Department of Agriculture and Fisheries
Biosecurity Queensland

PANAMA TR4 PROGRAM

Strategy

Tracing and Surveillance Strategy

Version 2.0, 10/08/2020

Please note: This document has been redacted to protect privacy and confidentiality.

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Queensland Government

Contents

Executive summary

Panama disease tropical race 4 (Panama TR4, the disease) is a disease of banana plants caused by the fungus Fusarium odoratissimum (syn: *Fusarium oxysporum* f. sp. *cubense* tropical race 4). The disease was first detected in Queensland in March 2015 on a commercial banana growing property in the Tully Valley in Far North Queensland. Risk minimisation requirements were placed on the property to control and contain the spread of the disease.

A legislated biosecurity program for the detection of Panama TR4, 'Surveillance Program for Panama disease tropical race 4 – Detection of disease in Queensland under the *Biosecurity Act 2014*', has been authorised by the Director General. The biosecurity program allows for the Panama TR4 Program (Program) to conduct surveillance activities to determine the presence of the disease in Queensland and the extent of the disease on known infested properties or suspected to be infested properties (suspect properties)[a].

Since the initial detection in March 2015, the disease has been confirmed on three additional properties located in close proximity to each other within the Tully Valley. After five years of surveillance activities, the disease appears to be contained in the short term to these four properties. However current scientific and epidemiological information does not provide the Program with a predictive model of how the disease will continue to spread.

This Tracing and Surveillance Strategy (strategy) prioritises early detection of the disease on infested, suspect and high-risk properties as this is where the greatest risk has been demonstrated to exist. The strategy also acknowledges the importance of carrying out surveillance on the remainder of the banana production area within the Northern Banana Biosecurity Zone (NBBZ) to ensure a robust model for detecting the disease and managing the disease through control and containment.

A substantial focus of the strategy is on geographical proximity because of the inherent risk that being close to an infested property brings, including people movement, machinery movement, feral animal movement and overland water flow. The strategy also provides for investigation of risk pathways on a case-by-case basis where the disease is detected on a property that is not in close proximity to a known infestation.

This strategy outlines a surveillance frequency model of eight-weekly surveillance on infested and suspect properties, three-monthly surveillance on high-risk properties and surveillance on at-risk properties once in a 12 month period.

Significant consultation and collaboration with the Australian Banana Growers' Council (ABGC), Agri-Science Queensland (ASQ) and banana growers has been integral for developing, updating and affirming the Program's strategy. Industry engagement has been important to ensure resources are deployed in a way that meet the needs of Biosecurity Queensland (BQ), the ABGC and the banana growing industry to facilitate early detection of the disease.

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[a] A suspect property is a property defined as being at risk of having Panama TR4 due to significant tracing links with an infested property. Examples of significant tracing links include ownership, plant material and appliances. If a suspect property shares tracing links with an infested property it may pose a significant biosecurity risk of disease spread. Alternatively, a suspect property is a property where plants have internal symptoms consistent with Panama TR4 and confirmatory diagnostic testing is pending. Properties classified as suspect are recorded in official records held by the Department.

This strategy is subject to a 12 month review period, but may be reviewed earlier on a further detection of disease on a new property or as directed by the Panama TR4 Program Management Board (Board).

Tracing and Surveillance Strategy

Purpose

The purpose of this strategy is to ensure an efficient, economic, flexible and robust surveillance model for the early detection of Panama TR4 to ensure prompt destruction of infected plants to minimise inoculum levels. The surveillance methodology outlined in this strategy is based on the best available scientific information and provides a high level of confidence that symptoms of the disease will be detected in the field if present.

The strategy acknowledges the commitment between the ABGC and the department to jointly deliver, govern and fund the Program until 30 June 2023, and therefore encourages the transition to industry management of the disease by promoting capacity building and education of growers.

Background

Panama disease tropical race 4

Panama TR4 is a disease of banana plants caused by the fungus *Fusarium odoratissimum* (syn: *Fusarium oxysporum* f. sp. *cubense* tropical race 4).

The fungus infects the plant through the roots moving into the vascular system to spread through the corm and pseudostem. The fungus eventually blocks the plants vascular system cutting off the supply of water and nutrients, which causes the plant to wilt and die. Scientific research has shown that the fungus does not enter the fruit.

It is not feasible to eradicate the disease as there are no proven control methods available to destroy the fungus. The fungus can survive in the soil and within alternative host plants for decades and there are currently no practical diagnostic protocols to detect the disease in soil or water. The disease affects most banana varieties, including Cavendish, and can lay dormant in the soil for many years prior to banana plants showing symptoms.

Panama TR4 is easily spread through the movement of infected plant material, and contaminated soil and water transferred by people, animals, vehicles, machinery and equipment or by natural processes such as overland water flow, drainage lines, floods, cyclones and wind. Spread of the disease can also occur through root-to-root contact of infected plants.

The disease poses a significant threat to Australia's $580m[b] commercial banana industry and the Queensland economy. All fresh bananas in Australia are grown domestically and no fresh bananas are imported due to the threat of disease to local production.

[b] Department of Agriculture and Fisheries 2019, *Queensland Ag Trends 2019-2020: Forecasts and trends in Queensland agriculture, fisheries and forestry production*, Queensland Government , viewed 14 May 2020 https://www.publications.qld.gov.au/dataset/83d36400-85ee-48d3-a05d-2c6aabc8f109/resource/c9d3c8ba-7a0a-49c7-b763-6d342d8b2b14/fs_download/agtrends-2019-2020.pdf

An account of the Panama TR4 Program and the disease in Queensland

Following the first detection of the disease in Queensland in March 2015 strict risk minimisation requirements were placed on the commercial banana growing property, and other closely linked property, to reduce the risk of disease spread.

The original Panama TR4 Tracing and Surveillance Strategy was developed following the first detection. Tracing activities were undertaken at this time to identify properties that were linked via risk pathways to the infested property and closely linked property. From these tracing activities, 90 commercial banana growing properties across Queensland were prioritised for surveillance using a risk-based approach and placed on a high frequency surveillance schedule.

The original strategy was reviewed and modified in late 2016 to include one round of surveillance on all commercial banana growing properties in the NBBZ that had no identified linkages to the infested property. The program's surveillance priorities were examined at the Panama TR4 Program Steering Committee meeting in December 2016 and a revised strategy was implemented in February 2017.

On 26 July 2017, the disease was confirmed on a second commercial banana growing property in the Tully Valley, [redacted] from the first infested property. Following the second detection and an acknowledgement of available funding, there was a need to revise the strategy to address the risk exposure across the industry and identify the best possible allocation of resources. Additional tracing activities were completed to provide an updated picture of the linkages across the banana growing industry. Analysis of the tracing information from the first and second infested properties showed 133 banana growing properties with linkages to one or both infested properties.

In October 2017 the strategy was further revised following a meeting between Program, ABGC and ASQ representatives. A new strategy was agreed whereby infested properties received six weekly surveillance, high-risk properties received three monthly surveillance and medium-risk properties received six monthly surveillance. Surveillance on all other commercial banana growing properties within the NBBZ was ceased.

On 8 February 2018, the disease was confirmed on a third commercial banana growing property, [redacted]. This property had been identified as being at a high risk of disease incursion due to proximity and [redacted]. No changes were made to the strategy as a result of the third detection.

In November 2019, almost five years after the disease was first detected in Queensland, a Tracing and Surveillance Strategy Review Working Group (working group) was established to facilitate an extensive review of the strategy. The working group comprised of banana growers and ABGC and Department of Agriculture and Fisheries (DAF) representatives. The review identified and recommended considerable changes to surveillance frequencies, the allocation of risk ratings, tracing activities and a number of operational practices.

In February 2020, Panama TR4 was confirmed to be present on a fourth commercial banana growing property in the Tully Valley. Tracing activities were conducted on the property following disease confirmation, however no new linkages from the past five years were identified.

The fourth detection of Panama TR4 in Queensland in February 2020 did not directly affect the review of the strategy.

Timeframe for disease spread

Fungal spores may lay dormant in the soil for many years and the fungus can also survive as an endophyte in asymptomatic alternative hosts. It is only when banana plants begin to show visual symptoms that it is possible to detect the disease.

Early detection of the disease and prompt destruction of infected plants is critical for minimising inoculum production and protecting the wider banana industry. The Program has a destruction protocol that is based on rapid destruction to reduce inoculum levels.

An independent Epidemiological Review[c] of Panama TR4 indicated that the extent of the disease on the first infested property was widespread and was most likely spread by machinery, people or vehicles. The review also indicated that the disease was presumed to have been introduced to the property at least five to 24 months before it was detected.

Current available scientific and epidemiological information cannot provide a predictive model for disease spread. Experience in Queensland over the past five years suggests that proximity to known infestations remains a significant risk of disease incursion. Therefore, high frequency surveillance on properties within the Tully Valley is considered the best means for early detection and inoculum management.

Consultation

This strategy has been developed and refined regularly since the disease was first detected in Queensland in 2015. The Program has worked collaboratively with the ABGC, ASQ and banana growers to ensure that the strategy is robust and continues to manage the evolving disease situation in Queensland.

The working group was supportive of making significant changes to the strategy and acknowledges the need to begin the gradual transition to industry management of the disease.

Timeframe for Review

This strategy will remain subject to a 12 month review period, but may be reviewed earlier on the detection of the disease on a new property or as decided by the Board.

References

[redacted]

[c] Viljoen A., 2017. An independent Epidemiological Review on Panama disease tropical race 4 on an infested property in northern Queensland. Report to Biosecurity Queensland, Department of Agriculture and Fisheries, State of Queensland.

Legislation

The Program's surveillance activities are conducted under the *Biosecurity Act 2014* (Qld). A biosecurity program is in force for the detection of Panama TR4, 'Surveillance Program for Panama disease tropical race 4 – Detection of disease in Queensland under the *Biosecurity Act 2014*'. This legislated and published program authorises the undertaking of surveillance activities.

Tracing

Tracing activities involve the use of surveys and other investigation methods to examine property events for the previous five years from the time of detection. Tracing often relies on the memory of individuals to recall past property events in the absence of records.

Five years is considered a reasonable timeframe to encompass disease spread and symptom expression as it may take as long as five years for wilt symptoms to appear in a field with very low inoculum levels (Rishbeth and Naylor, 1957 cited in Pegg et all, 2019)[d]. It is possible for very low populations of the fungus to be present in a banana field where plants do not show any wilt symptoms.

Traditionally, tracing activities had served two main purposes – to determine other properties that are most at risk of getting the disease through risk pathways from known infestations and to gather information about how the disease entered Queensland.

To date, the analysis of traced linkages and the identification of risk pathways has not proven to be a conclusive method for determining those properties most at risk for disease incursion. Similarly, these investigations have not provided any insight into where the incursion may have originated. Despite many theories, the source of the disease in Queensland is not known and, due to the nature of the disease, it is unlikely the source will ever be identified.

Under this current strategy tracing activities will be undertaken to understand the internal operations and farming practices of the infested property to determine disease pathways within the property boundary. The property's current and past biosecurity practices are also evaluated to ensure appropriate and effective risk minimisation requirements are developed to assist in the control and containment of the disease. Tracing activities may also be undertaken if there are any clear risk pathways to or from the property that require further investigation or action.

Where the disease is detected on a property that is not in close proximity to a known infestation, tracing may be undertaken on a case-by-case basis to investigate how the disease came to be present on the property and to investigate whether there are any other banana growing properties at high risk of disease incursion due to a clear risk pathway.

[d] Pegg KG, Coates LM, O'Neill WT and Turner DW (2019) The Epidemiology of Fusarium Wilt of Banana. Front. Plant Sci. 10:1395. doi: 10.3389/fpls.2019.01395

Allocation of risk ratings

Due to the inherent risk that being close to an infested property brings, geographical proximity remains a substantial factor in determining the likelihood that a property will become infested with Panama TR4. The relationship between proximity and disease incursion is evidenced through the locations of the current four infested properties within Queensland.

In 2020, as part of the comprehensive review of the strategy, the working group agreed that risk ratings should be allocated to properties based on their geographical proximity to known infestations. Using this risk-based approach, properties are categorised as:

- **Infested or suspect:** Commercial banana growing properties where the disease is known to be present and confirmed through diagnostic testing or commercial banana growing properties where there is reasonable belief there is a significant risk that the disease is present.
- **High-risk:** Commercial banana growing properties located in the 'high risk area' (see Appendix 1 outlining this area) and are at a greater risk of disease incursion due to their close geographical proximity to known infestations.
- **At-risk**: All remaining commercial banana growing properties located within the NBBZ (see Appendix 2 outlining this area) are at risk of exposure to the disease through unidentified pathways into Queensland and by disease incursion through uncontrolled pathways from known infested areas.

The 'high risk area', located in the Tully Valley, has been defined using the Cardwell Ranges (mountain range) and flood zones of the Tully River from the top of the Tully Gorge to the ocean. Properties within this area are considered high risk due to proximity and associated factors, such as shared suppliers, overland water flow, feral animal movement, machinery movement and general on-ground traffic, as well as the operation of agribusiness and other services within the area.

Applying this approach, there are four infested properties, one suspect property, 25 properties within the high-risk area and 223[e] remaining properties within the NBBZ.

Surveillance intensity

Any approach to surveillance for a disease that is non-eradicable must be financially prudent making it necessary to adopt realistic intervals for surveillance to accommodate limited resources. Using the risk-based approach, those properties at greater risk of disease incursion will receive surveillance more frequently than those at lesser risk. Because the disease can only be detected when symptoms are expressed in the host banana plant, only those properties where bananas are grown will receive surveillance.

[e] The total number of properties in the NBBZ is based on data collected by the Program in 2017 and may vary as the Program makes updates to their case files.

Figure 1: Risk rating inform surveillance priorities and intensities.

Surveillance on infested or suspect properties

Delimiting surveillance is carried out on infested or suspect properties to determine the extent of a potential infestation. Delimiting surveillance is undertaken once symptoms that are assessed as being consistent with the disease are first discovered on a property or when the disease is confirmed through diagnostic testing.

Delimiting surveillance involves surveillance officers walking every second row of the entire banana production area. This intense surveillance allows surveillance officers to visually inspect all banana plants on a property.

Once delimiting surveillance has been completed, surveillance shifts to an eight week frequency. This interval balances the need for early detection on the infested properties against the need to complete surveillance on other areas exposed to risk. Eight weeks is considered a reasonable timeframe to detect infected plants before they wilt and fall over, therefore limiting inoculum production. An eight week surveillance interval will enable rapid destruction of infested plants and reasonably limit inoculum build up in the soil.

Surveillance on high-risk properties

High-risk properties will receive surveillance every three months. The close proximity of these properties to known infestations presents greater risk exposure. This warrants intensive surveillance to ensure early detection and disease management to minimise the risk of disease spread.

Surveillance on at-risk properties

Each remaining commercial banana growing property within the NBBZ will have surveillance carried out once in a 12 month period. This scope of surveillance allows the Program to determine the presence of the disease across Queensland's major banana growing region and addresses the risk that the disease is entering Queensland by unknown means or has spread via uncontrolled pathways from known infestations. This approach provides a high level of confidence in detecting the disease if present as all commercial banana growing properties will receive surveillance. This approach also helps to confirm the absence of the disease, which assists the industry in meeting market access requirements. All commercial banana growing properties within the NBBZ have the potential for disease incursion.

This surveillance model requires seven full time surveillance officers.

Surveillance methodology

Program surveillance officers are trained and audited in accordance with documented and approved procedures that underpin this strategy. These documents outline surveillance processes that are based on best available scientific information about the detection of the disease. 'On the job' training provides the Program with confidence that surveillance officers have the skills necessary to identify external symptoms of the disease and understand risk minimisation procedures to limit disease spread.

Currently, the most effective way to detect the disease is through on-ground visual surveillance looking for symptoms of the disease expressed in banana plants. Surveillance is conducted on the entire banana production area of each property by walking every fourth row looking for external symptoms of the disease[f]. On a block where the banana plants are young and their leaf canopy is not fully developed, visual surveillance is undertaken by walking around the perimeter of the block. It is estimated that this methodology allows surveillance officers to visually inspect approximately 80% of plants on a property.

If visual symptoms consistent with Panama TR4 are detected, the plants are flagged and their location is recorded so that they can be further assessed and sampled if necessary. If internal symptoms of the disease are detected, samples are taken and sent for diagnostic testing. The Program uses a suite of diagnostic tests including a vegetative compatibility group (VCG) testing method to confirm whether the Panama TR4 pathogen is present.

Public inquiry led surveillance

All public inquiries and reports of symptoms consistent with the disease are followed-up by BQ within two business days. An assessment of the external symptoms of the plant/s is undertaken. The assessment may lead to internal examination of the plant/s or additional surveillance.

The industry and wider public are encouraged to report any symptoms of the disease. While these reports assist with detecting the disease and may result in additional surveillance activities, public reporting does not form part of this strategy.

Industry and public inquiry led sampling activities occur on a case-by-case basis and are not a surveillance activity.

Future surveillance delivery

The commitment between DAF and the ABGC to jointly fund, govern and deliver the Program until June 2023 will have an ongoing impact on this strategy. Although, currently, all surveillance is delivered by the Program, over time is it expected that all or part of surveillance could reasonably be transitioned to industry led models that support shared responsibility for managing the disease.

[f]For each surveillance event on a property the row that surveillance commences in must be altered to achieve greater coverage over the banana production area. Surveillance should commence in the second row for even numbered surveillance rounds e.g. 2, 4, 6 etc. and commence in row 3 for odd numbered surveillance rounds e.g. 3, 5, 7 etc.

Both targeted and general surveillance will continue to be an integral part of the management of the disease. Further ongoing actions to support future delivery models for surveillance include, but are not limited to:

- Explore the potential use of remotely piloted aircraft (RPA) for the purpose of undertaking surveillance in a more efficient and cost-effective way.
- Support industry uptake and understanding of control and containment measures to build industry capacity and capability for managing Panama TR4.
- Measure the uptake of biosecurity practices by commercial banana growers within the NBBZ by assessing each property using a clear set of criteria.
- Ongoing public awareness to encourage growers to look for symptoms of the disease and report via the BQ hotline.

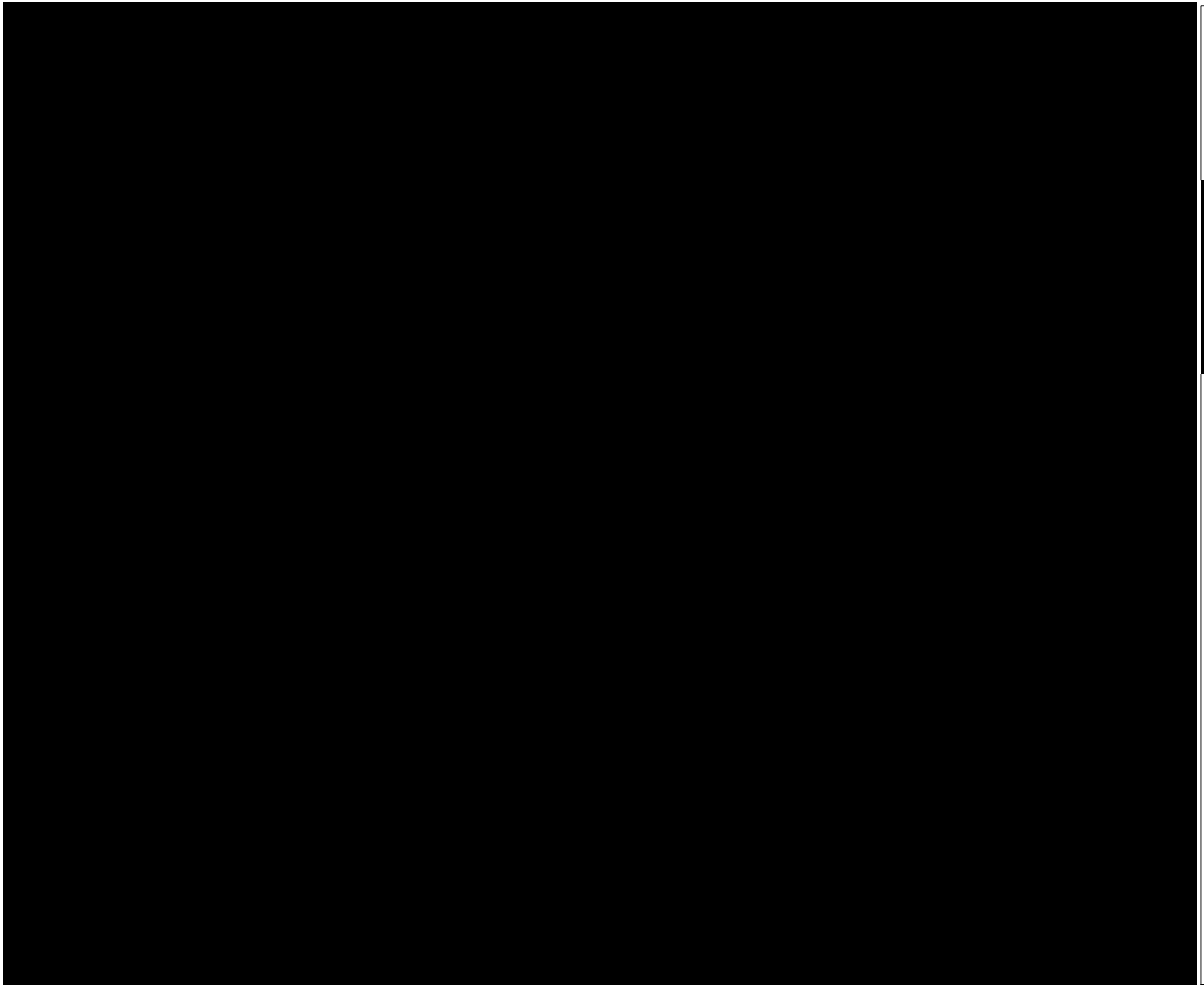
Approval and revision history

Author:	Name:	Luciana Arcidiacono and Marika Wright
	Title:	Panama TR4 Program Senior Policy Officers
Contributing author/s:	Name:	Donna Campagnolo
Reviewing officer/s		
Approved by:	Name:	Panama TR4 Program Management Board
	Title:	NA

Issue/approval date: 10/08/2020

Revision history

Version	Issue Date	Amendment details	Editor/s	Approved by
1.0	30/11/2017	First draft	Emma Jensen and Amelia Foster	Rhiannon Evans
1.1	17/04/2018	Minor amendments following the third detection	Amelia Foster	Brad McCulloch
1.2	06/08/2019	Draft updates for industry consultation	Emma Jensen	NA
1.3	21/08/2019	Administrative review of the strategy to include minor amendments	Shelley Kolstad, Luciana Arcidiacono, Emma Jensen, Donna Campagnolo and Amanda Palmer	Rhiannon Evans
2.0	10/08/2020	Major review	Luciana Arcidiacono Marika Wright	Board



Appendix 1

Panama disease tropical race 4

High Risk Area Tracing and Surveillance Strategy

Date: 15/07/2020

Note: Imagery used in these maps was captured in:
2018

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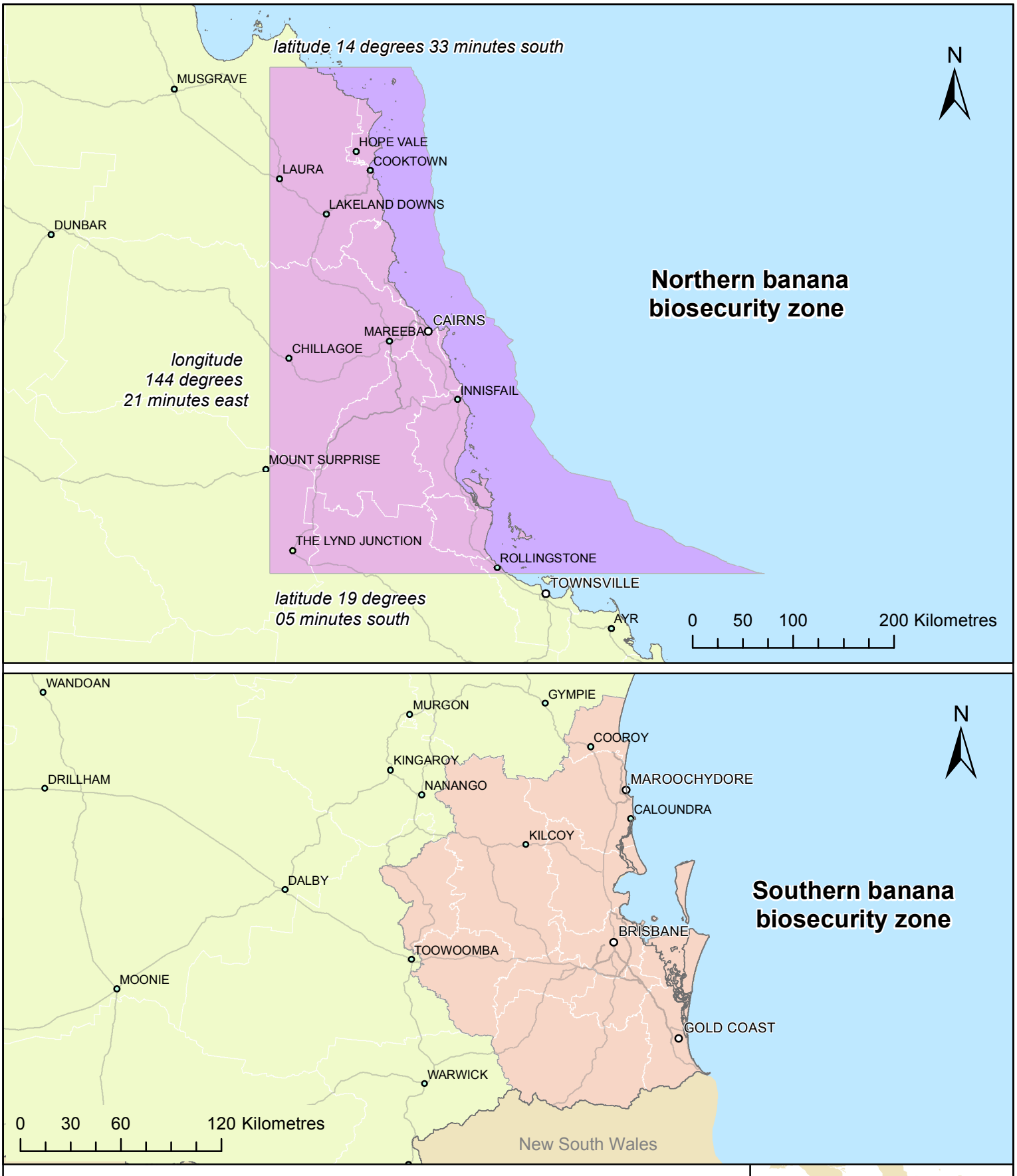
Digital data supplied by the Queensland Departments of Agriculture and Fisheries; Natural Resources and Mines; Geoscience Australia.
Projection and datum: Geographics, GDA94

Map produced by Biosecurity Queensland, Department of Agriculture and Fisheries on 15/07/2020.



Appendix 2 Banana Biosecurity Zone Map

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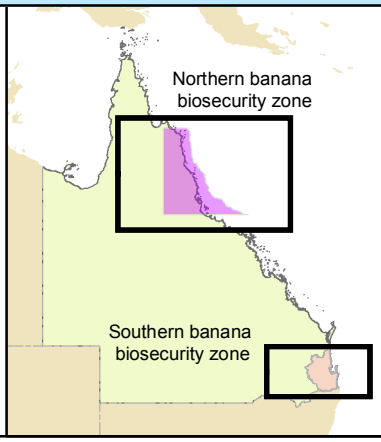
Legend

- Northern banana biosecurity zone
- Southern banana biosecurity zone



Published date: 6/06/2016