livestock Service (SAG) of the Ministry of Agriculture (MAG), created Chile's National Fruit Fly Programme to prevent the introduction and establishment of any fruit fly species of economic importance, including the Mediterranean fruit fly and the economically important species of the genera *Anastrepha* and *Bactrocera* (Olalquiaga and Lobos, 1993).

Chile's National Fruit Fly Programme operates through a centralized organizational structure in the Ministry of Agriculture. As part of a regional approach to the fruit fly problem, the Government of Chile signed binational agreements with Argentina and Peru. The main stakeholders involved in the establishment and maintenance of Chile as a fruit fly-free country were MAG-SAG and the NPPOs of Argentina and Peru through cooperative agreements. FAO and IAEA also had a fundamental role in capacity building and technology transfer through technical cooperation projects.

Following various failed attempts to eradicate the Mediterranean fruit fly from northern Chile using baits sprays, in late 1990, SIT was introduced. In 1995, after six years of an intensive integrated area-wide programme based on SIT, the fly was eradicated in Arica, and Chile was declared a fruit fly-free country (MAG-SAG, 1995).

Chile's success in achieving its fly-free status was driven by implementing two major strategic activities:

- An effective national and international quarantine system (including interprovincial quarantine road stations and international quarantine at ports of entry), and an extensive and highly sensitive fruit fly-trapping network to detect fruit fly introductions at an early stage. Outbreaks of exotic fruit flies, mainly the Mediterranean fruit fly, have been eradicated through the effective execution of an emergency eradication plan based on detecting and eradicating infestations.
- In Arica province, the ongoing Mediterranean fruit fly area-wide IPM programme uses SIT as a containment barrier to avoid the natural or artificial spread of fly populations into northern Chile, protecting the main fruit and vegetable production areas in the central and southern parts of the country.
- Since Chile was declared a fruit fly-free country, fruit exports have grown to an annual 320 million boxes of fruits, mainly table grapes, apples, stone fruits, kiwis and avocados, valued in 2016 at USD 4 billion (ASOEX, 2017). Chile's fruit fly-free status has allowed one of the most important export-oriented horticulture industries in the world to develop.

The following ISPMs were implemented successfully:

- ISPM 9 (*Guidelines for pest eradication programmes*)

- ISPM 10 (*Requirements for the establishment of pest free places of production and pest free production sites*)
- ISPM 26 (*Establishment of pest free areas for fruit flies (Tephritidae)*)

The future plans of stakeholders include:

- maintaining Chile's fruit fly-free status to protect its high-value horticultural industry; and
- incorporating new advanced technology for optimization of fruit fly surveillance and control tools.

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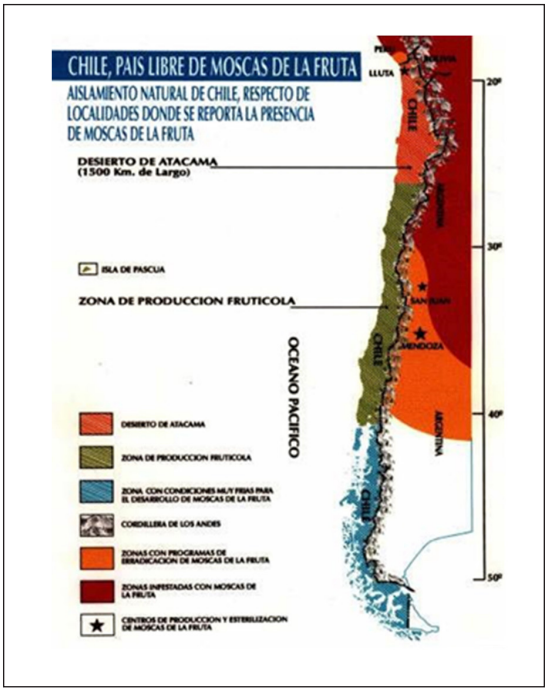
Figure 17: Mediterranean fruit fly (*Ceratitis capitata*) mass rearing and sterilization facility in Arica, Chile

© Ricardo Rodriguez, SAG Chile

Figure 18: Chile: a fruit fly-free country



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Case study 5

Mediterranean fruit fly (*Ceratitis capitata*) eradication from the Dominican Republic

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Timeline of the case study

2015–2017

Content of the case study

The presence of the Mediterranean fruit fly (*Ceratitis capitata*) in the Dominican Republic was officially reported in March 2015. The pest had already spread to 2 053 km2 in the eastern part of the country, constituting a major outbreak. An immediate ban to most exports of fruit and vegetables was imposed by trading partners, causing a loss of over USD 40 million for the remaining nine months of 2015.

As an emergency response, the government through its Ministry of Agriculture established the Moscamed Programme in the Dominican Republic (Moscamed-RD), providing the required financial and operational support to carry out all required surveillance and eradication activities. International organizations including IAEA, FAO, USDA, the Regional International Organization for Plant Protection and Animal Health (OIRSA) and the Inter-American Institute for Cooperation on Agriculture (IICA) made joint efforts with the Ministry of Agriculture against the Mediterranean fruit fly outbreak. An IPM approach based on area-wide SIT was used to eradicate the pest. A technical advisory committee of experts provided oversight throughout the eradication campaign. Official eradication was announced in July 2017 after six fly generations of zero catches. The Dominican Republic is now on the list of countries that have successfully eradicated the Mediterranean fruit fly, and has substantially strengthened its fruit fly surveillance system and emergency response capacity.

Establishment of Mediterranean fruit fly in the Dominican Republic would have had devastating effects on horticultural production and exports, and would have constituted a high pest risk for the entire Caribbean region and neighbouring mainland countries. The experience of the Dominican Republic proved that the availability of surveillance networks for early detection of invasive species is a critical phytosanitary measure to prevent pest introductions.

As a follow up, the Dominican Republic is establishing a national fruit fly programme with an assigned annual budget to maintain expertise, manage native fruit flies, and maintain the surveillance and response capacities for invasive fruit flies and other pests.

The following ISPMs were successfully implemented:

- ISPM 4 (*Requirements for the establishment of pest free areas*)
- ISPM 8 (*Determination of pest status in an area*)
- ISPM 9 (*Guidelines for pest eradication programmes*)
- ISPM 26 (*Establishment of pest free areas for fruit flies (Tephritidae)*)

Additional resources

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Figure 19: Location of the Mediterranean fruit fly outbreak in the Dominican Republic

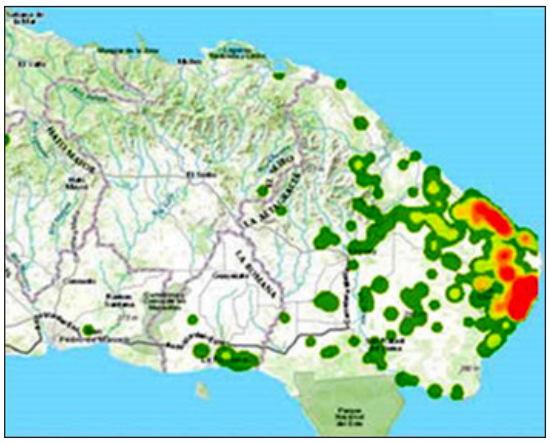

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Figure 20: Packing of sterile Mediterranean fruit flies before field release

© F. Martinez Pujols, Moscamed Programme Dominican Republique

Case study 6

Jamaica's response to a potential tomato leaf miner (*Phthorimaea abslouta*) outbreak

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Timeline of the case study

2020–2022

Content of the case study

Introduction

Tomato leaf miner (*Phthorimaea absoluta,* formerly *Tuta absoluta* (Meyrick)) is a major destructive pest of tomato worldwide. There is increasing concern about the rapid geographical expansion of the pest in tomato-growing areas due to the intensification of global trade and human movement. *Phthorimaea absoluta* has quickly reached economic pest status for tomato in invaded areas, despite the efforts of plant protection agencies.

P. absoluta was first collected in Peru in 1917 and has since spread into most countries of the Mediterranean basin. Currently, it can be found throughout Europe, the Middle East, Africa and parts of Asia. *P. absoluta* is still spreading and has become a regional concern for the Caribbean after being reported in Panama, Costa Rica and Haiti (CABI, 2021). Jamaica is self-sufficient in the production of tomato. There are over 1 500 farmers growing the crop, amounting to 460 ha (RADA, 2022). However, if *P. absoluta* establishes in Jamaica, it will likely devastate tomato production as it has in other countries, leading the country to increase tomato imports, and thereby increasing its food import bill.

The economic impact of *P. absoluta* is directly reflected in the rising costs of tomato crop production, namely additional costs for pest management, a decrease of marketable products and the potential loss of trading partners through restrictions on export to non-infested countries (CABI, 2021).

Pathway for entry into Jamaica

P. absoluta could be introduced into Jamaica by the import of infested host fruit and host plants, crates and packing boxes used to package infested host plants, and farm equipment and transportation vehicles. Jamaica currently imports, on average, 15 000 kg of tomato annually at a value of approximately USD 36 600.

There are several potential hosts, including wild and cultivated Solanaceous plants. The hosts of major concern for Jamaica are tomato, Irish potato, pepper and eggplant. Females are attracted to tomatoes, specifically, because of the odour.

Regional collaboration

Officers from Jamaica's Ministry of Agriculture and Fisheries have benefitted from two regional workshops.

In February 2020, the Workshop in Phytosanitary Surveillance of the Tomato Moth Tuta absoluta (Meyrick) was held in the Dominican Republic. The workshop was facilitated by the Dominican Republic Ministry of Agriculture in collaboration with the USDA Animal and Plant Health Inspection Services (APHIS), IICA and OIRSA. The workshop facilitated knowledge-sharing on phytosanitary surveillance and management of the pest in the Dominican Republic. The workshop provided basic knowledge to field and laboratory personnel on basic tools available for surveillance and control actions.

The IICA–University of Florida–USDA Regional Diagnostic and Surveillance Training Course for the Tomato Leaf Miner, *Tuta absoluta*, was held virtually in October 2020. The objective of the workshop was to build the capacity of plant health technicians in basic diagnostics and surveillance techniques for tomato leaf miner. The workshop included practical sessions, and sample moths were sent to facilitate dissection exercises. Jamaica was provided with trapping supplies to facilitate a three-month pilot project in ten agricultural zones across the country.

Jamaica's preparedness

As observed in many countries, it is very difficult to control and limit the spread of *P. absoluta*. In response to the national concern, the *Tuta absoluta* Working Group (TAWG) was developed in November 2020 as a subset of the Plant Health Coordinating Committee. TAWG comprises the emergency pest response agencies of Jamaica's Ministry of Agriculture and Fisheries, namely the Plant Quarantine Produce Inspection Branch as Jamaica's NPPO, the Research and Development Division, the Rural Agricultural Development Authority and the Caribbean Agricultural Research and Development Institute.

An Emergency Response Plan for *P. absoluta* has been drafted and is currently being finalized based on inputs from key stakeholders. A preliminary budget was developed, amounting to approximately JMD 45.3 million (USD 283 000).

The emergency response system consists of four components to prevent the introduction of *P. absoluta*:

- development and implementation of legislation relating to plant protection and quarantine;
- surveillance – port inspection and field monitoring;
- public awareness; and
- monitoring and review of preventative measures.

To date, the TAWG has:

- Completed the final draft of the Monitoring and Surveillance Protocol for *P. absoluta* for publishing.
- Trained 79 participants (plant quarantine officers and RADA extension officers) in surveillance of tomato leaf miner on 11 December 2020. Two follow-up practical training sessions were also held in the field to further build the capacity of extension officers.
- Completed a monitoring and surveillance pilot project, which was launched in December 2020 and concluded in April 2021. Thirty-seven traps were placed across the island in major tomato-growing areas, distribution centres and ports of entry. To date, there has been no occurrence of *P. absoluta* in the traps.
- Developed an online database. The database allows for real-time update of survey records, and allows collaboration between data managers that are in different locations.
- Completed a lure specificity trial to compare two types of lures for tomato leaf miner (Chemtica Lures versus Pherobank Lures)
- Developed public-awareness material, including field identification sheets, field guides, flyers and posters, which were disseminated to offices islandwide for distribution to stakeholders. Web flyers and pest alerts were also posted on the Ministry of Agriculture and Fisheries' social media platforms to target the wider public.
- Developed a draft quarantine order that will be gazetted under The Plants (Quarantine) Act as required.
- Conducted a tabletop simulation for the Emergency Response Plan for *P. absoluta*, on 28 January 2022, to create awareness among key stakeholders, evaluate the suitability of the current Emergency Response Plan to prevent, protect and mitigate against *P. absoluta*, and to assess Jamaica's readiness to respond to an incursion. Personnel from the emergency response agencies of the Ministry of Agriculture and Fisheries, as well as the Jamaica Customs Agency were present at the session.

In the event that *P. absolut*a is found in the monitoring traps, the pest response process flow (Figure 21) will be activated.

Challenges experienced and lessons learned

The major challenge observed during the survey pilot project was the delay in submitting samples to the diagnostic laboratory. This was due to conflicting work plans of the officers and travel restrictions. However, in follow-up discussions with designated supervisors, the group was able to leverage their collaboration with other agencies to facilitate timely submission of outstanding inserts to the laboratory.

It was also suggested that a courier service could be used to transport the inserts across parishes.

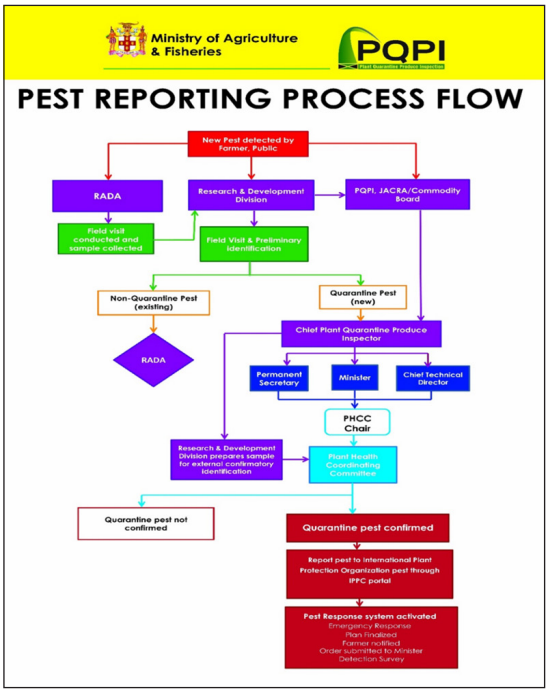
The inclusion of the Jamaica Customs Agency in the tabletop simulation exercise highlighted the limited awareness about their role in pest emergency response. Therefore, continued discussions with relevant stakeholders outside of the agriculture sector are valuable to raise their awareness.

To avoid breakdown in communication, data managers and supervisors were assigned to be contact points along a surveillance process flow.

The way forward

- TAWG will be assessing the need for additional monitoring sites as the surveillance programme is implemented.
- Field and laboratory personnel will be retrained in survey and identification procedures as required.
- To publish the Monitoring and Surveillance Protocol and the Emergency Response Plan, and to provide all agencies with copies.
- For optimum programme effectiveness, more trapping supplies will be procured.
- To ensure that the Emergency Response Plan can be enacted quickly in the event of an outbreak of *P. absoluta*, an emergency fund will need to be secured.

Figure 21: Diagram showing the pest reporting process that is activated upon pest incursion in Jamaica



Source: Author's own elaboration.

Additional resources

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Case study 7

Outbreak management of tomato brown rugose fruit virus (ToBRFV) in the United Kingdom of Great Britain and Northern Ireland

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Timeline of the case study

2019–2022

Content of the case study

Introduction

Tomato brown rugose fruit virus (ToBRFV) is a damaging virus of tomato (*Solanum lycopersicum*) and peppers (*Capsicum* spp.) (Luria *et al.*, 2017; Salem *et al.*, 2016, 2019). It was first observed in Israel in 2014 and in Jordan in the following year (EPPO, 2022; Salem *et al.*, 2016). Since then, the virus has been reported from across Europe and from parts of Asia and North America (EPPO, 2022). In some areas where it has been found, ToBRFV has caused substantial yield losses (Alkowni *et al.*, 2019; Avni *et al.*, 2020; Salem *et al.*, 2016). Other economic costs incurred have included hygiene costs, export costs and the cost of switching to a non-host crop in a specialized tomato and/or pepper production facility (EPPO, 2020).

The first outbreak of ToBRFV in the United Kingdom of Great Britain and Northern Ireland occurred in a tomato glasshouse in July 2019 (EPPO Reporting Service, 2019). Phytosanitary measures, including the removal and destruction of all tomato plants, the disinfection of the glasshouse, and a 14-week period of plant freedom, were taken to eradicate the virus (EPPO Reporting Service, 2019). This outbreak has now been declared eradicated (EPPO Reporting Service, 2020).

Contingency planning

Following on from the first outbreak, the United Kingdom of Great Britain and Northern Ireland developed a pest-specific contingency plan for the virus, which describes how the Plant Health Service for England will respond if an infection of ToBRFV is discovered on imported plants, fruit and seed, and in a growing crop (https://planthealthportal.defra.gov.uk/pests-and-diseases/contingency-planning/). The plan covers the immediate actions that would be taken to contain ToBRFV on a growing crop, the post-crop clean-up and surveillance.

Outbreak management

In 2020, the United Kingdom of Great Britain and Northern Ireland had five further outbreaks of ToBRFV. Action against these outbreaks was informed by the draft pest-specific contingency plan for the virus. The United Kingdom Plant Health Service also set up an outbreak management group, consisting of DEFRA policy and risk managers, the Animal and Plant Health Agency (APHA; inspectors) and Fera Science Ltd (diagnosticians) to work through the challenges of the various outbreak situations. Surveillance and diagnostics were adapted over the course of the response and training was provided to improve symptom recognition and biosecurity.

To support the outbreak response, there was extensive engagement with stakeholders and industry. The Agriculture and Horticulture Development Board (AHDB), together with the British Tomato Growers Association and Fera Science Ltd, set up a stakeholder group, which now also includes representatives from

ADAS (agricultural consultants), tomato growers, DEFRA and APHA. This group has allowed all parties to share their experience and expertise, better informing actions taken at outbreak sites and informing wider surveillance activities. This way of working, involving close collaboration between regulatory bodies and stakeholders, has provided a good model for outbreak management that could be replicated for future outbreaks. In addition, the stakeholder group has kept the tomato industry and other interested parties informed through meetings, conferences and the ToBRFV portal.

Lessons learned

To further improve ways of working, DEFRA led a lessons learned exercise for both the United Kingdom Plant Health Service and the stakeholder group. Across a number of different areas, including communications, policy, operations and science, three core questions were asked:

- What went well?
- What could be improved?
- What could be done differently?

From these, several recommendations were identified. Specific and general recommendations were implemented by the outbreak management group and the stakeholder group. General recommendations relevant to other outbreaks were also fed into the United Kingdom Plant Health Service's outbreak preparedness structure for implementation.

Current situation

As of 2022, there is one remaining outbreak of ToBRFV at a tomato production site in England. The United Kingdom of Great Britain and Northern Ireland's regulatory services and stakeholders continue to work together to help eradication efforts and prevent further outbreaks.

Figure 22: Symptoms of tomato brown rugose fruit virus at one of the tomato production sites

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Case study 8

Outbreak of Citrus black spot (CBS) in Tunisia: Challenges and lessons learned

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Timeline of the case study

2020–2022

Content of the case study

Context

Tunisia was alerted to an outbreak of citrus black spot (CBS) (*Phyllosticta citricarpa*), following several interceptions of CBS by the European Union on Tunisian citrus consignments in early spring 2019. This outbreak was the first in the Mediterranean region, raising serious concerns from commercial partners.

Online meetings were held with representatives of the ministry of agriculture in April 2019 to discuss issues relating to the interceptions of CBS. The Tunisian NPPO (Direction Générale de la Santé Végétale et du Contrôle des Intrants Agricoles) provided information on consignment traceability and the emergency actions planned. The Tunisian NPPO also put in place a self-imposed suspension of citrus exports to the European Union while the situation was reviewed.

Response

Emergency measures were discussed and undertaken with the support of relevant stakeholders, such as the Interprofessional Fruits Group, the Technical Centre for Citrus, farmers and trade unions.

The following priorities were identified:

- intensifying demarcation surveys, with sample collection and acquisition of GPS coordinates;
- establishing laboratory analysis methods according to ISPMs, including the purchase of necessary equipment and reagents;
- implementing a fungal treatment schedule, with a 50 percent subsidy on fungicides, intended to control CBS over an area of 2 000 ha of infected orchards; and
- information days to raise awareness on the disease and its control.

These activities cost TND 393 000 (EUR 121 255). By October 2019, the NPPO's quarantine laboratory was able to perform more reliable testing using molecular tools (real-time polymerase chain reaction (PCR)) to detect *P. citricarpa* on citrus fruits, and accurate mapping of the disease was developed so that citrus producers could benefit from a 50 percent subsidy on chemical treatment to control the disease. In parallel, a mid-term (2020–2022) contingency plan was developed (National Strategy to Control Citrus Black Spot) and included the following priorities:

- extending the phytosanitary survey to all citrus production areas in the country, with sampling and mapping;
- carrying out molecular testing in order to detect CBS;
- promoting scientific research on CBS biology, control and post-harvest measures;
- applying a 50 percent subsidy on fungal treatment to control the disease for small producers; and
- setting up an export certification scheme for citrus with a thorough inspection of packaging facilities as per related ISPMs.

The following ISPMs were implemented successfully:

- ISPM 4 (*Requirements of the establishment of pest free areas*)
- ISPM 6 (*Surveillance*)
- ISPM 7 (*Phytosanitary certification system*)
- ISPM 10 (*Requirements for the establishment of pest free places of production and pest free production sites*)
- ISPM 27 DP 5 (*Phyllosticta citricarpa* (McAlpine) Aa on fruit)
- ISPM 31 (*Methodologies for sampling consignments*)

Role of key stakeholders

The Chott Mariem Institute for Agronomic Sciences provided scientific support, the Technical Centre for Citrus helped in raising awareness about the disease, i.e. by printing brochures, and the Interprofessional Fruits Group helped purchase all necessary material, such as fungicides, equipment and reagents. At a regional level, the Regional Commissariat for Agricultural Development committed to organizing information days and providing sampling and inspection services. Tunisia also took advantage of technical support from the European Union and benefited from a study visit on detection and identification of the quarantine pest in November 2019, with the participation of the NPPO.

A workshop was held in Lisbon, Portugal, on the CBS survey toolkit and contingency planning from 26 to 28 November 2019 to share the Tunisian experience in controlling CBS.

The quarantine laboratory was also invited to participate in a proficiency test organized by the French National Agency for Food, Environmental and Occupational Health and Safety (ANSES) regarding *P. citricarpa* detection in 2020

Outcomes and impacts

Due to the emergency measures, and the actions undertaken in the framework of the national strategy, Tunisia was able to resume citrus exports to the European Union in January 2020, and there have been no interceptions recorded since on Tunisian citrus consignments. Tunisia exported 7 543 tonnes of citrus fruits to the European Union in 2020, and 11 530 tonnes in 2021.

Laboratory testing is performed according to the latest science, not only for *P. citricarpa* detection, but a PCR assay has now been adopted as a routine test for almost all quarantine pests. The distribution of CBS is now well known, and standard operating procedures have been refined for sampling and inspection. Producers are monitored and supervised, and scientific research is ongoing to provide answers about the pest, and its biology and epidemiology in Tunisia. Tools are also being developed to control it in the field and post-harvest.

Lessons learned and areas for improvement

The following lessons were identified:

- importance of phytosanitary surveys associated with laboratory testing for early detection;
- importance of consignment traceability;
- importance of involving stakeholders;
- importance of the availability of emergency funds to deal with a crisis situation; and
- development of contingency plans must not wait until outbreak of a pest is recorded. To that end, the NPPO developed a contingency plan to prevent the introduction and spread of *X. fastidiosa* to Tunisia.

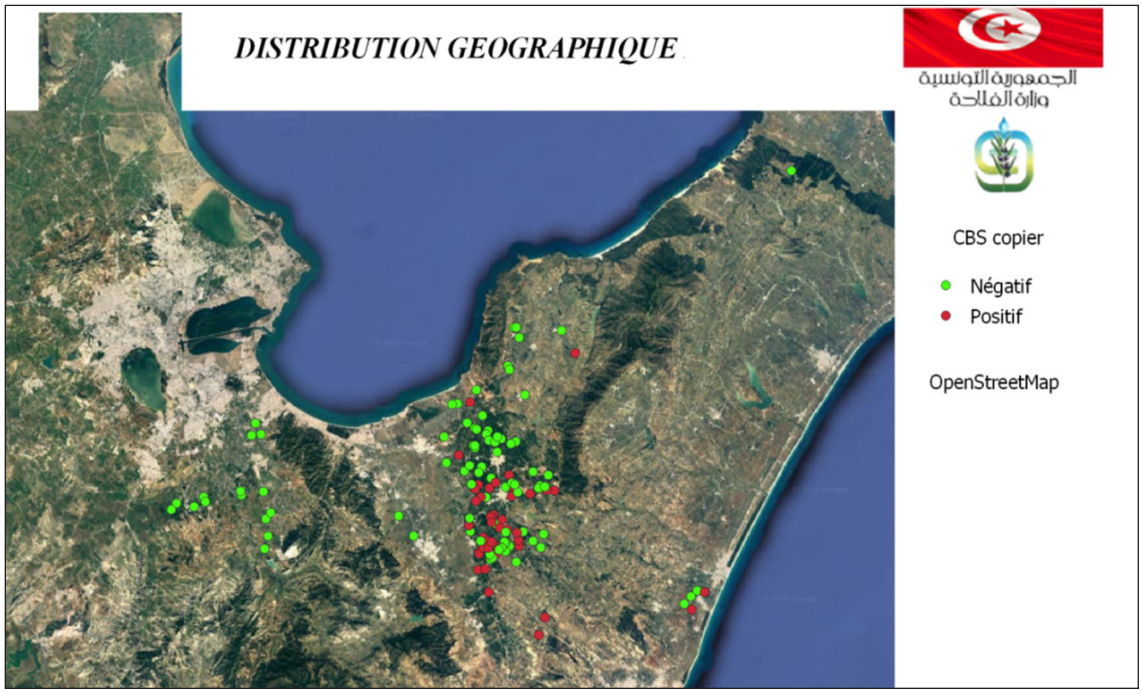
Next steps

The Tunisian NPPO is now developing a survey programme for other quarantine pests for early detection and to update pest status. These programmes include sampling and laboratory detection.

Figure 23: Small lesions mainly in the form of freckles, with larger lesions containing pycnidia in the centre

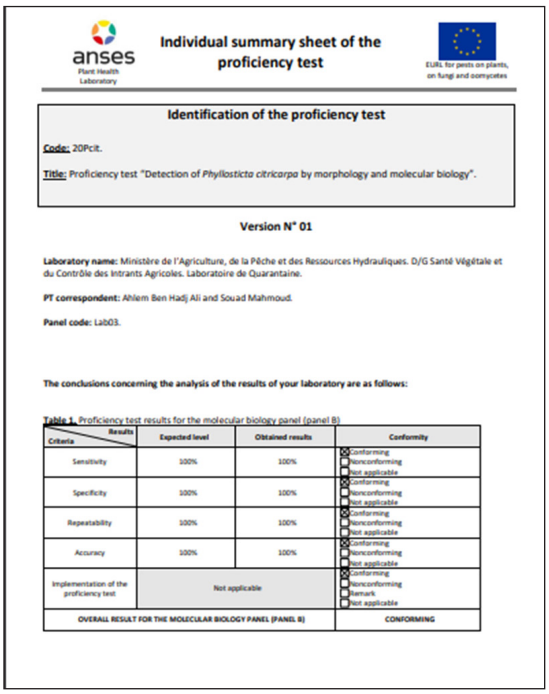
Source: EPPO. 2023. EPPO Global Database. https://gd.eppo.int

Figure 24: Distribution of CBS in Tunisia by November 2019. Red spots = infected orchards.



© G/D plant health and control of agricultural product, Tunisia

Figure 25: Proficiency test sheet attesting conformity of quarantine laboratory results in detecting *P. citricarpa* using molecular tools



anses
Plant Health Laboratory

Individual summary sheet of the proficiency test

EURL for pests on plants, on fungi and oomycetes

Identification of the proficiency test

Code: 20Pcit.

Title: Proficiency test "Detection of *Phyllosticta citricarpa* by morphology and molecular biology".

Version N° 01

Laboratory name: Ministère de l'Agriculture, de la Pêche et des Ressources Hydrauliques. D/G Santé Végétale et du Contrôle des Intrants Agricoles. Laboratoire de Quarantaine.

PT correspondent: Ahlem Ben Hadj Ali and Souad Mahmoud.

Panel code: Lab03.

The conclusions concerning the analysis of the results of your laboratory are as follows:

Table 1. Proficiency test results for the molecular biology panel (panel B)

Criteria \ Results	Expected level	Obtained results	Conformity
Sensitivity	100%	100%	☒ Conforming ☐ Nonconforming ☐ Not applicable
Specificity	100%	100%	☒ Conforming ☐ Nonconforming ☐ Not applicable
Repeatability	100%	100%	☒ Conforming ☐ Nonconforming ☐ Not applicable
Accuracy	100%	100%	☒ Conforming ☐ Nonconforming ☐ Not applicable
Implementation of the proficiency test	Not applicable		☒ Conforming ☐ Nonconforming ☐ Remark ☐ Not applicable
OVERALL RESULT FOR THE MOLECULAR BIOLOGY PANEL (PANEL B)			CONFORMING

Source: Author's own elaboration.

Additional resources

Boughalleb-M'Hamdi, N., Fathallah, A., Benfradj, N., Ben Mahmoud, S., Bel Hadj Ali, A., Medhioub, L., Jaouadi, I. *et al.* 2020. First report of citrus black spot disease caused by *Phyllosticta citricarpa* on *Citrus limon* and *C. sinensis* in Tunisia. *New Disease Reports*, 41: 8. http://doi.org/10.5197/j.2044-0588.2020.041.008

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Walters, M.L. & Griffin W. 2013. *The Importance of Training and Development in the Workplace.* Savannah, USA, The Leadership Center. 14 pp. www.theleadershipcenter.com/files/2019-10-01_11_35_28_importanceoftraining_developmentintheworkplace.pdf1236e8d5.pdf

ISPMS RELATED TO CONTINGENCY PLANNING

The present guide refers to International Standards of Phytosanitary Measures. ISPMs are available on the International Phytosanitary Portal (IPP) at www.ippc.int/core-activities/standards-setting/ispms.

ISPM 2. 2019. *Framework for pest risk analysis.* Rome, IPPC Secretariat, FAO. Adopted 2007. www.ippc.int/en/publications/592/

ISPM 5. Gl*ossary of phytosanitary terms.* Rome, IPPC Secretariat, FAO. www.ippc.int/en/publications/622/

ISPM 6. 2018. *Surveillance.* Rome, IPPC Secretariat, FAO. www.ippc.int/en/publications/615/

ISPM 8. 2021. *Determination of pest status in an area.* Rome, IPPC Secretariat, FAO. www.ippc.int/en/publications/612/

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ISPM 17. 2017. *Pest reporting.* Rome, IPPC Secretariat, FAO. Adopted 2002. www.ippc.int/en/publications/606/

ISPM 20. 2019. *Guidelines for a phytosanitary import regulatory system.* Rome, IPPC Secretariat, FAO. Adopted 2017. www.ippc.int/en/publications/602/

ISPM 41. 2019. *International movement of used vehicles, machinery and equipmen*t. Rome, IPPC Secretariat, FAO. Adopted 2017. www.ippc.int/en/publications/84343/

OTHER IPPC IMPLEMENTATION AND CAPACITY DEVELOPMENT RESOURCES

Establishing and maintaining pest free areas. A guide to understanding the principal requirements for pest free areas, pest free places of production, pest free production sites and areas of low pest prevalence. www.fao.org/documents/card/en/c/ca5844en

Managing relationships with stakeholders. A guide to stakeholder relations for national plant protection organizations. www.fao.org/documents/card/en/c/ca6383en

IPPC guide to pest risk communication. A guide for national plant protection organizations on communicating with stakeholders about pest risks. www.fao.org/documents/card/en/c/ca3997en

Pest status guide. Understanding the principal requirements for pest status determination. https://doi.org/10.4060/cb6103en

Prevention, preparedness and response guidelines for *Spodoptera frugiperda*. https://doi.org/10.4060/cb5880en

Prevention, preparedness, and response guidelines for Fusarium Tropical Race 4 (TR4) of banana. https://doi.org/10.4060/cc4865en

Resource mobilization Promoting contracting party partnerships. www.fao.org/documents/card/en/c/I7638EN

Surveillance: A guide to understand the principal requirements of surveillance programmes for national plant protection organizations. www.fao.org/documents/card/en/c/cb7139en

Definitions

The definitions below are sourced from the IPPC Glossary of phytosanitary terms (ISPM 5) and include only those glossary terms that are most relevant to this guide. The complete and updated glossary is maintained at: www.ippc.int/en/publications/622. The glossary is updated annually based on decisions taken by the CPM of the IPPC. The definitions below are accurate as of October 2022.

Biosecurity
A strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) to analyse and manage relevant risks to human, animal and plant life and health, and associated risks to the environment [FAO Biosecurity Toolkit, 2007]

Buffer zone
An area surrounding or adjacent to an area officially delimited for phytosanitary purposes in order to minimize the probability of spread of the target pest into or out of the delimited area, and subject to phytosanitary or other control measures, if appropriate [ISPM 10, 1999; revised ISPM 22, 2005; CPM, 2007]

Containment
Application of phytosanitary measures in and around an infested area to prevent spread of a pest [FAO, 1995]

Delimiting survey
Survey conducted to establish the boundaries of an area considered to be infested by or free from a pest [FAO, 1990]

Emergency action
A prompt official operation undertaken to prevent the entry, establishment or spread of a pest in a new or unexpected situation not addressed by existing phytosanitary measures [ICPM, 2001]

Emergency measure
A phytosanitary measure established as a matter of urgency in a new or unexpected phytosanitary situation. An emergency measure may or may not be a provisional measure [ICPM, 2001; revised ICPM, 2005]

Eradication
Application of phytosanitary measures to eliminate a pest from an area [FAO, 1990; revised FAO, 1995; formerly "eradicate"]

Monitoring survey
Ongoing survey to verify the characteristics of a pest population [FAO, 1995]

Outbreak
A recently detected pest population, including an incursion, or a sudden significant increase of an established pest population in an area [FAO, 1995; revised ICPM, 2003]

Quarantine area
An area within which a quarantine pest is present and is being officially controlled [FAO, 1990; revised FAO, 1995]

Treatment
Official procedure for killing, inactivating, removing, rendering infertile or devitalizing regulated pests [FAO, 1990; revised FAO, 1995; ISPM 15, 2002; ISPM 18, 2003; ICPM, 2005; CPM, 2021]

Appendix

CONTINGENCY PLAN TEMPLATE

Section	Generic contingency plan	Pest-specific contingency plan
1. Title	Clearly state the plan relates to plant health and the country/region/area concerned	Clearly state the pest that will be the focus of the contingency plan and the sector/situation concerned
2. Executive summary/ foreword/abstract	Set the context and summarize the content of the contingency plan	As per the generic contingency plan
3. Introduction	Describe the context, purpose and scope of the contingency plan	Describe the context, purpose and scope of the contingency plan, with reference to the generic contingency plan as appropriate
4. Organizational arrangements	Describe how the NPPO and associated organizations and teams are arranged to respond to an outbreak. This section should cover legislation, command structure, incident management system, training, exercises, stakeholder identification and consultation, operational resources and guidance, internal and external communication, funding and resources.	Because this section will be covered extensively in the generic contingency plan, there will be less of a need to cover organizational arrangements in the pest-specific contingency plan as a separate section. However, it could be covered briefly.
5. Summary of pest risk	N/A	Describe the pest's global distribution, host range, impacts, pathways of introduction and other relevant aspects of its biology. A summary of any interceptions and outbreaks in the country concerned, and a summary of available pest risk assessments could also be provided.
6. Official actions based on a suspected outbreak	Describe the generic elements, including the process and governance, notification, triage, escalation, official restrictions and measures, investigation, and the mobilization of resources and staff	Describe the pest-specific elements for each of the areas covered by the generic contingency plan
7. Official actions following confirmation of a pest outbreak	Describe the generic elements, including the process and governance, movement restrictions, demarcation (and legislation required), delimiting surveillance, investigation (and tracing), management measures, monitoring, stakeholder and external communication	Describe the pest-specific elements for each of the areas covered by the generic contingency plan
8. Review measures in cases of prolonged official actions	Describe the generic elements, including the trigger points for review and the types of audits being conducted	Describe the pest-specific elements for each of the areas covered by the generic contingency plan
9. Determining completion of official action	Describe the generic elements, including the criteria for pest freedom (and declaration of freedom), measures to maintain pest freedom, movement to containment or industry/landowner management, and reporting	Describe the pest-specific elements for each of the areas covered by the generic contingency plan
10. Recovery and compensation	Describe the generic elements, including de-escalation procedures, stakeholder support and compensation arrangements	Describe the pest-specific elements for each of the areas covered by the generic contingency plan
11. Evaluation and review of the contingency plan	Describe how the contingency plan will be reviewed and how regularly, and how lessons learned processes are carried out	Describe how the contingency plan will be reviewed and how regularly, and how they will be revised following a lessons learned process
12. Appendices	Appendices that may be included are further details of outbreak management processes, such as the incident management system and communication plans	Appendices that may be included are a pest fact sheet and detailed legislation requirements
13. References	As appropriate	As appropriate

IPPC

The International Plant Protection Convention (IPPC) is an international plant health agreement that aims to protect global plant resources and facilitate safe trade. The IPPC vision is that all countries have the capacity to implement harmonized measures to prevent pest introductions and spread, and minimize the impacts of pests on food security, trade, economic growth and the environment.

Organization

- There are over 180 IPPC contracting parties.
- Each contracting party has a national plant protection organization (NPPO) and an official IPPC contact point.
- Ten regional plant protection organizations (RPPOs) have been established to coordinate NPPOs in various regions of the world.
- The IPPC Secretariat liaises with relevant international organizations to help build regional and national capacities.
- The secretariat is provided by the Food and Agriculture Organization of the United Nations (FAO).

Did you read this guide?

Please send an email to ippc@fao.org and share your feedback.

Your responses will help the IPPC Secretariat and the IPPC Commission on Phytosanitary Measures (CPM) Implementation and Capacity Development Committee (IC) strengthen this and other guides and training resources.

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