

Banana best management practices

On-farm biosecurity

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Authors: Tegan Kukulies and Shanara Veivers, Agri-Science Queensland, Department of Agriculture and Fisheries,
PO Box 20 South Johnstone, Queensland, 4859

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Foreword

The Australian banana industry is vulnerable to pests and diseases. Growers need to ensure they are not reactive to a disease incursion but proactive in their biosecurity management practices, minimising the risk to their business. On-farm biosecurity management requires a consistent and sustained approach, and best management practices (BMP) need to become routine in daily farming operations.

This BMP guideline was developed following the detection of Panama disease tropical race 4 in North Queensland in 2015. This resource was developed as part of the Fusarium Wilt Tropical Race 4—Biosecurity and Sustainable Solutions Project. This project was funded by Horticulture Innovation Australia Limited using banana industry research and development levies with co-investment from the Department of Agriculture and Fisheries and funds from the Australian Government.

It's designed to help growers implement effective on-farm biosecurity practices—mirroring the industry's current environmental BMP guidelines with an intuitive layout and access to additional resources. The guideline has been designed as a valuable resource for all banana farming businesses, whether they have on-farm biosecurity systems in place or are planning to implement them. The reference material in this resource has a focus on Queensland and uses Panama disease tropical race 4 as an example however the practices are applicable to all production areas in Australia.

It consists of a self-assessment checklist and reference material divided into four major sections—zoning, general farm operations, crop production and fruit movement. These sections are broadly aligned with the *Panama disease tropical race 4: biosecurity standards and guidelines* document, which was developed in consultation with industry. The information in that document was also used to develop the Panama disease tropical race 4 section in the legislated *Queensland biosecurity manual*.

To safeguard the future of the banana industry, we need your help—implementing vital on-farm biosecurity practices are essential to ensuring our farms remain free from exotic pests and diseases.



Stephen Lowe

Chairman of the Australian Banana Growers Council

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Self-assessment checklist

On-farm biosecurity is a vital component of day-to-day banana farming operations and minimises the risk of introducing new pests, diseases and weeds onto your property. By completing this self-assessment checklist, you will quickly establish which on-farm biosecurity practices are working well and where improvements may be possible. The checklist will also help you prioritise areas for improvement and can be used as the basis for your on-farm biosecurity plan.

Use this self-assessment checklist as a guide only—it will never replace expert advice.

There may be a number of possible answers to some of the questions, so choose the answer that best suits your situation. If the question is not relevant to your particular situation, select 'N/A' (not applicable).

Most questions require a single answer, but for some questions more than one answer may be applicable. These questions are marked 'tick all that apply'. In these cases, an overall practice rating is determined by the number of practices that you select from the list.

There are three biosecurity practice ratings:

1. **Best** demonstrates **high level biosecurity practices** that minimise the risk of introducing new pests and diseases to a property
2. **Okay** demonstrates biosecurity practices that reduce the risk of introducing new pests and diseases to a property; however, **improvements should be made** to minimise the risk
3. **Improve** demonstrates biosecurity practices that are below industry standard and **improvements must be made** to minimise the risk.

Most questions will have all three of these practice ratings as possible answers. However, some questions will only have two possible ratings.

Any practices checked as 'improve' should be made a priority practice for the business to address and improve. Similarly, practices checked as 'okay' should be the next prioritised practices to be improved.

On-farm biosecurity is only effective if all practices are of a high standard and adhered to at all times. A single practice failure can potentially lead to the introduction of a new pest or disease.

Zoning

1. Is there zoning in place on your farm?

Best

Yes—go to question 2

Improve

No—go to ‘General farm operations’ checklist (p. 4)

2. How many zones is your farm divided into?

Best

Three (exclusion, separation and farming)

Okay

Two (separation and farming)—go to question 4

3. What practices are in place in your exclusion zone? (Tick all that apply)

- Designated area where visitors and staff park vehicles
- Area is surfaced (concrete, bitumen or gravel)
- Fences or barriers to manage people and vehicle movement into other zones
- Clear signage directs staff and visitors
- Footwear is managed at the edge of this zone
- Water run-off from this area is directed away from other zones

Best

6

Okay

4

Improve

< 4

4. What practices are in place in your separation zone? (Tick all that apply)

- Designated area where essential vehicles can drive
- Area is surfaced (concrete, bitumen or gravel)
- Fences or barriers stop essential vehicles and people crossing into other zones
- Vehicle disinfected upon entry and exit
- Clear signage directs staff and visitors
- Footwear is managed when moving from this zone into other zones
- Tools, equipment, vehicles and/or machinery remain in this zone
- Water run-off from this zone is directed away from other zones
- Loading and unloading system for farm supplies avoids cross-contamination between zones
- Visitors and staff sign in and out when entering and exiting this zone

Best

10

Okay

8

Improve

< 8

5. What practices are in place in your farming zone? (Tick all that apply)

- Fences or barriers to minimise movement of people, vehicles, machinery and animals
- Farm machinery and vehicles remain in the farming zone—if they need to cross zones they are cleaned and disinfected
- Wash-down facility available to clean and disinfect vehicles entering and exiting this zone
- Tools and equipment (e.g. cane knives) remain in this zone
- Footwear is dedicated to this zone
- Clear signage directs staff and visitors
- Water run-off is managed

Best

7

Okay

5

Improve

< 5

General farm operations

Staff and visitors

1. Overall footwear management

- | | |
|----------------|--|
| Best | <input type="checkbox"/> Footwear is managed by changing shoes AND using footbaths |
| Okay | <input type="checkbox"/> Footwear is managed by changing shoes OR using footbaths |
| Improve | <input type="checkbox"/> Footwear is NOT managed |

2. Footwear exchange/s (Tick all that apply)

- Footwear exchange stations are located at the edge of each zone
- Barriers and signs direct and instruct visitors and staff
- Footwear is changed in a manner that doesn't allow for cross-contamination
- Different footwear is dedicated to each zone
- Footwear in zones are easily distinguishable (e.g. colour-coded)
- Footwear is cleaned and disinfected (e.g. using an effective footbath)

Best	6	Okay	4	Improve	< 4
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3. Footbath/s (Tick all that apply)

- Stiff brushes and/or high-pressure water is available to remove all soil/mud from footwear
- Footbaths are long enough for two footsteps
- Barriers and signs direct people through footbaths
- Footbaths have a hard-surface approach and exit
- Footbaths are undercover
- Footbath disinfectant is mixed as per label instructions and changed regularly
- Footbath waste is disposed of in a safe manner (e.g. soil settled out and buried away from crops, disinfecting solution placed in vegetated area away from crops and waterways)

Best	7	Okay	5	Improve	< 5
-------------	---	-------------	---	----------------	-----

Vehicle and machinery movement

4. People required to access your farming zone (e.g. contractors and agronomists)

- | | |
|----------------|--|
| Best | <input type="checkbox"/> People that are required to access your farming zone are supplied with vehicles and machinery dedicated to your farm |
| Okay | <input type="checkbox"/> People that require access to your farming zone are NOT supplied with vehicles and machinery dedicated to your farm—vehicles and machinery brought to your farm are cleaned and disinfected upon entry and exit |
| Improve | <input type="checkbox"/> People that require access to your farming zone are NOT supplied with vehicles and machinery dedicated to your farm—vehicles and machinery brought to your farm are NOT cleaned and disinfected upon entry and exit |

5. Fertiliser delivery

Best

- Fertiliser is delivered and unloaded at the edge of the farming zone in a way that prevents the wheels of the delivery vehicle crossing into the farming zone (e.g. hi-ab crane, fork extensions)

Okay

- Fertiliser is delivered into the farming zone and the delivery vehicle is cleaned and disinfected upon entry and exit

Improve

- Fertiliser is delivered to your farm and there are no on-farm biosecurity procedures

6. Fuel delivery

Best

- Filling points on fuel tanks are located on the edge of the farming zone so that the fuel truck does NOT enter the farming zone and farm vehicles still have access

Okay

- Fuel tanks are located in the farming zone and fuel trucks are cleaned and disinfected upon entry and exit

Improve

- Fuel tanks are located in the farming zone and fuel trucks are NOT cleaned and disinfected upon entry and exit

- N/A—There are no fuel tanks on your farm

7. Waste

Best

- General shed waste is located on the edge of the farming zone to allow the pick-up truck to collect waste in a manner that does NOT allow the truck to cross into the farming zone

Okay

- General shed waste is located in the farming zone and the pick-up truck is cleaned and disinfected upon entry and exit

Improve

- General shed waste is located in the farming zone and the pick-up truck is NOT cleaned and disinfected upon entry and exit

8. Utilities (e.g. electricity and water service providers)

Best

- Access onto your farm by utility companies is minimised and any essential vehicles that move into the farming zone are cleaned and disinfected upon entry and exit

Improve

- Vehicles are NOT cleaned and disinfected if they require entry

- N/A—No utility companies have a requirement to enter your farm

9. Pallets

Best

- Pallets are delivered to an area designated for pallet delivery, which is either bunded or has sufficient fall to prevent soil entering the farm

Okay

- Pallets are inspected upon arrival and immediately returned if they have soil on them

Improve

- Pallets are inspected before they leave your property and cleaned and disinfected if required

10. Second-hand vehicles, machinery, equipment and tools

Best

- Only new vehicles, machinery, equipment and tools are purchased for your farm

Okay

- The history of the vehicle, machinery, equipment or tool is examined and the risks considered before it is purchased, and it is cleaned and disinfected before entering your farm

Improve

- Little consideration about the history of second-hand equipment is given and it is NOT cleaned and disinfected before entry

Roads and access

11. Roads to residences

Best Dedicated access roads to residences are hard-surfaced (e.g. ballast rock, bitumen) and farm machinery never comes into contact with these roads

Okay Residences located on your farm do NOT have dedicated access roads; however, vehicles are cleaned and disinfected when entering and exiting your farm

Improve Residences located on your farm do NOT have dedicated access roads and vehicles are NOT cleaned and disinfected when entering and exiting your farm

N/A—There are no residences located on your farm

12. Farms adjacent to public roads (Tick all that apply)

Blocks adjacent to public roads have been surveyed and fenced

Signs are erected to alert the public that no entry is permitted without permission

Water run-off from the road is directed away from your farm

N/A—There are no public roads adjacent to your farm

Best

3

Okay

1

Improve

< 1

13. Farms separated by public roads (non-contiguous)

Best Machinery and farm equipment is dedicated to either side of the public road, and roll-on/roll-off points are used to minimise movement and/or a ferry-style system is used to prevent contact with the road

Okay Movement of machinery and vehicles on or across a public road is minimised, and machinery and farm equipment that does need to cross the road is cleaned and disinfected each time it enters or exits your property (this is recorded in a register)

Improve Little consideration is given to manage movement across public roads

N/A—Your farm is a contiguous parcel of land (e.g. blocks are not separated by public roads, railway lines or easements)

14. Railway lines

Best There is a management strategy in place to manage movement across railway lines (e.g. drainage to divert run-off water, clean and disinfect vehicles and machinery each time they cross)

Improve Little consideration is given to the risk crossing a railway line poses to your property

N/A—There are no railway lines running through your farm

Cleaning and/or disinfecting facilities for vehicles and machinery

15. Do you have a cleaning and/or disinfecting facility on your farm?

Best

- Yes—go to question 16

Best

- No, because there are adequate separation measures in place (e.g. hard-surface roads, brick walls, fences) and vehicles and machinery are dedicated to your farm—go to question 19

Improve

- No, but a wash-down facility would complement the biosecurity practices in place on your farm—go to question 19

16. What do you treat?

- Farm equipment, vehicles or machinery entering the farming zone (**wash-down facility**)—go to question 17
- Service vehicles (including transport trucks, delivery vehicles and visitor vehicles) accessing the packing shed via the separation zone (**disinfecting facility**)—go to question 18
- All of the above—go to question 17

17. What practices are in place for your wash-down facility? (Tick all that apply)

- Hard-surface pad
- Gravel or hard surface on entry and exit
- Clean water (NOT recycled)
- Effective disinfecting products (e.g. quaternary ammonium-based products) used at recommended label rate and contact time
- Adequate water pressure to remove soil and plant material
- Water splash is controlled
- Instructional signage
- Cleaned thoroughly after each use
- Waste water/products managed to ensure containment and safe disposal
- Cleaning facilities available to clean and disinfect footwear, floor mats, tools and equipment
- Cleaning and disinfecting details recorded after each use

Best

11

Okay

9

Improve

< 9

18. What practices are in place for your disinfecting facility? (Tick all that apply)

- Hard-surface base or metal grid
- Gravel or hard surface on entry and exit
- Effective disinfecting products (e.g. quaternary ammonium-based products) used at recommended label rate and contact time
- Tested to determine efficiency of disinfectant coverage
- Maintained regularly to ensure effectiveness
- Instructional signage
- Each use of the facility recorded

Best

7

Okay

5

Improve

< 5

Self-assessment checklist

Fencing

19. Perimeter fencing

- Best** Your entire property boundary is fenced
- Okay** Fences are constructed along public roads and high-risk areas
- Improve** No fencing has been constructed

Tools and equipment

20. Tools and equipment

- Best** All tools and equipment are dedicated to zones on your farm and never leave these zones
- Okay** All tools and equipment are dedicated to zones on your farm—when tools and equipment need to cross into another zone they are cleaned and disinfected (records are kept of these occasions)
- Improve** Little consideration is given to the movement of tools and equipment within zones on your farm

Water supply, movement and disposal

21. Irrigation source

- Best** Irrigation water is sourced from a bore
- Improve** Irrigation water is sourced from a river, stream, channel or dam
- N/A—Your banana paddocks are not irrigated

22. Irrigation equipment

- Best** Irrigation pumps, sprinklers, drip tape and equipment are only sourced new
- Improve** Little consideration is given to the source of irrigation equipment
- N/A—Your banana paddocks are not irrigated

23. Water source for packing shed

- Best** Water for the packing shed is sourced from a bore, rainwater or town water
- Improve** Water for the packing shed is sourced from a river, stream, channel or dam
- N/A—Fruit is sent to a central packing shed

24. Water source for wash-down facilities

- Best** Water for wash-down facilities is sourced from a bore, rainwater or town water
- Improve** Water for wash-down facilities is sourced from a river, stream, channel or dam
- N/A—Your farm does not have wash-down facilities

25. Managing water run-off from your property

- Best** Soil erosion management practices (including grassed inter rows, contouring or laser levelling, sediment traps and/or wetlands) are used to minimise soil and water movement from your property into adjacent properties, roads and/or watercourses
- Improve** No attempts have been made to minimise soil and water movement off your property

26. Managing water run-off from neighbouring properties**Best**

- All run-off from neighbouring properties is intercepted and managed with the use of drains and sediment traps to divert water flow away from the farming zone

Okay

- Run-off from neighbouring properties is managed to the best of your ability with the use of drains to divert water flow away from the farming zone

Improve

- Little consideration is given to managing run-off from neighbouring properties
- N/A—Run-off water does not flow onto your farm from neighbouring properties

Waste management**27. Waste—plant material****Best**

- All waste plant material (including leaves, bells, stalks and fruit) are dumped in a dedicated area on your farm that does not drain towards paddocks in the farming zone—this area doesn't flood and is fenced to restrict access to feral animals

Okay

- All waste plant material (including leaves, bells, stalks and fruit) remain in, or are returned to the paddock

Improve

- Waste plant material (including leaves, bells, stalks and fruit) is spread to other properties
- N/A—There is no waste plant material as fruit is sent to a central packing shed

28. Waste—bunch bags and string**Best**

- Bunch bags and string are currently dumped as dry waste at the local dump or through a waste contractor, and there is a plan in place to safely dispose of this waste if an exotic pest or disease is detected on your property (e.g. cleaning and disinfecting prior to dumping or dumping as contaminated waste)

Okay

- Bunch bags and string are currently dumped as dry waste at the local dump or through a waste contractor

Improve

- There is no formal disposal method for bunch covers and string

Farm-based animal movement**29. Domestic animals and livestock****Best**

- Fences are constructed and maintained to contain livestock and limit the movement of domestic animals (including farm dogs)

Improve

- Movement of livestock and domestic animals (including farm dogs) is unmanaged
- N/A—There are no livestock or domestic animals (including farm dogs) on your farm

30. Feral animals and wildlife**Best**

- An animal-proof (e.g. chain link) fence is constructed around the boundary of your property to minimise movement of feral pigs, wallabies etc., and active control measures are in place to minimise feral pig numbers (e.g. trapping)

Okay

- Animal-proof fencing is constructed around some of your farm, and control measures are in place to minimise feral pig numbers (e.g. trapping)

Improve

- Some control measures are in place to minimise feral pig numbers (e.g. trapping)

Crop production

Land preparation

1. Tractors and equipment

- Best** Tractors and equipment used to establish new paddocks remain on your farm
- Okay** Tractors and equipment used to establish new paddocks are cleaned and disinfected when entering and exiting your farm (records of these movements and cleaning and disinfecting are kept)
- Improve** Tractors and equipment used to establish new paddocks are not cleaned and disinfected when entering and exiting your farm

Planting

2. Planting material

- Best** Planting material is sourced from certified tissue culture nurseries
- Okay** Planting material is sourced from bits or suckers from your own property, which has biosecurity management systems in place
- Improve** Planting material is sourced from bits or suckers from other properties

Crop production

3. Soil ameliorants (e.g. compost, mill ash)

- Best** The origin and processing of organic-based soil ameliorants have been considered, do not contain banana plant material and are sourced from an area that is not associated with banana production
- Improve** The origin and processing of organic-based soil ameliorants have not been considered
- N/A—No soil ameliorants are applied

Farm management

4. New staff and visitor biosecurity induction

- Best** New staff and regular visitors undergo an induction about on-farm biosecurity practices and records of training are kept
- Okay** New staff undergo an induction about on-farm biosecurity practices and no records of training are kept
- Improve** There is no induction for staff or regular visitors about on-farm biosecurity practices

5. Additional staff biosecurity training

- Best** In addition to general on-farm biosecurity training, farm staff are trained to identify plants with unusual symptoms and are made aware of how to report them
- Improve** Farm staff don't receive training on how to identify plants with unusual symptoms and are not made aware of how to report them

6. Cleaning and decontamination induction

Best

- Staff and visitors required to use wash-down facilities are inducted on how to thoroughly clean and disinfect vehicles, machinery, tools and equipment, and records of these inductions are kept

Okay

- Staff and visitors required to use wash-down facilities are inducted on how to thoroughly clean and disinfect vehicles, machinery, tools and equipment, and no records of these inductions are kept

Improve

- Staff and visitors are not inducted on the use of wash-down facilities

Improve

- There are no wash-down facilities on the farm

7. Monitoring on-farm biosecurity practices

Best

- Random spot checks are conducted to ensure staff and regular visitors are following on-farm biosecurity practices (checks are recorded)

Improve

- No random spot checks are conducted

8. Natural disaster management planning (cyclones, floods, storms etc.)

(Tick all that apply)

- A pre- and post-disaster management plan to protect wash-down facilities and ensure there is adequate resources to operate facilities post-disaster (e.g. disinfecting supplies, alternative power sources available)
- A plan that determines how plant debris and fruit that has come into contact with the ground will be managed
- A plan to rapidly educate and manage the movement of untrained personnel who may be required to access your property
- A plan to re-establish blocks using clean planting material
- A pre- and post-disaster management plan to protect on-farm biosecurity infrastructure (e.g. footbaths) and rapidly re-establish any damaged infrastructure post-disaster

Best

5

Okay

3

Improve

< 3

9. Records (Tick all that apply)

- Daily staff register
- Visitor register
- Training records for staff and regular visitors
- Records of disinfecting vehicles that enter and exit the separation zone
- Records of cleaning and disinfecting vehicles and machinery that enter and exit the farming zone (also includes other internal zones in the case of properties with multiple crops)
- Records of spot checks
- Records of planting in new blocks
- Property map with zones

Best

8

Okay

6

Improve

< 6

Fruit movement

Fruit harvest

1. Harvesting fruit (Tick all that apply)

- Tools that are used to harvest remain in the farming zone
- Leaves are NOT used for protection of bunches on trailers
- Transport vehicles and machinery are driven at a speed that reduces the spread of mud or dust
- Fruit that comes into contact with the ground is left in the field
- Fruit is delivered to the section in the shed that the farming zone extends into
- Farm tools and equipment are thoroughly cleaned and disinfected daily

Best

6

Okay

4

Improve

< 4

Fruit packing and packing shed

2. Packing shed activities (Tick all that apply)

- One-way traffic of fruit is maintained throughout the packing shed
- Fruit is packed into new cartons or clean returnable crates
- Packed cartons do not touch the floor of the packing shed
- The loading dock area is kept free from soil and plant material
- Reject fruit and plant waste is transferred back to the farming zone side of the shed without coming into contact with the floor

Best

5

Okay

3

Improve

< 3

Reference material

This section is designed to expand on the information in the self-assessment checklist and contains links to more information, including fact sheets, videos and legislative requirements. The majority of the images in this section are examples of on-farm biosecurity practices that banana growers have implemented.

Typically, pests and diseases are carried and spread in soil, water and plant material (plant material includes all material derived from a plant including sap and other residues), while some pests and diseases can also be spread in the air. This section focuses on the on-farm biosecurity practices that banana growers can implement to limit the spread of pests and diseases through soil, water and plant material. Panama disease tropical race 4 is used as an example throughout this section, as it is currently one of the industry’s biggest threats. By implementing, monitoring and strictly adhering to the practices detailed in this section, banana growers can have a high level of confidence that they are protecting their property from soil- and water-borne pests and diseases.

Zoning

On-farm biosecurity is a set of measures to protect farms from the entry and spread of pests, diseases and weeds—particularly critical for banana farms to prevent the introduction and spread of Panama disease tropical race 4. Zoning is the foundation of effective on-farm biosecurity. It provides simple and cost-effective biosecurity layers, which manage disease risk pathways onto and off your farm. A layered approach to on-farm biosecurity spreads the risk across a range of measures, as no single biosecurity practice is 100% effective.

Zoning is the division of your farm into separate areas (zones), and the management of movement between and within these zones. For effective on-farm biosecurity, many banana farms have adopted a three-zone system—**exclusion**, **separation** and **farming**. A three-zone system helps to manage movement, create separation between different areas of farming activities and restrict movement onto and off your farm.



More information

Download the ABGC Panama TR4 Extension Program *Zoning* fact sheet on the Australian Banana Growers’ Council website at www.abgc.org.au.

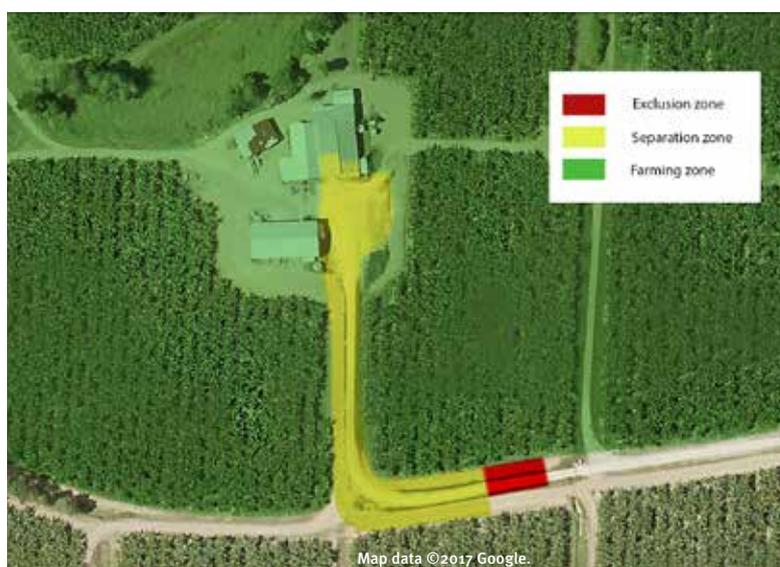


Figure 1: An example of how exclusion, separation and farming zones can be laid out on farm

Exclusion zone

Excluding vehicles from entering your banana farm is the best approach to reduce the risk of introducing unwanted pests and diseases onto your farm. The exclusion zone is an extension of the public road and is located at the main entry point to your farm. It is essentially a car park for non-essential vehicles and is used to exclude potentially contaminated vehicles coming onto your farm.

Ensure the zone has adequate parking space and turning area. Essential vehicles (e.g. delivery and pick-up trucks) that cannot be excluded from your farm must be cleaned and/or disinfected before entering and exiting into other zones on your farm (e.g. the separation zone). The exclusion zone should be adequately surfaced (e.g. concrete, bitumen or gravel) and consist of a combination of biosecurity layers (such as fencing, barriers and clear signage) to direct staff and visitors about who to contact, where to go and what to do before entering your farm.

Water movement from the exclusion zone requires careful consideration and, if necessary, drainage should be constructed to divert water away from other zones. However, water should not be diverted to neighbouring properties roadways or waterways. Footwear should be managed (e.g. footwear exchange and/or footbaths) when staff and visitors move from the exclusion zone into other zones (e.g. the separation zone).



Tip

Printable farm gate entry signage for Panama disease tropical race 4 is available to download on the Queensland Government website at www.publications.qld.gov.au.



Figure 2: Clear signage to direct people where to park



Figure 3: Drainage between zones to manage run-off water



Figure 4: Surfaced exclusion zone



Figure 5: Fenced exclusion zone

Separation zone

The separation zone manages movement of essential vehicles entering your farm, as it acts as a buffer between the exclusion and farming zones. The separation zone is an area on your farm that allows access to vehicles essential to your operation. Vehicles that may use this zone include vehicles to transport staff and visitors to the packing shed, delivery and pick-up trucks, and utility and waste collection trucks. These vehicles should be relatively clean before they are allowed to enter this zone. Before vehicles enter this zone (from a public road or exclusion zone) they should also be disinfected. When establishing the separation zone, an important consideration is to allow enough turning space for delivery and pick-up trucks entering and exiting this zone.

Farm vehicles and machinery should never cross or come into direct contact with the separation zone.

However, if farm vehicles and machinery must absolutely move across the separation zone and into another zone, they must be thoroughly cleaned and disinfected. Keeping records of this can also provide evidence that you are maintaining the status of your separation zone in the event of a Panama disease tropical race 4 detection on your property.

The separation zone should be surfaced (e.g. concrete, bitumen or gravel). If using gravel to surface this zone it needs to have good drainage and not be contaminated with soil. The separation zone should also contain a visitor and staff register, and have appropriate fencing, barriers and signage erected.

For many farms, the separation zone extends into the packing shed, where clean packed fruit, pallets, cartons and forklifts are stored.

Water run-off from the separation zone should be directed away from the farming zone (e.g. using appropriate drainage). To reduce the risk of cross-contamination between zones, essentials such as waste collection bins should be located on the edge of the separation and farming zones. This is so waste collection trucks do not cross into the farming zone. Moreover, fertiliser delivery trucks should deliver fertiliser at the edge of the separation and farming zones in a way that prevents the wheels of the delivery vehicle from crossing into the farming zone. Fertiliser bags and pallets should be inspected upon arrival and moved into the farming zone using a hi-ab crane, forklift extensions or another method that reduces the risk of cross-contamination between the separation and farming zones.



Remember

You set the ground rules for which vehicles enter your separation zone. Vehicles that enter this zone should be clean and free from soil and plant material.



Figure 6: Surfaced and fenced separation zone



Figure 7: Farm machinery should never enter the separation zone

Farming zone

The farming zone is the production area of your banana farm. It's an area where vehicles, machinery, tools and equipment operate, and where staff undertake farming activities. Farm staff and visitors may move in and out of this zone on a daily basis, so it is essential that this zone is managed effectively (e.g. managing footwear, fencing, barriers and signage, and recording these actions). Vehicles, machinery, tools and equipment should remain in the farming zone and never move into and out of this zone. If they are moved into or out of the farming zone, they must be cleaned and disinfected upon entry and exit.

Water from neighbouring properties and other zones within your property should be directed away from the farming zone. It's also important to consider water movement within blocks of your farming zone and it may be necessary to construct internal drainage within the farming zone. Essentials such as fuel tanks should be located on the edge of the farming zone so the fuel truck can refill from the separation zone without having to cross into the farming zone and increase the risk of cross-contamination.

Growers that manage multiple crops as a single farming operation (e.g. sugar cane and bananas) will need to consider managing these crops as separate operations. This may involve dividing the farming zone into multiple sub-zones.

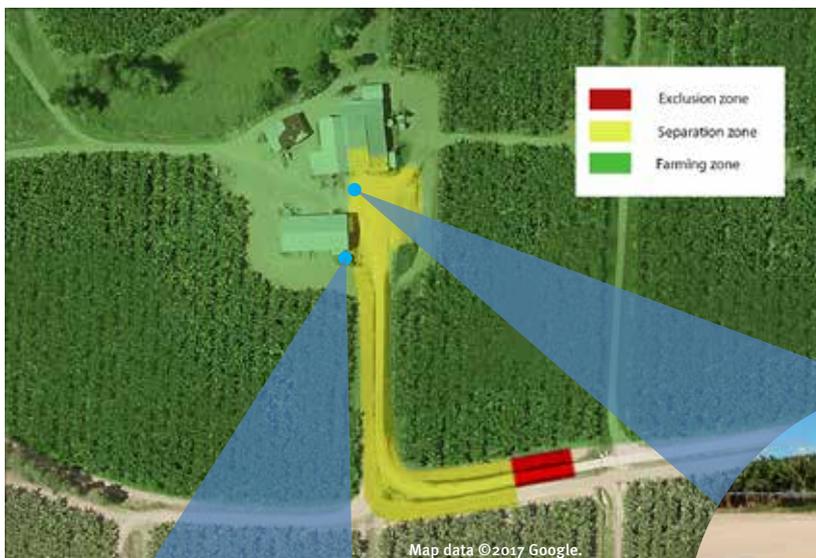


Figure 8: Fuel tank located on the edge of the farming zone



Figure 9: Rubbish bin located on edge of the separation and farming zones

Packing sheds

Packing sheds require close examination. For many farms the packing shed is a point of transition between the separation and farming zones. Some areas of the packing shed form part of the farming zone (e.g. hanging harvested bunches and the bunch wash area), while other areas of the packing shed can form part of the separation zone (e.g. packing line, dispatch, amenities and lunch area).

When considering where to draw the line between the separation and farming zones, the division typically occurs at the point of bunch washing. As the packing shed contains a large amount of foot traffic on a daily basis, the movement of staff, visitors, water and plant material between the separation and farming zones within the packing shed must be considered.

Remember

There is no limit to the number of zones you may choose to have on your property; however, a typical banana farm consists of **exclusion, separation and farming** zones. Zoning your farm is the foundation for effective on-farm biosecurity. The most important thing about zoning is that it needs to work for you and your business, and it must be a layered approach as no single practice is 100% effective.

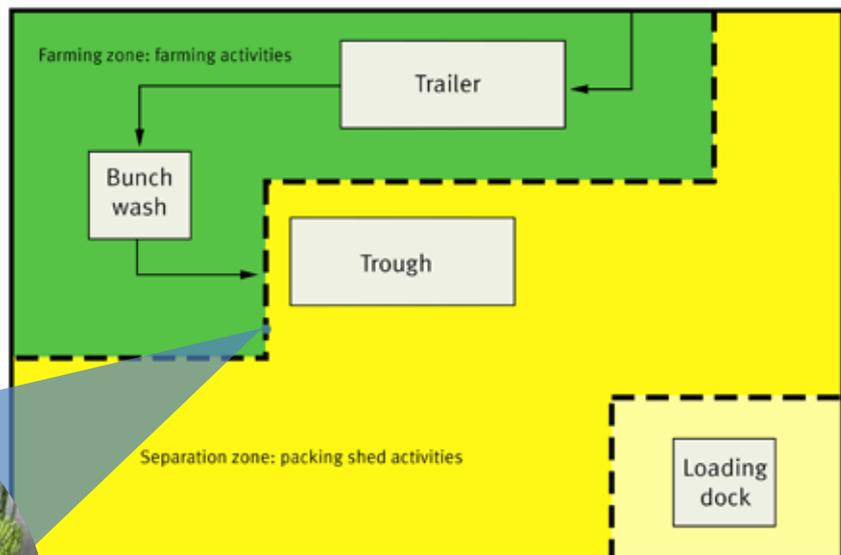


Figure 11: Block wall in the packing shed to separate farm activities from shed activities

Figure 10: An example of how a packing shed can be zoned

General farm operations

Managing the movement of soil, water and plant material entering and exiting your farm is the key to effective on-farm biosecurity. The biosecurity practices you implement to manage movement need to be simple, effective and easy to follow to ensure they become integrated into day-to-day farm operations.

People movement

Managing the movement of all people entering and exiting your farm is essential to reduce the risk of introducing unwanted pests and diseases—it only takes one dirty shoe to introduce infected soil and/or plant material onto your farm. Implement a robust, easy-to-follow system to manage the risk footwear poses to your property.



More information

Watch *On-farm biosecurity—managing footwear* on the Biosecurity Queensland YouTube channel at www.youtube.com/BiosecurityQld.

Footwear exchange stations

Excluding all unnecessary footwear from entering your farm and providing dedicated clean, on-farm footwear for staff and visitors is the best approach. Footwear exchange stations manage the risk that footwear poses to your property. They are a good way to define where and how footwear is exchanged. Footwear exchange stations also consist of footbaths, and cleaning facilities (e.g. hard bristle brushes) to ensure that footwear is cleaned prior to using the footbaths.

Footwear exchange stations add an additional layer to your biosecurity system by reducing the risk of introducing infected soil and plant material from entering and exiting your farm. Footwear exchange stations are used for footwear worn by staff, contractors, visitors and YOURSELF.

The design of your footwear exchange station can vary; however, it must satisfy some fundamental criteria for it to work effectively and reduce the risk of cross-contamination:

- Footwear exchange stations are located at the edge of each zone on your farm or at critical entry points.
- Footwear exchange stations are used by everyone entering and exiting your farm.
- Clear signage is used to direct and instruct staff and visitors about what they are required to do.
- Fencing and/or barriers are constructed to direct staff and visitors through footwear exchange stations so they are unavoidable.
- Footwear exchange stations are physically separated in a way that minimises the risk of cross-contamination (e.g. bench seat and/or a small brick wall allows dedicated on-farm footwear to be separated from personal footwear).
- Footwear is maintained in good condition (e.g. no holes).
- Footwear is cleaned and disinfected (e.g. using effective footbaths).
- The inside of footwear is clean and dry, and staff wear socks to protect their feet if they share footwear.
- Footwear is dedicated to zones and easily distinguishable (e.g. colour-coded and/or numbered).
- Footwear exchange stations are cleaned regularly and designed so they are easy to clean and disinfect, and water drainage direction is taken into consideration (e.g. constructed of hard-surface materials).

You can add an additional layer of protection by having two footwear exchange stations. These are generally placed at the edge of each zone or at critical entry points (e.g. between the exclusion and separation zones, and between the separation and farming zones). Colour-coding and/or numbering footwear helps staff and visitors understand which area they are allowed to move in, and ensures the footwear exchange procedure is being correctly followed.



Figure 12: Example of footwear exchange between the **exclusion** and **separation** zones



Figure 13: Example of footwear exchange between the **separation** and **farming** zones

Remember

Exclude first and treat second. The best option is excluding footwear from coming onto your farm rather than only treating it. If you use your personal shoes in the farming zone they are potentially contaminated. It's important that you lead by example—practice what you preach and adhere to the footwear management systems that you have implemented on your farm.

Footbaths

Footbaths are a good way to add an additional layer of protection. They are an important component of a footwear exchange station. The location and design of the footbath must be carefully considered, especially if they are not integrated into the footwear exchange station.

Typically, there should be at least two footbaths on your farm and they should be built into footwear exchange stations. They should be located at the edge of each zone or at critical entry points to your farm. It is suggested that footbaths are positioned:

- between exclusion and separation zones for staff and visitors
- between separation and farming zones for staff that require access to paddocks.

The effectiveness of footbaths relies on removing soil and plant material prior to using disinfecting products that kill the remaining spores that can be carried on footwear. Research to date, using spores that cause Panama disease tropical race 4, shows that there are a number of products that are effective at killing spores. For example, products containing 120 g/L didecyldimethyl-ammonium chloride applied at a 1% solution have been shown to be effective.

INFO

More information

Download the *Panama disease tropical race 4 research update: disinfectant trials* fact sheet on the Queensland Government website at www.publications.qld.gov.au.

Footbaths should not get excessively dirty, as the majority of soil should be removed from footwear prior to entering the footbath. Soil and organic matter will reduce the effectiveness of disinfectants. Research to date indicates that disinfectants are no longer 100% effective once a solution contains more than 5% soil or organic matter. If a footbath is routinely dirty you should re-evaluate the footwear management practices you have in place (e.g. there may not be adequate cleaning facilities available to clean footwear prior to the footbath being used).

The disinfecting solution should be changed regularly or when it has reached a point at which the solution no longer covers the whole sole of footwear.



Tip

There are test strips available that indicate the concentration of quaternary ammonium-based disinfectants. Consider using these strips to routinely check the concentration of disinfecting solution in footbaths. This will ensure they remain effective.

It's a good idea to have tools available to remove clods of soil and mud from footwear. This could include hoses, firm bristle brushes, scrubbing brushes, screwdrivers and hoof picks. Although this cleaning usually occurs immediately prior to the footbath, it's important to consider the exact location in which it takes place. It should not occur in the main thoroughfare to the footbath, as the area can become quite dirty and users of the footbath could re-contaminate their shoes with soil before walking through the footbath. Ideally the area would be to the side of the footbath and the water used to clean shoes would drain away from the main thoroughfare to the footbath.

The design of your footbath can vary; however, it must satisfy some fundamental criteria to work effectively and reduce the risk of cross-contamination:

- Clear signage, fencing and/or barriers are used to direct staff and visitors through the footbath.
- A hard-surface entry and exit is constructed to reduce tracking soil into the footbath.
- Boot scrubs, firm bristle brushes, tools (screwdriver or hoof pick) and/or water are used to remove excess soil from footwear before entering the footbath.
- The footbath is long enough for two full footsteps.
- The footbath sides are closed in to prevent visitors and staff avoiding walking through the footbath solution.
- The disinfecting solution is made at the correct label rate and changed regularly as per the label recommendation.
- The footbath and the area around it are cleaned and disinfected regularly.
- The footbath is undercover.



Caution

Avoid skin contact with disinfectant products. If staff and visitors are required to walk through a footbath in their personal shoes, ensure they are wearing closed-in shoes.



Remember

Disinfecting solution will not penetrate clods of soil. It is essential to clean footwear, especially highly contaminated footwear, before walking through a footbath. Soil and organic matter in footbaths reduce the effectiveness of disinfecting products.

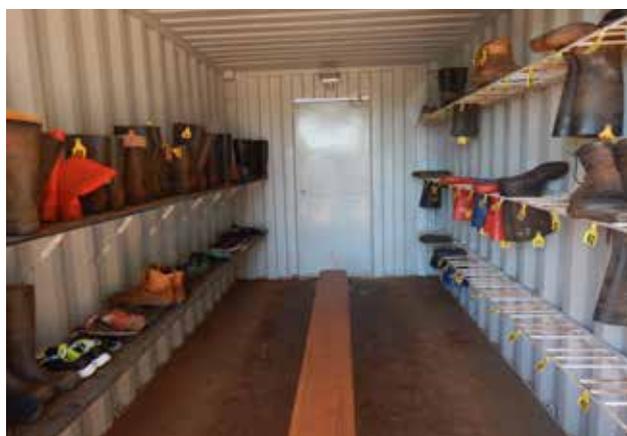


Figure 14 and 15: Example of a shipping container modified to be a footwear exchange station



Figure 16: Shoes should be cleaned before walking through a footbath

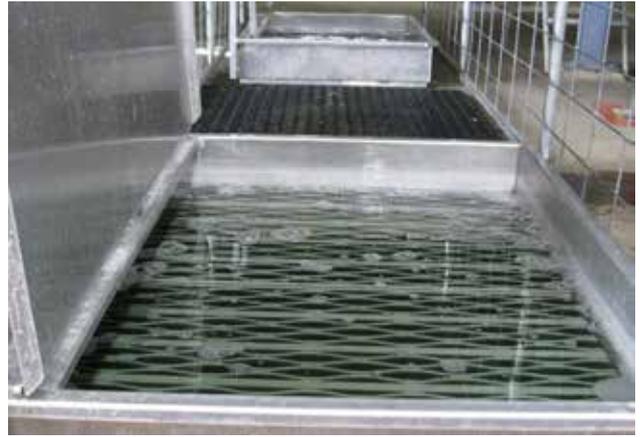


Figure 17: Example of a footbath



Figure 18: Example of a footbath



Figure 19: Example of a footbath

Vehicle and machinery movement

To reduce the risk of introducing infected soil and plant material onto your farm, it's important to manage the movement of all vehicles and machinery.

The best on-farm biosecurity management strategy is to **exclude first and treat second**. Vehicles and machinery that are not essential to your business must be excluded from entering your farm. If essential vehicles and machinery cannot be excluded from your farm, it's important that they are thoroughly cleaned and disinfected upon entry and exit. Soil and plant material can get lodged in a number of places on vehicles and machinery.

INFO

More information

Use the vehicle and machinery wash-down checklist in the *Panama disease tropical race 4: decontamination guide* on the Queensland Government website at www.publications.qld.gov.au.

Providing adequate wash-down facilities located in appropriate locations is essential to minimising the risk to your farm. Designated entry and exit points should be established on your farm, with the use of signage, fencing and physical barriers to restrict movement of vehicles and machinery.

Ideally, farm-based vehicles and machinery should be dedicated to each zone on your farm, and they should never cross into other zones. If farm-based vehicles or machinery require access into other zones, they must be cleaned and disinfected upon entry and exit. Essential vehicles (e.g. pick-up and delivery trucks) should only be allowed to access your farm via a main access road located in the separation zone. Essential vehicles and machinery should never cross into other zones (e.g. farming zone). Therefore, fuel tanks, waste bins, fertiliser delivery and pallets should be located at the edge of the separation and farming zones so that pick-up and delivery trucks never cross over into the farming zone. If essential vehicles or machinery must enter the farming zone (e.g. utilities, contractors and agronomists), they must be cleaned and disinfected upon entry and exit.

If second-hand vehicles, machinery or equipment are purchased for your farm, it is critical to know the history of each item and they must be cleaned and disinfected before entering your property.

A farm may be contiguous or non-contiguous. A contiguous farm has blocks that are not separated by public roads, railway lines or easements. It's easier to manage on-farm biosecurity on contiguous farms compared to non-contiguous farms.

For non-contiguous farms (e.g. farms separated by public roads, railway lines or easements) there are several management strategies that can be implemented to manage the movement of vehicles and machinery. The best management strategy is to dedicate farm-based vehicles and machinery to either side of the public road, railway line or easement. Lunch and toilet facilities should also be dedicated to either side to reduce the movement of vehicles and machinery. If farm-based vehicles and machinery cannot be dedicated to either side of the public road, railway line or easement, they may be floated across with a 'roll-on roll-off' trailer system or a ferry-style system. Wash-down facilities should be established at either side of the public road, railway line or easement to clean and disinfect vehicles and machinery each time they cross. If there is no alternative option available, you may need to consider the costs and benefits of continuing to farm non-contiguous blocks once this level of management is required. It may not be worth the capital input and risk of farming on both sides of the public road, railway line or easement.

Remember



Vehicles and machinery can easily pick up infected soil and plant material, and introduce pests and diseases onto your farm. It is critical to restrict movement of vehicles and machinery entering and exiting your farm. If vehicles and machinery must cross into other zones or across a public road, railway line or easement, they must be cleaned and disinfected upon entry and exit. It's important to maintain a register of all vehicle and machinery movements and the cleaning and disinfecting that occurs.

More information



Download the *Visitor register* template on the Queensland Government website at www.publications.qld.gov.au.

Download the *Panama disease (tropical race 4) equipment, vehicle and machinery clean down and decontamination* fact sheet on the Australian Banana Growers' Council website at www.abgc.org.au.

Download resources from the 'Panama disease tropical race 4 grower kit' on the Queensland Government website at www.publications.qld.gov.au.



Figure 20: Plant material can be easily lodged under vehicles and machinery



Figure 21: Cleaning wheel arches

Roads and access

To ensure effective on-farm biosecurity, it's important to think about roads and access on your farm. The roadways and access points you establish on your farm should be aligned with the way in which you have zoned your farm.

A main access road, typically located in the separation zone, should be established for essential vehicles that cannot be excluded from your farm. A disinfecting facility should be placed at the entrance to this zone to allow vehicles to be cleaned and disinfected upon entry and exit. It's important that the main access road consists of a hard surface (concrete, bitumen or gravel) and water run-off from this zone is diverted and never enters the farming zone. Similarly, water from the farming zone should never flow into the separation zone and across the main access road.

The main access road should allow enough turning space for essential vehicles. It may be necessary to remove some banana plants to allow more turning space. To add an additional layer of biosecurity and control for movement of vehicles and machinery crossing into other zones, appropriate fencing and physical barriers should be constructed along the main access road. Vehicles and machinery used in the farming zone should never come into contact with the main access road. If farming zone vehicles and machinery must cross the main access road, they must be cleaned and disinfected.

A dedicated hard-surface access road should be established for residences located on your farm. Farm-based vehicles and machinery should never come into contact with these roads. Water run-off from residence roadways should be diverted and never come into contact with the farming zone.

Remember

A main access road consisting of concrete, bitumen or gravel should be constructed for essential vehicles that cannot be excluded from your farm. To reduce the risk of cross-contamination between zones, farm-based vehicles and machinery used in the farming zone should never come into contact with the main access road.



Figure 22: Hard-surface access road with fencing to minimise risk of accidental movement



Figure 23: Residence in an exclusion zone with dedicated road access

Cleaning and/or disinfecting facilities for vehicles and machinery

Cleaning and/or disinfecting facilities are used for farm-based and external vehicles and machinery that require entry and exit to your property. The facility adds a layer of protection to your farm, allowing you to clean and/or disinfect vehicles and machinery in one effectively managed area. The design and location of your facility depends on your farm layout and zoning, and the types of vehicles and machinery that require access to your farm.

There are three steps you need to consider before establishing cleaning and/or disinfecting facilities on your farm.

Step 1: Determine which vehicles require cleaning and disinfecting

Before allowing any vehicles and machinery onto your farm ask yourself, ‘To conduct my banana farming business and keep my farm free of pests and disease, does this vehicle and machinery absolutely need to come onto my farm?’. Excluding vehicles and machinery from entering your farm is the best and most cost-effective option. However, if vehicles and machinery must access your packing shed or enter your farm, cleaning and/or disinfecting is the next best strategy.

Step 2: Determine the purpose of the facility

If exclusion is not possible and cleaning and/or disinfecting is required, it’s important to consider the areas vehicles and machinery will need to access on your farm. If essential vehicles and machinery require access to the packing shed via a main access road, appropriate use of zoning (separation zone) and a disinfecting point that disinfects all relevant surfaces will be effective. However, if they require access to your production area (farming zone), a wash-down facility will be required to undertake thorough cleaning and disinfecting to remove soil and plant material.

Step 3: Determine the design of the facility

The design of your wash-down facility will vary depending on which zones vehicles and machinery will need to access on your farm.

There are two types of facilities:

- **wash-down facilities**—used to clean and disinfect vehicles and machinery that require entry and exit to the farming zone
- **disinfecting facilities**—used to disinfect vehicles that are generally free from soil and plant material, and are only accessing the packing shed (separation zone).

In some circumstances, these two facilities can be combined into one multipurpose facility.



Figure 24: Example location of a wash-down pad

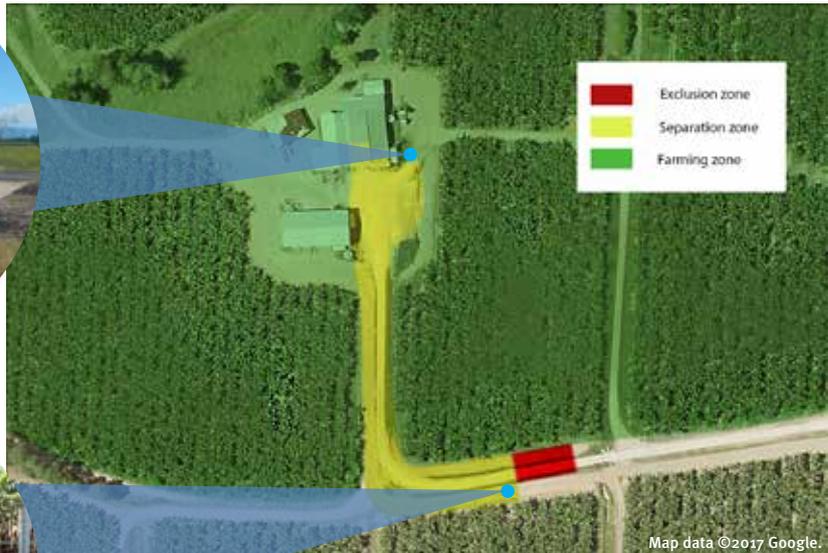


Figure 25: Example location of a disinfecting facility (e.g. spray grid)

Wash-down facilities

Wash-down facilities are used for cleaning farm-based and external vehicles and machinery that require entry and exit to the farming zone. Likely situations for the use of a wash-down facility include crossing a public road (non-contiguous farms), moving vehicles and machinery between farms, or for infrequent occasions when external off-farm vehicles and machinery require access.

A wash-down facility must satisfy some fundamental criteria for it to work effectively:

- The wash-down facility is located in an appropriate site (e.g. the edge of the farming and separation zones away from areas that drain into waterways or coastal waters).
- A hard-surface pad is constructed (e.g. concrete).
- A hard-surface entry and exit is constructed.
- A four-step cleaning and disinfecting process for machinery, vehicles, equipment and tools is in place, which includes a thorough clean with fresh water and detergent, a rinse with fresh water, a disinfecting treatment and recording completion upon entry and exit.
- Disinfectant is used at the recommended label rate and applied to vehicles and machinery that are free of soil and plant material.
- Waste water must be captured and contained within a controlled drainage area (e.g. sump). It is well contained and controlled in a way that will not allow overflow in a high rainfall event.
- The wash-down facility is cleaned between uses.
- Protective clothing (such as aprons or coveralls) is provided to ensure that clothing does not become contaminated during the wash-down process.
- Staff and regular visitors undergo training in cleaning and disinfecting procedures.
- Records of cleaning and disinfecting are completed (e.g. registration, description, date and who undertook the cleaning).



Figure 26: High-pressure hose and sump are essential elements of a wash-down facility

Cleaning and disinfecting process

Step 1: Cleaning

Ensure vehicles and machinery are parked in a safe position on the wash-down pad. Identify areas that may require cleaning with compressed air rather than water (e.g. radiators). Use clean water with a biodegradable, detergent-based cleanser to clean all surfaces so they are visibly free from soil and plant material. Consider the pressure of water that is required. On highly contaminated vehicles and machinery, use low-pressure water initially with tools such as brushes to dislodge soil and plant material, as it reduces the amount of splashback. Once soil and plant material are removed, use high-pressure water. Clean machinery from the top down and clean under the guards, underneath the vehicle or machinery, and the cabin (floor mats). It's also important to undertake this cleaning process for any tools or equipment that you are taking onto your farm.

Step 2: Rinsing

Rinse all relevant surfaces with fresh, clean water to remove product residue. Detergent residue may reduce the effectiveness of disinfectant products.

Step 3: Disinfecting

Apply an appropriate disinfectant (e.g. quaternary ammonium-based products) at the recommended label rate and contact time to all relevant surfaces. An additional rinse step may be considered following disinfection.

Step 4: Checking and record keeping

Undertake a final check to ensure all areas have been cleaned. Replace guards or belly plates that were removed for cleaning. To avoid recontamination of the vehicle or machinery, wash the pad so it is free of soil and plant material. Record details each time a vehicle or piece of machinery is cleaned and disinfected.



Remember

A wash-down facility is for low-frequency use by vehicles and machinery that are contaminated with high levels of soil and plant material. A wash-down facility is the most suitable facility to thoroughly clean and disinfect vehicles and machinery entering and exiting the farming zone.



More information

Download the *Panama disease tropical race 4: decontamination guide* on the Queensland Government website at www.publications.qld.gov.au.

Disinfecting facilities

Spray grids, vehicle dips and spray shuttles are a good way to apply disinfecting products (e.g. quaternary ammonium-based products used at the recommended label rate and contact time) to essential vehicles entering your separation zone. These facilities are only suitable for vehicles that are free of soil and only require access to your packing shed (via a main access road in the separation zone). They are not suitable for treating dirty vehicles and machinery that contain clods of soil and plant material—these types of vehicles and machinery require cleaning and disinfecting.

To ensure the effectiveness of using spray grids, vehicle dips and spray shuttle facilities, adequate zoning is required. If essential vehicles have to enter your farm (e.g. pick-up or deliveries), the best option available is to disinfect all relevant surfaces upon entry and exit. To add additional layers of protection, other biosecurity practices should be used in conjunction with spray grids, vehicle dips and spray shuttles, such as adequate zoning, footwear management, fencing and barriers. This is because the capacity of each facility to clean and disinfect all surfaces of the vehicle (e.g. the tops of trays, the load itself, the driver's footwear and vehicle floor mats) is limited.

Spray grids

A spray grid is suitable for disinfecting essential vehicles that require access to your packing shed. Spray grids are used for lightly contaminated vehicles. The design of your spray grid facility can vary. Some spray grid designs consist of a cattle grid and wings of corrugated iron to control splash, with high-pressure spray nozzles directing jets of water and disinfecting product underneath the vehicle. Some spray grid designs use an automated system that is triggered by sensors.

The design of your spray grid must satisfy some fundamental criteria for it to work effectively:

- The spray grid is located in an appropriate area at the main entrance of your farm.
- Appropriate signage and instructions inform oncoming traffic about how to use the spray grid.
- All vehicles are treated upon entry and exit.
- A hard-surface entry and exit are constructed (e.g. concrete, bitumen or gravel).
- Fresh water from an uncontaminated source is used.
- Effective disinfectant is made at the recommended label rate.
- Waste water must be captured and contained within a controlled drainage area (e.g. a sump). It should be well contained and controlled in a way that will not allow overflow in a high rainfall event.
- The spray grid is long enough to treat a full tyre rotation with disinfectant.
- The spray grid is wide enough to treat all vehicles.
- Spray nozzles are positioned to provide coverage to potentially contaminated surfaces of vehicles (e.g. wheel arches, chassis, etc.).
- Records of entry and exit are kept.



Tip

Regularly maintain your spray grid (e.g. spray nozzles) to ensure consistent and efficient coverage.

Remember

Spray grids are suitable for treating lightly contaminated essential vehicles that require access to your packing shed. Only essential vehicles and machinery that absolutely need to be on your farm should pass through the spray grid. Vehicles and machinery that are non-essential to your farm (such as staff and visitor vehicles) should never enter and should remain in the exclusion zone. Additional disinfecting treatment is required for driver footwear and floor mats.



Figure 27: Spray grids can be suitable to disinfect low-risk vehicles that need to access your packing shed via your separation zone



Figure 28: An example of gravel at the approach and exit of a spray grid



Figure 29: An example of waste water being contained



Figure 30: Clear instructions on how to drive over spray grid

Vehicle dips

A vehicle dip is suitable for applying disinfectant to essential vehicles that frequently require access to your packing shed. Vehicle dips are only suitable for vehicles free of soil, as the disinfectant does not penetrate clods of soil.

The design of your vehicle dip must satisfy some fundamental criteria for it to work effectively:

- The vehicle dip is located in an appropriate area at the main entrance of your property.
- All vehicles are treated upon entry and exit.
- Appropriate signage and instructions inform oncoming traffic about how to use the vehicle dip.
- A hard-surface entry and exit are constructed (e.g. concrete, bitumen or gravel).

- A roof is placed over the vehicle dip to minimise dilution of the product or overflow in a high rainfall event, especially in high rainfall areas.
- The vehicle dip is long enough to treat a full tyre rotation with disinfectant.
- The vehicle dip is wide enough to treat all vehicles.
- Effective disinfectant is made at the recommended label rate.
- Soil is removed regularly as it reduces the effectiveness of disinfecting products.
- Waste water must be captured and contained within a controlled drainage area (e.g. a sump). It should be well contained and controlled in a way that will not allow overflow in a high rainfall event.
- Records of entry and exit are kept.



Figure 31: Vehicle dips are useful to disinfect low-risk vehicles that require access to your packing shed via your separation zone



Figure 32: Vehicle dips located in high rainfall areas should have a roof over them

Remember

Vehicle dips are suitable for treating lightly contaminated essential vehicles that require access to your packing shed. Only essential vehicles and machinery that absolutely need to be on your farm should pass through the vehicle dip. Vehicles and machinery that are non-essential to your farm (such as staff and visitor vehicles) should never enter and remain in the exclusion zone.

Spray shuttles

A spray shuttle can be used to disinfect all relevant surfaces of essential vehicles and machinery that require access to your packing shed. Spray shuttles are used for vehicles and machinery free of soil. Typically, the spray shuttle is located at the entry to your separation zone.

The design of your spray shuttle must satisfy some fundamental criteria for it to work effectively:

- The spray shuttle is located in an appropriate area at the main entrance to your farm.
- Appropriate signage and instructions inform oncoming traffic about how to use the spray shuttle.
- All vehicles and machinery are treated upon entry and exit.
- A hard-surface entry and exit are constructed (e.g. concrete, bitumen or gravel).
- Effective disinfectant is made at the recommended label rate.

Remember

Spray shuttles are suitable for treating lightly contaminated essential vehicles that require access to your packing shed. Vehicles and machinery that are non-essential to your farm (such as staff and visitor vehicles) should never enter and remain in the exclusion zone.



Figure 33: Spray shuttles can be used to treat lightly contaminated essential vehicles that require access to your packing shed via your separation zone



Tip

There are test strips available that indicate the concentration of quaternary ammonium-based disinfectants. Consider using these strips to routinely check the concentration of disinfecting solution used in wash-down and disinfecting facilities. This will ensure they remain effective.

Fencing

Fencing and barriers are critical to managing the movement of people, vehicles, machinery, equipment and animals entering and exiting your farm. Before fencing your property, it's important to review your regional council guidelines to ensure your fencing complies with local government by-laws, and have your property boundaries surveyed to ensure you are fencing within your property.

INFO

More information

Download the *Panama disease tropical race 4: fencing* guide on the Queensland Government website at www.publications.qld.gov.au.

If you are considering land clearing and infrastructure (such as fencing) in areas of native vegetation on your property, additional advice should be sought from the Queensland Department of Natural Resources and Mines. You may need to meet regulatory requirements under the *Sustainable Planning Act 2009* and other legislation. For regions outside Queensland check your relevant state or territory requirements.

INFO

More information

Visit the 'Vegetation management' web page on the Queensland Government website at www.qld.gov.au.

Perimeter fencing

Fencing should be used to define your property perimeter. It's important to contact your neighbours before commencing this process. Perimeter fencing should be fit for purpose and appropriate for the level of risk. For example, to manage the movement of feral pigs, mesh/pig-proof fencing is most suitable. For low-risk areas, three plain wire strands may only be required. Electric fencing and barbed wire can be used to manage animals; however, it's important to consider the potential impacts these have on native wildlife. Natural barriers such as vegetation can be used in addition to fencing to control movement onto and off your farm. Keep in mind that emergency services may require access to your property—emergency personnel have priority access.



Figure 34: Pig-proof fencing can be used in high-risk areas



Figure 35: Plain wire may only be required in low-risk areas

Zone fencing and barriers

A key purpose for implementing zoning is to control movement of potentially infected soil and plant material within different areas (zones) of your farm. Movement can be controlled with barriers (e.g. brick wall, post and chain barrier) and fencing. Signage at key entry points to zones is important to direct movement and ensure zones are not disregarded.

If your property has been issued with a notice of the presence of Panama disease tropical race 4, your property is considered infected land (and therefore quarantined) and there will be a point in your packing shed where a line will be drawn between your farming zone and your separation zone. Movement between these zones will need to be controlled.

By implementing the three-zone system—exclusion, separation and farming—you are well on your way to meeting this requirement and managing movement within your farm.



Figure 36: Fencing between exclusion and farming zones to minimise movement between zones



Figure 37: Barriers such as brick walls are also a good way to limit movement between zones



Remember

An appropriate combination of fencing, barriers and signage is essential to manage movement onto and off your property. The type of fencing and/or barrier must be fit for purpose and regularly maintained. Entry points should be kept to a minimum; however, lockable gates (using the lock-to-lock or double-lock system) need to be constructed at points where emergency services and utilities require access. Fencing should be designed in a way to minimise impacts on native wildlife.

Tools and equipment

Tools and equipment are essential items for farming and packing shed activities. Tools and equipment that come into contact with soil and plant material on a daily basis, and have the ability to spread potentially infected soil and plant material, must be managed appropriately.

To reduce the risk of spreading soil and plant material into different zones within your farm, it's important that:

- tools and equipment are dedicated to zones (i.e. one set stays in the farming zone and a separate set stays in the separation zone)
- tools and equipment never leave your farm
- tools and equipment are regularly cleaned and disinfected
- tools and equipment are cleaned and disinfected if they absolutely have to move between zones or leave your farm
- records are kept of the use, inspection, cleaning and disinfecting of all tools and equipment, and a register is kept of all tools and equipment
- contractors are supplied with dedicated, clean on-farm tools and equipment
- all staff are trained to use and disinfect tools and equipment.

Water supply, movement and disposal

Irrigation and floodwater are pathways that can spread diseases such as Panama disease tropical race 4. Water sources used for irrigation systems, packing shed activities and wash-down facilities should be free from Panama disease tropical race 4.

Water likely to be free from Panama disease tropical race 4 is either:

- water that has not come into contact with agricultural soil or banana plants
or
- water that has been treated to destroy contaminating organisms.

Table 1: Likelihood that irrigation sources are contaminated with Panama disease tropical race 4

Irrigation source	Reliability of irrigation source
Bores	Bore water that has not come into contact with agricultural soil or banana plants is unlikely to be contaminated.
Town water	Town water that is used in packing sheds, wash-down facilities or holding tanks is unlikely to contaminate a property as it has undertaken a purification and treatment process to destroy some contaminating organisms associated with human health issues.
Rainwater	Rainwater collected from a clean surface (e.g. roof) and stored directly into a clean tank is unlikely to be contaminated as it has not come into contact with soil or plant material.
Dams	Upstream properties, people, animal movement, surface water run-off and erosion could contaminate a dam. Growers irrigating from a contaminated dam could potentially become infected.
Channel water	Channel water pumped from a dam could potentially become contaminated as it is an open water source and inflow could have come into contact with contaminated soil and plant material.
Creeks and rivers	Growers pumping from creeks and rivers can have a high risk of contaminating their property. If a property is infected upstream of a watercourse, growers downstream could potentially become infected.

Water movement onto and off your property

Managing run-off

Managing run-off water is a vital component in protecting your property and neighbouring properties from potentially contaminated water. Although difficult in the high rainfall environments in which bananas are grown in north Queensland, run-off from neighbouring properties should be intercepted and managed in a way that diverts flow away from your production area. Soil erosion management practices (such as grassed inter rows, contouring, laser levelling and sediment traps) will minimise water and sediment movement within and off your farm.

Remember

You only have control over the biosecurity of your own property. You rely on good biosecurity practices upstream from your farm and the industry as a whole. Everyone has an important role to play in managing the movement of water onto and off their properties. Water that has been collected from any source (e.g. bore, dam, waterways, etc.) has the potential to become infected if it is not managed properly on farm. Therefore, it's important that storage facilities and irrigation systems are clean and free of potentially infected soil and plant material.





Figure 38: Example of earthworks and drains directing water away from a production area



Figure 39: Environmental best practices such as grassed inter rows minimise water and sediment movement within and off your property



Figure 40: Drainage used to intercept water from neighbouring properties and divert water away from a production area

Waste management

Waste management is an important factor that needs to be considered in an on-farm biosecurity plan. Waste (such as reject bananas, stalks, string, bunch covers and effluent water) should be disposed of in a way that complies with local government by-laws and does not spread potentially infected soil, plant material and water to other areas of your farm, surrounding properties or waterways.

In the event that an exotic pest or disease is detected on your property, unusable bunch covers, string and irrigation tape should be treated as contaminated and disposed of in a safe manner. This could include cleaning and disinfecting prior to dumping, or using suitable commercial waste contractors to treat the waste as contaminated.

Plant material (such as leaves, pseudostems, bits and suckers) should be left in the paddock of origin and never leave your farm. Reject bananas and stalks should be disposed of in a dedicated location on farm where it is less likely to be accessed by feral pigs or other animals (suitable fencing of this site may be required). It should be placed in an area where it does not flood, and where the material cannot enter waterways and surrounding properties. Records and invoices should be kept as evidence of waste management practices undertaken on farm.



Remember

The method of disposal should comply with all applicable legislation and regulations, including local government by-laws (contact your local government authority/council).

Animal movement

Animals can spread infected soil and plant material onto, off and around your farm. The movement of feral animals, native wildlife, livestock and domestic animals should be managed effectively on your farm. There are a number of strategies that can be implemented to reduce the risk of animals moving soil and plant material.



More information

Queensland's native wildlife is protected by the *Nature Conservation Act 1992* and regulations. You may need to apply for a damage mitigation permit if it's necessary to take wildlife to minimise damage to, or loss of, your crops. Visit 'Damage mitigation permits' on the Department of Environment and Heritage Protection website at www.ehp.qld.gov.au. For regions outside Queensland check your relevant state or territory requirements.

Management strategies

Hinge joint mesh fencing

Top wire should be plain wire (not barbed) to protect native wildlife. This type of fencing is the most suitable solution to exclude feral and native animals (such as pigs, cassowaries and wallabies) from entering your farm. It can be used to limit movement of domestic animals and livestock onto adjacent blocks within a property.

Trapping

Trapping is a suitable management strategy for minimising feral pig populations.



Figure 41: Hinge joint mesh fencing



Figure 42: Feral pig trap



More information

Download *Trapping feral pigs on the Cassowary Coast: a practical guide* on the Queensland Government website at www.publications.qld.gov.au.

Electric fencing

This type of fencing is suitable for controlling feral animals such as pigs and wild dogs. Electric fences can injure native wildlife such as cassowaries, wallabies, birds and gliders.

Waste plant material disposal

Waste plant material (such as bunch stalks and reject bananas) disposed of on farm can attract pigs and other wildlife onto your farm. Where possible, food sources should be removed to minimise the risk of animals entering your farm. Waste plant material should be placed in a suitable, dedicated location on your farm and out of flood-prone areas. This location should also be fenced to minimise movement of feral animals into and out of the area.

Crop production

Land preparation

Earthworks and removal of previous crops

On-farm practices that involve the movement of vehicles and machinery (such as undertaking earthworks and establishing or removing crops) have the potential to move soil and dust throughout your farm. It's important to undertake these practices in a way that minimises soil movement and dust dispersal. People and traffic movement on windy or wet days can increase the risk of spreading pests and diseases in soil or dust particles.

There are a number of measures that can be used to reduce the spread of soil and dust throughout your farm:

- Minimise the use and movement of contractors.
- Dedicate vehicles and machinery to the zones on your farm (if not possible, ensure thorough cleaning and disinfecting to remove all soil and plant material upon entry and exit between zones and off farm).
- If possible, only use farm-based equipment to undertake earthworks.
- Undertake major earthworks at times of the year that minimise soil movement (e.g. the dry season rather than the wet season).
- Exercise the concept of 'arrive clean, leave clean' for all machinery movements. Partial dismantling of equipment might be required to be confident that your hygiene requirements have been met.
- Drive farm vehicles and machinery at low speeds that minimise dust.

Sampling and soil testing

Before taking soil or plant samples from your farm, seek advice from the Department of Agriculture and Fisheries. There are simple requirements you need to follow to ensure you don't inadvertently spread pest and diseases.



More information

Read the online guide 'Restrictions on moving plant material, soil and related equipment within Queensland' on the Business Queensland website at www.business.qld.gov.au.

Under Queensland's *Biosecurity Act 2014*, individuals and organisations whose activities pose a biosecurity risk have a greater legal responsibility for managing them. This general biosecurity obligation means they must take all reasonable steps to ensure they do not spread a pest, disease or contaminant. For regions outside Queensland check your relevant state or territory requirements.



More information

Download the *Biosecurity Act 2014* on the Queensland Legislation website at www.legislation.qld.gov.au.

Planting

Soil movement

One of the main pathways that causes the spread of pests and diseases (such as Panama disease tropical race 4) is the movement of soil. Soil movement must be managed in a way that reduces the risk of spreading unwanted pests and diseases between different zones on your farm, between blocks within your farming zone and onto neighbouring properties. To minimise soil movement on your farm, consider options such as planting cover crops, timing activities that reduce soil movement and dust dispersal, constructing fences and barriers, installing appropriate drainage to manage surface water run-off and dedicating vehicles and machinery to the zones on your farm. If vehicles and machinery cannot be dedicated to each zone, and must move into other zones or off farm, they must be cleaned and disinfected upon entry and exit.

Plant material and movement

Many pests and diseases can be spread by infected planting material. Planting material is the most common way that Panama disease tropical race 4 is moved between farms. Sourcing clean planting material for the establishment of new blocks or banana farms is critical to reduce the risk of spreading pests and diseases.

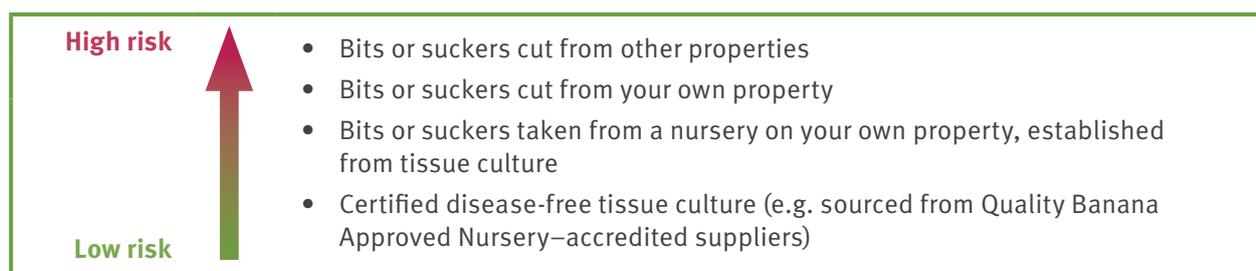


Figure 43: Biosecurity risk associated with sourcing planting material

Tissue culture sourced from certified nurseries (e.g. Quality Banana Approved Nursery–accredited suppliers) is the most suitable type of planting material for banana farms as the plants are produced from disease-indexed tissue culture, providing the best protection against moving and spreading serious diseases onto your property.

Although there is less risk, using planting material sourced from your own property can also result in the unintentional spread of pests and diseases across your farm. To minimise this risk, an alternative for growers who prefer bits or suckers as opposed to tissue culture is to establish an on-farm nursery block from certified disease-free tissue culture. Ideally this nursery block would be located on an elevated area of your farm and not in a flood prone area. Ensure that appropriate biosecurity practices are put in place to reduce the risk of introducing pests and diseases into your nursery. Planting material can then be sourced from this area.

Sourcing planting material from other farms poses a high biosecurity risk and this practice should be avoided at all times. This is an irresponsible practice and could mean you are not meeting your general biosecurity obligation. Breaching your general biosecurity obligation can result in significant financial penalties.



Figure 44: Certified tissue culture is the lowest risk planting material



Remember

Never use bits and suckers sourced from other banana farms. The biosecurity risk is high, as it could contain pests and diseases that could infect your banana farm and threaten your livelihood.



More information

For details of your biosecurity obligations in regards to planting material, download the *Banana industry biosecurity guideline* on the Department of Agriculture and Fisheries website at www.daf.qld.gov.au.

Crop production

Weed control

Weed species on your banana farm should be managed so the risk of spreading pests and diseases is reduced. It's important to treat weed species in the same manner as other plant material. This is because various weed species can act as alternative hosts of diseases such as Panama disease tropical race 4.

Research has shown that alternative weed hosts of Panama disease (different races) include, but are not limited to:

- *Chloris inflata* (purpletop rhodes grass)
- *Euphorbia heterophylla* (milk weed)
- *Tridax procumbens* (coat buttons, Mexican daisy)
- *Cyanthillium cinereum* (vernonia)
- *Paspalum fasciculatum* (Mexican crown grass)
- *Panicum purpurascens* (syn. *Urochloa mutica*, para grass)
- *Ixophorus unisetus* (foxtail millet, Mexican grass)
- *Commelina diffusa* (native wandering jew, scurvy weed)
- *Megthyrsus maximum* (para grass).

Alternative crop inputs

Input from organic sources (especially soil ameliorants such as compost, mill ash and mill mud) can be beneficial to your bananas but are also capable of hosting a range of pests and diseases. It is recommended that you source any organic-based farm inputs from an area that is not associated with bananas. Ensure the risks have been assessed before sourcing and applying any organic-based inputs to your property.

Farm management

Inductions

All staff should undergo an induction before commencing work. It's important to include your on-farm biosecurity practices in your induction package. Ensure staff know how to comply with your on-farm biosecurity practices and understand the importance of adhering to them. Inductions are also useful to inform existing staff about any new or updated practices and processes. People who frequently visit your property should also undergo a farm induction. It's important to keep signed and dated records of all inductions.

Depending on your employees' role within the business, specific inductions may be necessary with detailed information about certain tasks that new staff are required to perform. It's important that farm staff also undergo an induction about how to identify suspect banana plants with unusual symptoms, and are aware of how to report them. Similarly, it's important that staff responsible for using wash-down facilities to clean and decontaminate vehicles and machinery are educated on how to do this effectively.

It's a good idea to conduct random spot checks to ensure staff are complying with your biosecurity practices. Keeping a record of these spot checks is also recommended.



Tip

Use the *Panama disease tropical race 4: identifying and reporting suspect plants* video in your induction package to train staff on how to identify and report suspect plants. Watch the video on the Biosecurity Queensland YouTube channel at www.youtube.com/BiosecurityQLd.



Remember

You are legally obliged to report any suspect plants showing signs of Panama disease tropical race 4 to Biosecurity Queensland within 24 hours of becoming aware of the symptoms. If you think you have infected plants, call Biosecurity Queensland immediately on 13 25 23. For more information on your legal obligations, download *Panama disease tropical race 4: legislative requirements* on the Queensland Government website at www.publications.qld.gov.au.

Natural disaster preparedness

The best way for your business to cope with the impacts of natural disasters (cyclones, floods and storms) is to have a disaster management plan in place before the disaster occurs. Being prepared is critical, and to help prepare your business for a natural disaster you should develop a pre- and post-disaster management plan. The plan should contain information on the activities that need to be undertaken before the natural disaster occurs, including:

- identifying resources you may need on hand—have them ready in case you are cut off by floodwater or road closures
- identifying equipment that will need to be brought in and where it can be kept—consider alternative power and communication, and what you will need to have in place
- determining how fruit that comes into contact with the ground and debris will be managed.

Once the disaster has passed, you will need to rapidly re-establish the systems you require to protect your farm from pest or disease introduction:

- Consider what you might need to do to fully clean and disinfect large equipment if it is required on your property.
- Identify areas on your farm where thorough cleaning and disinfecting could be undertaken that poses less risk to your production area.



Figure 45: It is important to be prepared for natural disasters such as cyclones



More information

Read the online guide ‘Preparing your business for natural disasters’ on the Business Queensland website at www.business.qld.gov.au, and the Panama tropical race 4 pre-cyclone planning fact sheet on the Australian Banana Growers’ Council website at www.abgc.org.au.

Communication

Regular communication is an important tool for any business owner. Effective communication ensures key personnel, staff and visitors understand the businesses goals, what is expected of them and any updates or changes. Regular toolbox talks are a great way of ensuring your staff are up to date with important information about your on-farm biosecurity practices. Key personnel and businesses (e.g. agronomists, contractors and utility companies) that visit your property should be made aware of any changes or updates to your on-farm biosecurity practices. This ensures visitors to your farm comply with your on-farm biosecurity.

Record keeping

Record keeping is essential to your business. Good record keeping allows you to plan and work more efficiently, generate meaningful reports and manage potential risks that could have an impact on your business.

Keep a detailed record of staff inductions and any ongoing training related to on-farm biosecurity. A register should be kept for visitors and staff entering and exiting your farm. You should also keep a register of all vehicle and machinery cleaning and disinfecting, and of all cleaning and disinfecting of tools and equipment moving between the different zones on your farm. Record the date and source of any plant propagation material used on your property, including where you planted it.

Records are important and will be called upon if an emergency plant pest or disease is detected on your property. For properties that have multiple crops, separated parcels of land or internal biosecurity, keeping detailed records of the biosecurity practices implemented will help to prove separation between these areas in the event that a new pest or disease is introduced to your property.

Consider undertaking spot checks and audits of your staff practices and the equipment used for hygiene management. This is to ensure the biosecurity practices you have in place are being followed as specified. Always keep a record of your audits, as records provide evidence of the biosecurity systems you have in place to prevent pest and disease introduction and spread.



Figure 46: Record keeping should be a routine part of your on-farm biosecurity practices



Tip

It is a good idea to record the details of the last property on which your visitors had contact with banana plants or fruit in your visitor register.

Table 2: Visitor register example

Visitor register							
Date	Name	Reason for visit	Time in	Time out	Contact number	Property details of last contact with banana fruit or plants	

Fruit movement

Restrictions apply to the movement of bananas interstate and sometimes within Queensland. Make sure you are aware of the requirements for moving plants and plant products interstate or into declared quarantine areas within a state.



More information

Read the online guide 'Restrictions on moving plant material, soil and related equipment' on the Business Queensland website at www.business.qld.gov.au.

Fruit harvest

When harvesting fruit, there are a number of practices that can be implemented to reduce the risk of spreading pests and diseases between the different zones on your farm and onto other farms:

- Avoid harvesting fruit from plants that have any unusual symptoms.
- Avoid using leaves for protection of bunches on trailers.
- Clean and disinfect tools and equipment (including harvest trailers) on a daily basis.
- Leave bunches that come into contact with the ground, as they can become contaminated with soil.
- Treat bunch bags and string as contaminated waste.
- If the picking trailer must cross a public road to transport fruit to the packing shed, ensure the tractor and trailer are cleaned and disinfected upon entry and exit to the paddock and packing shed.

Fruit packing and packing shed

For many farms, the packing shed is a point of transition between the separation and farming zones. The division between these two zones is generally at the point of fruit washing. For harvested fruit coming into the packing shed and moving through this point of transition, it's important to:

- maintain one-way traffic of fruit through the packing shed and ensure that no backward movement of fruit or material occurs along the processing chain
- ensure fruit is hung without making contact with the ground
- use clean water from an uncontaminated source for fruit washing, and ensure all soil and plant material is removed from bunches before entering the separation zone
- pack fruit into new cartons and place immediately on clean pallets free of soil and plant material
- never allow cartons to touch the floor
- ensure the loading dock is a clean hard surface, free of soil and plant material
- ensure that pick-up and delivery vehicles access the clean side of the packing shed via a main access road, and provide a footwear exchange and/or footbath for the driver to use before entering and exiting the cab of the vehicle
- keep a register of all fruit consignments and transport company details.

More information

Department of Agriculture and Fisheries



www.daf.qld.gov.au



13 25 23

Australian Banana Growers' Council



www.abgc.org.au



info@abgc.org.au



(07) 3278 4786

