

Summary of the independent epidemiological review of Panama disease tropical race 4 on the infested property in Queensland

Background and scope

In March 2015, the devastating disease of bananas, caused by *Fusarium oxysporum* f. sp. *ubense* Panama disease tropical race 4 was detected in Queensland in Australia's major banana growing area, accounting for approximately 95% of commercial production. While the disease had been detected in the Northern Territory in 1997, until then, the disease occurred nowhere else in Australia.

Biosecurity Queensland, part of the Queensland Government's Department of Agriculture and Fisheries (DAF), in partnership with the Australian Government and the peak industry body, the Australian Banana Growers' Council (ABGC), mounted a major emergency response. The objectives were to determine the distribution of the disease in Queensland, prevent disease spread, and to work with stakeholders to encourage active participation in the response to facilitate industry resilience, recovery and sustainability in the presence of the disease.

The first infested property¹ and a second property linked by shared plant material, machinery and management, were placed under quarantine immediately and strict risk minimisation measures remain in place. The disease was detected in nine locations on the original infested property prior to ABGC purchasing the properties and closing all farming operations in October 2016.

Further detections of the disease were always expected to occur on other properties over time and this occurred in July 2017 when a detection was made on a second property, some 2.9km from the first site.

During early 2017 Biosecurity Queensland's Panama TR4 Program engaged the services of Stellenbosch University's Professor Altus Viljoen to carry out an independent epidemiological review of the disease on the infested property in Queensland.

The epidemiological review was undertaken as a component of scientific research to underpin and inform the Program's policies and procedures. The information gained from this project will form part of the Program's already extensive body of knowledge that we have about the disease.

The epidemiological project objective was to review all information pertaining to the positive detections of the disease on the infested property and provide an assessment of the possible source, history and distribution of the pathogen and efficacy of the current spread minimisation measures.

The purpose of this summary is to provide an overview of the findings of the review and the department's response to any recommendations made therein.

The project examined tracing information and any other relevant information from the original infested property to identify the potential pathways by which the disease may have been introduced into Queensland, to identify the ways the disease may spread from the current known location and, where appropriate, suggest changes to the methodology and prioritisation process.

¹ At the time of the review, there was only one confirmed Panama TR4 infested property in Queensland.

The epidemiological review was asked to assess whether it was possible to deduce answers to the following questions:

- how long has the disease been present on the infested property (IP)?
- are the first blocks where the disease was detected the index blocks on the IP?
- what was the likely source of introduction?
- how widespread can we assume the pathogen to have spread on the IP?
- how is it most likely to have spread?
- what is the likelihood the disease has been spread off the IP prior to us detecting the disease and implementing containment measures?
- what is a likely timeframe for symptom development as a result of disease spread off the IP to a site with banana plant hosts?
- what is the likely surveillance timeframe to determine the lifting of a quarantine notice from a property where disease has not been detected (but is suspected of being spread there through shared machinery and management in absence of farm biosecurity measures), and in the presence of banana plant hosts?
- what is the risk that the dam on the property is an ongoing source of further spread through irrigation water?
- could other measures be adopted to minimise further spread off the IP?
- is it possible to detect a pattern in disease development on the property that can inform targeted surveillance and early disease detection on other properties?
- what is the level of risk that the dam, Travelling Dairy Creek and other drainage lines off property pose as an ongoing source of further spread off property? How can this risk be minimised?
- what is the level of risk downstream in the Tully River to growers pumping water out of the river, or for extractive industries such as sand dredging? How can this risk be mitigated?
- based on current knowledge of the 10m radius destruction protocol being used on the IP, is there anything you would change about the destruction protocol that can facilitate ongoing production while minimising the risk of disease spread?
- based on the information available how would you prioritise surveillance, or target any additional surveillance across the industry not currently being addressed?

Key findings

During his assessment, Professor Viljoen studied both the infested property itself, and assessed pertinent response information provided by both DAF, the ABGC, other local banana growers and the owners of the infested property. Drawing on his knowledge of the pathogen and its epidemiology he has drawn the following conclusions from his investigation.

Nine (9) recommendations:

1. *Continue surveillance for at least another 12 months.*

Agreed. The Queensland Government has continued to fund a surveillance program for 2017/18. An independent evaluation will be conducted during 2017/18 on the Panama TR4 Program with a view to determining the cost/benefit of continuing longer term control, containment of the disease and options for how such a program might be delivered and funded. Any recommendations identified will be considered in forward planning for the ongoing management of Panama disease tropical race 4 in Queensland.

2. Surveillance of non-banana growing areas, especially the creeks flowing off the IP.

Not agreed. There is currently no reliable test for the presence of Panama disease tropical race 4 in soil and water, making the ability to determine the presence of the disease in non-banana growing areas either impossible or incredibly labour and cost intensive. While there is a slim possibility that planting sentinel plants to test for presence of the disease might detect the disease in non-banana growing areas, it would also build inoculum in the location further increasing the risk of disease spread.

3. Additional tracing to connect the IP with Panama disease tropical race 4 affected properties in the Northern Territory.

Not agreed. The review identifies three possible time periods of infection, prior to 2009, or in 2011 at the time of re-planting, or after re-planting in 2012, of the blocks where the disease was first detected on the IP.

Considerable investment has been made by the Program into tracing the source and spread of the disease that focussed on a seven year timeframe and long-term discussions with the previous property owner relating to the heavily infested blocks. Tracing surveys can draw on a variety of information sources, but predominantly that source is historical memories of those people involved (predominantly growers). Just under one hundred banana properties were found to be connected to the original infested property, by movement of risk items over the last five years. Reliance on memory recall of interviewees from five years ago, let alone more than eight years ago is likely to be patchy at best.

4. State government and ABGC support to introduce affordable biosecurity measures.

Not agreed. The Queensland Government through Biosecurity Queensland's Panama TR4 Program has invested heavily to assist the banana industry in the development and introduction of on-farm best management practises and resources informed by rigorous science, allowing a period of adjustment of farming behaviours across the banana industry. Additionally the Queensland Rural and Industry Development Authority (QRIDA) have productivity loans available to assist with the financial impact of developing on-farm biosecurity measures. Low interest loans may be accessed for biosecurity measures including fencing and wash-down facilities.

The considerable costs quoted in the review were sourced from a limited assessment of the cost of implementing biosecurity measures across a small number of multi-properties.

5. Aerial surveillance to improve detection of diseases and grower irregularities.

Agreed. Disease symptoms can be similar to other diseases and conditions that affect bananas, and in the early stages, these symptoms are located on the underside of the plant, making aerial detection challenging. Research is currently underway using remote sensing technologies such as aerial surveillance, to determine which tools can effectively detect the disease remotely. When effective tools are available, the Program will certainly consider their inclusion as part of the surveillance program. It is unclear what is meant by grower irregularities, the Program will not be pursuing this line of surveillance.

6. *Guidelines to deal with future detections and reintroductions of Panama disease tropical race 4 into the area.*

Not agreed. The Panama TR4 Program has a suite of communication material and resources ready for immediate implementation on the confirmation of disease on new properties. Through the collaborative work of government and the peak industry body the ABGC, substantial resources has been made available to future proof the industry for growers, science researchers, stakeholders and educators to combat the risk of disease spread and to continue to farm in the presence of the disease.

7. *An investigation into the history of the index blocks prior to 2009.*

Not agreed. As with the response given to recommendation three (3).

8. *Detailed investigation on the planting of the index blocks, and information on the identities and working history of temporary workers and backpackers.*

Not agreed. The review recognised the tracing effort to be only as good as people's memory of the events, so additional investment and investigation into events that occurred six years ago or greater could be less reliable than the information that was attained in 2015.

9. *The scaling up of research efforts.*

Not agreed. Significant investment by the Queensland and Australian Governments and the Australian banana industry to progress research and development projects that focus on finding new banana plant varieties that are resistant to Panama disease tropical race 4 are currently underway. Several other research projects are currently investigating topics such as effective disinfectants, clean planting material systems, diagnostic tests for detection of the disease in soil and water, identification of weed hosts in Queensland, suppressive groundcovers and rotation crops, epidemiology, presence of pathogen propagules in banana sap, influence of root exudates on chlamyospore germination, characterisation of the disease suppressive microbiomes, fungicide treatments and banana soil physico-chemical properties and nutrition.

Additional information

The following points are additional information from the review to further inform the summary of findings.

The review considers three possible scenarios on the potential origin and mode of introduction of the disease to north Queensland;

1. The disease was present on the two index blocks at the time of purchase by the previous owners in 2009.
2. Introduction of the disease occurred at the time of replanting the fallowed blocks with banana plants in 2011 purchased by the previous owners of the infested property.
3. Introduction of the disease from the Northern Territory or overseas during or after 2011. Originating from the Northern Territory was highlighted as the more likely of the two, for reasons detailed in the full review.

- The randomness of the pattern of detection of the disease on the infested property indicates that the disease is widespread on the farm and was most likely spread by machinery, people or vehicles.
- Symptom development where the disease was introduced by infected planting material is known to be rapid, 3-6 months. Where the disease is spread by soil, symptoms are much slower and unpredictable to show and could become visible only after 1-3 years.
- The review states there is a 'good chance' the disease was moved off the infested property before it was detected in March 2015 and the disease 'may' have moved to a non-banana site.
- The recommendations around origin and mode of introduction discuss that a better understanding of the history of the infested property's two index blocks is warranted. Several lines of investigation are suggested.
- The review suggests using the PCR diagnostic test on weeds along the banks of the creeks and the dam used to irrigate on the infested property, to confirm the presence of the disease there. Stating the dam, overland water flow and drainage lines remain risk pathways for disease spread on and off the infested property.
- Being able to effectively test soil and water for the disease is highlighted several times throughout the review and the importance of molecular markers becoming available through ongoing research.
- The review recommends establishing a managed ground cover on the IP that prevents erosion and soil movement, may be more effective in stopping movement of the disease in times of high rainfall and cyclones.
 - Unmanaged weeds were identified as undesirable with the potential to attract other pests that can also potentially spread the disease.

The review made note of the surveillance, awareness and research strategies of the Program as being highly effective and rigorous.

At the conclusion of the review several questions asked by the Program remain unanswered;

- where the disease came from
- the date of disease introduction
- how the disease was introduced
- where the fungus has spread to since the original introduction, and how.
- what would be a suitable timeframe for removing the quarantine on a property where strong links to an infested property are established, with existing host plants and no new detections through surveillance over a two year period.