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Supporting production nursery businesses during a biosecurity incursion: Review of social and economic impacts and business continuity

Milestone 103

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Executive summary

- This literature review is the initial research component of a larger research project NY18010 *Ensuring Business Continuity during biosecurity incursions: Social and Economic research learnings for the Production Nursery Industry*.
- The overall project objective is to develop a framework of supportive measures to assist individuals and businesses in the production nursery industry to cope with and recover from a biosecurity incursion event.
- The production nursery industry is a significant sector of the broader Australian horticulture industry, being extremely diverse and highly integrated into many other horticultural industry supply chains.
- While the industry has initiated a range of programs and projects over the past decade or so to improve grower biosecurity *preparedness* to prevent incursions, there remains a need to better understand the range of impacts and supportive measures required to assist growers *respond and recover* from biosecurity incursions.
- This paper reviews a broad suite of literature from academic research, industry and government sources, to identify both the broad diversity of impacts on nursery businesses and the types of supportive measures required to help businesses respond and recover.
- The review of impacts reveals three main areas:
    1. Impacts on farm or nursery operations, deriving both from the pest itself and the efforts to control it.
    2. Economic and financial impacts on individual businesses, and to the broader industry. These flow from the nature of the impacts on nursery business operations, the related capacity of nursery businesses to produce and deliver products, and to the protective actions taken by customers, markets and jurisdictions.
    3. Social impacts on growers, including both negative and positive effects; notably, personal psychological/emotional impacts, and consequences to social relations with other growers and related businesses in the industry, and within the local community.
- The review of support mechanisms highlighted the importance of following key elements:
    - Strong and early biosecurity preparedness measures that build grower capacity to deal with an incursion.
    - A broad view by biosecurity response management, inclusive of contextual factors at a range of scales.

- Inclusive, planned and proactive stakeholder engagement.
- Decision-making that is methodical, participatory, transparent and holistic.
- Flexibility and responsiveness of the management approach.
- Anticipation of resistance and conflict, awareness of their benefits and risks, and proactively implementing mechanisms that help manage them.
- Programs and forums that support growers to build and share their knowledge and skills, and to develop greater connectedness and trust.
- Provision of practical information and assistance related to the broad range of supportive measures and resources that may be required by businesses.
- Approaches that are future oriented, building the capacity of growers to deal with the longer-term demands of a biological incursion.
- Communication that is early, frequent, clear, up-to-date, and informative; and, communication framings that focus on positive actions.
- Formal evaluation of the management approaches and measures taken.

- This review also investigated the potential contribution of the Business Continuity Management (BCM) approach to building the resilience of businesses to a biosecurity incursion.
  - BCM has a primary focus on helping businesses to navigate severely disruptive events to minimise interruption to trade, while building broader disaster management and business resilience characteristics.
  - BCM additionally includes a focus on integrating the various external aspects of a disruptive event, which in the case of a biosecurity incursion would include: the formal biosecurity management system, interactions with relevant stakeholders, and considerations of flow-on effects, to and from, supply chains, environment and community.
  - This holistic approach positions BCM as well suited to supporting management of biosecurity incursions growers and industry.

1 Introduction

The production nursery industry is a significant sector of the broader Australian horticulture industry, being extremely diverse and highly integrated into many other horticultural industry supply chains. The incursion of an emergency or high priority plant pest in a production nursery business can have devastating consequences, both financial and personal, that may flow through to other businesses and people in many industries, communities and regions. The industry has initiated a range of programs and projects over the past decade or so to improve grower preparedness (Loechel et al., 2018; Nursery & Garden Industry Queensland, 2015; Plant Health Australia, 2013a), however there remains a need to better understand the range of impacts and supportive measures required to assist growers respond to and recover from incursions.

While high-level economic impact studies can calculate the overall impact of biological incursions at a broad, industry-wide scale, for industries to recover requires the recovery of many individual businesses. Further, while economic and financial factors are clearly of central importance to business recovery and ongoing viability, the more profound impacts of a biosecurity incursion may be on the social, emotional and psychological wellbeing of the people involved (Maclean et al., 2018; Mankad & Curnock, 2018; Mankad, Zhang, & Curnock, 2019). This review therefore seeks to provide an overview of research on both social and economic factors impacting production nursery businesses during an incursion, as well as the supportive measures that may be required to assist businesses respond and recover.

This review begins with an overview of the production nursery industry and its efforts to improve biosecurity preparedness, drawing primarily on a recent study of related issues by Loechel et al. (2018). The review then turns to an exploration of the many and diverse types of impacts of biosecurity incursions on growers and their businesses. To provide context, an overview is first provided of a typical biosecurity response, as outlined in the formal guidelines for an emergency plant pest incursion (PLANTPLAN; Plant Health Australia, 2019). This information about procedures for a regulated response provides a useful insight into potential impacts on nursery business operations. The review then describes findings (albeit from a limited pool of available research) on estimated economic impacts on nursery businesses and industry. A broader range of social research literature allows description of the various social and psychological/emotional impacts of a biosecurity incursion on growers and their communities. The review social and economic impacts is then followed by a corresponding focus on research on the types of supportive measures and actions that can be taken to assist efforts to prepare for, manage, and recover from, a biosecurity incursion. This is complemented by an overview of the types of supportive material and tools currently available to production nursery businesses and the plant industries more generally.

A key component of any approach seeking to support recovery efforts, is a focus on what measures businesses themselves can take to be better prepared. For this reason, this review

also includes a focus on Business Continuity Management (BCM), a comprehensive and well-established system that assists businesses plan for, manage and recover from severely disruptive events. The review explores the potential for BCM to be applied to biosecurity management by businesses, to better enable continuity of trade during and after an incursion.

1.1 Background

This literature review is the initial research component of a larger research project NY18010 *Ensuring Business Continuity during biosecurity incursions: Social and Economic research learnings for the Production Nursery Industry*. The overall project objective is to develop a framework of supportive measures to assist individuals and businesses in the production nursery industry to cope with and recover from a biosecurity incursion event. This initial literature review component informs the research components that follow, namely interviews of growers and stakeholders, and a survey of production nursery businesses. These three research components utilise differing information sources and methods to identify potential social and economic impacts of a biosecurity incursion and corresponding support measures. The findings of this research will then inform the development of the business continuity framework, which will be tested with a range of stakeholders through a scenario workshop process, prior to finalisation.

1.2 Defining terms

Various terms are used to refer to what we here call a 'biosecurity incursion', namely the occurrence of a confirmed or suspected emergency plant pest or disease. Other terms used include:

- 'biosecurity incident' e.g. PLANTPLAN (Plant Health Australia, 2019); *Biosecurity Incident Management System* (Biosecurity Emergency Preparedness Working Group, 2012)
- 'biosecurity event' e.g. term used under the Queensland Government Biosecurity Act (Queensland Government, 2020b)
- 'biological invasion' e.g. (Maclean et al., 2018); articles in the journal *Biological Invasions* (Springer, 2020)
- 'outbreak' e.g. the website *National pest & disease outbreaks* (Commonwealth of Australia, 2020).

The term 'biosecurity incursion' will be used in this review as it is the preferred usage by Hort Innovation, is used in the production nursery industry biosecurity advice (Greenlife Industry Australia, 2020c), and is in common usage in Australian academic literature (e.g. Mankad & Curnock, 2018; McAllister et al., 2017).

There are a range of terms used to refer to plant pests and diseases that pose a significant threat to plant industries nationally, or within jurisdictions. The existence of such pests and diseases may constitute a 'biosecurity incursion' for the jurisdiction involved. Commonly used labels are:

- Emergency Plant Pest (EPP): used in the Australian Government coordinated plant biosecurity system e.g. PLANTPLAN (Plant Health Australia, 2019)
- High Priority Plant Pest (HPP): typically used by the various plant industries to refer to their most problematic plant pests, with each plant industry typically having their own specific list (Plant Health Australia, 2020b) and generally requiring notification to authorities if sighted or suspected
    - at a national level, they are referred to as "National priority plant pests" (Australian Government, 2020; Plant Health Australia, 2020b)
- 'notifiable plant pest': each jurisdiction maintains a list of notifiable pests as part of their quarantine legislation (Plant Health Australia, 2020c); however the different jurisdictions use different terms to refer to these, for example, the Australian Government, as indicated above, uses "National priority plant pests", the NSW government uses "Notifiable plant pests and diseases" (NSW Government, 2020), Queensland government refers to them as "Priority plant pests and diseases" (Queensland Government, 2020a), and the WA government as "Declared pests" (Government of Western Australia, 2020)
- 'exotic plant pest': used nationally for the Exotic Plant Pest Hotline (Plant Health Australia, 2020f).

The different labels are not always technically synonymous: they may differ according to specific technical delineations, or according to the specialised or preferred usage of an industry body or jurisdiction. However, for the purposes of this document, in most cases it will be sufficient to refer to such pests collectively as emergency plant pests (EPPs).

2 The production nursery industry

The Australian production nursery industry is comprised of businesses and organisations that primarily produce plants for sale (termed 'greenlife') to retail nurseries as well as a multitude of other plant industries. The range of end-use plant industries include the ornamental plant market, vegetable growing, fruit and nut orchardists, forestry, landscaping, and the re-vegetation and rehabilitation sectors (Loechel et al., 2018; Nursery & Garden Industry Queensland, 2015). This makes the production nursery industry one of the largest and most diverse plant industries in Australia, producing in excess of 10,000 different plant species (Plant Health Australia, 2013a).

Production nursery businesses are located in all states and territories of Australia, with the majority of production occurring in the eastern states. Major growing regions include the South-East region of Queensland, the Northern Rivers and Central Coast regions of New South Wales, the greater Melbourne region of Victoria, and Perth in Western Australia (Hort Innovation, 2020). Production occurs year-round, with peaks arising during key crop planting periods and the spring season for ornamental retail product lines. The national peak industry body that represents production nurseries is called Greenlife Industries Australia (GIA) [formerly the Nursery and Garden Industry Australia Limited (NGIA)] [1]. The GIA is supported by state-based bodies present in most Australian states, such as Nursery & Garden Industry Queensland (NGIQ), Nursery & Garden Industry NSW & ACT Ltd (NGINA) and the Nursery and Garden Industry Victoria (NGIV).

2.1 Value of the industry

The Australian production nursery industry has an estimated farm gate value of $2.44 billion, representing the largest single industry contribution to the Australian horticultural industry at 17% of the total value of Australian horticulture (Hort Innovation, 2020). However, due to its role in supplying other major plant industries, it underpins an overall annual value of plant production in Australia exceeding $14.5 billion (Plant Health Australia, 2013a). The industry is comprised of over 1650 production businesses and employs over 23,000 employees, equating to more than 19,000 full-time equivalent staff in 2019, or again about 17% of the total in horticulture (Greenlife Industry Australia, 2020d).

2.2 Biosecurity in the production nursery industry

The production nursery industry plays a critical role with regards to biosecurity in the horticultural industry because it is situated at the beginning of the supply chain of many other plant industries. Thus, the capacity of nursery businesses to detect and respond to biosecurity incursions is of crucial importance. In 2019, Plant Health Australia (PHA)

[1] Members of the Nursery and Garden Industry Australia Limited (NGIA) voted in June 2019 to establish a new national industry body, Greenlife Industry Australia (GIA).

identified 17 specified “High Priority Pests” (HPPs) for the production nursery industry (Plant Health Australia, 2020b, 2020e). Fifteen of these were also HPPs of other Australian plant industries, and six were included in Australia’s National Priority Plant Pests list (considered Australia’s most serious exotic plant pest threats with 42 species listed in 2019) (Plant Health Australia, 2020b). The production nursery industry was impacted by five of the nine active national response plans managed under the Emergency Plant Pest Response Deed (EPPRD; described below in section 2.2.1) during 2019, and in each case was not the sole industry involved (Plant Health Australia, 2020e). This highlights the interconnectedness of the production nursery industry with other Australian plant industries and the importance of maintaining a high level of biosecurity in the industry.

Additional to the interconnectedness of the industry with others, is the degree to which movement of goods occurs. Significant movement of fresh product occurs both intra- and inter-state, through agricultural and horticultural regions, and cities and towns across Australia. Such movements have the potential to transport pests into areas otherwise free from these threats. This may adversely impact not only production nurseries but also other plant industries, agricultural cropping and livestock pastures, their associated communities, and the general environment (Nursery & Garden Industry Australia, 2016).

2.2.1 Biosecurity programs and policy

The national body, GIA, represents the biosecurity interests of the production nursery industry. It is a member of Plant Health Australia (PHA), the national coordinator of the partnership between Australian governments and plant industries for plant biosecurity in Australia. The PHA is the custodian of the Emergency Plant Pest Response Deed (EPPRD), which is a formal legally binding agreement between PHA, the Australian Government, all state and territory governments and national plant industry body signatories (Plant Health Australia, 2020a). The GIA is a signatory of the EPPRD, along with about 40 other plant industries. The EPPRD addresses the management and funding of responses to biosecurity incursions, including formalising the role of the various plant industries’ participation in decision making, including their contribution towards the costs related to approved responses. The EPPRD also addresses the potential for compensation payments for growers (known as ‘owner reimbursement costs’). Underpinning the EPPRD is PLANTPLAN (Australian Emergency Plant Pest Response Plan), the agreed response plan for an emergency plant pest incursion (Plant Health Australia, 2019, 2020a). It 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 (Plant Health Australia, 2020a).

GIA and its various state industry bodies provide a range of supporting materials, tools and programs to help producers improve their biosecurity standards. Key among these are the:

1) *Industry Biosecurity Plan for the Nursery Industry* (Plant Health Australia, 2013a). This high-level plan provides a mechanism for the nursery industry, various levels and agencies of government, and other stakeholders (e.g. other plant industries,

community groups and non-government organisations) to assess current biosecurity practices and future biosecurity needs. It also identifies procedures to minimise the occurrence and/or impact of a biosecurity incursion.

2) *Biosecurity Manual for the Nursery Production Industry* (Plant Health Australia, 2010). This on-farm guide is oriented towards nursery business owners/managers to help them implement biosecurity measures in their operation. It contains information on pest management, identifying the industry's High Priority Pests, the management of people, vehicles and equipment with respect to biosecurity, and recording methods for pest surveillance and visitors' movements.

3) *Australian Plant Production Standards* (APPS) [formerly the Nursery Production Farm Management System (NPFMS)] (Greenlife Industry Australia, 2020a). This is the overarching framework for the Australian production nursery industry's best management practice program. The program contains three main components:

    a. *Nursery Industry Accreditation Scheme, Australia* (NIASA), a best management practice program covering areas of crop hygiene, crop management, water management and general site management;

    b. *EcoHort*, an environmental management system designed to assist growers to address and demonstrate sound environmental stewardship and natural resource management; and

    c. *BioSecure HACCP*, a comprehensive biosecurity program for growers. It is significantly more detailed and all-encompassing than the entry-level Biosecurity Manual.

    d. In addition, the APPS provides a range of educational, technical, communication and other information and tools.

4) *Pest ID*, an online electronic plant pest identification resource (Nursery & Garden Industry Queensland, 2020).

In addition, industry levies support the provision of a range of programs, projects and associated personnel to strengthen grower capacity in relation to biosecurity. These include grower biosecurity training programs, emergency pest information resources, and pest incursion contingency planning. The GIA website provides a dedicated biosecurity section (Greenlife Industry Australia, 2020b) hosting a range of related information products and tools on plant pests and biosecurity topics. The GIA biosecurity program also provides regular newsletters and updates on specific topics, such as endemic and exotic pests. A detailed overview of these supportive measures and how they could potentially be improved, particularly in relation to EPP surveillance and reporting, was provided by Loechel et al. (2018).

3 Impacts of biosecurity incursions on the production nursery industry

3.1 Biosecurity incursions – what's involved

In order to understand the likely impacts of a biosecurity incursion on a nursery business, the first aspect to consider is the chain of events that occurs once an emergency plant pest, or reasonable suspicion of one, is detected. An understanding of the regulatory response – the processes, procedures and practices involved – and of what they require of producers, will provide for clearer insight into the likely impacts from them.

Detection of an EPP or suspected EPP, is the trigger for the start of a response effort. Detections may occur in a number of ways, such as: in the nursery upon sighting an unusual plant symptom or pest; during transportation of plants; and, in a laboratory if samples were submitted for testing (for example for other reasons such as nutrient analysis). A suspected sighting of an EPP must be reported immediately. This can be done through the national Exotic Plant Pest Hotline, however some jurisdictions encourage reporting through their own dedicated biosecurity hotline. A phone call to the national EPP Hotline will be directed to a state/territory agricultural officer in the jurisdiction where the pest detection occurred. Reporting independently to a state/territory agricultural department office/officer is generally not encouraged by the jurisdictions, however, is permissible. Of note, recent research in the production nursery industry (Loechel et al., 2018) found that few of the nursery growers who participated in the survey would consider reporting to the EPP Hotline. Instead, they preferred to report to a nursery industry-based technical officer, state/territory agricultural department office/officer, or local pest expert, such as a commercial pest agronomist. Overall, the participants indicated a reluctance to report suspicion of an EPP due to fear of the consequences to their business (e.g. quarantine, business shutdown, financial losses, etc.) and themselves (e.g. social impacts, reputational damage). Further, some indicated they would only report to someone they had dealt with before and trusted to consider, in addition to biosecurity procedures, their needs as a grower.

Reporting an EPP initiates a detailed investigation by authorities, which could involve an on-farm visit for collection of samples for a laboratory diagnosis. If a reasonable suspicion of an EPP is formed by the authorities, the samples are sent to a test laboratory for diagnosis and precautionary steps are then taken to quarantine the property in the period while awaiting the diagnostic results.

3.1.1 What does a typical regulatory response involve?

Receipt of a report of a suspected EPP marks the start of the official Response phase. As noted above, procedures for responding to a report of an EPP or suspected EPP are described in detail in PLANTPLAN, the Australian Emergency Plant Pest Response Plan and

are similar for all jurisdictions (Plant Health Australia, 2019). Additional details are provided in the *Biosecurity Incident Management System* (BIMS) document (Biosecurity Emergency Preparedness Working Group, 2012), with which PLANTPLAN is explicitly aligned. BIMS sets out the incident management system used for managing the national response to biosecurity incidents and is consistent with contemporary incident management systems which are widely recognised and used throughout Australia (Plant Health Australia, 2019).

Biosecurity incursions are managed at different levels, national, state/territory, and local, with each level associated with a corresponding control centre. At the national level, the Australian Government Department of Agriculture manages its responsibilities from the National Coordination Centre (NCC). For state & territory jurisdictions, there are three different types of centres that may be established during a response, at state/territory, local and field levels. The state/territory centre is known as the *State Coordination Centre* (SCC), the local as the *Local Control Centre* (LCC) and at the field level as *Forward Command Posts* (FCP). Depending upon circumstances (i.e. the nature, location, size and stage of the incursion) some of these centres may be merged for efficiency of coordination.

While state and territory governments each have their own biosecurity and quarantine legislation, PLANTPLAN procedures are agreed by all Parties to the EPPRD (industry and federal, state and territory governments) and must be followed in the management of a response to a biosecurity incident, as PLANTPLAN is legally binding on all Parties. However, the steps of a response outlined in PLANTPLAN may occur in a slightly different order, or concurrently, depending upon the type and scale of the response (Plant Health Australia, 2019).

Phases of an EPP response

Responding to an incursion is broken down into three phases in PLANTPLAN:

- Investigation and alert phase
- Operational phase
- Stand down phase.

However, PLANTPLAN notes several significant caveats to this simple ordering of phases, due to the emergency/fast-moving nature of a biosecurity incursion. Notably, PLANTPLAN states (Plant Health Australia, 2019:19):

- *While the phases of PLANTPLAN are depicted as separate events, they should all be viewed as part of a continuous process.*
- *Due to the potential urgency and evolving timeline of an Incident and response, the operational phase can be commenced prior to all activities in the investigation and alert phase being completed.*
- *The actions described in these phases are not a definitive list and the course of an EPP response may require fewer or additional actions to be performed*.

The initial stages of an EPP are therefore subject to considerable uncertainty, particularly leading up to confirmation through laboratory diagnosis. This period of uncertainty may

continue for some time, particularly if early samples were of insufficient quality to enable a clear diagnosis, or if results require further confirmation.

An overview of the types of actions that typically take place in the three different phases of the Response, as outlined in PLANTPLAN and likely to affect growers, is provided in Appendix A.

Relief and Recovery

'Relief and Recovery' is the terminology used within PLANTPLAN and the Biosecurity Incident Management System (BIMS) to refer to planned measures (e.g. information provision, administrative assistance with financial claims, referral to counselling services) for supporting affected individuals and communities both during and following an emergency response. Relief and Recovery activities are intended to be implemented from the very beginning of the official response (Investigation and Alert Phase), although some may apply to specific periods. The state and territory jurisdiction have responsibilities for provision of Relief and Recovery activities, although there is an expectation that some will also be delivered through industry and local communities (Biosecurity Emergency Preparedness Working Group, 2012; Plant Health Australia, 2019). Relief and Recovery activities are discussed further in section 4.2.2.

3.2 Impacts of a biosecurity incursion

3.2.1 Farm operational impacts

The different phases of the regulatory response described above require a range of actions to be taken by growers that lead to various impacts on the operation of the business. At the extreme, although perhaps not necessarily uncommon, quarantine may require the complete cessation of plant stock movement on-and-off the property, and therefore of trade. If a business is not allowed to import or export product, or if the regulatory response requires the complete destruction of the businesses plant stock and/or dismantling of significant infrastructure, such as growing structures, the business may need to halt operations entirely for a period of time. However, there are potentially many intermediate positions on the continuum from complete cessation of operations through to limited, specific, and/or discrete effects on normal business operations. Also, the times at which, and time periods over which, these disruptions apply may also vary. This uncertainty surrounding the extent and duration of the various time periods further complicates decision-making.

The description of the regulatory response above provides a basis for anticipating some of the types of activities the grower could expect to occur on their property, or that may be required of them to perform, that could affect day-today operations. In summary, they could include:

- frequent visits by the authorities, such as state government departmental officers and pest experts

- requirements for the provision of information to authorities and/or access to farm records
- learning about the biosecurity/ quarantine measures that are required to be implemented
- learning about the various aspects of the incursion response, which can be quite complex
- implementing required biosecurity/ quarantine measures
- training of staff
- ongoing monitoring and recording of activities, events and observations; documentation of procedures and operational plans; reporting to authorities as required
- ongoing review and modification of business practices and any physical/ infrastructure/ equipment changes as required.

3.2.2 Economic impacts

Economic impacts on individual businesses and the broader production nursery industry could be expected to flow from the nature of the impacts of the regulatory response on nursery business operations, their related capacity to produce and deliver products, and to the protective actions taken by customers, markets and jurisdictions. In addition, it is foreseeable that other plant-based businesses and industries, and associated communities, may also be affected. However, there is little publicly documented information on the economic impacts of biosecurity incursions on either the production nursery industry as a whole or individual production nursery businesses. The industry has reported an estimate of the economic impact of one exotic plant pest incursion, Red Imported Fire Ant (RIFA), in the state of Queensland, based on the interstate and intrastate movement protocols imposed by the Queensland Government (Nursery & Garden Industry Queensland, 2015). The estimate was derived from a survey of Queensland nursery industry businesses. The survey revealed that the industry was investing over $18 million per year in RIFA compliance costs and protocol implementation at the time, totalling over $180 million across the prior 10-year period. The paper contrasted this with a reported investment of $13 million in RIFA eradication in the 2006/07 year by the Queensland government. The paper also reported estimates of 1200 production nursery growers, producing a total of $821 million in production value per annum in Queensland at the time. Based on these figures, the RIFA costs would have equated to an average $15,000 per business per annum, or 2.2% of their annual production value. The types of nursery business costs incurred were listed in a separate paper as property mitigation measures, lost trade, market access, administration, preventative treatments/barrier treatments, and compliance costs (Almond Board of Australia et al., 2019).

The cost of the pathogen Myrtle Rust for the production nursery industry in the eastern states (QLD, NSW & VIC), was reportedly assessed in 2012 by the NGIA at approximately $27 million/annum (Almond Board of Australia, et al. 2019). Costs listed related to crop management, lost trade, market access, administration, and loss of commercial varieties.

For Australian horticultural industries more broadly, costs-shared for recent incursions were estimated at (Almond Board of Australia et al., 2019):

- $30 million for the Citrus Canker response to the Emerald, QLD outbreak in 2004
- $25 million for Banana Freckle outbreak in the Northern Territory, 2013
- $6 million for Tomato Potato Psyllid outbreak in Western Australia, 2017
- $18.7 million for Citrus Canker outbreak in the Northern Territory, 2018.

Apart from the costs of managing incursions, the production nursery industry invests considerable sums each year in biosecurity projects and programs to prevent and prepare for EPPs. The GIA National Biosecurity Manager (J. McDonald, personal communication, October 8, 2020) identified that the Australian nursery industry has invested, or partnered with stakeholders to invest, a total of $6.1 million over the past 5 years (2016-2020). This figure is comprised of $3.7 million from industry levy funds and $2.4 million from stakeholders including state and federal governments.

Looking overseas, economic impacts on the nursery industry in the USA, resulting from incursion management of Sudden Oak Death has generated a number of insightful reports (Dart & Chastagner, 2007; Frankel, 2008; Suslow, 2006). Sudden Oak Death, a disease of oak (*Quercus spp.*) and tanoak (*Lithocarpus densiflorus*) trees, first erupted in 1995 in the San Francisco Bay Area of California, in the United States. The pathogen responsible, *Phytophthora ramorum,* was identified in 2000. The disease spread widely in the US and into Canada in the early 2000s, through the sale of nursery stock from California and Oregon. The pathogen was also found in nurseries in the state of Washington. Many US states, as well as Canada, banned the importation of nursery plants from all three states and the US Department of Agriculture (USDA) placed all nurseries with host plants in the three states into quarantine. Suslow (2006) identified the types of costs incurred as being either one-time costs or recurring costs, although it was apparent that some of the 'one-time costs' occurred every time a reinfestation was detected through ongoing monitoring operations. One-time costs included replacement of the soil or growing media, destruction of affected stock and replacement with clean stock and/or switching to different non-host species, and loss of sales and markets. Recurring costs included prophylactic crop treatments, stock tracking programs, water disinfection programs, pathogen detection tests, new growing and labour practices, and ongoing loss of sales and markets due to reputational damage. Dart & Chastagner (2007) quantified the costs of plant stock destruction alone at over $USD11,000 per nursery per year, for the two years 2004 and 2005, for 32 affected nurseries in Washington State. However, this cost only accounted for the dollar value of the destroyed plants. Costs for the actual destruction and disposal of the plants (by burning and/or burial) along with other costs borne by the nurseries (similar to

those identified by Suslow (2006) above) were additional and unquantified. Indeed, Frankel (2008:22) reported that extension staff estimated that the dollar value of plants destroyed comprised only a "very small" percentage of the overall costs borne by affected nurseries.

3.2.3 Social impacts

A biosecurity incursion can have profound and far reaching consequences for business owners and managers. The economic impacts described above demonstrate how biosecurity incursions can be financially devastating. However, the unique characteristics of a biosecurity response incur additional stressors on growers, beyond the financial. Mankad (2016) in a review of the psychological factors affecting farmers' biosecurity decision-making, noted the unique character of the biosecurity context. Mankad contends that due to the high personal, social, emotional and financial investment farmers have in their business, a biosecurity event can affect multiple and often deeply personal domains of a farmer's life. In addition to the financial domain, other areas of impact identified by Mankad (2016) included: health and safety, including mental health; social relationships; ethical decision-making; and, recreational activities.

Fear of the consequences of an incursion is evident in reluctance to report unusual or suspicious signs of exotic pests to authorities. Loechel et al. (2018) investigated ways of improving biosecurity surveillance practices within the production nursery industry, notably of reporting unusual or suspicious signs to authorities. They found fear of the consequences of reporting potentially dissuaded many producers from reporting and was identified in relation to quarantine, business disruption, financial impacts, psychological stress, and industry and community reputational damage.

Bacher et al. (2018) propose a standardised system to categorise the various types of socio-economic impacts of 'alien taxa' or 'biological invasions'. However, their focus is more on the longer-term management of established invasive pests than emergency responses and control actions of pest incursions. The framework they developed is based on the capability approach to assess human well-being in welfare economics and social sciences (Sen, 1999). This approach is an established framework in human development policy and has apparently inspired, among other things, the creation of the human development index of the United Nations. The core of the approach is to focus on what people can do and be in their life, i.e. on their general capabilities. "The overarching premise for all constituents is the freedom of choice and action, i.e. the opportunity to be able to achieve what a person values doing and being"(Bacher et al., 2018:162). Citing Robeyns (2005) they contend that what is ultimately important for human well-being is how much the realised activities of people have changed. In contrast, a biological incursion effectively reduces capability by restricting opportunities and imposing costs.

The capability approach identifies four main constituents of human well-being: safety; material and immaterial assets; health; and, social, spiritual and cultural relations. Each of these constituents is then comprised of a wide range of examples or subcategories. The categorisation system is inclusive of both social and economic impacts. However, while it

may be helpful in expanding the conceptual range of types and sub-types of impacts that arise from biological incursions, the framework is perhaps somewhat too high-level and general to be of practical use in identifying social impacts of biosecurity incursions in an Australian nursery business context.

Shackleton et al. (2019) summarise a range of effects of biological invasions on human populations, however their focus tends to be more on the medium-to-longer-term effects of introduced invasive pests over many years, rather than the short-medium term impacts over months and years of emergency plant pest incursions. The negative impacts they identify, such as health and safety issues, loss of ecosystem services, loss of cultural services, reduced access to land, and reduced biodiversity values, are perhaps too broad level compared to the business, industry and community scale impacts that form the focus of this study.

Maclean et al. (2018) investigated ways to build resilience to biological incursions, using as a case study the response to Panama Disease Tropical Race 4 (TR4) in the banana industry in northern Queensland, Australia. They noted a range of literature addressing some of the broader social dimensions of biosecurity incursions such as communication, knowledge, social equity, conflict resolution, risk perception and uncertainty. However, more specifically, based on the northern Queensland case study of an EPP incursion, Maclean et al. (2018) identified the following socio-emotional impacts:

- the personal effort, ingenuity and resilience that was required of farmers to implement the required on-farm biosecurity measures, partly due to a lack of outside support to do so
- feelings of regret for previous attitudes of complacency and lack of preventive action
- a broad range of other negative feelings experienced during the incursion event such as anxiety, confusion, apprehension, fearfulness, isolation, abandonment, injustice, mistrust, self-justification, anger, and blaming
- some experienced positive feelings of community solidarity, of 'being in this together' with other farmers and as a local industry (while others reported experiencing isolation and/or abandonment due to a perceived lack of industry or community support)
- experience of contestation among both growers and experts (and consequent confusion) about the nature of the disease, incursion dynamics and what to do about it.

These challenges lead to a variety of responses ranging from:

- in the main, highly active, future-oriented positive action (such as a rapid and deep financial commitment to preventive biosecurity measures)
- more fatalistic responses, accepting the inevitable spread of the disease, particularly amongst those who lacked the financial resources to take substantive action and leading to inactivity

- active resistance or antagonism to the views and actions of authorities and experts.

In the main, however Maclean et al. (2018) reported strongly motivated action to put in place practical measures to prevent and/or control spread of Panama TR4, noting "Ultimately, what was most important to growers was not keeping the disease out of their farms per se, but of keeping their businesses operational regardless of disease presence or absence" (2018:101). This saw growers working together with the industry body (Australian Banana Growers' Council) and government agricultural department staff, to negotiate new standards and guidelines for continuing banana production even when a property experienced an infestation.

4 Supporting growers affected by a biosecurity incursion

Approaches and measures to support production nurseries during and after a biosecurity incursion can apply at a range of scales, from national through to individual business level. The review of relevant literature in this section will begin with broader level considerations that may apply across most scales from national to local, before moving to more concrete measures relevant to individual businesses. This latter section will be where the concept and practice of business continuity planning are discussed.

4.1 Supporting industries, businesses and communities

The literature cited in this section is broadly applicable to many plant industries dealing with biosecurity incursions, including the production nursery industry, where relevant literature is scarce. Many of the learnings presented come from the invasive species (IS) management literature, which perhaps has limitations in terms of not always being attendant to the urgent time-frames characteristic of EPP incursions. However, many other lessons are drawn from social science investigations of the biosecurity response to the Panama TR4 disease outbreak in the banana industry in northern Queensland, Australia, which are more relevant.

4.1.1 Building social ecological system resilience

The paper by Maclean et al. (2018) discussed above, takes a broad 'social ecological system' approach to conceptualising the challenge of responding to a biosecurity incursion. In addition, it utilises the concept of 'resilience' to understand how these systems, which are a blend of social and biophysical factors connected in complex ways, can cope with and adapt to change. This approach views resilience in terms of multiple stakeholders and scales, from local through to national, in a political and policy context typically defined by scarce resources and contestation, and in terms of the influences, and sensitivity, of broader social and ecological environments. A resilience approach seeks to identify and enhance the attributes of a system, at multiple levels (local, regional, and beyond), that enable it to respond most beneficially. From this standpoint Maclean et al. (2018) propose several key considerations for managing a biological incursion:

- The reasons why different stakeholders may engage in response efforts to manage a disease can be diverse. Providing opportunities for stakeholder groups to voice their views and values and reflect on them can assist managers to better understand the constraints and opportunities for different management options.
- Programs that support people to build their knowledge and skills and provide opportunities for the different stakeholder groups to share their knowledge and learn from one another, can build collective capacity to manage the disease.

- Approaches that support people-place connections and acknowledge the important stewardship role of growers on their own farms and those in their region may also build social resilience.
    - More broadly, social resilience can be enhanced by approaches that support existing community networks, build social capital, and support people and groups in a place to work together. Forums that assist this process include both formal arenas such as workshops to discuss and debate management strategies and informal get-togethers that support affected growers and strengthen social cohesion.
- Programs that build the capacity of growers to deal with the longer-term impacts of a biological incursion may be important, as some pests may not be eradicable and may need to be managed into the future. This may involve establishing mechanisms that foster collaboration between government, industry and grower groups. These forums enable negotiation and debate around management approaches and co-development of knowledge, as well as supporting adaptation or transformation through exploration of new avenues for growth.

4.1.2 Social Impact Assessment (SIA) supporting invasive species management

Crowley et al. (2017a) contend that management of invasive species will benefit from social impact assessment (SIA). However, similar to Shackleton et al. (2019), their focus is more on interventions to manage more established invasive pests, which tend to have more generous time-frames than the rapid regulatory responses characteristic of an emergency plant pest incursion, particularly in its early stages. Nevertheless, their recommendations that officials and authorities broaden their scope to include the human and social dimension of interventions remains pertinent. They note that democratically produced management plans that are cognisant of social dimensions are more likely to carry greater societal legitimacy than those proposed in a top-down manner by officials and technicians. They go on to highlight several principles of SIA that would appear beneficial to many interventions:

- flexibility and responsiveness in application, including prospective assessment, mitigation during delivery, and retrospective appraisal of outcomes
- awareness of both social risks and opportunities
- a deliberative approach to management, recommending community engagement from the start
- consideration of how management planning processes might affect and be received by the target group and concerned publics
- anticipation of resistance and conflict, and proactively implementing mechanisms that help manage it, including notably:
    - using inclusive and participatory processes that value diverse sources and forms of knowledge and social equity

- widening the definition of the 'success' of management from achieving narrow biophysical goals of say, eradication or containment, to also include those valuing social outcomes likely to be beneficial in the longer term, such as increasing the shared value of the project and building trust among stakeholders.

Crowley at al. (2017a) also describe the multi-stage process of an SIA that include components of potential value to consider for the management of a biosecurity incursion. However, due to the urgency and time-constrained nature of the initial response stage, and necessity for immediate compliance (i.e. in the early part of the Investigation and Alert Phase), these aspects may apply more appropriately to the period immediately following, and leading up to broader grower and community engagement. The SIA process includes the following stages that may be beneficial to include in biosecurity incursion management planning:

- *scoping* early and widely to include consideration of current context, past experience, the broad range of potential impacts, important stakeholders and affected parties, and potential management options and their own intended and unintended impacts
    - the current context may include socio-political aspects of existing inequities and tensions, or historical events and relationships (including historical management efforts) that may influence the outcomes of intended management approaches
- *assessment*, which involves using participatory processes and more rigorous and detailed attention to stakeholder identification and analysis, and the identification and evaluation of social impacts of management alternatives
- *decision-making*, methodical and participatory ('analytic-deliberative') comparison of management alternatives, holistically integrating the economic, biophysical/environmental and social impacts, and technical feasibility, to explore and determine agreed actions
- *implementation* could benefit from an emphasis on:
    - adaptability and responsiveness to a dynamic situation, where management actions can themselves result in some of the most significant impacts
    - active engagement between response managers, affected individuals and communities, and interested publics
    - diverse, inclusive project management and delivery groups
    - measures to maintain open communication feedback mechanisms throughout delivery
- *appraisal*, in addition to attention to ongoing feedback during the management response, upon completion (or cessation) of the response effort, the response should undergo a formal appraisal, evaluating outcomes against aims and

predictions (this potentially equates to the 'incident debrief' component of the Stand Down Phase).

4.1.3 Stakeholder engagement for better management of invasive species

Shackleton et al. (2019) undertook a review of stakeholder engagement for the study and management of invasive species. Again, their focus tended to be on more established invasive pests than emergency pest incursions. Similar to the recommendations flowing from research described above on SIA by Crowley at al. (2017a), they encourage more integrative and collaborative engagement. They conclude that stakeholder engagement processes lead to more beneficial environmental and social outcomes if they include the following key components:

- legitimate representation of stakeholders
- professional facilitation, including structured methods for aggregating information
- balancing power dynamics among participants
- provision of information and decision-making power to all participants.

Additionally, Shackleton et al. (2019) cite the value of using multi-criteria decision analysis (MCDA) and structured decision-making (SDM) processes to improve decision-making in invasive species management situations. These processes are both methodical and participatory or 'analytic-deliberative' as described in Crowley et al. (2017a) above, and act to:

- improve co-design, co-creation and co-implementation of management actions
- promote social learning and provide feedback to stakeholders
- enhance collaboration and partnerships to enable a broader range of input from diverse sources and types of knowledge.

More broadly, Shackleton et al. note that efforts to improve stakeholder engagement for invasive species management should attend to the following (2019:19):

1) *investigate the local context in which engagement is sought to ensure that the most appropriate type of engagement … is implemented for the given purpose and context*;
2) *systematically represent the needs and priorities of as many affected parties as possible, using approaches such as stakeholder analysis to ensure legitimate representation early in the process*; and
3) *pay attention to power dynamics, using professional facilitation and structure elicitation techniques to ensure the knowledge and other inputs of all participants are valued and that all stakeholder groups are given opportunities to contribute*.

Advancing collaborative knowledge systems for plant biosecurity surveillance

Robinson et al. (2017) investigated stakeholder engagement for different modes or stages of plant biosecurity in remote communities in northern Australia as part of the project '*Advancing collaborative knowledge systems for plant biosecurity surveillance*' (Plant Biosecurity Cooperative Research Centre, 2018). The importance of context in developing an engagement approach was emphasised, noting the different levels and types of knowledge, motivation to engage, and capacity to respond among stakeholders (industry, government, and local producers and community members, including Indigenous groups). Robinson et al. (2017) also found that engagement efforts during the response phase were most effective following strong engagement during the 'preparation' mode of day-to-day biosecurity prevention and surveillance.

The following 'key principles' for stakeholder engagement in biosecurity were identified:

Transparency over consensus: transparency in decision-making and trust building can be more important than whether a consensus position is fully achieved, when prioritising different stakeholder engagement options

A comprehensive view of stakeholders: industry and government need to take an expansive view on what constitutes a stakeholder across the broader, affected community

Strategic integration of engagement: stakeholder engagement during all phases of biosecurity needs to be well-integrated into the strategic planning of the biosecurity system; and should involve a fully collaborative approach to two-way information sharing.

Matching engagement to need: stakeholder engagement needs to be appropriately planned and tailored for the different stages and phases of a biosecurity situation; notably, during the 'preparation' mode as compared to the emergency response mode.

The project produced several research articles and capacity-building tools related to plant biosecurity stakeholder engagement, some of which are summarised in the subsections that follow.

4.1.4 Cost-effective stakeholder engagement options

Liu et al. (2019) investigated the most cost-effective stakeholder participation options in a biosecurity management context, using as a case study a response scenario to the Panama Disease Tropical Race 4 (TR4) in the banana industry in northern Queensland. Data was based on consultation, through interviews and a workshop, of a broad range of stakeholders, including growers, local and Indigenous organisations, banana industry representatives and government officers. Views were elicited about what was most important in developing a stakeholder engagement framework for TR4 surveillance and, through a process of identifying intermediate means and ends, converted into four high level objectives: making more informed decisions, maximising buy-in, empowering people, and minimising the stress of biosecurity incidents.

A range of engagement alternatives to achieve this, located at local, State/Territory, and National scales, were identified and presented to participants. The results showed that, in order of preference, use of local networks, adaptive management and industry networks were the most favoured options, receiving this same priority ranking by all stakeholder groups. Use of traditional media and local authorities achieved medium-level support. Least favoured were broader scale alternatives, such as building state and national capacity and use of regional networks and social media. With regards to cost-effectiveness, again, options to engage local stakeholders, and enable capacity to undertake adaptive approaches to biosecurity management, were found to be more cost-effective than engagement efforts that seek to build capacities at higher decision-making levels.

4.1.5 Managing conflict in stakeholder engagement processes

McAllister et al. (2017) employed statistical network analysis, together with qualitative data, to better understand conflict in a biosecurity incursion response where rapid, coordinated action is required. The study investigated Australia's response to an outbreak of the disease Myrtle Rust where attempts at eradication were highly contested and ultimately proved unsuccessful. The study focused on the forums (working groups and committees) where collaboration and coordination among organisational stakeholders of the response effort occur, and which tend to be sites of contestation. One key focus of the study was exploring the relationship between collaboration and coordination. Collaboration as inclusive, participatory decision-making tends to be viewed as a 'universal good', however the divergent goals of stakeholders that bring about contestation, can generate uncertainty and greatly slow collective decision-making, impeding the rapid coordination of the response that is required. The study concluded that spaces for collaboration and coordination need to explicitly embrace contestation, acknowledging both its value and risks, and implement agreed rules and processes that expedite disputes and collective decision-making. In this regard, consideration may also need to be given to capacity building of participants, in terms of a) defining expected behavioural norms appropriate to the stakeholder diversity inherent in key policy forums, and b) developing skills of negotiation, conflict resolution, and expectations management important to their effective functioning.

Maclean et al. (2018) also noted that contestation and conflict often occurs regarding management of a biosecurity response, so processes that recognise this and address conflict management issues should be incorporated from the beginning. This is likely to include a management approach that:

- takes a broad perspective, considering the local social, political, historical, economic and ecological context
- draws on diverse sources and types of knowledge
- recognises that contestation is not necessarily a barrier and indeed, processes that allow for debate and divergence of opinion can be beneficial, as they enable

different stakeholders to voice their experiences, express their management concerns and develop solutions.

Crowley et al. (2017b) focus on managing conflicts that arise in invasive species management more generally. They identify three key principles to minimise the incidence and severity of conflicts (having parallels in the principles and processes of SIA described by Crowley et al. (2017a) and in the contributions of Maclean et al. (2018) described above):

- greater and explicit attention to the socio-political contexts of management
- early, inclusive, public engagement
- open, responsive communication strategies.

4.1.6 Supporting adaptive coping and response action among growers

Mankad & Curnock (2018) explored the impact of a biosecurity incursion on social structures and relations among banana growers three months after a Panama Disease Tropical Race 4 (TR4) outbreak nearby, in northern Queensland, Australia. Analysing the findings of 25 semi-structured interviews with growers, they reveal the emergence of three social groupings: active adopters, passive adopters and maladaptive adopters. These groupings were associated with the coping styles and social influences amongst growers, as well as proximity to the outbreak source (relating to risk/threat perception) and socioeconomic capacity to respond. The research revealed some of the social pressures and impacts that may affect growers following a biosecurity incursion. These included experiencing a high level of normative pressure to adopt biosecurity procedures, which related to social comparisons amongst peers and risk of social disapproval for non-conforming behaviour. However, the research also highlights potential opportunities for improving stakeholder engagement with growers. The authors suggest several ways in which an awareness and responsiveness to these social dynamics could help biosecurity authorities and extension officers improve or tailor their engagements with growers:

- using more targeted communication
- encouraging early biosecurity uptake by incentivising desirable behaviours
- normalising a pest management culture
- developing financially sensitive approaches that are viable for smaller enterprises.

This research also highlighted the importance of social support mechanisms to assist adaptive coping and problem-solving skill development. Collective processes such as forums for community deliberation, sometimes referred to as ‘interactional infrastructure’ (Kilpatrick & Loechel, 2004) provide sites for building social capital. They can provide leadership and capacity building opportunities for growers, strengthens cohesion across different social groups, and encourage interdependence and contact between peers who may not ordinarily interact.

Mankad et al. (2019) explored the motivational drivers of response behaviours among banana growers affected by Panama Disease Tropical Race 4 (TR4) outbreak in northern Queensland, Australia. Using survey data collected from 57 growers, they reveal that apart from income dependence on banana growing, the main psychological drivers of protective action were intrinsic reward (personal satisfaction from taking action to protect their business), peer opinion (approval by other growers for taking action), and self-efficacy (self-belief in their ability to carry out the recommend actions). Interestingly, the perceived threat and self-reported knowledge of Panama TR4 and biosecurity practices were not significant motivators of protective action, and response cost (expense associated with taking protective actions) did not appear as a barrier for protective action. Thus, the strongest social-psychological motivators were personal satisfaction associated with protecting their farm, gaining peer approval for their proactive behaviours, and having a strong sense of competence in undertaking the required biosecurity actions. The finding on the importance of peer approval aligns with that of Mankad and Curnock's (2018) earlier study described above, which found that farmers were often experiencing a high level of normative pressure associated with social comparisons amongst peers within their banana-growing communities. These findings again suggest that mechanisms that not only build knowledge about protective actions but enable social learning among peers, appear important for improving grower adoption rates.

4.1.7 Effective communication strategies to engage the public

Key principles and strategies for engagement around biosecurity, identified from the project *Advancing collaborative knowledge systems for plant biosecurity surveillance* by Robinson et al. (2017) are summarised in section 4.1.3 above. This project also identified specific rationales, objectives, and methods for engagement, together with evaluation and consensus-building strategies to achieve cost-effective engagement and communication. Notably, the *Engagement for Collaboration Tool* considered both strategic and practical elements of engagement and communication activities. It uses a framework or methodology that guides the process through five steps over two stages and is designed to be applicable to both the preparedness and response phases of biosecurity. This body of work also emphasises the importance of communication that begins early and is frequent, clear, up-to-date, and informative. The *Engagement for Collaboration Tool* builds on the Australian Government's *National Biosecurity Engagement and Communication Framework* ('National Framework') which details how to design, share and use relevant communication tools and products (Australian Government, 2013). An illustrated overview of the *Engagement for Collaboration Tool*, in the form of the project brochure *Working together for plant biosecurity: how to effectively engage stakeholders*, can be found on the project website https://www.pbcrc.com.au/research/project/4004/ (Plant Biosecurity Cooperative Research Centre, 2018).

More broadly, in terms of mass communication strategies for the general public, Clarke et al. (2020) investigated news media coverage of Emerald Ash Borer in the US. They compared the various forms and messages in this coverage to those recommended by research on the

effectiveness of communication strategies to engage the public in managing invasive species. Clarke et al. (2020) found that the framings typically used tended to be militaristic (fighting an invading 'alien' species), fatalistic (spread was inevitable), anthropomorphic (ascribing human qualities to the pest), and/or sensationalist (overly dramatic). Accessing a broad range of research, they found that such framings of invasive pests are generally found to be counterproductive in engaging the broader public. While they may gain the public's attention in the short-term, they tend to reduce self-efficacy and self-confidence, foster a sense of powerlessness, marginalise some target audiences, or otherwise discourage engagement with pest management efforts. In contrast, framings that focus on positive actions improved self-efficacy, self-confidence and engagement. They also reported that relying only on "expert" voices to convey messages may also be problematic because, while it may increase credibility, it tends to reinforce the division between science and society, and thus between biosecurity and people's sense of their daily lives. Because the everyday activities of the public, (e.g. gardening, recreation activities in natural environments, travel) can intersect powerfully with biosecurity outcomes, they advocated that opportunities should be taken to include the public in media campaigns.

The findings of Clarke et al. (2020) compare with those of Mankad and Loechel (2020) who investigated the intentions of growers and the general public in southern Australian fruit growing regions to implement biosecurity measures to protect against fruit fly. They found that participants' intention to act was associated with both confidence in their ability to implement effective control measures and their perceptions of how badly their own property or community was likely to be affected by the threat. The results further clarified that specific knowledge about fruit fly control measures, rather than general knowledge about fruit fly itself, was a more significant predictor of intention to act.

4.2 Supporting businesses affected by a biosecurity incursion

The research presented in the prior section generally referred to approaches and processes of biosecurity incursion responses that are supportive of businesses, industries and communities at a broad level. This section will focus more specifically on biosecurity-related information and tools that support individual production nursery businesses.

4.2.1 Prior to a biosecurity incursion – education, prevention and preparedness

Production nursery industry support

As noted in section 2.2.1 above, the industry peak body GIA provides a broad range of biosecurity related programs, tools and information, as well as personnel dedicated to biosecurity roles, and links to relevant external organisations and resources. Key personnel roles include the National Biosecurity Manager and Biosecurity Certification Officers. Biosecurity resources range from pest factsheets, through on-farm grower biosecurity training programs, regular industry updates on biosecurity and pest-related topics, and,

ultimately, to the comprehensive nursery business biosecurity program, *Biosecure HACCP*. Links to these resources can be found in the *Biosecurity* section of the GIA website.

State/territory level production nursery industry bodies, such as the NGIQ, also provide industry and technical advisory personnel and many biosecurity information resources, including an organisational website that links to many of the same resources and tools described above for the GIA.

Plant-industry support generally

More broadly, nursery businesses are supported by general plant-industry biosecurity information, training and tools provided at other levels. These include, notably, those provided by Plant Health Australia, and national and state & territory governments. A list of some of the key resources follows:

- PHA Biosecurity Online Training (BOLT) – provides e-learning courses related to plant biosecurity. Access is free for most courses
- PHA website holds a broad range of information relevant to plant biosecurity. Generally pitched at a high system-wide level and quite technical, so perhaps more suited to professional stakeholder personnel with a biosecurity related role, than for growers to inform on-farm preparedness. Includes both a biosecurity section (dedicated webpages) and a separate biosecurity portal, to provide a definitive set of information about the Australian plant biosecurity system, including:
    - explanation of the structure, key components and function of the Australian plant biosecurity system
    - pest-specific technical information database
    - information on key topics such as risk assessment and mitigation, contingency planning for specific EPPs, diagnostics, and surveillance
    - a dedicated webpage for each plant industry, including the production nursery industry, with links to key resources, including a list of the industry's High Priority Pests with linked fact sheets, contingency plans and diagnostic protocols relevant to these pests
    - the Biosecurity Portal with links to a wide range of resource types, relevant organisations, and topic areas
    - the National Plant Biosecurity Status Report (Plant Health Australia, 2020b), which provides an annually updated summary of many of the elements on the website
- agricultural department websites both at the national and state/territory level, providing specific information and contacts
- the farmbiosecurity website: provides information pitched at the producer level, covering farm biosecurity generally, as well as a dedicated nursery industry section
    - https://www.farmbiosecurity.com.au/industry/nursery-garden/.

4.2.2 Support during the response phase of a biosecurity incursion

The information in the prior section is mainly relevant for the period leading up to an incursion, namely prevention and/or mitigation of risks, surveillance and incursion preparedness. However, once an incursion is reported, triggering a regulatory response, a further set of information resources will be required by growers. The relevant *content* of this information, namely what occurs in a regulatory response, how this is likely to affect growers, and what actions they may be required to take, is provided earlier in this report in section 3.1 and Appendix A. Thus, this section, will focus on the main sources where supportive information to assist growers during a biosecurity incursion can be found.

Information sources

- *Reporting an EPP*: as noted in section 3.1, detection of an EPP or suspected EPP, is the trigger for the start of a response effort and suspected sightings of an EPP must be reported immediately to authorities. These authorities can be contacted via the national Exotic Plant Pest Hotline, a state or territory specific biosecurity contact number, or directly to an agricultural department office or officer. A phone call to the EPP Hotline will be directed to a state/territory agricultural officer in the jurisdiction where the pest detection occurred. The relevant officer will seek further information about the detection and provide guidance on the initial steps of the investigation.
- *Initial investigation*: Assuming the initial inquiry finds further investigation is merited, a property visit will be undertaken by jurisdiction agricultural/biosecurity personnel. These officers, or other jurisdictional staff involved in the response, will then provide the main source of information support in the event of a biosecurity incursion affecting a property.
- *During and after an incursion*:
    - Jurisdictional agricultural/biosecurity personnel involved in the response will continue to provide the main source of information support throughout the response.
    - Information provision is available at various levels of an incursion response, national through local, in the form of the National Coordination Centre (NCC), State Coordination Centres (SCC) and/or the Local Control Centres (LCC). Such information provision is a formal component of the Biosecurity Incident Management System, namely the Public Information Function. This function controls information provision across four main activities: media, web and internet, call centres, and community engagement (Biosecurity Emergency Preparedness Working Group, 2012).
    - Production nursery industry staff (national and/or state-based) who are knowledgeable about biosecurity will provide additional information, as well as advocacy support, throughout the incursion.
        - Interestingly, the national *farmbiosecurity* website advises that leaders in a producer's peak industry body are to be their main

contact and source of information during biosecurity incidents (Animal Health Australia & Plant Health Australia, 2020).

- Jurisdictional and industry personnel will generally work together to assist growers respond to and recover from a biosecurity incursion. Such collaborative efforts were evident in reports on the Panama TR4 response, where Biosecurity Queensland officers and Australian Banana Grower's Council staff worked together to support affected growers return to trade (Flenley, 2020; Maclean et al., 2018).

Relief and Recovery

As noted earlier, PLANTPLAN specifically refers to a coordinated approach to support affected individuals and communities both during and following an emergency response as 'relief and recovery' (Plant Health Australia, 2019: Section 3.4). Activities are to commence from "day one" and continue throughout the incursion response, and even following the Stand Down Phase. PLANTPLAN notes that while jurisdictions have a responsibility to provide relief and recovery activities, some may be provided through industry groups and local communities. However, PLANTPLAN provides few details on the types of activities required. However, the earlier *Biosecurity Incident Management System* document (Biosecurity Emergency Preparedness Working Group, 2012: Appendix 2), with which PLANTPLAN is aligned, provides a list of types of activities and their responsible parties. The types of activities listed include: provision of information and updates about the biosecurity incursion; assistance with administrative claims; financial advice and support; referral to or provision of personal counselling and support services; and, translation and interpreting services.

Owner reimbursement costs

Financial compensation for damage incurred during a biosecurity incursion (typically for destruction of plant stock and associated materials) is addressed under the label 'owner reimbursement costs' (ORCs). It can be a subject of considerable concern to growers and detailed information is provided in both a dedicated section of the same name in the PHA website (Plant Health Australia, 2020d) and in even further detail in the EPPRD (Plant Health Australia, 2020a). Again, it is likely that personnel from both the jurisdiction's agricultural/biosecurity agency and the production nursery industry body (GIA and/or the state-based entities) would be well able to advise growers on queries relating to ORCs.

Of note, in related research, Loechel et al. (2018) found that ORC provisions were considered too restrictive and narrowly targeted by some production nursery businesses and industry support personnel. Expanding financial assistance mechanisms to cover a greater range of time periods, stages or types of EPP incursions covered by ORCs, was viewed as important to alleviate most of the financial impacts suffered by growers. Apart from the substantive financial assistance this would provide following an incursion, it was seen as an important way of reducing grower fear about the consequences of reporting a biosecurity incursion, and thereby minimise disincentives to report.

Other Financial support

The Biosecurity Incident Management System (Biosecurity Emergency Preparedness Working Group, 2012: Appendix 2) includes mention of temporary financial relief, potentially available through other government services and/or non-government agencies. Financial advisory services may also be available through, for example, the Rural Financial Counselling Service.

Personal support services

As dealing with a biosecurity incursion can be an extremely stressful and emotionally fraught experience, some growers are likely to benefit from referral to local counselling services or hotlines. However, as reported above, social science research into supporting growers during an incursion suggests that local grower-led social support mechanisms may also be quite helpful (Maclean et al., 2018; Mankad & Curnock, 2018).

4.3 Business continuity: practical steps to build resilient businesses

An important objective of the relief and recovery role outlined above, is restoration of business activity to pre-incident levels, or where this is not feasible, to support transition to alternate activities (Biosecurity Emergency Preparedness Working Group, 2012: Appendix 2). The recovery or restoration of trade as soon as feasible after a disaster is the aim of what is known as business continuity management (BCM) and is an aspect of crisis management that has been evolving since the 1970s, although the terminology of 'business continuity' only emerged in the 1990s (Herbane, 2010).

The concept of organisational recovery from a disaster is a cornerstone of the crisis management field, although the broad extent of the literature suggests the term disaster is used interchangeably with the terms crisis, catastrophe, emergency, business interruption or contingency (Herbane, 2010). Further, from a conceptual standpoint it is apparent business continuity management reflects the much wider crisis management literature, and its origins can be traced back to earlier 'contingency planning' and 'disaster recovery planning' approaches used by organisations. Herbane (2010) notes important milestones in the development of business continuity as a management discipline included the formation of the US Disaster Recovery Institute (DRI) in 1988 and the UK-based Business Continuity Institute (BCI) in 1994, seeing the subsequent emergence of certification standards for practitioners, training guidelines, and formal membership criteria.

The concept and practice of BCM also stands in interesting contrast with the well-utilised model of Prevent-Prepare-Respond-Recover (PPRR) (Howes et al., 2013). The PPRR model originated out of the Comprehensive Emergency Management (CEM) approach that also emerged in the United States in the 1970's (Cronstedt, 2002). Risk management – assessment and mitigation – is central to the 'prevent and prepare' or *pre-disaster* side of the event, focussing on how to protect from the potential losses caused by a disruptive event (Zio, 2018). Good practice in BCM is considered to incorporate risk management planning, which while it may remain a separate activity and role within an organisation, is

seen as strongly integrated into business continuity planning so that all relevant risks can be identified and appropriate responses planned (Business Continuity Institute, 2017). However, the *post-disaster* aspects of 'respond and recover' are where the business continuity focus is more particularly situated, seeking to enhance the capability of an organization to maintain or quickly resume operational status during and/or after a disruptive event. Business continuity is formally defined by the International Organization for Standardization (ISO) as "*the capability of an organization to continue the delivery of products or services within acceptable time frames at predefined capacity during a disruption*" (International Organization for Standardization, 2019). Sahebjamnia et al. (2015) note that traditionally, BCM (or Business Continuity Planning (BCP) as they refer to it) has been distinguished from Disaster Recovery Planning (DRP), being separate contingency plans that apply to different time horizons in the post-disaster phase. In this conceptualisation, BCM/BCP is seen as applying to the immediate period after an incident, seeking to resume key business operations to a minimum acceptable pre-defined level within a maximum tolerable timeframe. In contrast, DRP seeks to achieve the full recovery (restoration) of all disrupted operations to their normal business state by an acceptable timeframe post-disaster. Nevertheless, in practical disaster recovery terms, organisations are required to develop plans for both the short-term resumption (i.e., BCPs) and long-term restoration (i.e., DRPs) of their affected operations (Sahebjamnia et al., 2015).

More broadly, it is apparent that there are a variety, and evolving, range of conceptualisations and definitions of post-disaster response and recovery stages within the research literature and broader commercial 'business continuity' applications (Suresh et al., 2020). For example, an advantage of BCM, as compared to the more traditional planning for response and recovery of disaster management approaches, and reflected in the ISO (2019) definition above, is its focus on identifying how critical business functions, notably delivery of products and services, can continue operating with minimal downtime *during* a disruptive event. The focus is on continuing a feasible level of trade where possible, in order to minimise the ultimate impact of the event on business viability.

4.3.1 Business continuity management for greater organisational resilience

The concept of 'organisational resilience' is increasingly utilised in relation to an organisation's disaster management capability (Burnard & Bhamra, 2011; Vogus & Sutcliffe, 2007). Suresh et al. (2020) note that the ultimate aim of BCM is to improve the resilience of organisations to enable continued operations even under very adverse or abnormal conditions. Organisational resilience is formally viewed as the ability of an organisation to absorb and adapt in a changing environment to enable it to deliver its objectives and to survive and prosper (International Organization for Standardization, 2017). It can thus be seen to be nested within the broader, more holistic concept of socio-ecological system resilience discussed earlier (Maclean et al., 2018), which incorporates multiple facets of an organisation's environment. Organisational resilience, while not as extensive, can be viewed as including many pertinent aspects, notably supply chains (Suresh et al., 2020) but also industry, government, community and environmental considerations.

While the core concept of resilience, in the capacity of a system to absorb shocks and adapt in a changing environment, remains, applied to a business context it can be seen in the capacity of an enterprise to survive, adapt, and grow in the face of turbulent change (Fiksel, 2006; Linnenluecke & Griffiths, 2010). It has been related to an organisation's proficiency in keeping its capabilities at a stable level despite the challenging business environment in which it operates (Suresh et al., 2020). A further advance has been identified where firms learn from past disruptions and shift to a stronger posture (Sheffi, 2005). This may involve what is referred to as 'transformational' change that goes beyond the restoration of prior operational levels to exploit alternative production opportunities (Clément & Rivera, 2016; Dowd et al., 2014). This may be necessitated because past production opportunities are no longer available, effectively forcing a shift to other avenues for trade that may or may not be as profitable as prior opportunities (e.g. a biosecurity incursion may render commercial production of a prior plant species unviable so new species need to be produced). More optimistically, as alluded to above, the experience of preparing for and enduring a disaster/disruption incident, may facilitate the gaining of new knowledge, practices, procedures or skills that improve productivity and/or identify new more profitable lines of business. In summary, for the purposes of this review, BCM is considered to cover all of these aspects of organisational resilience: both immediate and medium- to longer-term recovery timeframes; response, resumption and restoration of activities; and, both improvements to normal business operations and development of alternative business opportunities. Further, it will consider not only internal operations of the business, but broader concerns that may affect or be affected by the business, e.g. supply chains, the requirements of the formal emergency management system, and industry, government, community and environmental aspects.

In the context of biosecurity incursions, which involve multiple stakeholders and can vary in type, scale and intensity, often depending on the nature of the pest, BCM thus appears a highly appropriate approach.

4.3.2 BCM in practice

Business continuity planning is generally encompassed within a broader system of policies, processes and roles relating to it. Examples include the Business Continuity Management System (BCMS) (International Organization for Standardization, 2019) and Business Continuity Management Lifecycle (Business Continuity Institute, 2017).

As stated by the International Organization for Standardization (2019), their BCMS has the following points of focus:

- understanding the organisation's needs and the necessity for establishing business continuity policies and objectives
- operating and maintaining processes, capabilities and response structures for ensuring the organisation will survive disruptions
- monitoring and reviewing the performance and effectiveness of the BCMS

- continual improvement based on qualitative and quantitative measures.

Business continuity management may be operationalised through a BCM programme and more specifically a Business Continuity Plan, defined as "*documented information that guides an organisation to respond to a disruption and resume, recover and restore the delivery of products and services consistent with its business continuity objectives*" (International Organization for Standardization, 2019).

It is important to note at the outset that BCM must be cognisant of the amount and type of impact that the organisation may or may not accept, or be able to accommodate, during or following a disruption (International Organization for Standardization, 2019). Clearly, some levels of impact may be completely beyond the capacity of an organisation to effectively respond to or recover from, and these limits may need to be delineated in the BCP to prevent the futile use of remaining resources, or deleterious impacts on other parts of the organisation, environment or community.

A range of benefits and challenges of BCM were highlighted by Suresh et al. (2020) and are summarised in Table 1.

Table 1 Advantages and challenges of BCM

BENEFITS	CHALLENGES
Augmenting a firm's ability for its goods and services to reach customers despite business risks	Inadequate commitments from senior management
Enabling better stakeholder interaction, with a well-defined framework for dealing with business risks	Insufficient allocation of resources for contingency procedures
Identification of vital directions to be taken to shield the essential functions of the company	Ambiguous understanding of the tasks related to the set-up and running of BCM activities
Recognition of possible threats and their impact on operations	Improper assignment of responsibility to the team and not to line management;
Efficient and transparent role assignments within the risk management process	Unsatisfactory training processes
Reduction of financial loss in the eventuality of disruptions	

Source: Adapted from Suresh et al. (2020)

Suresh et al. (2020) note that while BCM is highly dependent on an organisation's human resources, and level of engagement by staff, these limitations are certainly not unique to BCM, applying to many organisational initiatives.

A determined focus of BCM is striving to identify those activities that are feasible to maintain with adequate planning and preparedness even while a disruption is ongoing. Thus, while BCM highlights that with careful analysis some types of disruptive events may be less disruptive than otherwise imagined, it also points to the possibilities of what good planning, even for highly disruptive events, can achieve. Some significantly disruptive events

can be countered with good planning, need not completely shut down a business, and can thereby minimise the ultimate level of impact. This focus of BCM therefore suggests it is well suited to assisting businesses prepare for and respond to a biosecurity incursion and developing greater resilience from the experience.

5 Conclusion

The production nursery industry in Australia is facing an increasing array of exotic pest threats and is critical to strong biosecurity for many downstream plant industries. The industry has made significant investments over recent years in improving the biosecurity practices of production nursery businesses, particularly on prevention and preparedness programs. However, current research suggests that there remains significant room for improvement in how businesses prepare and respond to incursions.

While this review has highlighted the limited amount of research on the social and economic impacts of biosecurity incursions undertaken specifically in the nursery industry, it has identified a broader range of literature relevant to plant industries. Additionally, it has drawn on relevant research on the social impacts of invasive species generally. These findings have pointed to the broad range of business, financial, social and emotional impacts experienced by growers and associated businesses and communities during a biosecurity incursion.

The review of impacts revealed three main areas of impact:

1. impacts on farm/nursery operations, deriving both from the pest itself and the actions of the grower and requirements of the regulatory response to control it
2. economic and financial impacts on individual businesses and to the broader industry, which flow from: the nature of the impacts on nursery business operations; the related capacity of nursery businesses to produce and deliver products; and, to the protective actions taken by customers, markets and jurisdictions
3. social impacts on growers, including both negative and positive effects; including personal psychological/emotional impacts and consequences to social relations with other growers and related businesses in the industry, and within the local community.

This review has also identified a broad array of research relevant for supporting individuals, businesses and communities during a biosecurity incursion. The research reviewed produced practical findings for supportive actions and mechanisms derived across a range of approaches. The various approaches included notably: the higher-level perspective of socio-ecological system resilience; the social impact assessment approach to supporting invasive species management; social science research on plant biosecurity incursion management, including stakeholder engagement; and, the more formal and applied guidelines for relief and recovery efforts within PLANTPLAN.

The research findings highlighted the followings key elements of effective support during a biosecurity incursion:

- strong and early biosecurity preparedness measures that build grower capacity to deal with an incursion
- a broad view by biosecurity response management, inclusive of contextual factors at a range of scales
- inclusive, planned and proactive stakeholder engagement
- decision-making that is methodical, participatory, transparent and holistic
- flexibility and responsiveness of the management approach
- anticipation of resistance and conflict, awareness of their benefits and risks, and proactively implementing mechanisms that help manage them
- programs and forums that support people to build and share their knowledge and skills and develop greater connectedness and trust
- provision of practical information and assistance related to the broad range of supportive measures and resources that may be required by businesses
- approaches that are future oriented, building the capacity of growers to deal with the longer-term demands of a biological incursion
- communication that is early, frequent, clear, up-to-date, and informative; and, communication framings that focus on positive actions
- formal evaluation of the management approaches and measures taken.

These research findings demonstrate that efforts that are supportive of growers affected by a biosecurity incursion are critically important to helping them build their response capacity. Such efforts can help growers respond effectively to an incursion, minimise financial losses, assist coping with the associated emotional toll, and engender greater trust among stakeholders and the broader biosecurity system. Together they help build resilience in individuals, businesses, communities and the biosecurity system.

This review has also investigated the potential contribution of the business continuity approach to building the resilience of businesses to a biosecurity incursion. BCM has a primary focus on helping businesses to navigate severely disruptive events to minimise interruption to trade, while building broader disaster management and business resilience characteristics. Part of this includes a focus on integrating the various external aspects of the disruptive event, which in the case of a biosecurity inclusion would include the formal biosecurity management system, interactions with relevant stakeholders, and considerations of flow-on effects, to and from, supply chains, environment and community. This holistic approach thus positions BCM as well suited to supporting growers manage biosecurity incursions.

While this review of the broader literature provides important lessons, it will nevertheless be important to engage with key stakeholders and growers in the production nursery industry to inform the development of an industry tailored business continuity framework. Thus, the next steps of this project will involve interviewing growers and stakeholders in the production nursery industry with direct experience dealing with biosecurity incursions, followed by a larger scale survey of production nursery businesses likely to have been impacted. This engagement will seek to further define the specific impacts and corresponding support measures most important to growers and stakeholders. These results will then be used to inform development of a BCM framework that best supports growers manage an incursion and build ongoing business resilience.

Appendix A Phases of an EPP response

Responding to a biosecurity incursion is broken down into three phases in PLANTPLAN:

- Investigation and alert phase
- Operational phase
- Stand down phase.

Investigation and Alert Phase

The aim of this phase, which begins when a report is received by authorities, is to clarify whether an EPP is present and provide a detailed scoping of the extent of the incursion or potential incursion. The nursery business owner/manager is likely to experience the following procedures:

The initial/preliminary investigation

This stage typically involves:

- initial discussion with the person they notify about the suspect EPP, which may initially be simply by telephone. This person will usually seek to elicit further relevant information and provide preliminary instructions, including potentially:
    - documentation and/or provision of further relevant information, such as pest/plant descriptions, photographs, time and location of pest/infested plants, people and /or equipment, trace back and/or trace forward information[2]
    - precautionary restriction of movement of plants, people, vehicles, materials and equipment until a property visit by an agricultural departmental officer can be arranged
- property visit: visitation of the property by an agricultural departmental officer or plant pest specialist for an inspection and collection of samples for diagnosis and any other relevant details
- further precautionary measures to limit spread of the suspect EPP by putting into place appropriate interim quarantine restrictions on affected properties. Quarantine measures may include:
    - restrictions on the movement of vehicles, equipment and plant material/products on and off the affected property until diagnosis of an HPP/EPP is confirmed or ruled out
    - official serving of the owner or manager with a notice of quarantine
    - interim control or containment measures

[2] 'Trace back' information relates to tracing where the pest/disease may have come from prior to infesting the property (e.g. via visitors or received consignments of plant stock) and 'trace forward', to where it may have gone once leaving the property.

    - establishment of buffer zones around affected properties
- preliminary actions to determining the likely extent of the incursion, including further property visits and checking of records for any urgent trace forwards and trace backs
- precautionary decontamination procedures that may need to be arranged for people, produce, vehicles or machinery that have recently left the property.

Detailed investigation upon initial confirmation

In the case where an EPP is highly suspected or initially confirmed, further procedures are likely to include:

- measures to determine the extent of the incursion, namely delimiting surveys of the area to determine the extent of the distribution of the EPP and inform the extent of necessary quarantine zones
    - survey teams will consult with property owners or managers in order to identify:
        - movement of plant materials and products that may assist in the spread of the EPP
        - equipment which is shared between properties
        - personnel or contractors that may have moved from affected to unaffected properties
        - linkages from and between affected properties
- further sampling and diagnostic tests to fully confirm the presence of an EPP
- decontamination, disinfection and hygiene procedures for all farm personnel and visitors, including those involved in the response, as well as for vehicles and farm equipment entering and leaving the property
    - this may include the need for the property owner to construct facilities on the property to enable such procedures, such as foot baths, change rooms or a vehicle wash down area
- destruction and disposal of infected and 'at-risk' plants and produce and contaminated materials
- maintaining records and an accurate inventory of plants and produce for valuation purposes
- actions to ensure the short-term needs for food and other welfare requirements of farm personnel.

Information and advice

The officials leading the response efforts are required to provide a range of information or advice to property owners (Plant Health Australia, 2019:24), notably:

- the results of diagnostic tests
- quarantine procedures, including the need for cooperation and the potential for compulsory restrictions
- issues of confidentiality

- where producers can go for further information about the outbreak
- availability of support, including counselling services to assist with social, economic or other issues.

However, some information is at the discretion of officials as to whether they provide to producers. Types of information in this category may relate to a comprehensive explanation of the intended response actions and the potential for compensation to be paid (Owner Reimbursement Costs) as part of a Response Plan.

Extended periods of uncertainty

Even when an EPP diagnosis is confirmed, there may still be an extended period until a decision on eradication or an alternative action is made. This decision is based on both technical and economic grounds and involves several different committees as described in PLANTPLAN. The Consultative Committee on Emergency Plant Pests (CCEPP) must determine the feasibility of eradication, based on technical and cost/benefit factors, and provide a recommendation (Response Plan) to the National Management Group (NMG). The Response Plan may or may not recommend trying to eradicate the EPP and alternative actions may include various levels and time periods for control or containment (transition to management). The CCEPP may need to appoint a Scientific Advisory Panel (SAP) when additional information or technical advice is required (more than one SAP may need to be convened and international expert advice may need to be solicited). The NMG, which is comprised of representatives from all affected parties (federal and jurisdiction governments and affected industries) must determine cost-sharing arrangements and decide whether to accept the recommendation of the CCEPP and implement the recommended Response Plan. If the NMG doesn't accept the CCEPP recommendation, further consultation will be required until an agreed action is reached.

Thus, even if a decision is ultimately made to not try to eradicate the pest, precautionary control and containment procedures put in place may need to be maintained for an extended period, sometimes many months. The procedures may be modified over time according to new decisions based on changing information or priorities and may be in place for many years in ongoing attempts to limit the spread of the pest.

The outcome of the Investigation and Alert Phase will determine whether an EPP is present or not, and if so, whether it is feasible and cost-beneficial to eradicate. Where an EPP is found and a decision is made to attempt eradication, the Operational Phase will be activated. However, if the Investigation and Alert Phase determines that eradication is either not required (e.g. the pest is not found to be an EPP) or not feasible, the Stand Down Phase will be implemented, returning the situation from emergency response arrangements to normal business (Plant Health Australia, 2019).

Operational Phase

Where a decision is taken by the NMG to eradicate the pest, the response effort enters the Operational Phase. In addition to the original and ongoing quarantine, decontamination/hygiene procedures, and broader containment measures, instigated in the

Investigation and Alert Phase, further procedures for eradication may be required (for detail see the Standard Operating Procedures (SOP) *Planning eradication at affected properties* (Plant Health Australia, 2013b). Any required procedures are compulsory, and it may be incumbent on the business owner to undertake actions such as the following:

- on-site destruction (burning and/or burial) of affected or at-risk plants and related materials (e.g. growing media, pots, netting etc)
- removal of affected or at-risk plants and related materials for off-site destruction
- sterilisation/hygiene procedures for trucks transporting affected plants and related materials
- dismantling of growing structures, excavation of burial pits, construction of pyres for burning affected materials
- establishment of controlled access to site using specified entry and exit points, utilising additional back up security if required
- recording and documentation of activities, including photographic records for verification purposes
- development of a farm operational plan to determine:
    - a risk-based plan for continuing operations, to the extent that this is feasible
    - what can be grown and under what restrictions
    - the duration of the EPP confirmation program (monitoring and sentinel testing)
    - the requirement for ongoing compliance with movement restrictions
    - the maintenance of records and their associated audit
    - written agreement by the owner/manager on the reporting of any variations to the program.

In addition to these activities applying to the property where the EPP is found, they may also apply to other affected parties, such as neighbours and intermediary businesses (e.g. suppliers, clients, transport businesses). Further, the authorities are likely to be involved in ongoing media and communications to indirectly affected parties and the broader community, which may directly or indirectly affect or otherwise involve the business owner/manager and staff.

Upon initial containment or eradication of the pest or disease, further work may be required to confirm the pest is no longer present ('proof of freedom'). Proof of freedom may include a period of research and/or surveillance activities for an extended period before it is determined that the response has been effective (Biosecurity Emergency Preparedness Working Group, 2012).

Stand Down Phase

The aim of this phase is to provide guidance for moving from emergency response arrangements to normal business. This phase is implemented in the case of one of the following occurrences:

- the Investigation and Alert Phase determines the incursion does not to relate to an EPP (e.g. it may be found to be another type of pest, such as an uncategorised Plant Pest that is not reasonably believed to meet the definition of an EPP)
- the Investigation and Alert Phase indicates the EPP is no longer present (e.g. a single pest find, such as in only one plant from a consignment of overseas stock)
- implementation of the Response Plan in the Operational Phase has been successful and the EPP has been eradicated
- eradication of the EPP is determined not to be feasible (technically and/or financially cost-beneficial) by the authorities.

In the latter case, where at some point in the Investigation and Alert Phase the eradication of the EPP is deemed by authorities to no longer be feasible, a decision will be made to either:

- end the emergency response, in which case the Response Plan will be terminated, and immediate actions are taken to move from emergency response arrangements to normal business
- commence a 'Transition to Management' Phase, where attempts to eradicate the EPP end and instead strategies are implemented to otherwise manage (contain) the pest.

Transition to Management can be viewed as a means to stand down response activities nationally in an orderly way, moving from seeking to achieve eradication of the EPP to management of the EPP in an effective way outside of the EPPRD. A revised Response Plan is developed to achieve this within a defined and reasonable timeframe of up to 12 months.

One of the implications for producers of moving management of the EPP outside the EPPRD may be that further claims to compensation (Owner Reimbursement Costs), previously accessible under the EPPRD, may no longer be admitted.

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