

Final Report

Management of Banana Pests and Diseases in North Queensland

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Australian Banana Growers' Council

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Management of Banana Pests and Diseases in North Queensland (BA17005)

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Summary

Both Leaf Spot (Yellow Sigatoka) and Leaf Speckle are significant endemic diseases of bananas. These diseases are major production constraints when not controlled and have the potential to mask an outbreak of the similar, but more destructive exotic disease, Black Sigatoka. Additionally, the banana industry in NQ is facing an enormous challenge to contain and manage Panama Tropical Race 4 (TR4) which has the potential to devastate the entire industry. Other exotic pests and diseases pose constant and serious threats to the industry.

An opportunity existed through BA17005 to continue the important work conducted in BA09055, BA12007 and BA15003 to provide a resource such as a Plant Health Liaison Officer (PHLO), to assist banana growers contain and manage significant pests and diseases in North Queensland (NQ) and ensure early detection of exotic pests and diseases. This in turn would help maintain the continuity of supply of north Queensland bananas to Australian consumers.

Key activities to achieve these goals included surveillance for leaf diseases on all NQ farms and some backyards, educating growers and the local industry on the biosecurity matters, supporting best practice disease management and adoption of on-farm biosecurity measures, and providing guidance in future biosecurity surveillance and management strategies.

The project was highly successful with comprehensive disease surveillance data collected from all farms in the NQ region. Biosecurity Best Management Practice concepts for disease control were promoted through a wide range of educational material and activities e.g. the Best Management Practices Manual as well the dissemination of information through various media channels to growers, aerial operators, agronomists, government and research bodies, and the communities of NQ. Leaf specimens were taken which allowed the confirmation of leaf spot diagnosis and the continued absence of Black Sigatoka. Complaints of excessive disease levels were also investigated and acted upon in a timely manner.

Through the work of the PHLO, close to 100% compliance with the relevant leaf spot guideline was achieved in NQ through a voluntary industry approach and a greater proportion of growers had improved their on-farm biosecurity practices. This enhanced biosecurity for the whole banana industry. Low disease levels help maintain a consistent quality and supply of bananas, minimise production costs and are beneficial to the environment and workplace safety through the reduced need for chemical spraying.

Data generated through this project is an important resource to monitor and understand disease outbreaks in the target region, assess compliance with recommended banana guideline and contribute to evidence of ongoing freedom from Black Sigatoka. Professional working partnerships with BQ and AgriScience Queensland (ASQ) were facilitated through the PHLO, which enhances overall biosecurity for the banana industry. These features are of key importance for the ongoing management and containment of TR4 and assisting growers to meet their biosecurity obligations. Containment of TR4 is critical to reducing the impact of this disease on banana production in Australia's largest production area.

Owing to the success of BA17005, it was recommended that a similar project be continued to provide effective disease surveillance, biosecurity extension advice and integrated disease management in NQ.

Keywords

Banana; leaf spot; Yellow Sigatoka; *Pseudocercospora musicola*; *Mycosphaerella*; Leaf Speckle; Integrated Pest Management; surveillance; monitoring; biosecurity.

Introduction

Leaf Spot (yellow Sigatoka) and Leaf Speckle are significant endemic diseases of bananas that if uncontrolled, are major production constraints and have the potential to mask an outbreak of the similar, but more destructive exotic disease, black Sigatoka. Additionally, the NQ banana industry is facing an enormous challenge to contain and manage Panama Tropical Race 4 (TR4) which has the potential to devastate the entire industry. Other exotic pests and diseases pose constant and serious threats. Maintaining effective surveillance, prevention and the control of exotic and endemic pests and disease is crucial to the ongoing viability of the Australian banana industry and requires ongoing investment, activity and vigilance.

Under the Biosecurity Act 2014, banana growers have a general biosecurity obligation (GBO) to manage the risks of pests and diseases, and this includes leaf spot. Failure by growers to fulfil their GBO may result in a biosecurity order being issued, requiring a grower to take specific action to control leaf spot. These are legally enforceable, and penalties apply for failing to comply with a biosecurity order.

The challenge faced by the banana industry in NQ to contain and manage Panama Tropical Race 4 (TR4) is huge. Since the discovery of TR4 in March 2015, the disease has been contained to five farms in the Tully valley and the continued implementation of effective on-farm biosecurity best management practice is critical to protecting the industry against further spread of this disease or any others. Increased awareness and early detection afford the industry the best opportunity to control endemic disease and eradicate exotic diseases should they enter Australia.

Since 2009, the banana industry has been investing R&D levies in a series of projects to employ an industry liaison officer to help growers reduce and manage banana pests and diseases. The first project BA09055, was run by the Australian Banana Growers' Council (ABGC) who employed an Industry Liaison Officer on the project. BA09055 encompassed surveys in the NQ production areas to assess the level of yellow Sigatoka and was widely recognised as a success in terms of monitoring, reporting and addressing leaf disease issues on farms in Far NQ. The project worked in closely with Biosecurity Queensland (BQ) and achieved a dramatic reduction in regulatory intervention for leaf disease control in the region.

That surveillance work was continued by ABGC in BA12007, but the scope was broadened to include the provision of biosecurity extension advice to banana farmers. The project focused on integrated disease management of Yellow Sigatoka and other diseases, both on farms and host plants existing in the general community and concluded at the end of 2015. BA12007 achieved visual surveillance of 100% of banana farms in the NQ production area for leaf spot and other diseases and it lowered the risk threat threshold concerning emergency plant pests. A professional working partnership was built with BQ and ASQ in NQ and at least 60% of growers adopted some biosecurity best practice management on their farms.

Since 2011 and with the introduction of the Biosecurity Act in 2014, state government involvement in biosecurity regulation has diminished with the expectation that industry will take on a greater responsibility to manage biosecurity risks into the future. For example, BQ now provides a responsive regulatory service only to reports of excessive levels of leaf spot in commercial plantings and banana growers are now advised through an industry guideline that they should meet the 5% of Leaf Spot threshold to meet their General Biosecurity Obligation.

With the reduction in surveillance and regulatory activities by government, this methodology relies entirely on individual growers or other informed members of the community identifying outbreaks or incursions and reporting them. This situation represented an unacceptably high-risk level to the industry and therefore investment continued in BA15003 Integrated Management of Yellow Sigatoka and other disease in North Queensland (also delivered by ABGC). BA15003 successfully provided resources to:

- assist growers in controlling pests and diseases
- improve the awareness and adoption of on-farm biosecurity measures.
- undertake inspections.
- provide a point of contact regarding pest and disease management for all stakeholders including (industry, agronomists, regulators and researchers) including being responsible for alerting BQ to any suspected detections of exotic incursions.

The model developed by BA09055, BA12007 and BA15003, whereby industry takes on greater responsibility in managing endemic diseases and leaves BQ to focus on new pest or disease incursions, has been hailed as a model of partnership between government and industry. As a result, investment in the current follow-on project BA17005 was supported to continue this important work and to expand on outcomes to provide some analysis of previously collected pest and disease data. This will contribute to future biosecurity surveillance and management

strategies.

Effective on-farm biosecurity is important for the surveillance, prevention and containment of pests and diseases and is an integral component of an effective Integrated Pest Management (IPM) Program. Through BA17005 there was the opportunity for both growers and the community to be better educated about banana diseases, their identification and prevention. Maximising the adoption of best practice on-farm biosecurity and improving the efficiency of pest and disease management is the best way for industry to protect itself from future exotic pest and disease incursions and improve profitability and sustainability.

This project contributed to Outcomes 1 and 2 of Hort Innovation's Banana Strategic Investment Plan 2017- 2021 to improve pest and disease management and increase adoption of BMP to improve industry biosecurity.

Methodology

A full-time Plant Health Liaison Officer (PHLO) was engaged by ABGC to undertake the project which worked closely with commercial banana plantations, BQ, the community and others in the NQ industry. The PHLO conducted regular in-field surveys across all farms in the northern production zone to assess the levels of both yellow Sigatoka and Leaf speckle. Effective management of banana pests and diseases was facilitated by:

- educating and supporting NQ growers on the symptoms of important endemic and exotic diseases, effective integrated pest and disease management, biosecurity best management practice and adoption of on-farm biosecurity measures.
- sharing information with and between growers, aerial operators, chemical sellers, government and university research staff.
- undertaking pest and disease inspections as per the methodology outlined in Appendix 1.
- advising growers how to meet their general biosecurity obligation.
- collating, reviewing and analysing inspection data to inform future biosecurity approaches.
- alerting BQ and relevant scientists in ASQ if any other suspect banana diseases were found.
- collecting voucher specimens through inspections of commercial and residential properties.

The role assisted and encouraged growers to access information to improve their pest and disease control.

The role was managed by the ABGC CEO Mr Jim Pekin and ABGC R&D Manager and supported by the office team.

1. Inspection of farms

There are approximately 265 farms across the northern production zone from Rollingstone in the south to Lakeland and Hopevale in the north and including Mareeba. Methods for conducting surveillance for leaf disease by the PHLO is detailed in Appendix 1.

2. Data collection

Data was collected for the project using a specific Biosecurity App called Konect via the PHLO's phone. This facilitated the speed and ease with which data could be recorded, downloaded and allowed the generation of area maps. The types of data collected include farm details, location, size of farm and types of bananas grown, dates of inspections, leaf spot status and number of visits required for the grower to meet the guidelines. As in the past projects, IT support for the App, some of the data analysis and mapping of inspection sites and status was outsourced to AgKonect, a software and data analysis company.

Outputs

1. Comprehensive disease surveillance data from farms in the north Queensland production area.

It is estimated that there are 260-275 commercial farms in the northern production zone. The number is never constant since individual farms are bought and sold throughout the year and farms may go in and out of banana production. Comprehensive disease surveillance data was collected from Dec 2018-Mar 2022 from all farms in the NQ production area (Table 1). This included:

- the number of farms inspected.
- the number of farms with leaf spot above prescribed levels where the grower then received a verbal directive from the PHLO to undertake voluntary control measures and necessitated a revisit to check for compliance. Hence some farms may receive two or three additional visits to bring leaf spot under control.
- the number of farms with leaf spot above prescribed leaf spot levels which failed to undertake voluntary control measures and were subsequently referred to BQ.
- maps were generated showing location of farms inspected and the leaf spot infections recorded in each 6 monthly period for the life of the project (An example is found in Appendix 2).

Table 1 Leaf disease surveillance data for 6-monthly intervals in the northern banana production area between Dec 2018 and Mar 2022.

Time Period	Total number of inspections conducted	Number of farms Inspected	Number of farms receiving at least one re-visit	Number of farms referred to BQ	% Farms Voluntarily Compliant /year
Dec 18 - May 19 MS 102	272	222	27	0	100
Jun 19 - Dec 19 MS 103	346	255	48	0	
Dec 19 - May 20 MS 104	334	246	37	0	100
Jun 20 - Dec 20 MS 105	369	263	46	0	
Dec 20 - May 21 MS 106	345	269	32	0	99.3
Jun 21 - Mar 22 MS 190	509	417	49	2	
Average in each 6-month period	335	255	37	0.3	99.8

Over the life of project, the PHLO conducted a total of 2,175 inspections since some farms required follow-up inspections. Additionally, the PHLO made numerous phone calls, text messages and impromptu visits to growers throughout the year. This supplementary communication was a great tool for achieving a swifter response to compliance, which in turn helped minimize leaf spot pressure in certain growing regions. Communication between the PHLO and growers experiencing leaf spot pressure from neighboring farms, is of great importance in ensuring that their region is managing the disease in an appropriate time frame.

- On average, 85% farms inspected in each 6-month period were compliant with state government Banana Industry Biosecurity Guideline at the first farm visit, and 100% were voluntarily compliant after a follow up visit/s. This is well above the target of achieving 80% compliance with the relevant biosecurity legislation through a voluntary industry approach and surpasses the achievements of predecessor project BA15003. Only two growers over the life of the three-year project were referred to BQ for intervention in securing cooperation in leaf spot control.

2. Education material distributed promoting on-farm best management practice for disease control.

- The PHLO provided leaflets/posters to new growers and those experiencing problems with leaf disease. This

material also included general biosecurity extension advice on the use of BQ-approved sanitizers, spray schedules and other on-farm practices such as signage and footwear management.

- The PHLO attended five Banana Agribusiness Manager's (BAGMan) meetings which are coordinated by the National Extension Project. These meetings gave the PHLO opportunities to talk with resellers and agronomists. The PHLO also gave a Power point presentation at a BAGMan meeting (2019) (with 25 attendees) as a reminder to all agronomists, re-sellers and growers of the importance early reporting and 'Keeping exotic diseases on your radar'.
- Bunchy Top shed posters were offered to all NQ growers to raise awareness of the disease and improve preparedness in the event of any future Bunchy top incursion.
- Articles were published in Australian Bananas Magazine
 - Apr 2019 'Hitting the right spot with leaf disease Management'
 - Dec 2019 'Crunch time for leaf spot'
 - Dec 2021 'De-leafing critical for controlling leaf spot'
- The PHLO had many positive engagements with existing and new banana growers entering the industry and was proactive in informing them about the (i) challenges the banana Industry is facing (ii) the importance of Biosecurity Best Management Practices and (iii) the implementation of Biosecurity measures on their farms. In addition to this, the PHLO provided these new growers with information on any issues they may have and referred them to the relevant industry stakeholders for assistance.
- The PHLO often received enquiries from growers seeking advice on different ways to implement additional on-farm biosecurity measures and zoning ideas specific to their farm. After visiting the growers and giving the advice, the PHLO referred the grower to the ASQ extension officers who then visited these growers and delivered all the relevant information and recommendations. At times the PHLO received enquiries about environmental issues from growers and referred them to either the ABGC reef team or the national extension project.

3. Liaison with BQ

Over the three-year time frame of BA17005, the PHLO liaised closely with North Queensland BQ staff when necessary. Due to the high level of compliance, the PHLO did not need to call upon BQ because there were only two Corrective Action Requests (CARs) issued. However, a BQ representative accompanied the PHLO to a small number of growers in the Innisfail district with ongoing leaf spot issues.

Assistance was given to BQ by the PHLO regarding the location of banana farms in the northern zone, and advice was provided to BQ staff on how to contact different growers.

The PHLO assisted BQ with creating a Best Management Practice (BMP) brochure and shared aggregated data on the status biosecurity measures implemented on farms in different regions.

He also collaborated with the government agencies (BQ and ASQ) regarding unusual diseases issues and their management for example banana leaf rust and sooty mould.

4. The collection of voucher specimens

Voucher specimens were taken from 103 farms from the Cairns and Cassowary Coast regions of the NQ growing area between December 2018 – March 2022. These samples were submitted to ASQ in Mareeba for leaf disease diagnosis. The most detected disease was Yellow Sigatoka, and less frequently, Cordana leaf spot and Banana Leaf Speckle (Table 1). These diagnostic results provide additional confidence that the Northern production zone remains free of Black Sigatoka.

Table 1 Test results for voucher specimens taken from leaf samples, sourced from different areas across the northern production zone, between Dec 2018- Mar 2022. Note: Some leaf samples were found to be infected with more than one disease.

Disease detected	Number of Samples
Total samples taken	103
Yellow Sigatoka (<i>Pseudocercospora. musae</i>)	90
Cordana leaf spot (<i>Neocordana musae</i>)	25
Banana leaf speckle (<i>Mycosphaerella musae</i>)	14
Tropical speckle (<i>Ramichloridium sp. Metulocladosporiella sp.</i>)	9
Deighthoniella (<i>Deighthoniella torulosa</i>)	1
Banana rust (<i>Uredo musae</i>)	1
Symptoms not related to disease	1

5. On-farm Biosecurity

The status of implemented on-farm biosecurity measures was observed and recorded for every farm visited in each reporting period. These included fencing, biosecurity signage, car parking, foot bath and boot exchange and vehicle decontamination. This data was collected from all four NQ grower districts: Greater Tully, Innisfail and districts, Tablelands and, Lakeland and Far north (Table 2).

Table 2: The status of implemented on-farm biosecurity measures in each of the four growing regions in NQ (A) at Dec 2019 based on farm numbers in each region, (B) Mar 2022 based on farm numbers in each region (C) Mar 2022 based on farm areas. Percentages represent the proportion of the total in each region for farm numbers or area. Biosecurity measures include fencing, biosecurity signage, car parking, foot bath and boot exchange and vehicle decontamination. *Vehicle Decon: Could include spray grid/spray shuttle.

(A) Dec 2019 based on farm numbers

Biosecurity measures	Region (No. of farms)							
	GREATER TULLY		INNISFAIL & DISTRICTS		TABLELANDS		FAR NORTH	
Fence	23	44%	41	25%	23	79%	8	62%
Biosecurity signage	47	90%	118	73%	29	100%	8	62%
Carpark	31	59%	49	30%	21	57%	8	62%
Footbath & boot exchange	30	57%	37	23%	23	79%	6	46%
Vehicle decon *	31	59%	50	31%	23	79%	7	54%
Total Farm No. (ha)	52 (3,398 ha)		162 (5,233 ha)		29 (2,054 ha)		13 (597 ha)	

(B) Mar 2022 based on farm numbers

Biosecurity measures	Region (No. of farms)							
	GREATER TULLY		INNISFAIL & DISTRICTS		TABLELANDS		FAR NORTH	
Fence	23	44%	48	27%	24	77%	8	66%
Biosecurity signage	47	90%	155	88%	29	94%	9	75%
Carpark	30	58%	56	31%	25	81%	7	58%
Footbath & boot exchange	31	60%	50	28%	23	74%	6	50%
Vehicle decon *	31	60%	58	33%	26	84%	7	58%
Total Farm No. (ha)	52 (3,338 ha)		177 (5,504 ha)		31 (2,174 ha)		12 (692 ha)	

(C) Mar 2022 based on farm areas

Biosecurity measures	Region (area in hectares)							
	GREATER TULLY		INNISFAIL & DISTRICTS		TABLELANDS		FAR NORTH	
Fence	2,495	75%	2,018	36%	1,838	85%	689	99%
Biosecurity signage	3,309	99%	5,080	92%	2,132	98%	690	99%
Carpark	2,916	87%	3,544	64%	1,994	92%	680	98%
Footbath & boot exchange	3,010	90%	3,179	57%	1,921	88%	660	96%
Vehicle decon*	2,810	84%	3,228	58%	2,050	94%	673	97%
Total Farm No. (ha)	52 (3,338 ha)		177 (5,504 ha)		31 (2,174 ha)		12 (692 ha)	

It is evident in Table 2, that growers in the far north and the Tablelands have been the most proactive about implementing these biosecurity measures on their farms followed by growers in the greater Tully area. Growers in Innisfail and districts are lagging growers in other regions in terms of the adoption of specific biosecurity measures. The campaign by the PHLO to assist growers to put up biosecurity signage was largely successful.

To assess whether there has been an increase in adoption of biosecurity best practice, a comparison of the status of on-farm biosecurity measures in each region based on farm numbers was made between 2019 and 2022 and the overall change net change in each region was calculated (Table 3). Data shows that there has been an overall increase in the implementation of various biosecurity practices across the northern production zone since 2019 which enhances the biosecurity of the whole industry (Table 3).

Table 3 The status of various implemented biosecurity practices in 2019 compared with 2022 and the overall change in status for each region in the northern production zone.

Region	Biosecurity Practice	2019	2022	Change	Net change
Greater Tully	Fence	44%	44%	0	
	Biosecurity signage	90%	90%	0	
	Carpark	59%	58%	-1%	
	Footbath & boot exchange	57%	60%	+3%	+3%
	Vehicle decon	59%	60%	+1%	
Innisfail & Districts	Fence	25%	27%	+2%	
	Biosecurity signage	73%	88%	+15%	
	Carpark	30%	31%	+1%	
	Footbath & boot exchange	23%	28%	+5%	+25%
	Vehicle decon	31%	33%	+2%	
Tablelands	Fence	79%	77%	-2%	
	Biosecurity signage	100%	94%	-6%	
	Carpark	57%	81%	+24%	
	Footbath & boot exchange	79%	74%	-5%	+16%
	Vehicle decon	79%	84%	+5%	
Far North	Fence	62%	66%	+4%	
	Biosecurity signage	62%	75%	+13%	
	Carpark	62%	58%	-5%	
	Footbath & boot exchange	46%	50%	+4%	+20%
	Vehicle decon	54%	58%	+4%	

Based on data gathered throughout the project, the PHLO assigned a high, medium, or low rating to each farm. The rating highlights the adoption *and effective use* of on-farm biosecurity measures in each growing region, and for the areas that need improvement (Table 4). The ratings for adoption of on-farm biosecurity measures were defined as:

- High: The grower has implemented a range of biosecurity practices which are effectively managing controllable biosecurity risks on their farm.
- Medium: The grower has implemented some biosecurity measures which address some of the controllable biosecurity risk pathways.
- Low: the biosecurity practices which have been implemented by the grower have not adequately addressed biosecurity risks.

Farms that were rated medium and low indicate the need for some improvement in their on-farm biosecurity.

The largest increase in adoption was in the Innisfail district followed by the Far North and Tablelands. This demonstrates that this project as well as other industry initiatives, are having a positive influence on the adoption of biosecurity measures on farms. While there is still scope for improvement, it is particularly encouraging to see an increase in these protective measures in Innisfail and districts since the area has large number of farms which are generally smaller than those in Tully and the area and has historically slower to

adopt biosecurity best practice.

Data in Table 4 gives another insight into the status of on-farm biosecurity measures implemented at the end of the project across these growing regions and which is an indication of their preparedness should TR4 spread, or another serious incursion occur i.e. a higher percentage of farms and hectares with high levels of on-farm biosecurity measures occur in Lakeland and Far North regions compared to low levels in Innisfail and districts region. The Innisfail area remains more vulnerable to pest and disease incursions such as Panama TR4 and, if the disease were to be detected there, containment would be more difficult, and the spread is likely to be more rapid.

Table 4: The number and area (hectares) of banana farms with high, medium, and low biosecurity status rating and the percentage of the total they represent in the different regions of NQ, as of Mar 2022. Note - Biosecurity ratings were High- The grower has implemented a range of practices which are effectively managing controllable biosecurity risks on their farm; Medium-The grower has implemented some practices which address some of the controllable biosecurity risk pathways; Low- The practices which have been implemented by the grower have not adequately addressed biosecurity risks.

Region	On-farm biosecurity ratings Mar 2022							
	Low		Moderate		High		Totals	
	No. Farms	Area (ha)	No. Farms	Area (ha)	No. Farms	Area (ha)	No. Farms	Area (ha)
Greater Tully	23	526	11	616	18	2,197	52	3,338
	44%	16%	21%	18%	35%	66%	100%	100%
Innisfail and districts	134	2814	33	1,739	10	951	177	5,504
	76%	51%	19%	32%	6%	17%	100%	100%
Tablelands	9	315	10	643	12	1,217	31	2,175
	29%	14%	32%	30%	39%	56%	100%	100%
Lakeland & Far North	4	4	3	32	5	656	12	692
	33%	1%	25%	5%	42%	95%	100%	100%
Totals	170	3,658	57	3,030	45	5,021	272	11,710
	63%	31%	21%	26%	17%	43%	100%	100%

6. Cyclone recovery advice

In February 2021, Far North Queensland banana farms were heavily impacted by Cyclone Niran which caused major damage to banana plantations, and in some cases, 100 % of growers' crops were destroyed. Even growers that recorded 20-50 % losses to their crops struggled to come to terms with the significant impact it has had on their farm businesses.

The PHLO spent a week contacting growers by phone and on farm visits to determine the extent of their damages and estimate percentage of crop losses. Additionally, the PHLO offered growers any information and support they may have needed with the recovery.

The PHLO worked in collaboration with the biosecurity extension officers to assist with post cyclone clean up, available financial support grants being offered and to encourage growers to be aware of the likelihood of banana pests and diseases incursions e.g. Yellow Sigatoka and Banana Weevil borer affecting their crop during the recovery period.

Outcomes

1. Leaf spot and other foliar disease surveillance and management

- The northern banana industry achieved 100% compliance with relevant legislation through a voluntary industry approach between 2018 and 2022. This is substantially higher than the project's goal of 80% compliance and surpasses the achievements of the previous related projects. This high level of compliance may be directly attributable to the work of the Liaison Officer.
- Growers had a better understanding and awareness among of how to manage leaf spot disease on their farms.
- The knowledge and awareness in the region of the importance of effective control of endemic pests and diseases among all growers and local communities was increased.
- The industry was better prepared for the increased foliar disease pressure associated with the wet season in late spring/summer and were better able to avoid major flare ups.
- A significant reduction in regulatory intervention was required for leaf disease control as <1% of growers required notifications to the regulatory authority. This resulted in greater biosecurity for the NQ banana industry.
- The lower levels of leaf spot achieved through the voluntary industry approach assisted in reducing production costs across the region and contributed to maintaining a consistent quality and supply of bananas.
- The comprehensive database of banana farms generated from data collected during the project is an important resource for ABGC to monitor and understand the location, distribution and frequency of disease outbreaks in the target region and assess compliance levels with legislation.
- The professional working partnership achieved through the Liaison Officer with BQ and ASQ in NQ enhanced awareness, communication and understanding between government departments and banana growers. This facilitated coordination and enhanced biosecurity outcomes for the banana industry.
- Collection and testing of leaf disease samples by ASQ contributed to accurate disease diagnosis and the exotic disease surveillance program. This monitoring is critical for early detection of exotic diseases as well as ensuring the continued absence of Black Sigatoka.
- A working relationship was established and maintained with aerial fungicide spray operators to monitor their observations regarding disease pressure, fungicide resistance and any other issues they may have.

2. Biosecurity best practice

- There has been an increase in the range of biosecurity practices implemented by NQ growers and their understanding about the importance of preventative measures to reduce the incidence and spread of endemic pests and diseases has increased. This assists in better biosecurity risk management across the whole industry.
- The risk of Black Sigatoka and other exotic diseases has been decreased by surveillance of all farms in the northern production area. Diagnostic results of the 103 voucher specimens collected confirmed the ongoing absence of Black Sigatoka and provided insight into the relative incidence of the most common foliar diseases.
- The PHLO has a much better understanding of Banana Bunchy Top disease and its identification and is distributing bunchy top posters to farms. This improves the industry's chance of detecting bunchy top early and its eradication should an incursion occur in the NQ production area.
- The importance of biosecurity to growers is kept top of mind and continually reinforced by regular discussions with individual growers encouragement to implement and correctly use on-farm biosecurity measures. This helps mitigates complacency in the grower community.
- Over 90% of the growing area in each region now has biosecurity signs erected on the boundary which greatly assists in monitoring and controlling the movement of people and vehicles on and off the farm.
- Continued positive engagement with the growers in NQ has contributed to the PHLO being regarded as a trusted source of information. This includes both established growers and new growers to the industry. Where appropriate, the PHLO refers growers to other industry Extension Officers for support which enhances cross collaboration and between projects and adds value to the delivery of other extension effort in the banana

industry.

- Professional working partnerships continue to be maintained with BQ and AgriScience Qld NQ through regular phone calls, emails and meetings. Better biosecurity outcomes are achieved when government and industry work well together, the foundation being effective communication.
- Stakeholders and the community have a greater awareness and understanding of biosecurity issues associated with the banana industry. Good biosecurity is everyone's responsibility.

3. Cyclone recovery

The knowledge of the industry, distribution of farms and the rapport established by the PHLO with all NQ growers represents a resource whose value to the industry is wider than biosecurity. Cyclones are common in the major production area of NQ and the PHLO provides important industry information and grower support that greatly aid disaster management.

Monitoring and evaluation

The focus of BA17005 was to assist banana growers contain and manage significant pests and diseases in NQ and ensure early detection of exotic pests and diseases. This helps maintain the continuity of supply of NQ bananas to Australian consumers. The goals were achieved through surveillance and biosecurity extension advice which was provided to farmers and the broader community. This project was highly successful with delivered outcomes exceeding the original expectations.

Domain	Key Evaluation Questions
Effectiveness To what extent has the project achieved its expected outcomes?	All the outcomes as set out at the commencement of the project were achieved indicating the project's effectiveness. This is evidenced by the data which shows that the project • Met the goal of visual surveillance of 100% of commercial farms in the northern production zone. • Increased awareness of the importance of effective containment of endemic pests and diseases amongst growers and other stakeholders. • Enhanced the overall adoption of on-farm biosecurity best management practice in NQ (Table 2,3,4). • Reduced the threat of Black Sigatoka and other diseases by visual surveillance of all farms in the northern production zone twice yearly and the results from testing of voucher specimens confirming the ongoing absence of Black Sigatoka (Table 1). • Increased the awareness of biosecurity issues relating to the banana industry and the importance of managing non-commercial plantations through e.g. project activities non-commercial farm inspections, such as field day Mareeba and the Innisfail show, ongoing liaison with BQ.
Relevance How relevant was the project to the needs of intended beneficiaries?	This project provided outcomes that were highly relevant to the needs of growers, government departments, and other industry stakeholders • The 100% compliance with relevant state biosecurity legislation was achieved through a voluntary industry approach and this can be attributed directly to the Liaison Officer Mr Rickson, and the activities he conducted during the life of this project. • Surveillance conducted in this project is the only consistent, regular surveillance across every banana farm in the northern production zone which makes up 95% of the national banana industry. It is therefore of great benefit to the whole industry, its growers, governments and other stakeholders in enhancing industry capability in early detection and preparedness. • The awareness and uptake of on-farm biosecurity has been increased through BA17005. Convincing growers of the need to adopt biosecurity best management practice and facilitating practice change is critical to the

	sustainability of the industry yet challenging after 6 years of dealing with a major incursion of TR4. The fact that this project contributed to an increase in the adoption of on-farm biosecurity, demonstrates its relevance to the industry. • The project greatly assisted growers meet their General Biosecurity Obligation under state legislation to manage foliar diseases which are a major production constraint. This minimizes the disease pressure in the region, prevents costly flare ups across a wide area of the industry. Assisting growers to better manage endemic diseases and decrease the risk of exotics, improves profitability and therefore supports regional communities and ongoing supply to consumers. • Through individual farm visits and face-to-face conversations, the extension and communication of information and on-farm biosecurity within the northern production zone has been greatly enhanced.
Process Appropriateness How well have the intended beneficiaries been engaged in the project? To what extent were communication and engagement processes appropriate to the target audience?	• The cultural control method where infected leaves are removed is the best way of reducing inoculum levels of foliar diseases since the fungi depends on living material for survival and spore dispersal is minimized if infected leaves are removed early before sporulation. The resulting reduction in the incidence and severity of disease means that de-leafing is appropriate for the northern production zone. In the moist warm temperatures of NQ, conditions are conducive to rapid growth of fungi, which is why levels of leaf infection are recommended to be kept below 5% all year round. Without the help of the Liaison Officer, it is likely that many growers would have failed to meet the requirements and production losses from disease would be much greater. • Also de-leafing is also an appropriate control method for use in the northern production zone. Commercial plantations dominate the area with little interruption by residential areas. Residential banana plants are far less common, are less likely to act as reservoirs for disease and are easier to monitor and inspect than they would be in the more populated areas of SE Queensland. • The project achieved target levels of engagement with all stakeholders. • The range of communication and engagement processes used to the target audience was appropriate since it reached all stakeholders and was effective at achieving the planned outcomes. • Content was provided through the communications project in magazine articles and the e-bulletin however the main form of communication in the project is through face-to-face meetings. This is the form of extension that most growers prefer. • As well as the communications project, BA17005 collaborated regularly with BA19004 National Banana Extension project and BA17002 and BA20002 Banana Industry R&D Coordination to engage the target audience. Collaboration also occurred with BA18000 Banana Bunchy Top Project, and the reef extension projects to optimize opportunities across the industry's collective extension effort.
Efficiency What efforts did the project make to improve efficiency	• ABGC has delivered BA17005 efficiently by implementing agreed activities according to agreed schedules and budgets outlined in the research agreement. • The project also tries to improve efficiency wherever possible by reducing costs associated with running the vehicle, ensuring travel is conducted in the most well-organized manner and by collaborating with other projects in the area to enhance project delivery. • Effective relationships Mr Rickson built with ASQ and BQ, enhanced biosecurity and assisted the action of government and other stakeholders to be more coordinated and efficient.

Recommendations

1. It is recommended that continued investment in a resource such as the PHLO is necessary to reduce the incidence of leaf spot in the main production area, facilitate the integrated disease management of yellow Sigatoka and other diseases in North Queensland and provide enhanced biosecurity for the NQ banana industry.

Prior to the banana industry making an investment in this type of project (10 -12 years ago) growers often failed to keep up with their de-leafing and spray schedules. The benefit of investing of project such as BA17005 and its predecessor projects has been demonstrated over this time. Often it is the 6 monthly visit by the Plant Health Officer which reminds growers to prioritise these activities to minimize disease pressure and reduce costs for the entire NQ industry and keeps the adoption of biosecurity best practice top of mind thereby addressing complacency.

2. Ongoing monitoring and extension of best management practice by a trained liaison officer provides invaluable biosecurity support for the northern production zone since it allows early detection and action when emerging plant pests occur such as black Sigatoka, Panama TR4 and Bunchy top virus.
3. A dedicated resource linked closely to the industry and located within the region provides a significant advantage in industry adoption, with all major plantations participating in on-farm inspections. Critical to the successful adoption of biosecurity best practice was having a person with an understanding of banana production systems to engage with growers and work through issues to find potential solutions that are practical and realistic. The banana industry via the R&D Strategic Investment Advisory Panel Committee strongly supported the project to be re-established.
4. The scope of BA17005 was appropriate to the current needs of the NQ banana industry and it is recommended that a new follow-on project continue to provide the current scope of service. Continued data collection will expand the existing dataset and will assist in the optimization of future biosecurity surveillance and management strategies.
5. Maintain the collection of voucher specimens of leaves be taken each year to provide disease diagnosis and for fungicide resistance testing of isolates. Representative samples should be taken from each NQ growing region each year.
6. Continue to build collaboration between all banana extension and communication projects to ensure greater coordination and dissemination of information as well as opportunities to add value.
7. Familiarisation and training in the role of the banana industry Plant Health Liaison Officer was provided to Mr Rickson by his predecessor Mr Lardi in the last three months of the previous project. This ensured a seamless transition into BA17005, and this approach should be considered for other projects wherever possible to minimize the loss of industry capability and knowledge.

Intellectual property, commercialisation and confidentiality

No project IP, project outputs, commercialisation or confidentiality issues to report.

Acknowledgements

ABGC would like to thank Mr Carl Rickson for his dedication and hard work in the role of the Plant Health Liaison Officer over the last 3 years. He has been an invaluable asset and worked hard to gain the respect and trust of the growers in the region and ably taken over the role from Mr Louis Lardi.

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We would also like to thank the banana growers of North Queensland who gave their cooperation and practiced good leaf spot control measures and biosecurity best management practice.

Appendices

Appendix 1 Methodology for Leaf spot/ Leaf speckle surveillance on FNQ Farms

Each of the approximately 265 farms in the Northern banana biosecurity zone were visited twice a year. The Northern banana biosecurity zone includes farms from Rollingstone in the south, to Lakeland and Cooktown in the north including the Atherton Tablelands.

The order of farms visited each 6-monthly period was determined by the most efficient way to traverse the district. Areas were inspected by road. If farms revisits were required, they were scheduled in a way to make the most efficient use of resources.

The inspection process was as follows:

- The Plant Health PHLO scheduled farm visits with the owner or farm manager at least several days in advance.
- On the appointed day, the PHLO arrived at the appointed pick-up point where he left his vehicle (preferably outside the farm gate).
- Before entering the farm, the PHLO sprayed his boots with Sterimax or Sporekill.
- The PHLO then adhered to all biosecurity practices of each individual farm and traversed the plantation with the grower or farm manager in the grower's vehicle. This had two purposes: 1) to reduce the risk of transmission of plant diseases by the PHLO vehicle and 2) to enable the Plant Health Liaison Officer to talk to the grower about the disease issues, biosecurity best practice and if the grower required information, the Plant Health Liaison Officer was then able to provide it.
- The PHLO and the grower/ farm manager drove slowly through the plantation usually around the perimeter of blocks, inspecting plants for leaves which may have been showing more than 5% leaf area affected by Yellow Sigatoka or Leaf Speckle as per the Banana Industry Biosecurity Guideline. The Banana Industry Biosecurity Guideline was established under the Queensland Biosecurity Act 2014 to provide guidance to persons who cultivate bananas on discharging their general biosecurity obligation (GBO).
- Incidental surveillance for any unusual symptoms on banana plants e.g., Panama TR4, or bunchy top disease was undertaken concurrently with leaf disease surveillance by the PHLO.
- In cases where leaves were found with at least 5% area affected by Yellow Sigatoka or Leaf Speckle, the PHLO then verbally directed the grower to undertake de-leafing (removing the leaf from the banana plant and placing on the surface of the soil to rot) and a regular fungicide spray program. The grower had 14 days to comply with this verbal direction before the PHLO returned to inspect if de-leafing operations have been undertaken. Each visit was recorded in the AgKonect App to facilitate data recording and management.
- If a grower did not comply with the verbal direction, the PHLO then issued a written Corrective Action Request (CAR) to undertake de-leafing operations.
- If the grower did not comply with the CAR within 14 days, Biosecurity Queensland (BQ) was notified. BQ officers then visited the property to facilitate the grower meeting their General Biosecurity Obligation. The PHLO was subsequently notified by BQ of the outcomes of the process.
- Strict biosecurity practices were followed when the PHLO left each farm including spraying his boots with Sterimax when he returned to his vehicle.
- Each week the PHLO's vehicle was decontaminated by pressure spray, cleaning with Farmclense then the tyres were treated with Sterimax.
- The PHLO took voucher specimens from affected leaves from each district which were sent to QDAF labs at Mareeba for testing. The aim of this testing was to provide ongoing evidence of area freedom from Black Sigatoka and give an indication of common foliar diseases affecting plantations in the north.

(a) 5 % Yellow Sigatoka



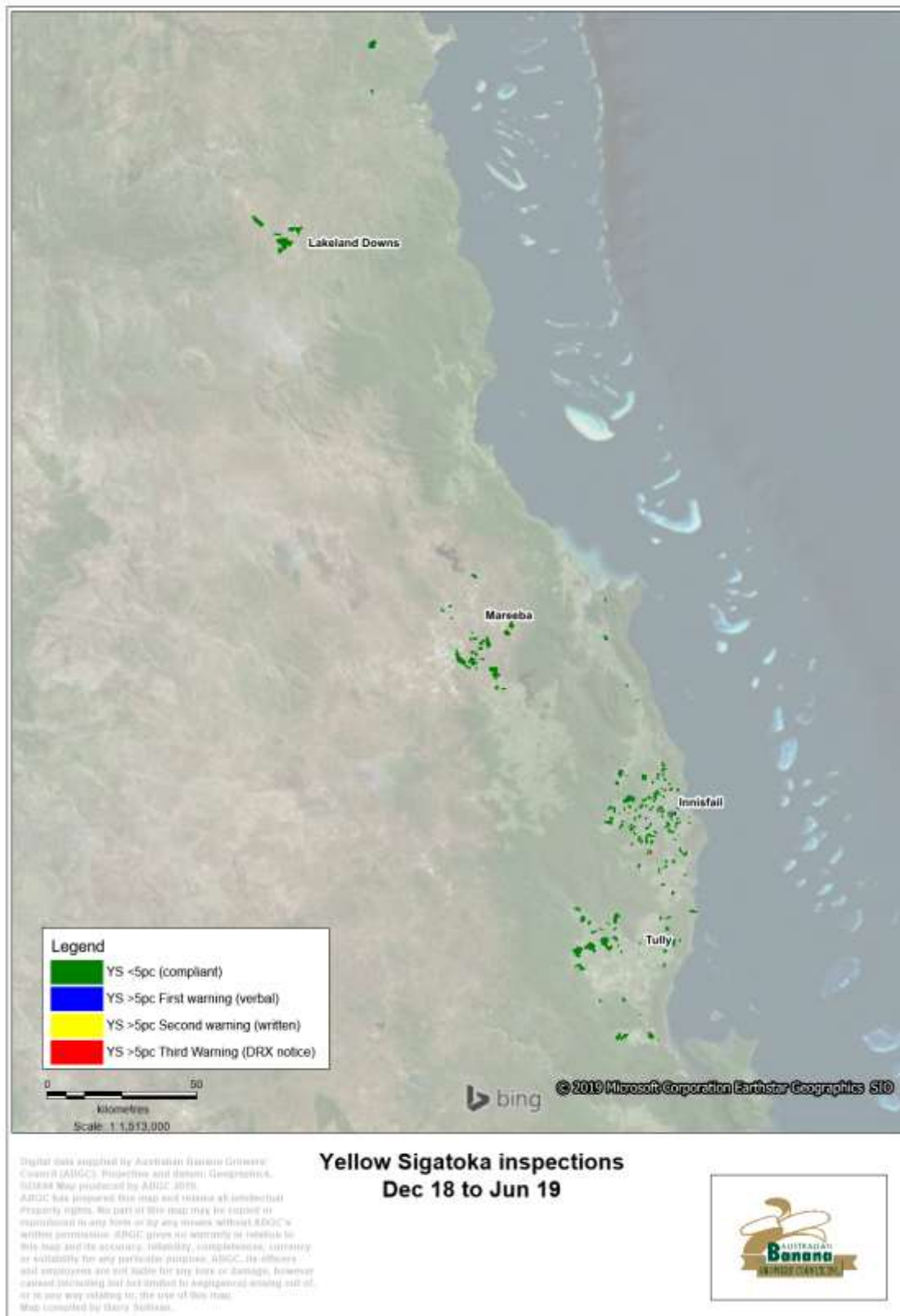
(b) 5 % Leaf speckle



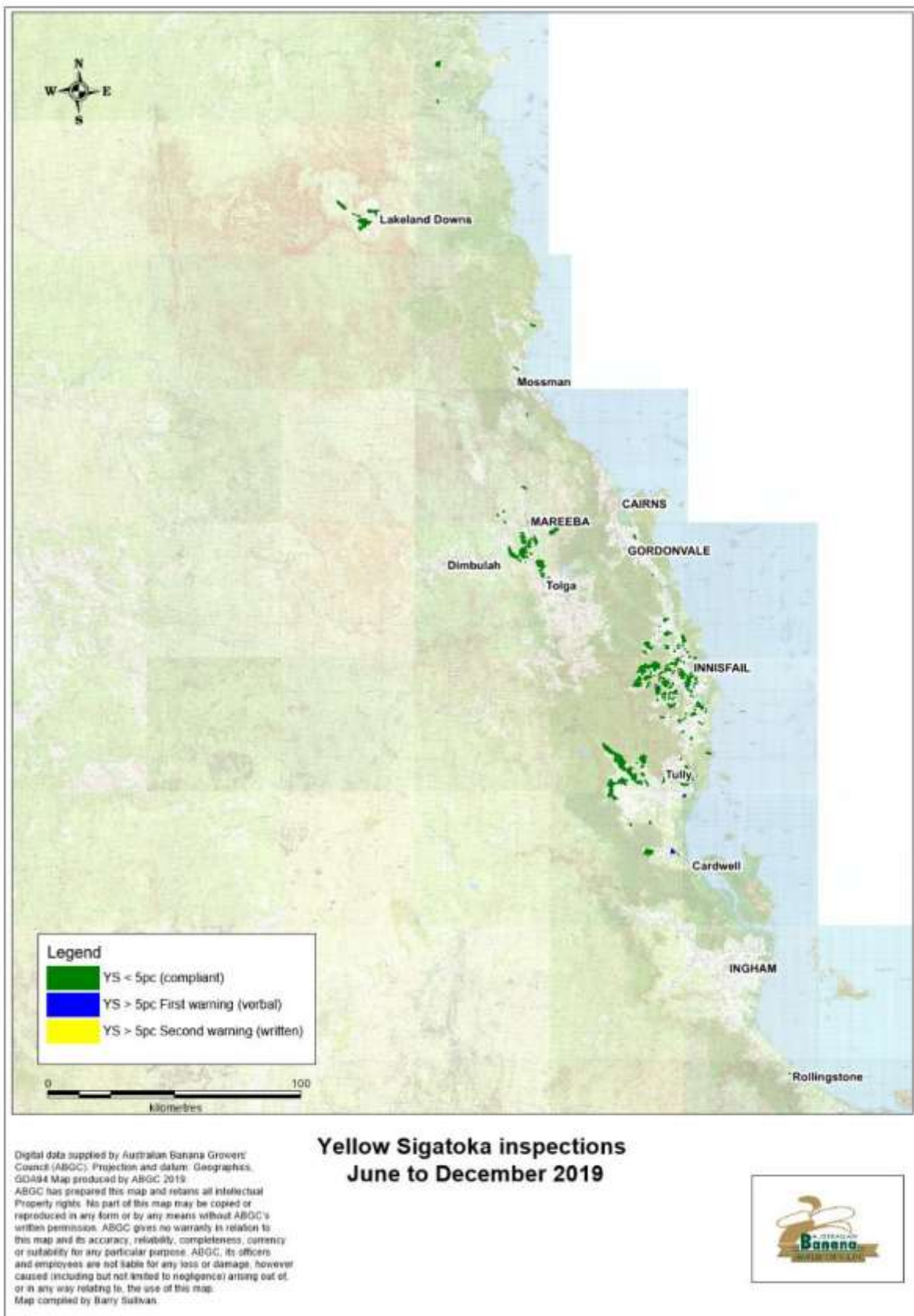
Figure 1 Image of a banana leaf showing 5% leaf area affected by yellow Sigatoka (a) and leaf speckle (b). Leaf spot is a significant endemic disease in far north Queensland, and it is recommended to growers that they keep infection levels below 5% of the leaf area to meet their General Biosecurity Obligation under the Biosecurity Act 2014.

Appendix 2 Location of farms visited and places where leaf spot infection was observed in the Northern production zone in each 6-month reporting period except for the last reporting period which was 9 months.

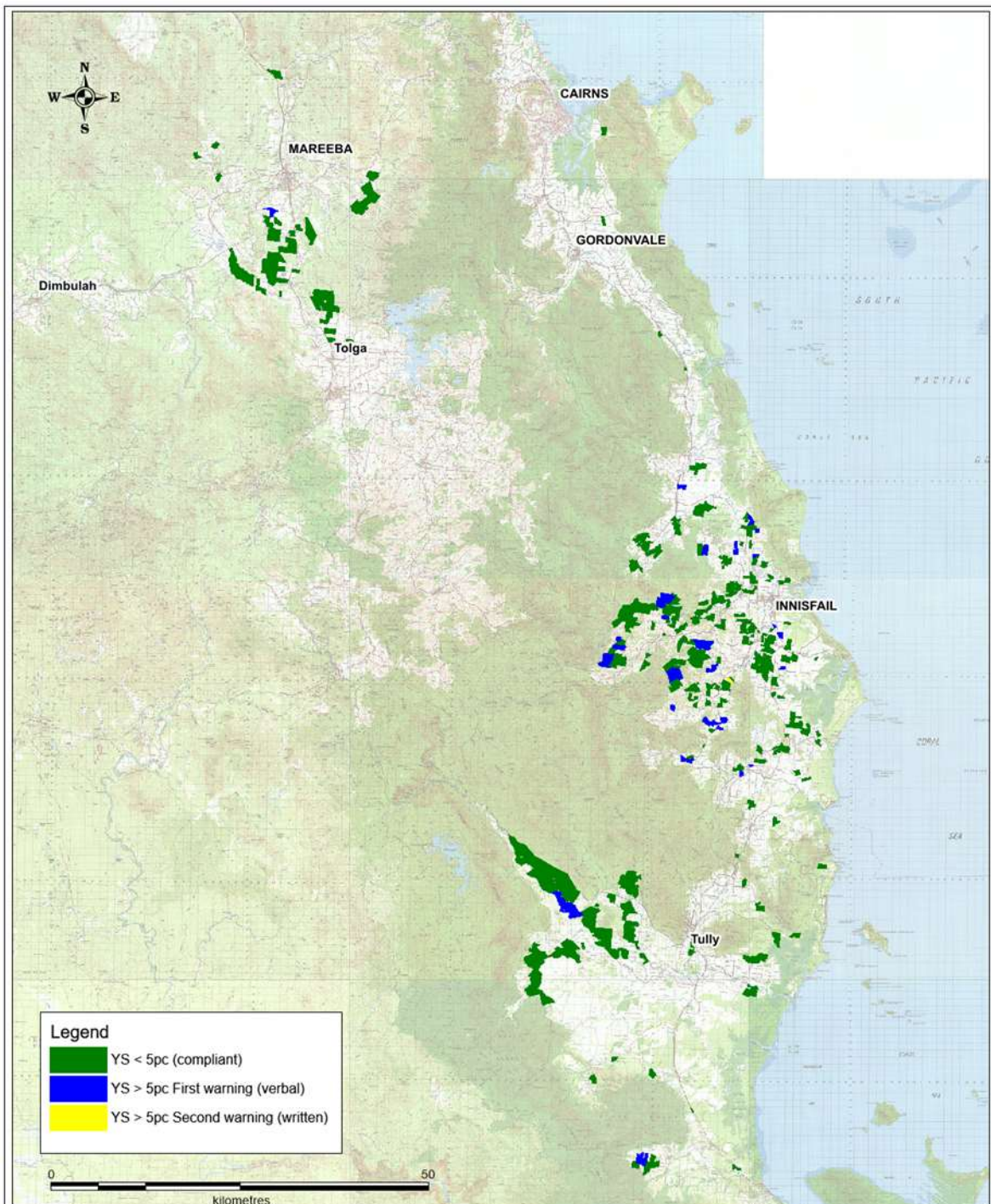
(A) Dec 2018 – May 2019



(B) Jun 2019 – Dec 2019



(C) Jan 2019 –Jun 2020

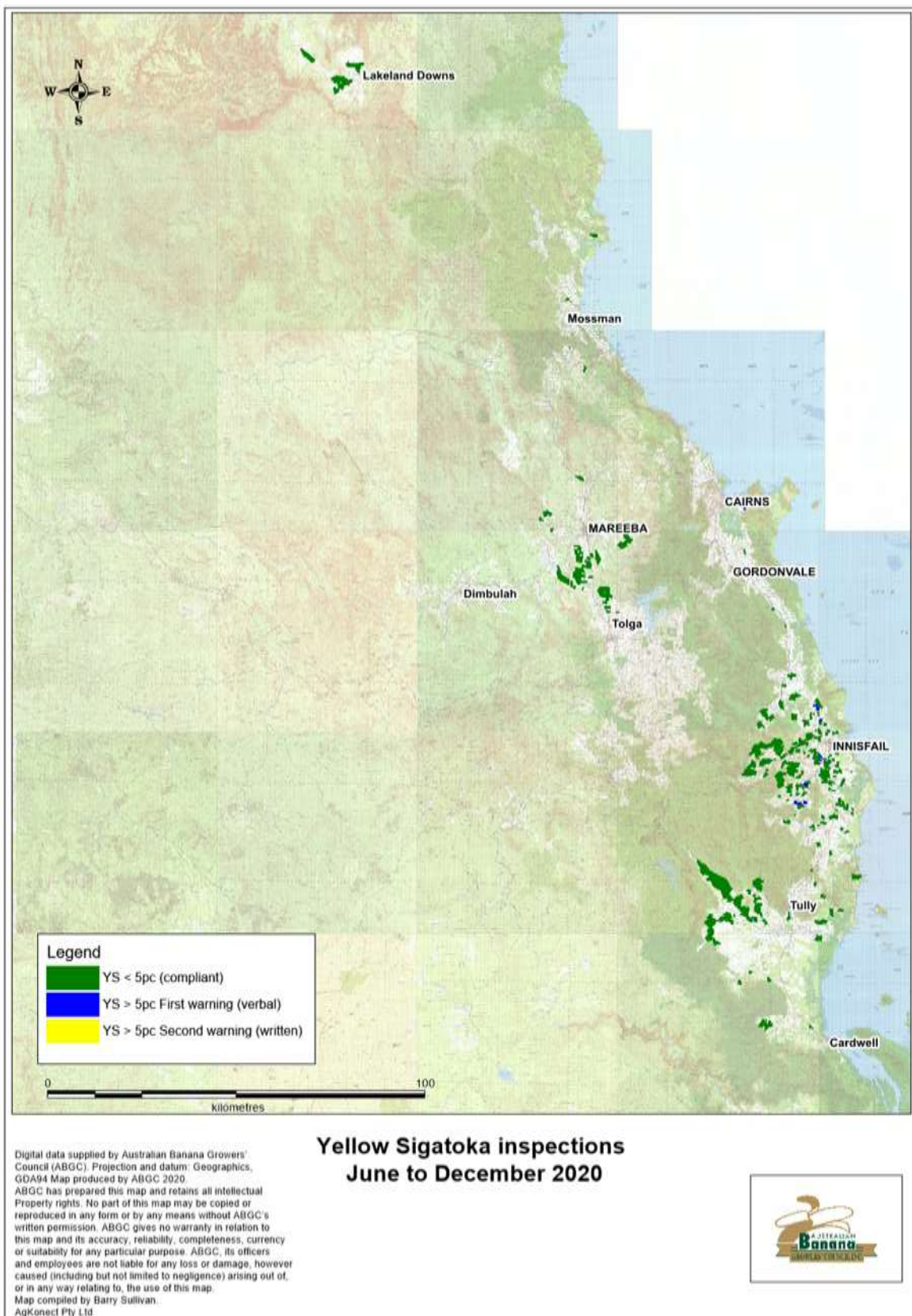


Yellow Sigatoka inspections January to June 2020

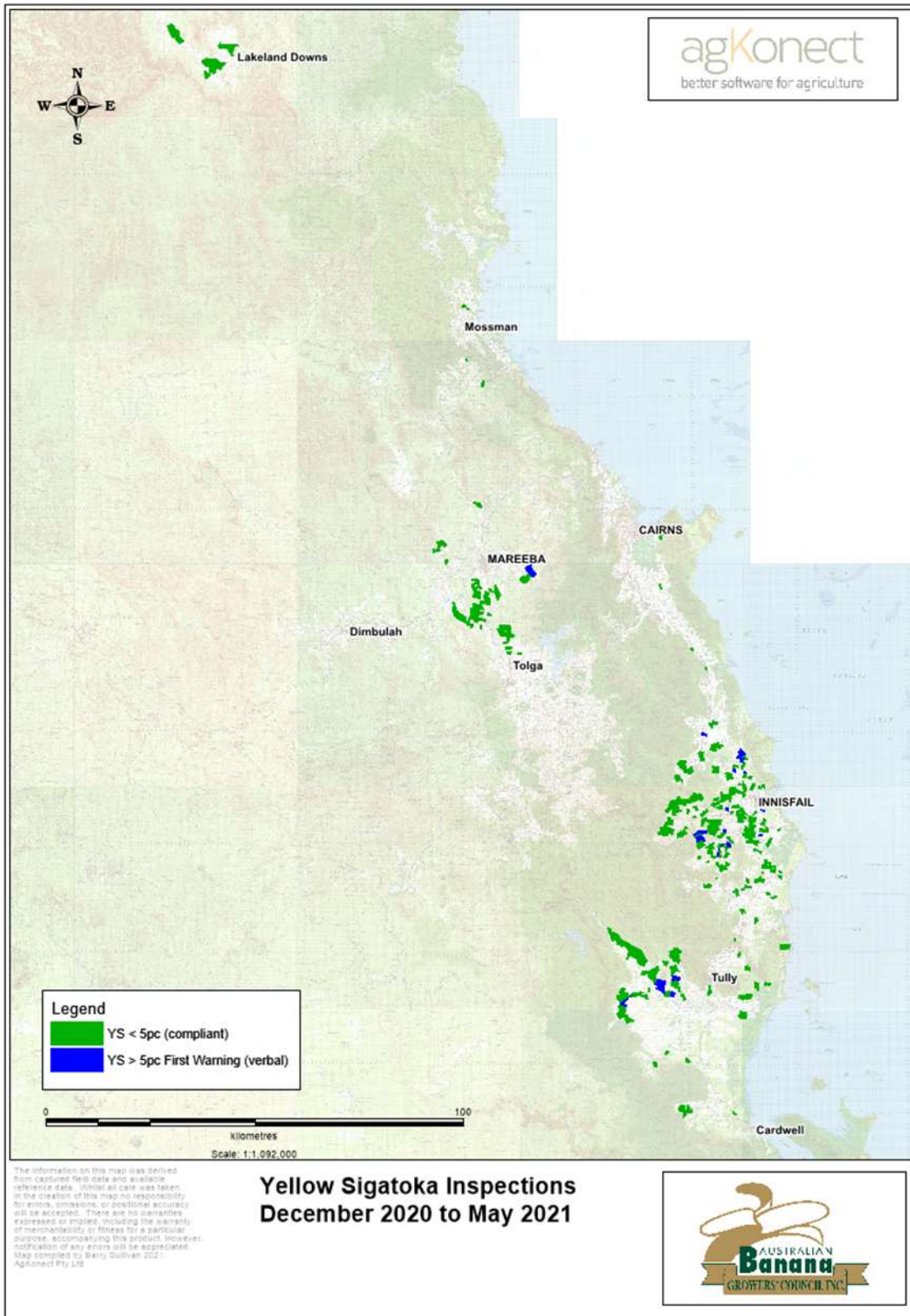
Digital data supplied by Australian Banana Growers' Council (ABGC). Projection and datum: Geographics, GDA94 Map produced by ABGC 2020.
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Map compiled by Barry Sullivan.



(D) Jun 2020 - Dec 2020.



(E) Dec 2020 to May 2021



(F) Jun 2021 to Mar 2022

