National Plant Biosecurity **Diagnostic Strategy**

2021-2031

Plant Health AUSTRALIA

Australian Government
Department of Agriculture, Water and the Environment

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PHA would like to acknowledge the input of the Subcommittee on Plant Health Diagnostics (SPHD) and other plant biosecurity diagnostic stakeholders into the development of this strategy. PHA also gratefully acknowledges the contributions made by the Strategy Advisory Group. The group comprised:

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Subcommittee on Plant Health Diagnostics (SPHD)

SPHD provides leadership in plant pest diagnostics policy, standards and coordination for Australia. The subcommittee was established in December 2004 by the Plant Health Committee to sustain and improve the quality and reliability of plant pest diagnostics in Australia. Key roles and responsibilities of SPHD include:

- reviewing and developing diagnostic policies, protocols and standards
- reviewing, developing and implementing strategies to address national capability and capacity issues
- endorsing National Diagnostic Protocols
- coordinating and fostering the National Plant Biosecurity Diagnostic Network
- coordinating national capability building through a professional development framework
- driving the development and uptake of accreditation and quality management systems for diagnostic laboratories
- improving the surge capacity of diagnostic services to support plant pest responses.

Copyright statement

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Contents

Acronyms

APPD	Australian Plant Pest Database
ASEAN	Association of Southeast Asian Nations
EPP	Emergency Plant Pest
IGAB	Intergovernmental Agreement on Biosecurity
IPPC	International Plant Protection Convention
LAMP	Loop-mediated isothermal amplification
NATA	National Association of Testing Authorities
NDP	National Diagnostic Protocol
NPBDN	National Plant Biosecurity Diagnostic Network
NPBS	National Plant Biosecurity Strategy
PaDIL	Pest and Disease Image Library
PHA	Plant Health Australia
SPHD	Subcommittee on Plant Health Diagnostics
STAR-D	System for Timely, Accurate and Reliable Diagnostics

Executive summary

The National Plant Biosecurity Diagnostic Strategy (the strategy) provides a framework to strengthen Australia's plant biosecurity diagnostic system. It is one of several strategies that supports the broader national biosecurity system through its alignment with the Intergovernmental Agreement on Biosecurity (IGAB) and the National Plant Biosecurity Strategy (NPBS).

The strategy's vision is that by 2031 the plant biosecurity diagnostic system sustains and improves the quality and reliability of diagnostic outcomes to support Australia's economy, environment and community. Achieving this shared vision requires collective effort nationally to ensure the people infrastructure, standards and tools used deliver the highest-quality plant pest diagnostic services.

The 2021–2031 strategy is based around six interconnected goals shown below. Each goal is supported by a series of actions that will guide and support national policy relating to the delivery of plant pest diagnostic services and inform investment in research, development and extension. The actions can also be used to guide state/territory, regional and local efforts or efforts by individual governments, plant industries and stakeholder groups.

Goal 1	**Strengthen national and international diagnostic connections**
Goal 2	**Develop the expertise required to enable the delivery of world class plant pest diagnostics**
Goal 3	**Promote the use of innovative tools, technologies and approaches for improved diagnostics**
Goal 4	**Ensure appropriate, sustainable and coordinated resourcing to support the diagnostic system**
Goal 5	**Coordinate systems, policies and infrastructure to deliver reliable diagnoses**
Goal 6	**Enhance data analytics to inform biosecurity decision making**

The scope of the 2021–2031 strategy covers plant pests (i.e. any species, strain or biotype of invertebrates or pathogens injurious to plants, plant products and bees) that impact Australia's plant industries, environment and community.

The 2021–2031 strategy is preceded by the 2012–2020 strategy. That strategy played a key role guiding activities to support improvements to the national plant biosecurity diagnostic system. Some of the key achievements of the 2012–2020 strategy include:

- implementation of the National Plant Biosecurity Diagnostic Network (NPBDN)
- improved and enhanced output of National Diagnostic Protocols (NDPs)
- development of laboratory standards with accreditation and proficiency testing.

The 2021–2031 strategy seeks to build upon the achievements and momentum of the 2012–2020 strategy and provide continued benefits for the broader national biosecurity system through the following outcomes:

- a world-class coordinated plant biosecurity diagnostic system built on expertise shared through national and global collaboration
- Australia has the highest calibre of plant pest diagnostic expertise to identify priority and emerging plant pests
- Australia has fit for purpose tools and strategies to identify priority and emerging plant pests
- the national plant biosecurity diagnostic system is sustainably resourced to identify priority and emerging plant pests
- Australian plant pest diagnostics are delivered to a world-class standard
- enhanced biosecurity decision-making supported by coordinated and accurate diagnostic data.

The successful implementation of the 2021–2031 strategy will support the needs of diagnosticians and ensure that Australia's plant biosecurity diagnostic system is robust and effective into the future. It will also result in an improved national plant biosecurity system that will manage threats to Australia's plant industries, environment and community while supporting trade and market access.

National Plant Biosecurity Diagnostic Strategy at a glance

Vision	A plant biosecurity diagnostic system that sustains and improves the quality and		
Goals	 **1** Strengthen national and international diagnostic connections	 **2** Develop the expertise required to enable the delivery of world-class plant pest diagnostics	 **3** Promote the use of innovative tools, technologies and approaches for improved diagnostics
Actions	**1.1** Develop the NPBDN to be the central coordination point for all activities within the national diagnostics system. **1.2** Extend membership of the NPBDN to better connect the broader diagnostic system. **1.3** Foster global partnerships and connections with different sectors to encourage collaboration and increase responsiveness.	**2.1** Address current and emerging gaps in the capacity of the national diagnostic system. **2.2** Deliver professional development pathways for diagnosticians.	**3.1** Develop and implement a framework to assess the suitability of tools, technologies and approaches for the national diagnostic system. **3.2** Identify, assess and promote laboratory and in field diagnostic methods that increase diagnostic capacity and support surveillance activities. **3.3** Develop, update and endorse National Diagnostic Protocols and facilitate the use of non NDP resources for priority and emerging plant pests. **3.4** Enhance community and citizen science contributions to diagnostics.
Expected outcomes	A world-class coordinated plant biosecurity diagnostic system built on expertise shared through national and global collaboration	Australia has the highest calibre of plant pest diagnostic expertise to identify priority and emerging plant pests	Australia has fit for purpose tools and strategies to identify priority and emerging plant pests
Implementation	**National Plant Biosecurity Diagnostic**		

reliability of diagnostic outcomes to support Australia's economy, environment and community

4 Ensure appropriate, sustainable and coordinated resourcing to support the diagnostic system

4.1 Design and adopt a framework to assess the current and future needs of the diagnostic system in terms of human resources, skills and infrastructure.

4.2 Establish the critical and appropriate resource requirements for the national diagnostic system.

4.3 Identify and implement appropriate funding and resource allocation models.

The national plant biosecurity diagnostic system is sustainably resourced to identify priority and emerging plant pests

5 Coordinate systems, policies and infrastructure to deliver reliable diagnoses

5.1 Implement and maintain proficient quality laboratory and management procedures for the diagnostic system.

5.2 Develop and maintain appropriate national reference standards.

5.3 Ensure access to equipment, consumables and other resources to deliver reliable diagnoses.

5.4 Develop improved processes to facilitate the collection, storage and rapid transfer of positive controls (including live) and suspect samples.

Australian plant pest diagnostics are delivered to a world-class standard

6 Enhance data analytics to inform biosecurity decision making

6.1 Implement and maintain an interoperable and integrated national diagnostic information management system to capture, share and analyse data.

6.2 Ensure capability for best practice management of diagnostic data within the NPBDN.

6.3 Enhance the quality and accessibility of reference collections across Australia.

Enhanced biosecurity decision-making supported by coordinated and accurate diagnostic data

Strategy Implementation Plan

Introduction

Australia's biosecurity system relies on fast and accurate identification of plant pests, especially where these may be exotic or significant, trade sensitive established pests.

The capacity to diagnose a plant pest is an essential component of Australia's biosecurity system across the biosecurity continuum encompassing pre border, border, and post border activities. This underpins pre border certification programs, border inspection and quarantine programs, as well as post border eradication programs and many of the everyday management practices involved in the production and trade of plants and plant products.

A strong national plant biosecurity diagnostic system is essential to the delivery of plant pest diagnostics services. The following four components have been identified as necessary for the whole diagnostic system to operate and deliver the best performance[1,2]:

1. **Collections**, consisting of specimens and other material for reference, vouchering, teaching, providing genetic material, producing images, recording variation and anchoring names to attributes of organisms (using the concept of type specimens).
2. **Human capability**, being a store of undocumented experience and expertise.
3. **Information** contained in images, policies, standards, diagnostic protocols, gene sequences and systematic publications, on-line keys and other taxonomic resources.
4. **Interactions and linkages** between the other three components necessary for the whole system to work together.

Achievements under the 2012–2020 strategy

Activities to support the strengthening of the national plant biosecurity diagnostic system were supported by the 2012–2020 strategy. That strategy set out the recommendations and actions necessary to ensure Australia had the people, infrastructure, standards and tools to deliver diagnostic services. It also established an important foundation for the continued reform and improvement of the national plant biosecurity diagnostic system.

Implementation of the 2012–2020 strategy was led by SPHD and guided significant improvements in the national biosecurity system. Specific achievements included:

- The NPBDN was established and has grown to more than 500 members across Australia, New Zealand and the Pacific nations
- A NPBDN coordinator[3] was appointed in 2019 to promote communication and facilitation of activities within the NPBDN
- Over 300 NPBDN members from more than 30 different organisations have built connections and shared information at the nine Annual Diagnosticians' Workshops held since 2012
- More than 50 NPBDN members have gained essential skills and knowledge through the Diagnostic Residential Program since the first round of the program in 2012
- Over 30 pest or technique specific training workshops have been held to provide NPBDN members with core skills to support their work
- More than 40 NDPs for plant pests have been endorsed through SPHD, with over 80 NDPs under development
- A new policy was developed to improve the import of High Priority Pests positive control material for diagnostic tests

1 Hodda M, Van Der Schyff G, Welsh L (2017b) Enhancing Diagnostic Capability for Priority Pests: Collections and Capability audit. CSIRO, Canberra

2 Merriman P (2012) Decline of Australian Agricultural experts in plant industries: causes & retrieval. Agricultural Science 24 (2), 18-22.

3 The NPBDN Coordinator is based within Plant Health Australia and was initially funded in 2018–2019 by the Department of Agriculture, Water and the Environment for a period of two years.

- Eight rounds of the National Plant Health Proficiency Testing Program have been completed since 2012, with high levels of diagnostic performance achieved in participating NPBDN laboratories
- The number of NPBDN laboratories having NATA accreditation for the delivery of specific diagnostic tests has increased from 4 to 6
- The National Plant Pest Reference Collections Strategy and implementation plan were developed to ensure biological collections continue to support Australia's trade and biosecurity
- A revised NPBDN website was launched to improve communication with NPBDN members and assist in pest identification.

Challenges

While significant activity has occurred over the last decade to strengthen the national plant biosecurity diagnostic system, a range of existing, emerging, and growing challenges are increasing the threat of biosecurity risks.

These include factors such as globalisation, international and interstate movement, climate change, tourism and the increasing volume of goods moved[4,5,6,7]. Further compounding these challenges is a number of other trends including the emergence of new plant pests and new pathways (such as online retailers), the shifting geographic spread of existing plant pests, agricultural expansion and intensification, increased urbanisation and changing land uses[8]. In conjunction with these increasing challenges and trends, there is an ongoing competition for resources across the national plant biosecurity diagnostic system.

All these factors have combined to place significant pressure on the ability of diagnosticians to meet their biosecurity responsibilities.

At the same time, overseas markets for primary produce are becoming more competitive as trading partners strengthen their own biosecurity systems and requirements. Consumer preferences and expectations for information on food safety and quality are driving a greater need to ensure production systems are ethical, effective and safe. Part of these expectations include a growing need to maintain Australia's favourable biosecurity status over the next decade and into the future through faster and more accurate diagnoses.

Fundamental to this is a renewed focus to ensure Australia has the people, resources, infrastructure, policies, standards and tools to provide delivery of plant pest diagnostic services.

This strategy focuses on addressing these challenges over the next ten years through provision of a long-term policy focus, coupled with a process of regular of regular monitoring, review and reporting against the goals and actions. The strategy aims to remain agile and responsive to the changing and demanding biosecurity environment expected over the next decade.

Consultation and development

This strategy has been developed through consultations with a wide range of plant biosecurity diagnostic stakeholders including:

- Australian, state and territory governments
- research and development corporations
- research bodies
- universities and
- museums.

Direction and advice to inform development of the strategy was provided by SPHD and the Strategy Advisory Group. Members of the Strategy Advisory Group and the list of organisations engaged are provided in Appendix 1 – Stakeholder consultation.

4 CSIRO 2014, Australia's biosecurity future: preparing for future biological challenges, Commonwealth Scientific and Industrial Research Organisation, Canberra.

5 Grafton, Q, Mullen, J & Williams, J 2015, Australia's agricultural future: returns, resources, and Risks, final report for the Australian Council of Learned Academics, Melbourne.

6 Hajkowicz, S & Eady, S 2015, Rural industry futures: Megatrends impacting Australian agriculture over the coming twenty years, report prepared for the Rural Industries Research and Development Corporation, Canberra.

7 Cope, R, Ross, J, Wittmann, T, Prowse T & Cassey, P 2016, Integrative analysis of the physical transport network into Australia, PLOSONE.

8 Craik, W., Palmer, D. & Sheldrake, R. 2017, Priorities for Australia's biosecurity system: An independent review of the capacity of the national biosecurity system and its underpinning Intergovernmental Agreement, prepared for the Department of Agriculture and Water Resources, Canberra, Australia. Available at www.agriculture.g.ov.au/igabreview.

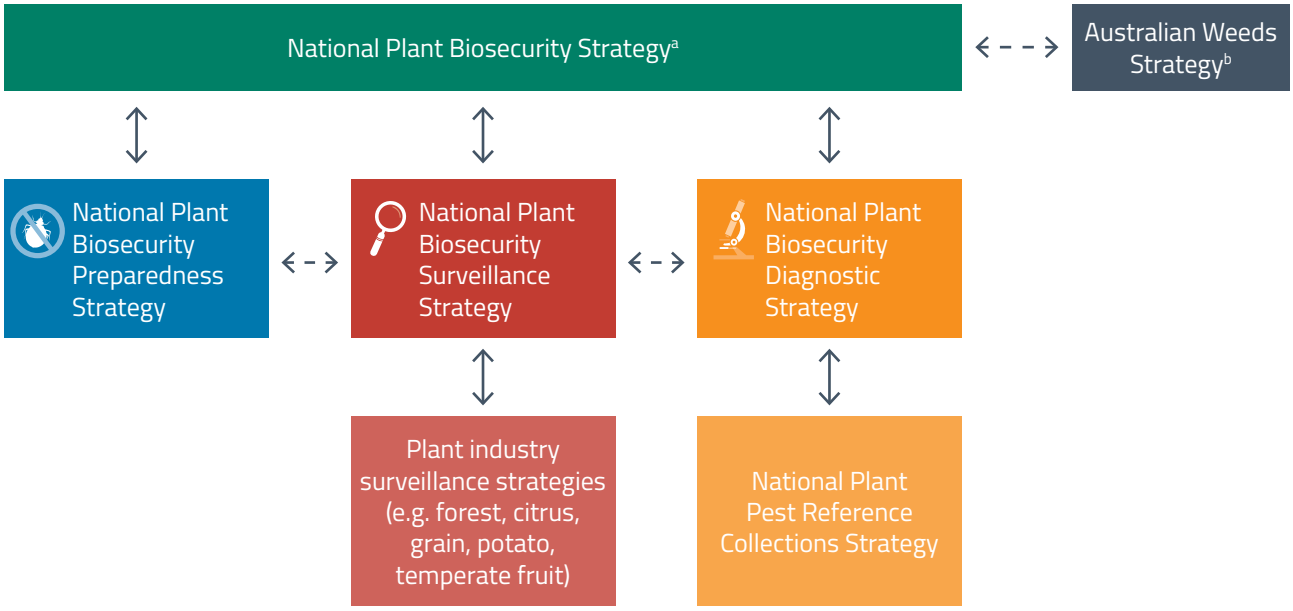
National approach to plant biosecurity

The Australian Government and state and territory governments work under the principles set out in the IGAB. The IGAB aims to strengthen Australia's biosecurity system, enhance national collaboration among Australian governments, and support our biosecurity system to meet current and future challenges. The current version of the agreement was ratified in January 2019 and replaced the previous IGAB which came into effect in 2012.

This strategy aligns with the IGAB and underpins the overarching NPBS. The NPBS is a ten-year plan that outlines a set of goals and actions to strengthen Australia's plant biosecurity system. The strategy has provided the focus and strategic direction for national plant biosecurity activities since 2010, and drives the way governments, plant industries and the community to work closely together.

This strategy also complements other national strategies—National Plant Biosecurity Preparedness Strategy and the National Plant Biosecurity Surveillance Strategy—to further strengthen plant biosecurity arrangements over the next decade. Figure 1 shows the relationship between key plant biosecurity strategies at the national level.

Figure 1. Key national strategies relevant to plant biosecurity



a The National Plant Biosecurity Strategy Implementation Group has oversight of the National Plant Biosecurity Strategy and its three sub-strategies on preparedness, surveillance and diagnostics

Scope of the strategy

This strategy focuses on improved outcomes for the national plant biosecurity diagnostic system and applies to plant pests that impact Australia's plant industries, environment and community.

For the purpose of this strategy, plant pests are defined as any species, strain or biotype of invertebrate or pathogen injurious to plants, plant products or bees.

The strategy should be considered in conjunction with the National Plant Biosecurity Preparedness Strategy and the National Plant Biosecurity Surveillance Strategy which together support implementation of the National Plant Biosecurity Strategy.

Guiding principles

The strategy is guided by the following principles:

1 >

An effective biosecurity continuum

An effective biosecurity system manages the pre-border, border and post border elements (the biosecurity continuum) to mitigate risks.

2 >

Collaboration

Biosecurity is a responsibility shared between all governments, plant industries, natural resource managers, land custodians or users, and the community.

3 >

Evidence-based

Biosecurity activities are undertaken according to a cost-effective, science based and risk-managed approach.

4 >

Coordination

Biosecurity activities are well coordinated to ensure resources are targeted towards agreed national priorities.

Strategic direction to 2031

The strategy identifies six interconnected goals to achieve the vision for Australia's plant biosecurity diagnostic system to 2031. The goals and expected outcomes are:

	1	2	3	4	5	6
Goals	**Strengthen national and international diagnostic connections**	**Develop the expertise required to enable the delivery of world class plant pest diagnostics**	**Promote the use of innovative tools, technologies and approaches for improved diagnostics**	**Ensure appropriate, sustainable and coordinated resourcing to support the diagnostic system**	**Coordinate systems, policies and infrastructure to deliver reliable diagnoses**	**Enhance data analytics to inform biosecurity decision making**
Expected outcomes	A world-class coordinated plant biosecurity diagnostic system built on expertise shared through national and global collaboration	Australia has the highest calibre of plant pest diagnostic expertise to identify priority and emerging plant pests	Australia has fit for purpose tools and strategies to identify priority and emerging plant pests	The national plant biosecurity diagnostic system is sustainably resourced to identify priority and emerging plant pests	Australian plant pest diagnostics are delivered to a world-class standard	Enhanced biosecurity decision-making supported by coordinated and accurate diagnostic data

Each goal is supported by a series of actions that are described in this section. More information on the implementation of the strategy, including performance measures, key contributors and indicative timeframes for delivery, is available in the National Plant Biosecurity Diagnostic Strategy Implementation Plan.

GOAL 1

STRENGTHEN NATIONAL AND INTERNATIONAL DIAGNOSTIC CONNECTIONS

EXPECTED OUTCOME:

A world-class coordinated plant biosecurity diagnostic system built on expertise shared through national and global collaboration

ACTION 1.1:

Develop the National Plant Biosecurity Diagnostic Network to be the central coordination point for all activities within the national diagnostic system

The NPBDN has grown to be a critical component of the plant biosecurity diagnostic system in Australia since its formation in 2011. It connects diagnosticians to facilitate improved communication and sharing of expertise, offers targeted professional development opportunities and coordinates some elements of the plant biosecurity diagnostics system.

A well maintained NPBDN will bring additional benefit to the plant biosecurity diagnostic system. Through making the NPBDN the central coordination point direction will be provided to address capability gaps, duplication of effort and investment will be minimised and open communication will facilitate the smooth operation of the entire plant biosecurity diagnostic system.

The NPBDN will:

- build awareness of the NPBDN to target audiences
- facilitate professional development to address capability gaps
- facilitate laboratory exchanges through the NPBDN both nationally and internationally
- provide an open forum for discussion and intellectual exchange
- curate an up-to-date and relevant website for its membership.

ACTION 1.2:

Extend membership of the National Plant Biosecurity Diagnostic Network to better connect the broader diagnostic system

At present, NPBDN membership focuses on representatives with technical and policy expertise from the Australian Government, state and territory governments, CSIRO, PHA, universities and the New Zealand Ministry for Primary Industries. However, there is a wealth of expertise and experience available from outside these core organisations that has minimal input into national plant health diagnostics.

Extending membership of the NPBDN to include other people and institutions connected to plant pest diagnostics will help broaden the reach of the NPBDN across the diagnostic system. This should focus on existing organisations that are currently underrepresented, such as museums and universities. It should also focus on attracting new members such as those ranging from privately run diagnostic facilities through to agronomists and farmers.

Broadening the reach of the NPBDN will enhance the reputation of its membership. It will also strengthen the diagnostic system by improving the coordination of diagnostic services and ensuring more access to skills and expertise. In extending the NPBDN membership it is recommended that the current standards continue to be applied to ensure the integrity of the NPBDN.

ACTION 1.3:

Foster global partnerships and connections with different sectors to encourage collaboration and increase responsiveness

A suite of activities already connects individuals and groups. These include the NPBDN Diagnostic Residentials, research projects, development of NDPs and the Commonwealth-led pre-border biosecurity activities.

With a global view of biosecurity diagnostics, the NPBDN should undertake coordinated activities and build formal relationships with diagnostic networks internationally, such as the National Plant Diagnostic Network (USA) and the Association of Southeast Asian Nations (ASEAN) Regional Diagnostic Network. In addition, there is scope to extend collaboration within Australia through connecting with the different sectors with similar purposes (e.g. animal and human health, biodiversity). Often similar technologies, challenges and policies are in place across these sectors.

Cooperation with diagnosticians in Asia-Pacific nations would be consistent with Australia's obligations under the Sanitary and Phytosanitary Measures Agreement to assist developing nations and undertakings in the International Plant Protection Convention (IPPC) to collaborate with international partners to limit the spread and impact of plant pests. Avenues to support cooperation would include the ASEAN Regional Diagnostic Network Project, the ASEAN Diagnosticians Forum, the Asia and Pacific Plant Protection Commission, QUADS meetings and bilateral, scientific linkages between Australian and regional diagnosticians.

Connecting the NPBDN with the international community and aligned sectors will:

- provide access to additional capability and capacity,
- provide access to new skill sets and technologies,
- facilitate Australian diagnosticians to gain experience with exotic pests,
- reduce duplication in research or policy development to improve the delivery of plant pest diagnostic services at a regional level.

GOAL 2

DEVELOP THE EXPERTISE REQUIRED TO ENABLE THE DELIVERY OF WORLD-CLASS PLANT PEST DIAGNOSTICS

EXPECTED OUTCOME:

Australia has the highest calibre of plant pest diagnostic expertise to identify priority and emerging plant pests

ACTION 2.1:

Address current and emerging gaps in the capacity of the national diagnostic system

In many respects diagnostic services are under strain with a number of specialist areas and key disciplines experiencing difficulties attracting and retaining people. Significantly, an approach to identify and review gaps in human capacity is not currently available.

In order to support the needs of plant pest diagnosticians, there is a requirement to determine the current and emerging gaps in human capacity across the national diagnostic system. There is also a need to fill the identified capacity gaps through reasonable measures such as professional development activities facilitated through the NPBDN (Action 2.2), targeted recruitment and the use of new technologies.

Successfully identifying these gaps and implementing measures to address them will ensure that diagnostic laboratories maintain an appropriate level of skills and expertise to deliver a high standard of diagnostic services. It will also ensure jurisdictions have sufficient resourcing available during the incident detection phase or the ability to generate timely and appropriate surge capacity when an Emergency Plant Pest (EPP) is detected.

ACTION 2.2:

Deliver professional development pathways for diagnosticians

The NPBDN works closely with Australian, state and territory governments, the New Zealand Ministry for Primary Industries, CSIRO, universities, museums, PHA and international institutions to identify professional development activities for NPBDN members. Current activities include short-term diagnostic residential visits, annual workshops and sponsored training courses.

It is recommended that these activities are continued and broadened over time to improve the skills, knowledge and expertise of current diagnosticians. The identification and design of these activities should be informed by assessing key current and emerging capacity gaps across the system to ensure professional development pathways meet the needs of diagnosticians (Action 2.1).

Pathways to introduce new diagnosticians should also be investigated in order to maintain an appropriate level of expertise. Options for maintaining this capability could also involve succession planning, mentoring programs and scholarships.

GOAL 3

PROMOTE THE USE OF INNOVATIVE TOOLS, TECHNOLOGIES AND APPROACHES FOR IMPROVED DIAGNOSTICS

EXPECTED OUTCOME:

Australia has fit for purpose tools and strategies to identify priority and emerging plant pests

ACTION 3.1:

Develop and implement a framework to assess the suitability of tools, technologies and approaches for the national diagnostic system

The speed and trajectory of advancements in technology has the potential to play a key role in addressing future plant biosecurity challenges. However, not all new technologies developed will readily be adopted into a diagnostics laboratory and in many instances, traditional techniques for the diagnosis of plant pests will continue to play an important role in completing a diagnosis.

A mechanism to assess the suitability of tools, technologies and approaches for the national diagnostic system is not currently available. Through the development of a monitoring and evaluation framework, end users will be able to assess the appropriateness of current and emerging technologies in a consistent manner to ensure their ongoing accuracy and reliability. This could improve the early detection of plant pests, support market access and allow barriers to the uptake of new technologies to be identified and further explored.

As part of this approach, there is a requirement to determine a process to ensure the frequency of the evaluations keep pace with advances in technology. There is also a need for the results of any evaluations to be clearly communicated through the NPBDN in a timely manner to ensure the capabilities and limits of these technologies are clearly understood across the system.

ACTION 3.2:

Identify, assess and promote laboratory and in field diagnostic methods that increase diagnostic capacity and support surveillance activities

Advances in technology in the past decade have accelerated the development of a range of in field and laboratory-based diagnostic methods. While some of the methods currently available are well established (e.g. loop mediated isothermal amplification (LAMP)), the choice has the potential to become overwhelming as the market for diagnostic tests increases and new technologies continue to be further developed.

There is no common approach available at present to identify and assess the adequacy of these diagnostic methods, so a process involving diagnostic and surveillance personnel needs to be developed to help inform decision making. The process should complement Action 3.1 and consider the overall costs and benefits associated with current and emerging methods. Through the NPDBN, the results will be assessed and reviewed with the adoption of suitable methods via inclusion in current and future NDPs.

Improvements in these areas will generate potential efficiencies for both diagnostics and surveillance. It will enable more samples to be surveyed more efficiently without overwhelming the dependency on human and physical resources of diagnostic laboratories. It will also make surveillance activities more effective through providing increased confidence, greater capacity and earlier feedback on outcomes.

ACTION 3.3:

Develop, update and endorse National Diagnostic Protocols (NDPs) and facilitate the use of non NDP resources for priority and emerging plant pests

NDPs are the globally recognised national standard for the definitive taxonomic identification of a pest or subgroup of pests. Coverage of priority pests with NDPs has increased significantly through the implementation of the 2012–2020 strategy, but many priority pests still do not have a draft or endorsed NDP.

The continued development of endorsed NDPs will provide diagnosticians with trusted protocols to deliver reliable diagnoses. This should focus on the development of new protocols for both priority and emerging pests, review and verification of existing drafts, and the inclusion of surveillance diagnostic information in existing NDPs. The development of NDPs also needs to be prioritised to critical gaps and high-risk pest threats, in combination with effectively using available established and published information to gain efficiencies in development.

There is also value in continuing to investigate and facilitate the use of non NDP tools, such as lucid keys, that could be equivalent to NDPs. Where suitable, these non NDP tools would increase the coverage of resources and approaches available to respond to priority and emerging pest threats.

ACTION 3.4:

Enhance community and citizen science contributions to diagnostics

Diagnostic tools used by the general public need to be used in an accurate and appropriate way to be effective. Currently, these tools (e.g. digital imagery) are under-utilised as they are poorly defined with respect to sensitivity and specificity, quality of data and generally there is a lack of expertise across a broad spectrum of the community.

Work should be undertaken to ensure the necessary tools, standards and systems are available and accessible to help citizen science make a positive contribution to diagnostics. This could focus on advances in diagnostic tools for use by members of the public to improve decision making and support sophisticated analysis. It could also involve the development of standards and systems for use by scientists that allow information collected from citizen science endeavours to be appropriately dealt with and included as part of the diagnostic system.

The suitability of any tools developed to enhance citizen science contributions to diagnostics should be assessed using the monitoring and evaluation framework to be developed as part of Action 3.1.

GOAL 4

ENSURE APPROPRIATE, SUSTAINABLE AND COORDINATED RESOURCING TO SUPPORT THE DIAGNOSTIC SYSTEM

EXPECTED OUTCOME:

The national plant biosecurity diagnostic system is sustainably resourced to identify priority and emerging plant pests

ACTION 4.1:

Design and adopt a framework to assess the current and future needs of the diagnostic system in terms of human resources, skills and infrastructure

Currently, there is no mechanism available to determine the resource requirements that allow the effective delivery of quality diagnostic services to support the current and future Australian plant biosecurity system. Resources in this context include human resources, skills and infrastructure such as specialist equipment and consumables.

A framework is required that identifies future trends in our plant industries and in turn ensures decisions relating to human resources, skills and infrastructure are implemented. Once developed, the framework will be used to determine the key resource requirements of the national diagnostic system (Action 4.2). Information generated by the framework will also help to address gaps in human capacity across the diagnostic system (Action 2.1) and inform the development of a national approach to ensure access to infrastructure (Action 5.3).

The ability of the framework to assist with decision making will help to minimise duplication and guide potential investment in resources across the national diagnostic system. It will also ensure the system has the capacity to support market access and respond to incursions where diagnostic laboratories are often required to manage an influx of samples.

ACTION 4.2:

Establish the critical and appropriate resource requirements for the national diagnostic system

This action will use the framework developed in Action 4.1 to determine the key resource requirements that allow the effective delivery of quality diagnostic services to the Australian plant biosecurity system. Through this process, efficiencies in delivery models should be sought, and assessed against the quality and redundancy required in the system.

As part of this assessment, there is a requirement to ensure resourcing is available for the on-going maintenance of large scale infrastructure and regularly review the scope of preparedness against priority and emerging pests. Alternative models for the delivery of diagnostic services may also be investigated.

ACTION 4.3:

Identify and implement appropriate funding and resource allocation models

Maintaining funding is an ongoing challenge for underpinning services such as diagnostics. A better funding model is needed to support plant pest diagnostic efforts into the future.

Funding and resources allocation models offer significant potential to help meet the resource needs for the diagnostic system. The models applied need to consider the outcomes of Action 4.1 and 4.2 where the future needs and minimum resource requirements of the national diagnostic system will be determined. A process to periodically evaluate the models should also be established.

The ability of these models to effectively address funding challenges will ensure resources are allocated to the areas of greatest need and improve confidence that resources are allocated to achieve the greatest risk reduction.

GOAL 5

COORDINATE SYSTEMS, POLICIES AND INFRASTRUCTURE TO DELIVER RELIABLE DIAGNOSES

EXPECTED OUTCOME:

Australian plant pest diagnostics are delivered to a world class standard

ACTION 5.1:

Implement and maintain proficient quality laboratory and management systems for the diagnostic system

Formal accreditation through the National Association of Testing Authorities (NATA) is available for plant pest diagnostic laboratories. While diagnostic laboratories should continue to pursue NATA accreditation, not all diagnostic laboratories in the NPBDN will or need to meet this high level of accreditation for each diagnostic test.

Implementation of an acceptable level of quality standards for laboratories in the NPBDN is essential to mitigate the substantial risks associated with plant pest diagnostics and provide confidence in the quality of diagnostic outcomes. As membership of the NPBDN extends, work should focus on identifying the specific system requirements (e.g. one system or a multi-levelled system) and investigating potential options to meet these requirements. These options could include NATA, a NPBDN driven accreditation system (like STAR-D) or other alternatives. The agreed approach should not preclude laboratories within the NPBDN achieving higher levels of formal accreditation.

The National Plant Health Proficiency Testing Program provides an opportunity for laboratories to verify their diagnostic techniques and support quality management systems. It is imperative that this program, or an alternative, continues to support the enhanced implementation of laboratory and management systems. Opportunities to increase program scope and connect with international proficiency testing programs should also be investigated.

ACTION 5.2:

Develop and maintain appropriate national reference standards

There is already a suite of endorsed national reference standards that have been produced by SPHD to maintain and improve diagnostic skills. At present, these important resources are limited to the production of EPP related documents such as NDPs. Further detail on NDPs is provided in Action 3.3.

Broadening national reference standards to address other aspects of plant pest diagnostics will provide clear guidance and instruction beyond EPP related documents. This could include the development of national reference standards for sampling, in-field diagnostic methods and high throughput protocols to support the integration of diagnostic methods with surveillance and triage. It could also cover citizen science data and the maintenance of reference collections across Australia.

In order to ensure reliable and accurate diagnoses, the reference standards developed should be reviewed and updated where appropriate to incorporate new methodologies in response to changes such as advances in tools and technology.

ACTION 5.3:

Ensure access to equipment, consumables and other resources to deliver reliable diagnoses

The ability to consistently perform rapid and reliable diagnostic services can be limited by the availability of infrastructure such as specialist equipment, consumables and other resources. Solutions are needed to address these limitations and guarantee the delivery of diagnostics into the future although the opportunities have not been fully investigated.

Ensuring access to infrastructure in and across the NPBDN will minimise unnecessary effort between jurisdictions and ensure the NPBDN as a whole has the capacity to deliver the required diagnostic services. It will also maximise the efficiency of available infrastructure and improve the ability of the NPBDN to respond to new and emerging issues.

These benefits will be realised by building on the findings of Action 4.2 to develop a national approach for the coordination of infrastructure across agencies and jurisdictions. As part of this process, there is a need to better communicate available infrastructure in the diagnostic system should be considered. There is also scope to explore whether hubs could be established in the NPBDN for the coordination and delivery of specialised diagnostic services.

ACTION 5.4:

Develop improved processes to facilitate the collection, storage and rapid transfer of positive controls (including live) and suspect samples

The importation of positive controls and the requirement to send controls and other diagnostic material into and across Australian state and territory borders can be a challenge. The continuation of ongoing issues relating to specimen transfer can slow the movement of cultures and suspect samples and present a significant risk to the ability of diagnosticians to rapidly identify plant pests.

More efficient, streamlined and harmonised processes are needed to improve access to positive control material and suspect samples within Australia for diagnostic testing or analysis. These processes should be informed by an assessment of current arrangements for the importation, containment, storage and handling of positive control material and suspect specimens.

As part of this approach, there is a requirement to ensure the processes developed are reviewed and updated as appropriate to ensure they remain fit for purpose and responsive to the needs of diagnosticians. There is also scope over time to investigate potential alternatives to live positive controls that achieve the same outcome without the movement of live samples.

GOAL 6

ENHANCE DATA ANALYTICS TO INFORM BIOSECURITY DECISION MAKING

EXPECTED OUTCOME:

Enhanced biosecurity decision-making supported by coordinated and accurate diagnostic data

ACTION 6.1:

Implement and maintain an interoperable and integrated national diagnostic information management system to capture, share and analyse data

The delivery of plant pest diagnostic services is reliant on a number of information management systems for data collation and exchange at the national level. These range from online resources, such as the Australian Plant Pest Database (APPD) and the Pest and Disease Image Library (PaDIL), through to sample tracking software and information sharing resources.

Enhancements are required to make these information management systems better integrated and interoperable to meet the needs and expectations of users. This will help facilitate the fast and secure sharing of diagnostic information on a more national scale, inform the design of biosecurity policies and programs, and contribute to the evidence required when making official claims around Australia's pest free status.

As part of this process, opportunities to develop a digital platform for the diagnostic system that allows diagnosticians to collaborate on specific diagnosis should also be investigated. The platform would improve responses to plant pests and enhance the ability of the diagnostic system to support the national plant biosecurity system.

In order to improve the connectivity of the different information management systems, there is a requirement to develop an approach to address issues with privacy and confidentiality that can restrict the sharing of information. One option could involve agreements by which signatory parties can contribute and receive access to data on an ongoing, trusted and confidential basis.

ACTION 6.2:

Ensure capability for best practice management of diagnostic data within the National Plant Biosecurity Diagnostic Network

The volume and complexity of data generated from plant pest diagnostic activities in Australia is expected to rapidly increase over the coming decade. This predicted increase can be attributed to advancements in tools and technology that allow the continuous collection of data in different forms from multiple sources.

In order to deliver quality outcomes and support decision making, adequate processes and systems within the NPBDN for managing these large data sets need to be investigated and tested. The processes and systems adopted should continue to be assessed over time to ensure they meet the needs of the diagnostic community and the broader national plant biosecurity system.

ACTION 6.3:

Enhance the quality and accessibility of reference collections across Australia

Collections are one part of the national plant biosecurity diagnostic system along with human capability, information, and interactions and linkages. While access to collections currently occurs through a combination on mechanisms, it is essential that the owners and users of collections can continue to access collection materials and information into the future.

Implementation of the **National Plant Pest Reference Collections Strategy** will deliver on this action. The 2018 strategy addresses the following points:

- the lack of verified specimens of many of the National Priority Plant Pests
- the need to coordinate the plant health, trade and biosecurity functions of collections
- the need for clear standards to prevent specimen deterioration
- how to improve the exchange of information between collections
- communication between collections and other parts of the plant health diagnostic system
- support for collections.

Enhancing the quality and accessibility of the many collections that exist in Australia will bring significant benefit to the national plant biosecurity diagnostic system. It will help provide high quality data for specimens while also enabling material collected for biosecurity and other purposes to support plant health diagnostics and trade.

Glossary

Diagnostics	Processes and standards associated with the accurate identification of a pest or host.
Emergency Plant Pest (EPP)	Has the meaning given in Clause 1 of the Emergency Plant Pest Response Deed.
Endemic plant pest	A plant pest which is native to Australia or an established plant pest which is not subject to containment and is therefore unlikely to be eradicated.
Environment	Includes: (a) ecosystems and their constituent parts, including people and communities; and (b) natural and physical resources; and (c) the qualities and characteristics of locations, places and areas; and (d) the social, economic and cultural aspects of a thing mentioned in paragraph (a), (b) or (c).
Established plant pest	A plant pest that is perpetuated, for the foreseeable future, within any area and where it is not feasible (whether in terms of technical feasibility or a benefit/cost analysis) to eradicate.
Exotic plant pest	A plant pest that does not normally occur in Australia.
High Priority Pest	A plant pest that has been identified as a priority threat, based on the likelihood and impact ratings, by a particular plant industry and is listed in a biosecurity plan.
National Diagnostic Protocol (NDP)	A Plant Health Committee endorsed Australian document containing detailed information about a specific plant pest or group of plant pests relevant to its diagnosis. A diagnostic protocol will include diagnostic procedure/s and data on: the pest, its hosts, taxonomic and contact information; detection, identification, acknowledgements and references. The NDP is developed for the accurate taxonomic identification of the organism.
Plant biosecurity	A set of measures which protect the economy, environment and community from the negative impacts of plant pests.
Plant biosecurity system	The combination of all measures, programs and services delivered by government, plant industries, the community and other stakeholders that enables the protection of plants, plant products or bees from significant exotic, endemic and established plant pests.
Plant health	The health (including with respect to germination, growth and further reproduction) of living plants and parts thereof, including seeds and germplasm.
Plant industries	Covers agriculture, horticulture, forestry, honey bees and amenity plants and plant products.
Plant pest	Any species, strain or biotype of invertebrate or pathogen injurious to plants, plant products or bees.
State and territory governments	The state and territory governments of Australia.
Surveillance	Processes which collect and record data on pest presence or absence through survey, monitoring or other procedures.

Appendix 1. Stakeholder consultation

Table 1. Strategy Advisory Group

Name	Organisation
Dr Brendan Rodoni	Victorian Department of Jobs, Precincts and Regions
Dr Jo Luck	Plant Biosecurity Research Initiative
Dr Stephen Dibley	Victorian Department of Jobs, Precincts and Regions

Table 2. Stakeholders consulted in the development of the strategy

Organisation
CSIRO
Curtin University
Department of Agriculture and Fisheries (Queensland)
Department of Agriculture, Water and the Environment (Australian Government)
Department of Jobs, Precincts and Regions (Victoria)
Department of Primary Industries (New South Wales)
Department of Primary Industries and Regional Development (Western Australia)
Department of Primary Industries and Regions (South Australia)
Department of Primary Industries, Parks, Water and Environment (Tasmania)
Department of Primary Industry and Resources (Northern Territory)
Grains Research and Development Corporation
Ministry for Primary Industries (New Zealand Government)
Plant Biosecurity Research Initiative
Plant Health Australia
Scion
Sugar Research Australia
Sydney Royal Botanic Gardens
University of Canberra
University of Southern Queensland
University of Queensland

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