Final Report

National Banana Bunchy Top Virus Program – Phase 3 - QLD

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Delivery partner:

Lagom Agriculture Pty Ltd

Project code:

BA15006

Project:

National Banana Bunchy Top Virus Program – Phase 3 – QLD – BA15006

Disclaimer:

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Content

Acronyms:

- NSW – New South Wales
- BBTV – Banana Bunchy Top Virus
- HIA – Horticulture Innovation Australia
- QAAFI – Queensland Alliance for Agriculture and Food Innovation
- R&D – Research and Development
- DAFQ – Department of Agriculture and Fisheries Queensland
- GPS – Global Positioning system
- QLD -Queensland
- SEQ – South-East Queensland
- APVMA – Australian Pesticides and Veterinary Medicines Authority
- ABGC – Australian Banana Growers' Council

Summary

Banana Bunchy Top Virus (BBTV) causes the most serious viral disease found in banana plants. It can have extremely devastating effects on commercial banana farming operations and can readily exist in private backyard banana plants within the known bunchy top zones in South Eastern Queensland and Northern New South Wales. There are only two known modes of spread of this disease the first being by the movement of infective banana aphids from plant to plant and the other being by the movement of infected planting material by humans. In South-East Queensland, within the known bunchy top zone, there are 35 known commercial farms operating which are regularly inspected and infections detected are destroyed. Following recent changes in State Government legislations, access to properties and farms in rural, urban and peri urban areas to carry out surveillance and control activities of BBTV can occur on an invitational-only basis.

Commercial farms are placed into various categories determined by their known Bunchy Top status:

- Category A farms – No BBTV recorded
- Category B farms – No BBTV recorded for 2 years or more
- Category C farms – No more than one BBTV recorded in the past 12 months
- Category D farms - More than 1 but less than 10 BBTV recorded in the past 12 months
- Category E farms – More than 10 BBTV recorded in the past 12 months

These categories determine the frequency of inspections that occur on the farms and are based on advice from the supporting virology team based in South-East Queensland (Dr John Thomas and Dr Kathy Crew) and based on current epidemiological knowledge. Category D and E farms are inspected monthly, and category C farms aimed to be inspected at 3-monthly intervals, but often more frequently. Category A and B farms are inspected usually only once per annum, but sometimes more frequently as situations permit. Overall, due to the very limited funds available, the category D and E farms receive the most attention. Unlike other parts of Australia, most banana farms in South East Queensland are situated on hillsides (predominantly eastern facing) in very rugged hazardous terrain. Inspection is carried out by inspectors (usually 1 or 2 persons) who walk the rows within the banana plantations, inspecting all plants to detect the bunchy top infections. When detected, the plant is marked with pink tape and its position recorded by GPS. It is then treated using both a herbicide and an insecticide directly injected into the stem of the plant, and oversprayed with a paraffin oil to contain the infectious (possibly winged and infectious) aphids that may be present on the plant. If one stem in a clump of banana plants displays symptoms, the whole clump will be deemed infected (even if it does not display visual symptoms at the time) and so is destroyed. The plants usually die within 3 to 4 weeks and are then no longer infectious. The virus does not survive in the soil.

This project has been highly successful in protecting commercial growers from BBTV epidemics and keeping their operations viable. Unfortunately, eradication of this disease has not been possible. It has been attempted in the past, but would require a very large investment and government support to have a chance of success. All of the farms only have very small numbers of infections from time to time with successive seasons having different levels of infections. All growers have been very appreciative of the services and support provided by the project in helping to keep their operations viable. They appreciate the difficulties encountered by the inspectors who consistently survey the farms and destroy detected infections. Many farmers find it very difficult to detect and identify BBTV and, in most cases, have relied on the inspectors to carry out this work.

Included in the inspection program has also been backyard banana plant inspections. The focus of these private properties has been particularly on 1 and 2km buffer zones adjacent to commercial farms. Other backyard inspections outside of these zones has been communicated through notifications from a number of different sources such as the Bunchy Top Telephone hotline, tip-offs from growers and others and also through contact via State Government authorities. In all cases, detected BBTV infections are treated when found reducing the available disease inoculum within these areas.

With every BBTV infection detected and treated, data was also collected which is added to a main dataset that has history back to 2010 During 2018, these data were contributed to a data modelling project undertaken by an epidemiology team from the University of Cambridge in the United Kingdom. Computer simulation models were developed to examine the spread of BBTV in farms and backyards, and to predict the effects of varying control parameters. The models will also have useful predictive capacity for managing potential BBTV incursions in north Queensland. The data provided by this project was considered some of the best available for this type of disease modelling.

BBTV continues to be a threat to the broader banana industry. It is recommended that work continues to maintain commercial banana viability in the southern Queensland and northern NSW, and to limit the risk of spread of disease to other banana-growing regions, especially north Queensland. A lapse in the control program would allow a cryptic epidemic situation to develop, threatening the broader industry, and would waste the considerable effort and resources that have resulted in effective management to date.

Introduction

The Banana Bunchy Top Virus ("BBTV") causes the most serious viral disease of bananas worldwide. Infected plants do not produce fruit and a plantation will become completely infected if the disease is not controlled. BBTV is spread in planting material and by the banana aphid - *Pentalonia nigronervosa* – and no other means. Varietal resistance or tolerance to bunchy top is not present in commercial banana cultivars and has not been recognised in bananas generally. Hence, the basic elements of control, based on research and experience, are:

Preventing movement of infested planting material between areas:

- Establishing new blocks using virus-free planting material;
- Protecting blocks from infestation from outside by removing disease sources;
- Inspecting blocks and destroying diseased plants on a frequency determined by the rate of symptom development and the sensitivity of detection; and
- Removing infected blocks, to accomplish eradication.

The Bunchy Top Virus was introduced to Australia from Fiji in 1913 in infected planting material. At the time, the banana industry was based in NSW and southern QLD. The disease spread rapidly and had a severe impact, requiring large scale disease management programs with regulatory backing, to enable production to continue. The southern industry has declined, and the relative impact of the Bunchy Top Virus on the industry as a whole reduced, but its local impact in parts of southern QLD and northern NSW remains high. Also, the Bunchy Top Virus poses a threat to uninfected districts. The Bunchy Top Virus is currently confined to SEQ and northern NSW, and thus over 95 percent of the Australian banana industry (Far North Queensland, Bundaberg, southern NSW, Western Australia and Northern Territory) is free of the disease.

Earlier phases of the Bunchy Top project had the following aims:

- Eradication of BBTV from all commercial banana plantations, and adjoining buffer zones;
- Eradication of BBTV from urban areas in NSW and QLD;
- Declaring the banana growing regions of southeast QLD and northern NSW a 'Pest Free Area' for BBTV;
- Declaring Australia a 'Pest Free Area' for BBTV.

During the current phase (July 2016 to June 2019) following a review of all of the data captured since 2010, it became apparent that without substantially increased funding and government and industry support, eradication of this disease was not possible. As a result to the project has aimed to:

Control, reduce and maintain the BBTV on commercial farms;

- Reduce the incidence of BBTV in buffer zones (including backyards) that may contribute to re-infection of commercial farms;
- Focus on containment preventing further spread into uninfected banana growing areas in northern NSW and SEQ.

Methodology

Personnel

This project commenced late May 2016 following a project restructure from the previous Banana Bunchy Top Phase 3 project (BA14011). Part of the restructure separated one national project into two State projects, BA15006 (Southeast Queensland) and BA15007 (Northern New South Wales).

Staffing included the project manager (Mr Barry Sullivan) and a casual inspector (Mr Blair Winders). Occasionally a third inspector would assist when necessary (Miss Samantha Stringer). All personnel had an excellent knowledge of the various areas and maintain a good rapport with the growers. All growers were very accustomed to Bunchy Top inspectors visiting their farms, and in many cases, the inspectors carried out their regular inspections with little or no contact with the growers. Most farms in the South East area were very small in size, with nearly all farmers selling their fruit to local markets.

Inspections

The known Bunchy Top zone in South-East Queensland is an area from the Queensland border north to Tinbeerwah (near Cooroy). In this area, there were 35 farms across 19 different locations that were regularly inspected during the life of this project. Including farms to the north as far as Bundaberg, there were a total of approximately 62 farms with a number of these farms north of the Bunchy Top zone with a total area of banana farms covering approximately 450 ha.

All inspection work was based on best practice techniques based on available current scientific information. All chemicals used to carry out the destruction of infected plants are listed on an APVMA minor use permit (http://permits.apvma.gov.au/PER14850.PDF) and are based on scientific efficacy testing. The method of application was by injection using a custom-made needle on an NJ Phillips type injection gun. Off-target damage to other plants was minimised through this application method.

The process for inspections was as follows:

- A list of the farms and the inspections schedules were kept for the monthly inspection program.
- Each month, planned inspections were completed based on the farms' BBTV status category and priority. There were 10 farms that require monthly inspections to keep the infections under control. Geographically, they were quite spread out across the SEQ area.
- Most growers required prior notification by phone of inspection, while others allowed access at any time.
- When the growers were not present, the inspectors left a written inspection report with staff or at their packing sheds, when inspections were complete (but in most cases, the growers were present).
- All detected infections were treated immediately (as described below) when found, and simultaneously each plant's location and details were mapped and logged into the database.
- Monthly inspection pressure was maintained on category C, D and E farms, destroying all infected plants immediately when detected across known BBTV region.
- Inspection of category A and B farms were done once per annum.
- Backyard inspections, based on buffer zones around existing commercial banana farms, were carried out from time to time as time permits. They were targeted at mostly 1 to 2km buffer zones adjacent to commercial banana farms plus the occasional ad-hoc notification inspections and targeted known potential Bunchy Top infected areas through local knowledge.
- Extensive backyard inspections occurred within the northern line area of the BBTV zone and initial infections found were destroyed, and subsequent follow-up inspections occurred throughout the life of the project, to confirm no further infections were present.
- Properties were entered through the front gate with the first approach to the front door of the residence. We explained to the property owner who we were and why we were visiting their property. We then asked the owner if they had banana plants and, if so, whether we could inspect them. In most cases, we were then invited to inspect the banana plants on the property (this was done through an invitation-process-only, and if we were asked to leave, we did so immediately, as we had no legislative power to be there unless invited).
- If no infections were detected, we recorded the site in the database and left the property.
- If infections were detected, we then explained the process of treatment and required a form be signed to allow us to treat the plants immediately. When the form was signed, we then injected the plant with herbicide and overspray with paraffin oil. We did not use insecticide when treating backyard bananas. In most instances, we reinspected again in 4 to 6 weeks to treat any regrowth.
- In situations where nobody was home or we could not access the property, we left an information brochure with our contact details and requested that we be called to arrange a more suitable time to access the property (very few actually called us back).
- All inspections were mapped and logged into the database using a mobile phone application. The maps and data demonstrated a spatial record of time spent carrying out the inspections.
- In some cases, growers requested that samples be confirmed by laboratory diagnosis. These samples were tested by Dr Kathy Crew (DAFQ) and Dr John Thomas (QAFFI) at the Eco Science Precinct in Brisbane. The scientists carried out both a visual inspection (in the first instance) of the sample followed by a molecular test (if required) and document their findings that we passed back to the grower. No samples identified as infected by the inspectors was ever disputed by the lab.

Notifications received through the Banana Bunchy Top telephone hotline are dealt with when received. Often, they are situated adjacent or close to commercial banana farms. Properties are inspected and infections treated when found. For other further away enquiries, we request for some photographs be sent through via either email or telephone, so we can analyse the images and contact the landholder back with our observations. If an on-site inspection is then required, then that is arranged or advice is given over the phone.

Some extension activities were carried during the project including presentations to garden clubs (including Brisbane and Yandina). Articles relating to the project have also been included in the ABGC Banana Magazine from time to time.

A Bunchy Top information brochure was developed and used for the project and also after treatment information and 'with compliments' slips were used for backyard and private property inspections.

Outputs

Upon commencement of the project, data has been captured during all aspects of inspection operations throughout the South-East Queensland growing districts (see Table 1). This included:

- Number of farms inspected
- Number of BBTV infections detected
- Treatment details including numbers of clumps, numbers of stems in clumps and number of symptomatic leaves. The leaf data allows estimation of the time of infection which is important for associated epidemiological modelling studies.
- Chemicals used for treatment
- Communications with the grower (i.e. by report form or by speaking with the grower)
- Number of yards inspected
- Number of infections detected in private yards and treatment details
- Number of yards visited that could not be accessed (nobody home) or did not have banana plants (all inspections are recorded).

Table 1: Disease surveillance details (treatment details not shown) between September 2016 and April 2019:

Time Period	Farm inspections	Farm infections	Yard inspections	Yard infections
July 2016 to Oct 2016	36	21	67	6
Nov 2016 to Jan 2017	20	20	95	10
Feb 2017 to Apr 2017	22	24	92	6
May 2017 to July2017	20	21	37	9
Aug 2017 to Oct 2017	34	20	53	6
Nov 2017 to Jan 2018	25	63	58	12
Feb 2018 to Apr 2018	21	44	145	12
May 2018 to July 2018	31	40	50	11
Aug 2018 to Oct 2018	45	56	46	38
Nov 2019 to Jan 2019	23	96	94	61
Feb 2019 to June 2019	37	73	36	57
Total	**314**	**478**	**773**	**228**

Table 2 shows the BBTV infection status categories of the farms. As the surveillance program continues, the infection categories vary over time. The farm categories list is used as a tool that can assist to determine the inspection frequency of the farms based on their respective categories. It does fluctuate somewhat as new farms are added to the list (database continually gets updated with new farms or farm changes over time) and the infection status can change often. Category D and E farms are targeted for the most inspections (monthly) with Category C farms targeted 3-monthly (or as often as possible), with Category A and B farms targeted once per year and as resources have allowed.

Table 2: Farm category data as per reporting periods during the project:

Time Period	Category A	Category B	Category C	Category D	Category E	Total
July 2016 to Oct 2016	20	6	1	7	1	35
Nov 2016 to Jan 2017	20	6	1	6	2	35
Feb 2017 to Apr 2017	20	6	1	6	2	35
May 2017 to July2017	20	6	1	7	1	35
Aug 2017 to Oct 2017	20	6	1	7	1	35
Nov 2017 to Jan 2018	20	5	2	3	5	35
Feb 2018 to Apr 2018	20	6	1	5	3	35
May 2018 to July 2018	20	6	2	2	5	35
Aug 2018 to Oct 2018	19	5	0	7	4	35
Nov 2019 to Jan 2019	19	5	1	6	4	35
Feb 2019 to June 2019	19	5	1	5	5	35

Backyard inspection data is shown in Table 3. The presence of uninfected plants and the absence of banana plants are also recorded as this is important information in determining potential reservoirs of infection around commercial properties.

Table 3: Yard inspections counts from June 2016 until June 2019:

Plants (clump/stems)	Count
Present and infected	200
Present and uninfected	188
Not present	178
Unknown	207
Total	**773**

Outcomes

The National Banana Bunchy Top Program SEQ phase 3 achieved 314 farm inspections and 773 backyard inspections from June 2016 to June 2019. This project has made a significant contribution to maintaining the viability of the South-East Queensland banana industry. At the end of the previous BBTV control program (BA 12006), the BBTV incidence was present on 10 farms. During this project, only one new banana farm presented with BBTV infections bringing the total to 11 farms while the remaining farms have presented free of BBTV. As a result of the more than 478 (farm) eradications performed in the current project, we maintained this excellent level of control. It should be noted that, despite the past 9 years of active BBTV inspection programs in SEQ, the same 10 farms presented with BBTV infections even though they had been actively controlled on a monthly-basis along with more than 9,000 backyard inspections looking for and controlling BBTV, with many of these properties being adjacent to the farms inspected and within the farm buffer zones. This demonstrates that it is very difficult to achieve eradication through rouging out the infected plants within a farm.

A strategic backyard program in areas along the northern line of the BBTV zone (at Tinbeerwah between Cooroy and Tewantin) has continued throughout the project period, to ensure any infections found were destroyed. Only one property had the presence of BBTV which was immediately destroyed and further surveillance of other previously known BBTV sites in the area revealed no further incidence of the disease. Other northern line areas were progressively inspected over the period with no further BBTV found.

Other areas visited during the project included the Bundaberg area. As many farms were visited at the time, only one major inspection was allowed due to concerns about the fungal disease Panama Tropical Race 4. The remaining growers agreed to meet with us and talk about BBTV and accepted information and brochures, etc., but they would not allow us to visit their farms.

The continuous maintenance of the commercial farms database and the constant updating of the BBTV detection data, including number of plants and leaves displaying symptoms, and their location coordinates provided a valuable epidemiological resource. Sharing these data with researchers from the University of Cambridge (Professor Chris Gilligan and Dr Hola Adrakey), DAFQ (Dr Kathy Crew) and the University of Queensland (A/Prof. John Thomas) allowed the development of epidemiological models which have already been used to assess the efficacy of current and proposed control strategies. The models also have the potential to devise pre-emptive containment and control strategies for potential incursion into currently BBTV-free regions such as north Queensland.

During the length of this project, we maintained good relationships with all stakeholders including the Queensland Department of Agriculture and Fisheries and the Australian Banana Growers Council, the virology research team and the banana growers. The growers indicated confidence in the project throughout the period with many indicating that our program was their only link to the greater banana industry.

Further discussion and analysis

During the life of this project, a number of specific observations were made. These observations are as a result of the experience of the inspectors, data captured and the extensive period of time that the farms have been visited. Of the 11 farms that continue to exhibit BBTV infections, the following have been noted:

Infection latency is highly likely a contributing factor to the continued infections of some commercial farms.

- Older plantations that have latent infections are extremely difficult to remove and ultimately the only way to achieve eradication is by removing all banana plants for a period and replanting.

- In plantations where new tissue culture plants have been planted amongst blocks of older plants, that may have already had infections amongst them, will nearly always show infections into the future, while the newer tissue culture plants never become infected.
- On one farm, we encouraged the farmer to remove a whole section of plants which seemed to be the source within the patch and in turn reduced the farm infection numbers by approximately 99% per year.
- It is very obvious to differentiate between infections that have blown in (aphids travelling on wind currents) as against latent infections with infections blown in being much easier to control and maintain if done so on a monthly -basis (so the earlier infections are treated, the better the result in younger infected farms).
- Evidence suggests that latent plants can be present for more than 2 years before symptoms become apparent.

Please refer to the appendices of specific maps explaining these ad-hoc observations.

Monitoring and evaluation

The focus of this project was the containment of BBTV to within the known infection zone and the reduction where possible and management of known farm infections, to allow commercial banana growers to remain viable. This was achieved through active inspection pressure and the immediate treatment of detected infections when found.

The success of this project has been through the dedicated hard work carried out by the inspectors in often adverse and difficult working conditions. The inspectors' vast experience and knowledge of the South-East Queensland banana growing area and knowledge of the geographic location of each farm and the commercial growers have been instrumental to this success. Also the vast knowledge of problematic yard infections that have previously had adverse effects on commercial growers has possibly aided to the project's success, as these particular properties were monitored over the period with infections destroyed when necessary.

The inspectors built an excellent rapport with the commercial growers and other landholders and gained their trust, allowing them access to their properties as often as required to carry out inspection duties. Although the inspectors passed on information about the disease to the growers, in some cases many times, including pointing out infected plants on their farms, most growers still have great difficulty identifying the infected plants especially during early stages of infection. The growers greatly appreciated the project's assistance over the period for enabling them to control BBTV infestations on their farms. They understand that it is a very difficult task requiring professionally trained inspectors to detect symptomatic plants. During the project, 314 inspections were conducted across the 62 commercial farms in the area.

Carrying out backyard and buffer zone inspections when possible was also instrumental to the success of the project. Reducing the possible outside infection pressure from properties adjacent to the farms may have assisted in reducing the infection numbers on the commercial farms themselves. This was a very labour intensive, time-consuming process that required a lot of communication with many property owners. Another benefit from the yard inspections was raising the awareness of BBTV within the community. While many property owners indicated that they know of some rules around the growing of banana plants, many do not understand what those rules are and the reasons why they exist. A yard inspection created the perfect opportunity to pass on information directly to a landholder about growing banana plants and more importantly information about banana diseases including BBTV. Information brochures were handed out to landholders during this process with relevant BBTV information. In many cases, further BBTV Hotline telephone calls were generated as a result of this process.

Due to Queensland DAF legislative changes, backyard inspections are carried out only by invitation of the property owner. In most cases the inspectors have been welcomed onto the properties to inspect their banana plants and treatment has been allowed when BBTV detections have occurred.

The ongoing close relationship with the virology research team based at the Ecosciences Precinct in Brisbane was very important to the project. In some cases, samples were collected and the disease presence verified by the research team as requested by growers. Plants deemed infected by inspectors always returned positive diagnoses when verified by the scientists. Their attention to detail and skill in detecting infections was excellent.

Recommendations

The current control program is based on long-practiced strategies which have proven effective over many decades. Although it is recognised that there are severe constraints to funding nowadays, the effectiveness of the current program is self-evident. The impact of any modification of the current strategies must be carefully assessed. Computer modelling has shown that relaxation in the application of any component of the current strategy is highly likely to result in increased, and ultimately uncontrollable, disease incidence.

As highlighted above with regards to the continuation of BBTV control/management programs to keep BBTV under control the following recommendations are:

1. The continuation of well-funded active surveillance programs in South-East Queensland to keep the disease in check.

2. As the South-East Queensland BBTV zone, in particular the northern line area, is the front line of defense to prevent the disease potentially spreading further north towards the greater industry, a greater emphasis should be placed upon both current surveillance programs and extension programs about the movement of potentially infected material. This should be carried out in close collaboration with the Queensland Department of Agriculture and Fisheries. This requires a well-funded program to protect the >$600,000,000 industry to the north.
3. Specific well-funded research programs to investigate further the insect vector (aphid), the chemical efficacy of current and potential new chemicals to control the insect, the occurrence of latent infections, and detection tools that can allow earlier detection of the presence of infection.

Refereed scientific publications

None to report

Intellectual property, commercialisation and confidentiality

No commercial IP generated

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I would like to thank the ABGC staff for their support with the BBTV Telephone Hotline.

I would also like to thank the broader banana industry for their interest and support in this project and a special thanks to all the growers within the SEQ Bunchy Top Zone for their cooperation and support.

Appendices

Appendix 1: Banana Bunchy Top Virus information brochure

PREVENT FURTHER SPREAD

Plant infected with Bunchy Top Virus

Bunchy Top has been in Australia for more than 100 years. While it has not been eradicated, it has been contained and its only found in a small part of Australia. To help prevent further spread we encourage growers of banana plants to monitor their plants and if they suspect Bunchy Top Virus may be present to contact the Bunchy Top Virus inspectors or their relevant state primary industry authority for further assistance.

THE NATIONAL BANANA BUNCHY TOP VIRUS PROGRAM

Qualified inspectors conduct home and property inspections as part of the program. Should Banana Bunchy Top virus be detected they can assit with either information on how to treat the infected plants or can treat them on your behalf free of charge (depending on your property location). Community support is vital for the program to be successful.

DO NOT MOVE BANANA PLANTS AROUND

As part of the project we discourage the movement of plant material on and off private properties as this can further spread the disease. If you would like to obtain banana plants please do so via an approved source. Please ask the inspector for more detail or contact your state primary industry authority.

BUNCHY TOP NATIONAL PROJECT

The National Banana Bunchy Top Virus Program is funded by Horticulture Innovation Australia Limited using the banana industry levy and funds from the Australian Government.

WHAT IS BANANA BUNCHY TOP VIRUS?

Plants become very stunted when infected with Bunch Top Virus.

Banana Bunchy Top virus is the most devastating viral disease found in banana plants worldwide and can affect all banana varieties. It poses a major threat to Australia's commercial banana industry and home grown bananas too. This brochure has been developed to provide information about the virus, its identification and control.

WHAT DOES BANANA BUNCHY TOP VIRUS LOOK LIKE?

In its early stages the symptoms are difficult to see to the untrained eye. The first symptom is short dark dot-dash lines appearing along the veins of the youngest leaf starting from the mid-rib. You can see the dot-dash lines best when you look upwards towards the sunlight through the bottom side of the youngest leaf. Dark green stripes running along the mid rib of the infected leaf may also be present.
When the disease is more advanced each new leaf becomes shorter, narrower and stands more upright giving a bunched leaf appearance,thats why it is called Bunchy Top. Plant growth is stunted and the leaf edges roll slightly upwards and tend to become yellow or lighter green. Bunches can become small and deformed also.

Healthy leaf. Infected leaf.

Bunchy Top Virus is particularly difficult to identify in its early stages. All varieties of banana plants are susceptible and so if you suspect you might have the disease in your banana plants please contact a Banana Bunchy Top inspector for assistance. The inspector can confirm if you have the disease in your banana plants and can assist with the correct treatment if necessary. This service is free of charge.

How is it spread?

Banana Bunchy Top Virus can only be spread in two ways:

1: By the Banana aphid -a small black insect which looks like other aphids you see in your garden, but only the banana aphid can spread Bunchy Top Virus, after it has fed for many hours on an infected plant.
All banana plants have banana aphids but not all aphids are carriers of the disease.

Banana Aphids

2: By the movement of infected planting material well meaning people who give away young plants or suckers to neighbours or friends risk spreading the virus. Please dont move plants on or off a property and only access clean planting material from an approved source. Please talk to the Banana Bunchy Top Inspector regarding accessing clean planting material or call or your state primary industry authority for more information.

Do not disturb the plants

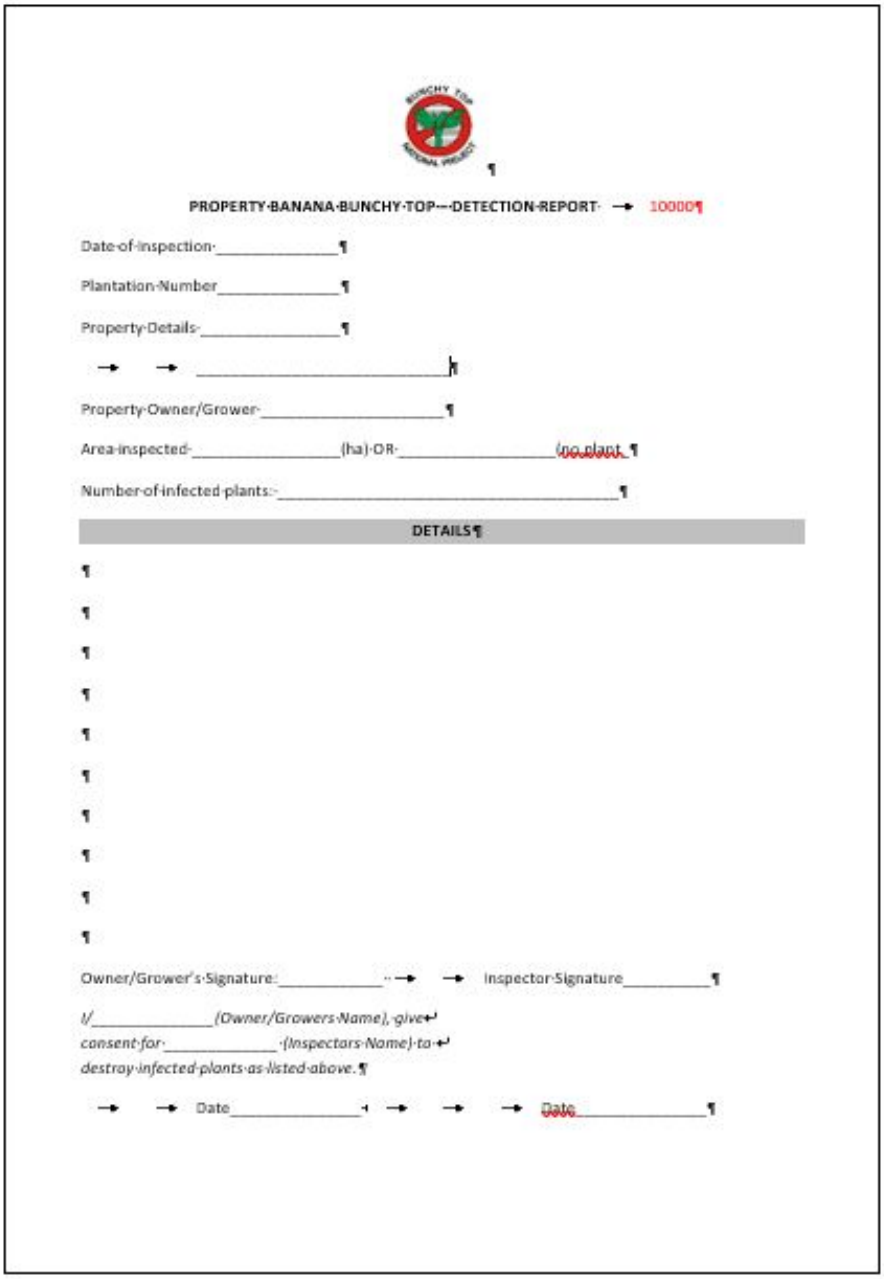
If you think your banana plants may be infected with Banana Bunchy Top Virus, seek more information first before disturbing the plants. Chopping off the plants will not destroy the virus and may cause further spread and future emerging suckers will also be infected with the virus.

What can I do?

Infected banana plant displaying many infected leaves.

To verify if your banana plants have Banana Bunchy Top Virus symptoms please call or text our inspectors or your state primary industry authority and if possible provide some clear pictures showing the overall plants and some close-ups of the sicker leaves (with the sun shinning through them if possible). An assessment can be made and if necessary an inspection can be arranged for your property.
If the virus is detected in the plants they will never recover and will need to be destroyed. This is done by first over spraying the plants with a non-toxic paraffinic oil to prevent the aphids from moving onto another banana plant and then by injection of a herbicide to destroy the plants. Other non chemical methods are available if need be (but this is much harder work).
For further information please call

Appendix 2: Example of a BBTV inspection report



PROPERTY BANANA BUNCHY TOP – DETECTION REPORT → 10000

Date of inspection: _____

Plantation Number _____

Property Details: _____

→ → _____

Property Owner/Grower: _____

Area inspected: _____ (ha) OR _____ (no plant

Number of infected plants: _____

DETAILS

Owner/Grower's Signature: _____ → → Inspector Signature _____

I/_____ (Owner/Growers Name), give
consent for _____ (Inspectors Name) to
destroy infected plants as listed above.

→ → Date _____ → → → Date _____

Appendix 3: Example of After Treatment Information Sheet

National Bunchy Top Project

After Treatment Information Sheet

Banana Bunchy Top Virus (BBTV) is a virus specific to banana plants that can be spread in two ways: The movement of infected planting material or by the banana aphid which is the only insect vector of the virus.

The recognised treatment of the virus in infected banana plants is by the destruction of the plants. The most effective method of destruction is by using a herbicide (Glyphosate 450g/L) and injecting it directly into the plant. This method has very little risk of off-target damage. It is also beneficial to overspray the banana plant with a paraffin oil solution (Biopest Oil @ 10ml/L). This helps to control the movement of the aphids and stop them from leaving the plant to infect other banana plants. This product is organically approved and has minimal impact on the environment.

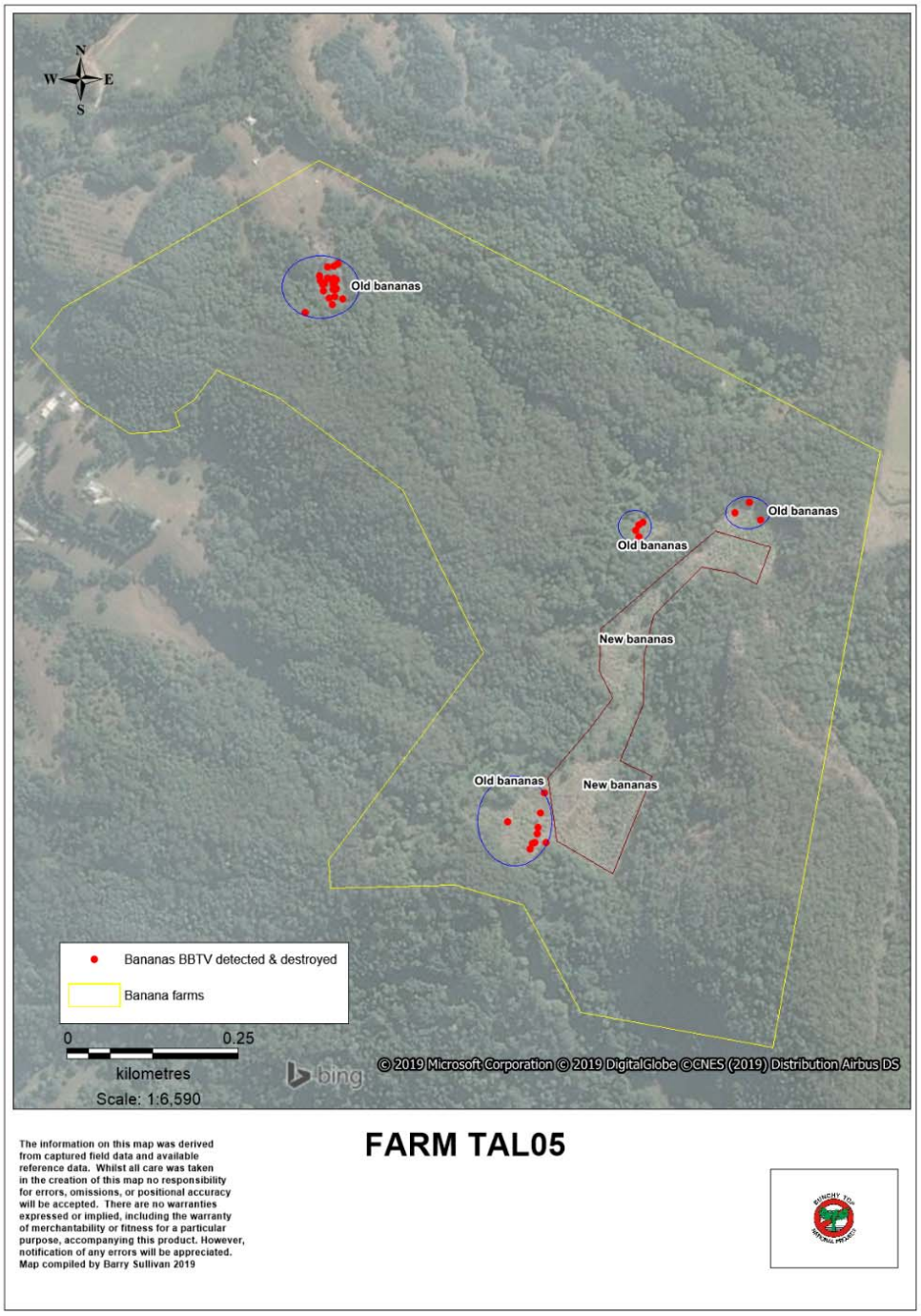
Below is a list of items to be aware of following the treatment of plants on your property:

- Please do not disturb the treated banana plant/s until they have completely browned off and died. This includes cutting, shaking or pushing the plant/s. This will ensure that both the herbicide and the biopest oil can have the maximum chance to work through the plant and prevent any infected aphids leaving the plant/s.
- Once the plant/s have browned off completely and died (this may take 4 – 8 weeks), they can be dug out and disposed of at your own will. Often the plant/s will fall over as they start to die. It is safe to use the dead material as compost or mulch.
- If you would like to re-plant bananas in the same location, this is ok, but make sure all of the existing banana plants are completely dead before doing so, otherwise the new plants may become re-infected through contamination of the old material (i.e. virus dies with the plant and is not present in the soil). It is advisable to only use disease-free planting material obtained through a recognised source (ie. tissue culture planting material). Please contact your local Department of Agriculture and Fisheries for more information (DAF).
- A follow-up inspection will occur by the inspecting officer in the coming months and will re-treat any remaining living banana plant material if required to eradicate BBTV from your property.

If you have further questions regarding Banana Bunchy Top Virus, please contact the Banana Bunchy Top project leader on 0418 696 596. Other information is available on the ABGC website http://abgc.org.au/projects-resources/industry-projects/banana-bunchy-top-virus/ or the Department of Agriculture and Fisheries website https://www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant/bunchy-top

Thank you for your cooperation.

Appendix 4: This map demonstrates how the older banana areas on a farm continue to be infected, while the new planted areas remain free of BBTV, even after many years.



Appendix 5: This map demonstrates how we continued to get infections both on the upper and lower sides of a gully and there always seemed to be a hotspot. We asked the grower to remove all of the plants from the hotspot area. After they were removed, our infection numbers greatly reduced with no further incidence above the hotspot area and only 2 below it in the past 2 years. This farm also has some suspected latent plants that become symptomatic only once every 12 months to 2 years or so. There are no other known infections anywhere that could affect this site.

Appendix 6: This map demonstrates the effects from wind-blown infected aphids that have been blown in from yard infections in a quite nearby neighboring town. As shown, the infections are very random across the patch. These infections are from a number of months of inspections. At the very worst, we had 20 infections over 2 consecutive months. Because we inspect this patch monthly, we were able to treat all infections at very early stages and had excellent results. The final inspection (June 2019) revealed no infections. All of these plants were planted from tissue culture, and monthly inspections have occurred ever since the first day they were planted, so it is believed that there are no latent infections present. A thorough inspection program around the neighboring town areas revealed a number of backyard infections that could have been causing this problem.