

## **Final Report**

# **Subtropical Banana Development and Extension Program**

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**Delivery partner:**

Regional NSW – Department of Primary Industries

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BA16007

**Project:**

Subtropical Banana Development and Extension Program BA16007

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## Content

Subtropical Banana Development and Extension Program	1
Content	3
Summary	4
Keywords	6
Introduction	7
Methodology	9
Project Team	9
Project Reference Group	9
Subtropical Packed Product and Reject Analysis studies	9
Maintenance and development of relationships with subtropical banana industry stakeholders	11
Linkages with other banana projects	12
Outputs	13
Project Reference Group	13
Subtropical Packed Product and Reject Analyses	13
Subtropical NextGen Growers Group	17
Extension/Knowledge Transfer Opportunities	18
Outputs achieved through collaboration with other projects	19
Outcomes	20
Packed Product Analysis	20
Reject Fruit Analysis	21
Subtropical NextGen Growers' Group	22
NSW Banana Growers' Associations	22
2018 National Banana Roadshow series	22
2019 Australian Banana Industry Congress	22
Monitoring and evaluation	23
Key Evaluation Questions	23
BA16007 (subtropical) End-of-project evaluation survey	25
2018 National Banana Roadshow Series (NSW events only) – Attendance and evaluation survey	28
Recommendations	30
Refereed scientific publications	32
Intellectual property, commercialisation and confidentiality	32
Acknowledgements	32
Appendices	33

## Summary

The majority of Australian bananas (95%) are grown in tropical regions, particularly far north Queensland. However, while only accounting for a small amount of the total volume, subtropical banana production is strategically important to the industry from a natural disaster and biosecurity risk mitigation perspective. Due to the unique environmental and climatic contexts within which subtropical banana cultivation occurs, specific development and research programs are required in order to deliver successful and sustainable industry outcomes.

*BA16007 – Subtropical Banana Development and Extension program* was developed to undertake both research and development and extension activities that contribute to the growth and development of the Australian subtropical banana industry. The extension activities and materials produced through BA16007 (subtropical) were targeted at growers and other industry stakeholders to assist with the transfer of research knowledge into improved practice outcomes

There were 4 key activities associated with BA16007 (subtropical):

- Packed product and reject fruit analysis studies
- The NextGen Growers group
- Key stakeholder engagement
- Improved communications and cooperative work practices with researchers of other national R&D projects

The results of the **packed product and reject analysis** study has identified the major causes of fruit defects within subtropical growing regions. Results were communicated in several formats including individual grower reports, workshops, Betterbanana.org articles and presentations/posters at industry congress. The results of this research were used to generate extension materials and activities to assist growers in the adoption or adaptation of farm management practices to improved subtropical fruit quality.

BA16007 (subtropical) successfully established the subtropical **NextGen growers' group** to develop the agronomic and business skills of new and emerging producers. In order to achieve this a study tour to north Queensland was undertaken to increase awareness and exposure to other banana production systems and establish linkages with the north Queensland NextGen banana growers.

In order to communicate the outputs of BA16007 (subtropical) to growers and industry stakeholders it was vital to engage with **Banana Growers' Associations** and teams conducting banana levy funded projects, particularly the **Australia Bananas Growers' Council** (ABGC) led communication project. Collaboration with these entities facilitated the dissemination of important information and helped to strengthen the existing relationships between the individuals and organisations involved. BA16007's (subtropical) contributions to the 2018 National Banana Roadshow series and the 2019 Australian Banana Industry Congress are examples of activities undertaken to achieve this.

By establishing and strengthening links with team members completing BA16001, BA16007 and BA18001 this project was able to fulfil the objective of linking with **national R&D projects**. Through these linkages BA16007 (subtropical) was able to contribute to the national nematode research program (BA16001), Australia Banana Roadshows and Banana Industry Congress (BA16007) and support the ABGC communication program (BA18001).

There were several recommendations regarding future research and development and the practical application of BA16007 (subtropical) outputs and outcomes which include:

- Continued monitoring of packed product and reject fruit should be undertaken to assist in monitoring fruit quality, not only in NSW but for the industry nationally. This would allow us to



determine whether the recommendations and extension activities generated through this research are leading to the adoption of innovative solutions and ultimately practice change by growers.

- Through consultation with growers, and in consideration of biosecurity best management practices, on farm innovation and demonstration trials should be developed to address the common causes of subtropical fruit defects.
- The continued success of the Subtropical NextGen growers' group is vital to the long-term sustainability of the subtropical industry. As such, time and resources should be willingly invested to ensure its growth and continued success.
- Continued investment in industry-wide events such as the Australian Banana Congress and the National Banana Roadshow series. These events represent the unique opportunity to gather members of the Australian banana industry, both regionally and nationally, to build and strengthen working relationships, share information and evaluate the future needs and priorities of the industry.

## Keywords

Banana; New South Wales; subtropical; Packed Product Analysis; Reject Fruit Analysis; NextGen growers; Banana Growers Association; Banana Roadshow; Australian Banana Industry Congress; extension; communication; research.

## Introduction

Banana production in Australia is often considered in the context of the two major climates in which it is grown; tropical and subtropical. The majority of Australian bananas (95%) are grown in tropical regions, particularly far north Queensland. However, while only accounting for a small amount of the total volume, subtropical banana production is strategically important to the industry from a natural disaster and biosecurity risk mitigation perspective. Subtropical banana production in Australia is geographically diverse. It is grown on the east coast from as far north as Bundaberg in Queensland to Taree, NSW in the south. Bananas are also cultivated in Western Australia, in the Carnarvon region. Consequently, the cultivation of bananas within the varied geographical and climatic contexts of these subtropical growing regions creates unique benefits and challenges dissimilar to banana production in tropical areas. Therefore, the subtropical banana industry requires specific development and research programs in order to deliver successful and sustainable industry outcomes.

The strategic investment of banana levy funds in research, development and extension materials and activities is seen as vital to ensure the continued advancement of the Australian banana industry within both a national and global context. However, in the past decade limited research and development activities has been conducted in subtropical growing regions. Recently though it has been recognised that research results from tropical systems are not necessarily valid in subtropical growing regions and that without subtropical focused R & D initiatives it is difficult to develop relevant and readily applicable extension materials. BA16007 (subtropical) aimed to address this need by identifying and delivering on subtropical industry development needs via links with stakeholders, investment in research, and communication and adoption of research outcomes.

A survey of NSW growers conducted in BA13025 (The New South Wales banana industry development officer project) to help determine production constraints and prioritise extension and development activities identified issues specific to the subtropical industry. Results from this survey showed growers do not conduct packed product or reject analysis, i.e. the systematic assessment of packed or rejected fruit to determine the cause of fruit defects. Packed product and reject analyses are a powerful tool for growers as quantification of defects and identification of the specific causes enables growers to actively apply measures to reduce or eliminate these issues. Fruit wholesalers in the Coffs Harbour region and Carnarvon contacted as part of BA13025 also identified poor fruit quality as an issue and requested packed product and reject analyses to highlight common fruit defect issues with growers.

The area of bananas planted in the Australian subtropics has declined significantly over recent years. *Fusarium oxysporum f.sp. cubense* race 1 poses a significant threat to the industry, with many plantations in the Tweed and southeast Queensland regions of Lady Finger and Ducasse susceptible varieties no longer viable. However, a core group of young growers and new entrants in both the Coffs Harbour and Tweed Heads/Richmond regions have established new plantings or are looking to expand. The Coffs Harbour young banana growers' group was established as a result of the work completed during the BA13025 project. Through this group, growers have established linkages with banana growers in the Tweed Heads region and north Queensland.

There are a considerable number of research and extension initiatives occurring within the Australian banana industry. Hort Innovation aims to capitalise on this investment by making sure that, where appropriate, projects work collaboratively with one another, to strengthen stakeholder connectivity, solidify relationships and maximise the impact of project outputs and outcomes through effective and efficient delivery.

BA16007 (subtropical) aimed to address the need for specific subtropical research and extension activities by focusing on a range of research, extension and collaboration activities. Some of these needs were identified through BA13025. Accordingly, a major component of BA16007 (subtropical) focused on packed product and reject analysis. BA16007 (subtropical) also aimed to build on the connectivity of

young growers that was developed through BA13025 via the establishment of a subtropical NextGen growers' group. In order to maximise the outputs and outcomes associated with investment in Australian banana research, BA16007 (subtropical) established and developed linkages with other Hort Innovation banana levy funded programs including:

- BA16001 – Improved plant protection for the banana industry led by QDAF
- BA16007 (tropical) - National banana development and extension project led by QDAF
- BA18001 - Banana industry communications program led by Australian Banana Growers' Council.

BA16007 has delivered on the planned outcomes and in doing contributed to the growth and long-term sustainability of the Australian subtropical banana industry. It is envisaged that the outputs and research findings generated by the project will help guide future projects that will continue to deliver value for our Australian banana growers.

## Methodology

This section of the report outlines the methodologies employed to deliver the research, development and extension objectives.

### Project Team

BA16007 was led by Matt Weinert in his capacity as Banana Industry Development Office (IDO) at NSW Department of Primary Industries until his resignation in November 2019. Tom Flanagan was appointed to the position of NSW banana IDO in January 2020 and led the project until its completion in May 2020. Technical support was provided by NSW DPI through Michael Davy from November 2017 until May 2018 and Leanne Davis (NSW DPI Technical Officer). Leanne from November 2018 until April 2020 contributed to all aspects of the project listed in this report. Valerie Shrubbs, Brett Renton and Annie Van Blommestein from WA DPIRD also contributed significantly to the project, particularly with the implementation of the reject analysis conducted in Carnarvon.

### Project Reference Group

A Project Reference Group was formed at project inception to provide guidance, support and oversight of the project methodology, outputs and outcomes. The PGR also assisted in the development of appropriate and effective project monitoring and evaluation procedures. The PGR was held biennially with an agenda being developed and minutes recorded for each meeting. The PRG was composed of a cross section of industry stakeholders including:

- Stephen Spear (Grower, Taylor's Arm (Nambucca) and Australian Banana Grower Council board member and Banana Industry Committee Trustee)
- Valerie Shrubbs (WA DPIRD, Development Officer)
- Annie Van Blommestein (WA DPIRD, Development Officer for Horticulture)
- Amy Spear (Australian Banana Grower Council, Communications Officer)
- Leanne Davis (NSW DPI, Technical Officer)
- Rosie Goodwin (Australian Banana Grower Council, Research and Development Manager)
- Bianca Cairns (Hort Innovation, R&D Manager)
- Tegan Kukulies (QDAF, Senior Development Horticulturalist)
- Melinda Simpson (NSW DPI, Berries Industry Development Officer)
- Zac McKeever (Grower, Tweed Heads region and Duranbah trial site manager)
- Paul Shoker (Grower, Coffs Harbour)

### Subtropical Packed Product and Reject Analysis studies

Packed product and reject analyses were undertaken in response to fruit quality issues and production constraints identified from a survey of NSW growers conducted during the BA13025 project and through discussions with subtropical banana wholesalers. Analysis focussed on quantifying fruit defects within the subtropical banana industry and identifying the causes of these defects. The findings were used to

inform and prioritise the development of appropriate extension and development materials and activities. The results also guide the prioritisation of future research topics and extension activities.

Research findings were communicated to participating growers through the provision of summary reports indicating the quantity and type of fruit defects identified. Results were also presented at the Banana Roadshow series in 2018 and the Australian Banana Industry Congress in 2019. A summary of the results from both studies has been developed into website articles for the Betterbananas.org website. A poster entitled “Common Banana Quality Issues” was created to assist growers and packers with the identification and classification of common fruit defects identified by the packed product analysis (Appendix 1).

The full methodology of these studies is outlined in the website articles (Appendices 2 & 3) published on the Better Bananas website which can be accessed via the following links:

- Packed Product Article: <https://betterbananas.com.au/2020/05/25/subtropical-packed-product-analysis/>
- Reject Fruit Analysis Article: <https://betterbananas.com.au/2020/05/22/subtropical-banana-reject-analysis/>

#### Subtropical Packed Product Analysis

Packed product analysis was conducted on four separate occasions between September 2018 and August 2019 at Golden Dawn, a major banana ripener and wholesaler in the Coffs Harbour region. A total of 71 cartons of fruit, containing 709 clusters, from 12 different growers were examined just prior to despatch. Major and minor fruit defects were assessed against the Woolworths Coffs Harbour Cavendish produce specifications issued 9<sup>th</sup> of December 2014. These specifications were chosen, in consultation with the major banana ripener and wholesaler in Coffs Harbour, as they are specific to the region.

#### Subtropical Reject Fruit Analysis

Fruit reject analysis was undertaken in all the major New South Wales production areas and in Carnarvon in Western Australia. Assessments in NSW were conducted by NSW DPI and in Carnarvon by WA DPIRD.

Cavendish and Lady Finger fruit were collected from the packing sheds of 16 NSW and 6 WA growers. A total of 35 lots of fruit rejected by growers were collected between June 2018 and May 2019 and assessed to determine the cause for their rejection or downgrade. The varieties evaluated and reported on included Cavendish and Lady Finger. Reject fruit were assessed and separated into three general defect categories; Pre-harvest physical defects, pest and disease related defects and post-harvest physical defects. These three defect categories were further broken into a total of 36 different defect types. The defect categories and defect types can be seen in the table below.

Table 1: Defect categories and defect types assessed during the reject analysis

	Defect Category		
	Pre-harvest physical defects	Pest and disease defects	Post-harvest physical defects
Defect Type	Animal damage	Caterpillar damage	Bruising
	Bell injection damage	Cigar end rot	De-handing damage
	Blemish/dry scars	Corky scab	Mechanical damage
	Doubles/fused	Flower thrips	Neck damage
	Early ripening	Fruit spotting bug	Over grading
	Immature fruit	Grasshopper	Sap stains
	Maturity bronzing	Mite	
	Misshapen fruit	Mokillo	
	November dumps	Rust thrips	
	Pruning damage	Scab moth	
	Rat damage	Silvering thrips	
	Rub	Soldier fly	
	Skin latex scald	Speckle	
	Split fruit	Sugarcane bud moth	
	Spray burn		
	Sunburn		

## Maintenance and development of relationships with subtropical banana industry stakeholders

### Banana grower association groups:

The long-established banana growers' associations represent the opportunity for growers within specific regions to network, discuss emerging industry issues and prioritise industry related activities and events. There are three groups at present in NSW; the Tweed/Richmond Banana Grower association, the Coffs Harbour Banana Grower Association and the Nambucca Banana Growers Association. BA16007 (subtropical) project lead and technical support officers were regular attendees at banana grower association meetings, with a focus on building relationships between stakeholders and growers and where appropriate providing updates and on the latest research and provide extension information. Maintaining close links with these groups is vital for the development and delivery of appropriate research, development and extension efforts.

### NSW NextGen grower group:

Prospective banana growers are the future of the subtropical banana industry. In recognition of this, BA16007 developed the subtropical NextGen grower group to develop the agronomic and business skills of new and emerging producers. The project established and facilitated communication through the formation of a WhatsApp group for the NextGen group members and managed the organization and logistics of group activities. In consultation with NextGen grower group members a study tour to far North Queensland was undertaken. The tour aimed at increasing awareness and exposure to other banana production systems whilst establishing and developing linkages with the north Queensland NextGen banana growers.

#### **Australia Banana Growers Council (ABGC):**

Continued and consistent engagement with the peak industry body was vital to achieving the project aims and maximising their outcomes. This was achieved through regular communication with the CEO, R&D Manager and the communications team.

### **Linkages with other banana projects**

#### **BA16001 - Improved plant protection for the Australian Banana Industry**

This project (BA16007) contributed to improving plant protection for the Australian Banana industry through the identification of nematode species impacting Australian banana production. Soil and root samples were collected from 12 farms in NSW, which were among the 63 farms sampled across all subtropical growing regions, to determine the distribution and population of different nematode species. Soil nutrient analyses were also completed as a part of this process.

#### **BA16007 - National Banana Development and Extension Project (Tropical component)**

Ensuring sub-tropical banana results were incorporated fully into the national banana development and extension aims of BA16007 was achieved through contribution to the Australian Banana Roadshows. This was achieved through collaboration with the north Queensland tropical component of the BA16007 provided by QDAF. The subtropical project leader contributed to the organisation of the Australian Banana Roadshows held in Murwillumbah (24/07/18), Coffs Harbour (26/07/18) and Carnarvon (30/08/18) and was a member of the 2019 Banana Industry Congress organising committee. Finally, both the tropical and subtropical BA16007 project teams worked collaboratively to organize a north Queensland study trip for members of the Subtropical NextGen group.

#### **BA18001 - Banana industry communication program**

The ABGC produces and maintains key communication channels that are vital for keeping growers and industry stakeholders informed and updated regarding R&D and industry news and events. This project contributed content published in the Australian Bananas magazine, Australian banana newsletters and the e-bulletins.



## Outputs

BA16007 had several major outputs that contributed in assisting subtropical banana growers' ability to access and implement new information, technologies and approaches, and make better decisions for their businesses including:

- Establishment of a project reference group to provide guidance and validation of project objectives and outcomes
- Packed product and reject analyses to better understand the specific defects that are impacting on subtropical banana quality
- Formation of the NextGen Growers Group to develop resilience within the NSW subtropical industry and ensure the next cohort of banana growers are connected
- Creating and delivering on extension/knowledge transfer opportunities
- Improved plant protection initiatives (BA16001 Nematode survey)

### Project Reference Group

The project reference group maintained consistent communication through phone calls, email and met via teleconference four times during the life of the project (March and September 2018 and February and November 2019). Examples of the PGR meeting agenda and minutes are available in Appendices 4 and 5 respectively.

### Subtropical Packed Product and Reject Analyses

The completion of the packed product and reject analyses resulted in several outputs being achieved which included; the provision of reports to participating growers, a packed product analysis workshop delivered to growers and Golden Dawn fruit wholesaler staff, the presentation of research findings at the 2018 National Banana Roadshow series and the Australian Banana Industry Congress 2019, publication of a website articles summarising the results of the studies and the release of a packed product analysis poster entitled "*Common Banana Quality Issues*". The details of these outputs are listed below:

- *Packed Product analyses grower reports*: Twelve growers contributed their fruit for evaluation as a part of the packed product analysis. The results from an evaluation of their fruit was formatted into a report and provided to each grower (Figure 2). This was the first instance in which growers in NSW have had an independent report of packed product assessments.

- *Reject analyses grower reports:* 26 growers participated in the reject analysis study. Like the packed product analysis, evaluation of reject fruit was formatted into a report and provided to each grower (Figure 3).

- *Packed product analysis workshop:* A workshop based on the findings from the packed product analysis was delivered in conjunction with the major ripener/wholesaler in Coffs Harbour on 07/12/18. This was organised in response to requests from the fruit wholesaler. The workshop used anonymized data and detailed the major and minor defects identified against the Woolworths Coffs Harbour specifications. A copy of the workshop presentation can be found in Appendix 8.



Figure 3: Project leader Matt Weinert presenting a workshop based on the findings from the packed product analysis.

- *Packed product and Reject analyses website articles, Betterbananas.org website:* Articles summarising the findings from both studies have been published on the Betterbananas.org website and can be viewed via the following links:
  - Packed Product Article: <https://betterbananas.com.au/2020/05/25/subtropical-packed-product-analysis/>
  - Reject Fruit Analysis Article: <https://betterbananas.com.au/2020/05/22/subtropical-banana-reject-analysis/>
- *Pack product analysis “Common Banana Quality Issues” poster:* A poster was developed to assist growers and packers with the identification and classification of common fruit defects identified by the packed product analysis. It describes the most common causes of fruit defects and provides specification criteria to determine whether fruit should be packed or rejected. A larger version of the published poster is available in Appendix 1.

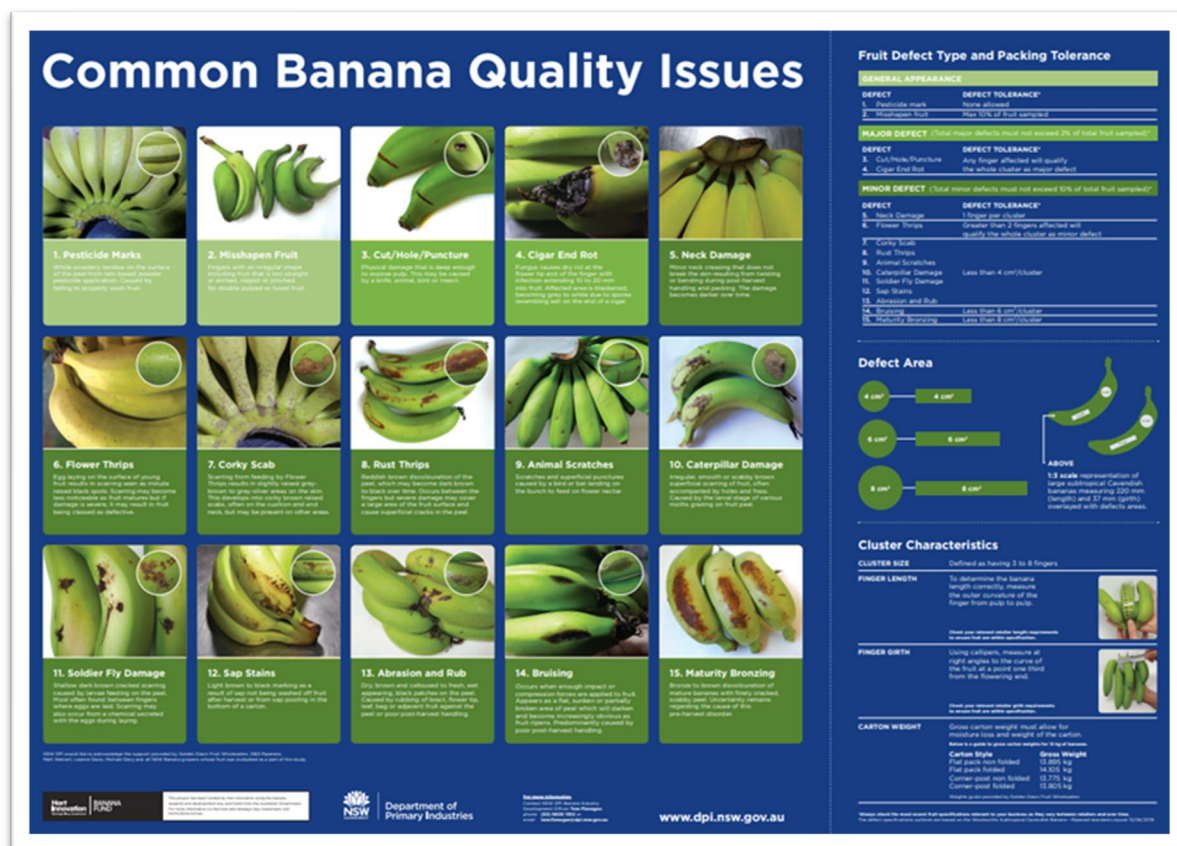


Figure 4: Poster created based on the findings from the packed product analysis.

- National Banana Roadshow presentation:** A presentation of the aims of the project and the results of the initial reject and packed product analysis was delivered at the 2018 National Banana Roadshow series. A copy of the presentation is included as Appendix 9.
- Australian Banana Industry Congress research posters:** Posters detailing the reject fruit and packed product analyses were presented at the 2019 Australian Banana Industry Congress held from 22-24 May on the Gold Coast. The poster helped generate discussion with staff from 'BA16001 - Improved plant protection for the Australian banana industry' and other industry stakeholders around possible areas of collaboration for future research and extension activities. Larger versions of the research presentation posters for the packed product and reject analysis studies are available in appendices 10 and 11 respectively.





Figure 5: Packed product and reject fruit analysis research posters presented at the Australian Banana Industry Congress 2019.

- **Other project communications outputs:** An article entitled “Rejects and reaching-out” was printed in the April 2018 edition of the Australian Bananas magazine. A copy of the article is available in Appendix 12.

## Subtropical NextGen Growers Group

The project successfully established and facilitated communication through the formation of a WhatsApp group for the NextGen growers and managed organisation and logistics of group activities.

A north Queensland study tour was held from the 24<sup>th</sup> to the 27<sup>th</sup> of July 2019. Six members of the NextGen group took part in the tour. The tour visited Cavendish and Lady Finger farms on the Atherton Tablelands, a Pacific Plantain and Monkey Banana plantation at South Johnstone, the Mission Beach Tissue Culture Laboratory and the banana weigh-in at the Tully Show. Participants were able to meet with NQ NextGen growers, ABGC board members and other growers. Visits were also made to the QDAF South Johnstone Research Station and toured the Hort innovation and Reef Plan funded research demonstration trials. In addition, there was a visit to the Daradgee Welding Works, who manufacture tools and machinery for the NQ banana industry.

The growers who attended the north Queensland trip presented for five minutes on three images to their respective BGAs, the three Tweed/Brunswick growers presented at the Tweed BGA on 27 August 2019 and the Coffs Harbour Growers at the Coffs Harbour BGA on 7 August 2019. This group is as much about building future subtropical industry leaders, as shown by the resurgence of the Tweed BGA, of which two of the trip members hold executive positions.



*Figure 6: Project leader Matt Weinert (NSW DPI) with 6 of the subtropical NextGen growers during the north Queensland tour, 2019.*

A story on the Subtropical NextGen NQ tour was published in the Australian Bananas magazine, August 2019 edition and included a front cover image of the tour group and a two-page story. The article is accessible via the following link:

- <https://abgc.org.au/wp-content/themes/abgc/assets/lib/magazine/magazine.html?file=https://abgc.org.au/wp-content/uploads/2019/08/Issue-56-August-2019-WEB.pdf>

## Extension/Knowledge Transfer Opportunities

### NSW Banana Growers Association

Attendance at the Tweed, Coffs Harbour and Nambucca Banana Growers Association meeting were used as a vehicle for disseminating project related goals and outcomes to growers within those regions. In addition, it provided a forum in which growers could provide feedback and make contributions to research and extension activities. Attendance at BGA meetings was consistently achieved by the IDO excluding instances in which attendance at other project related activities was necessary.

### 2018 National Banana Roadshow series

Matt Weinert contributed to promoting the NSW Roadshow events organised as part of the National Banana Development and Extension Project in 2018 and encouraged growers to attend the event. The Murwillumbah event had 21 attendees and Coffs Harbour also had 21 (attendees included growers, service providers and industry representatives only – excludes researchers).

### Australian Banana Industry Congress

The Australian banana industry congress (ABIC) event held at the Gold Coast (22<sup>nd</sup> – 24<sup>th</sup> May 2019) was attended by 373 delegates, 103 of which were banana growers.

The NSW IDO was a member of the organizing committee which assisted the project in contributing to the agenda and format of the event. The NSW IDO Matt Weinert in collaboration with the QLD BA16007 project leader and ABGC R&D manager Rosie Godwin organised the "Science snapshots" session. These sessions consisted of 6 x 3-minute research presentations followed by a panel discussion and the presentation of research posters which included the packed product and reject analyses results at the event.

### Media Engagement

Matt Weinert engaged with the media to communicate about the project and the subtropical industry more broadly. Provided below are a couple of examples:

- Pre-recorded interview with Matthew Weinert, Banana Industry Development Officer, Department of Primary Industries on ABC Radio, March 2018. Matt discusses how the banana industry is set to benefit from a \$1.5m investment into research and development. He describes two projects have been funded which aimed to increase premium fruit production and safeguard the supply of the \$1.1m subtropical crop.
- Matt Weinert was interviewed by Jesse Mulligan for RNZ in August 2018 regarding the prospect of a banana industry in New Zealand. A link to the interview can be found via the following link:
  - <https://www.rnz.co.nz/national/programmes/afternoons/audio/2018656848/expert-matt-weinert-is-bananas-about-bananas>

### Outputs achieved through collaboration with other projects

#### *BA16007 - Banana Development and Extension program (tropical component)*

This project worked collaboratively with the team responsible for the BA16007 tropical component of the Banana Development and Extension program to plan for the 2018 National Banana Roadshow series.

#### *BA16001 - Improved plant protection for the Australian Banana Industry:*

This project contributed data to a survey conducted to identify nematode species impacting Australian banana production undertaken by the 'Improved plant protection for the Australian Banana Industry' project team. The research results are available via the following link:

- <https://abgc.org.au/2018/09/05/plant-parasitic-nematodes-impacting-australian-banana-production/>

## Outcomes

This section of the report will present the intermediate and end-of-project outcomes achieved as a result of the project activities undertaken. The completion of the packed product reject analysis resulted in an improved understanding of the fruit quality being produced within the NSW banana industry as well as identifying and quantifying the causes and frequency of fruit defects. Through the identification of the most common fruit defects it is now possible to focus research, development and extension efforts in areas that may provide the greatest improvement in fruit quality for the smallest expenditure of resources. The project has also taken significant steps to ensure the long-term sustainability of the subtropical banana industry through the establishment and facilitation of the subtropical NextGen growers' group and consistent engagement and communication with NSW BGAs.

Communication of the project goals and outputs is instrumental to facilitate the dissemination of industry specific information and the adoption of recommendations of research outcomes to encourage practice changes. This has been achieved through events such as the National Banana Roadshow events, the Australian Banana Industry congress, links with industry stakeholders and via media engagement and communication.

### Packed Product Analysis

The packed product analysis undertaken by the project led to the identification and quantification of the leading causes of fruit defects within the NSW banana industry and highlighted that more work needs to be undertaken to encourage continued improvement of packed fruit quality. The research resulted in the first independent report of packed product assessments within the NSW industry and provides baseline data against which improvements or deterioration of packed fruit quality can be monitored; to date, this had not been possible.

The identification of the quantity and predominant causes of fruit defects also enables future projects or initiatives to focus research, development and extension efforts on areas deemed to provide the greatest improvement in fruit quality. In doing so, the packed product research findings from this project will assist in meeting 'Outcome 1.5' stated in the Hort Innovation Banana strategic investment plan (SIP) through the refinement of agronomic practices that leads to improvements in fruit quality. Continued monitoring of packed product quality would allow us to determine whether recommendations or extension activities generated as a result of the research have been successful in instigating practice change by growers.

The research found that while some growers in NSW met specifications consistently, most growers involved did not meet the fruit quality standards outlined in the Woolworths Coffs Harbour Cavendish produce specifications. The study provides information to assist growers in recognising and addressing the most common reasons for fruit being categorised as defective. Through communication of the research findings to growers and wholesalers, via reports and a workshop, the study aimed to provide feedback to growers that they could act upon to improve packed product quality. The findings of this study suggest that at present there is too much fruit with major or minor defects that is being packed, increasing the risk of consignments being rejected or their value reduced. As a result, growers are potentially leaving money on the table.

However, the good news for growers is, there are opportunities to improve quality by taking a closer look at the defects found in this study. This includes simple and cost-effective changes that can be made in the paddock, in the pack shed and in the supply chain. All of these can increase profitability for growers and further improve the quality of fruit we see on retail shelves.

The packed product analysis workshop held in Coffs Harbour in December 2018, was the first-time growers had received an independent assessment of fruit quality. There was no formal evaluation of the



workshop, however grower feedback about the workshop was positive and the fruit wholesaler has requested similar workshops in the future and to work collaboratively to develop packing specification training material. A comparison of packed product analyses results from September 2018 until February 2019 (prior to and after the workshop) demonstrated a change in practices with packed fruit quality improving for 25% of growers. For example, One grower improved from 50% of fruit within product specifications in September 2018 to 87% of fruit within product specifications in February 2019. An increase in grower awareness, due to the packed product analysis workshop, has been suggested by the fruit wholesaler as the main reason for this. Discussions with the Coffs Harbour fruit wholesaler in April 2020 indicate that there have been significant and sustained improvements in fruit quality as a result of the workshop completed by the project leader.

### **Reject Fruit Analysis**

The data obtained through the evaluation of rejected fruit within subtropical growing regions has enabled the identification of the major contributing factors that lead to the rejection or downgrade of fruit by growers. In conjunction with the results obtained through the packed product analysis, it enables future projects to prioritise areas for future research and the subsequent develop appropriate extension materials and activities that address the predominant causes of fruit defects. In parallel with the findings from the packed product analysis, the reject fruit analysis contributes to 'Outcome 1.5' stated in the Hort Innovation Banana SIP through the provision of data that assist growers to improve fruit quality.

The evaluation of reject fruit has built a detailed picture of the reasons these varieties are rejected in the major Australian subtropical production areas. Within the list of reasons for fruit defects are some that can be relatively easily improved with changes to pre or post-harvest practices, such as bruising and de-handing damage. Some other defects such as misshapen fruit, fused fruit and November dumps are caused or attributed to factors that we have limited control over (e.g. environmental conditions). This list provides us with the information we need to be able to prioritise the development of research, development and extension activities aimed at reducing Cavendish and Lady Finger rejects in the subtropics.

Through future discussion of these results with growers and other industry stakeholders it will be possible to prioritise research, development and extension activities most beneficial for increasing fruit quality and profitability in subtropical growing regions.

It is not possible to quantify the impact of results obtained from the packed product or reject fruit analyses on the subtropical industry generally without undertaking further research. It was the goal of this project to develop demonstrations trials to assist growers in recognising and addressing the fruit quality issues described by these studies. Unfortunately, this was not possible to achieve within the scope of this project due to the evaluation of rejected fruit within subtropical growing regions and packed product analysis being delayed. The trials will be investigated as an activity that could be undertaken within future projects.

The Betterbananas website article for both the packed product and reject analyses was only able to be published at the end of this project. It is hoped that it will provide growers with insights into the main cause of fruit defects with subtropical growing regions and inspire them to make the appropriate farm management practice changes required to improve fruit quality. At this stage it is not possible to provide metrics associated with the articles' reach or impact. However, an assessment of these metrics will be made in the future to guide improvements or adaptations to the way in which this research is communicated to growers to facilitate the adoption of recommendations or adapt existing crop management strategies.

### **Subtropical NextGen Growers' Group**

The project successfully established the subtropical NextGen growers' group which is currently composed of 18 members. In addition, a WhatsApp group was formed to increase connectivity and facilitate networking for members of the group whilst assisting with the development and organisation of group activities.

In collaboration with the group members the project organised and funded a north Queensland study tour which was held in July 2019 with the goal of increasing awareness and exposure to north Queensland banana production systems whilst building relationships with the north Queensland NextGen banana growers.

Whilst work needs to continue to ensure that membership numbers increase and that a greater number of activities are organized the initial success of this group represents an effort to ensure the future success and sustainability of the subtropical industry.

### **NSW Banana Growers' Associations**

Maintaining and strengthening relationships with the NSW BGAs has been instrumental not only to the achievement of the project goals but for facilitating communication between growers and other industry stakeholders. Links with these key industry groups will continue to be vital for any R&D projects focused on the national banana industry.

### **2018 National Banana Roadshow series**

The popular biennial event has been held as a part of the BA13004 project in 2014 and 2016 and this project in 2018. The successful 2018 national banana roadshow series included nationally and internationally relevant information across all production regions in addition to the presentation of regional specific information. It allowed for the dissemination of this information to growers and other industry stakeholders whilst creating an opportunity for networking. Please refer to survey results on page 28 for more detail on participant feedback.

These events are pivotal in bringing members of the national industry together to share information and experiences and will continue to be an important element of any future banana levy funded research, development and extension projects.

### **2019 Australian Banana Industry Congress**

The Australian banana industry congress events represent the opportunity for all participants within the banana industry to come together to discuss and share new research and development outcomes. The project leader's membership to the organising committee helped to contribute to the success of this event. In addition, the presentation of scientific posters that communicated the results of the packed product and research analyses led to the promise of future collaboration with QDAF in the development of extension materials and activities.

## Monitoring and evaluation

This section of the report will provide an evaluation and discussion of the overall project performance. This will be achieved by answering the Key Evaluation Questions outlined in the project's Monitoring and Evaluation Plan (M&E Plan) (Appendix 13). The M&E Plan was formulated during the initial phases of the project and was reviewed and accepted by the PRG. The Key Evaluation Questions outlined in the M&E plan were composed in order to effectively evaluate the project's effectiveness, relevance, appropriateness, efficiency and other aspect of the project not covered by these categories. The BA16007 (subtropical) program logic is available in Appendix 14.

An end-of-project survey was also developed and made available to growers and other industry stakeholders so that they could provide their own evaluation of the project. The results of this survey will also be discussed to provide an independent assessment of the projects effectiveness.

### Key Evaluation Questions

#### Effectiveness

*Has the overall program improved the viability of the Australian subtropical banana industry through an improved understanding of what causes reject fruit and have systems and tools been developed to build upon this improvement?*

Both the packed product and reject analyses studies have been able to generate data that enables the subtropical industry to identify and quantify the main causes of fruit defects within subtropical growing regions. It is also now possible to use this data as a baseline in order to track the improvements or deterioration in subtropical fruit quality into the future. Through these studies it has been possible to create 2 website articles summarising their results, a "Common Banana Quality Issues" poster to assist with the identification and evaluation of defect fruit, grower reports and presentations. Due to delays with these studies demonstration and innovation trials that were planned were unable to be conducted. It is planned that this will occur within future projects.

*Has this project contributed to improving communications across the subtropical banana industry to improve its viability?*

BA16007 (subtropical) has achieved this through regular attendance at BGA meetings, the establishment of the Subtropical NextGen Growers group, participation in the Banana Roadshow series and the Australian Banana Industry Congress and through links with the ABGC Banana industry communication program.

*Has the project improved communications and cooperative work practices between researchers and linked the subtropical industry with the national RD & E program in the plant protection area?*

By establishing and strengthening links with the team members completing BA16001 project, BA16007 (subtropical) was able to contribute data to the research conducted to identify nematode species impacting Australian banana production. In addition, a commitment has been made to work collaboratively to undertake research and develop extension materials based on the findings from the packed product and reject analysis studies within future projects.

*To what extent has this project contributed to ensuring RD&E outcomes from BA16001 and BA16007-tropical were effectively delivered to the subtropical banana industry?*

The project lead contributed to the organisation of the National Banana Roadshow and the Australian Banana Industry Congress which are major vehicles for the dissemination and communication of RD&E outcomes for BA16001 and BA16007.

### Relevance

*To what extent did the project meet the communication and RD&E needs of industry levy payers to improve the viability of and communication within the subtropical banana industry?*

Through attendance at BGA meetings and other important industry events, as well as taking advantage of avenues of communication offered through engagement with the media, BA16007 (subtropical) was able to effectively communicate with growers, industry stakeholders and the public. The project invested significant time and resources into meeting the communication and RD&E needs of industry levy payers through attendance at BGA meetings and engagement with other industry projects.

### Appropriateness

*Were target engagement levels of industry levy payers and RD&E providers achieved?*

Engagement with industry levy payers is predominantly achieved through attendance of the project lead at BGA meetings held in Murwillumbah, Coffs Harbour and Nambucca. There were several occasions in which the project leader was unable to attend BGA meetings which meant that targets for attendance were not met. This will need to be taken into consideration in future projects to ensure that appropriate planning is undertaken to avoid clashes between work commitments.

*Have regular project updates been provided to the PRG and through linkages with internal project networking, industry communication and extension projects?*

Regular informal project updates were provided to all PRG members via email by the project lead in a timely manner. At no point during the project were concerns raised by the PRG regarding the degree of communication and engagement of the project leader.

*How accessible were the extension events to subtropical industry levy payers?*

Every effort was made to ensure that all industry stakeholders felt as if they could access extension events if desired. Due to the geographic spread of the east-coast subtropical growing regions extension events are often held in at least a northern and southern location within the greater region. This did not occur for the workshop that presented the research findings from the Packed product analysis which was only completed in Coffs Harbour. It is the intention of future projects to present this information to growers located in north NSW growing regions.

*Did the project engage with subtropical industry levy payers through their preferred learning styles?*

Workshops and presentations have been identified as one of the most preferred learning styles by growers within the subtropical regions. These were utilised heavily during the life of the project to communicate information pertinent to the project and to present research outcomes to industry stakeholders.

### Efficiency

*Has this project achieved planned objectives while maintaining expenditure in line with budgeted allocations?*

Due to unforeseen events and circumstances not all the planned objectives were able to be met. This includes the development and presentation of demonstration trials, based on the packed product and reject analysis data, to assist growers to improve their fruit quality. A project variation was initiated to remove the budget allocation for these trials. All project objectives that were achieved were done so in line with budgeted allocations.

### Other

*Has this project increased collaboration between national RD&E providers to benefit the Australian subtropical banana industry?*

BA16007 (subtropical) collaborated with QDAF, WA DPIRD and ABGC on a range of projects which has helped to strengthen the relationships between these RD&E providers to the benefit of the Australian subtropical industry.

### BA16007 (subtropical) End-of-project evaluation survey

A survey was released at the end of BA16007 (subtropical) to enable growers and other industry stakeholders the opportunity to evaluate the project. There were less responses to the survey than anticipated with 16 people completing the survey. The table below displays the number of respondents that hold different roles within the banana industry.

*Table 2: Roles held within the banana industry of respondents.*

Role within the Banana Industry	No. of respondents
Grower	8
Supply chain	1
Researcher	4
Other	3

When asked to rate the project overall the average rating was 4.1 (1-5 scale) with 81.25% indicating that the project was “Good” and another 12.5% stating they thought it was “Excellent”. Respondents were also asked to rate the value of the work undertaken by the NSW Banana IDO for the subtropical banana industry. The value of the work completed by the NSW IDO was rated overall as 4.6 (1-5 scale) with 37.5% and 62.5% of respondents indicating that it was “Valuable” and “Very valuable” respectively. These responses indicate the project was perceived as being successful and the work contributed to the subtropical banana industry by the NSW as being “Very valuable”. This result helps provide justification for the continuation of the IDO role and the way in which BA16007 (subtropical) was developed and executed.

Respondents were also asked whether they believed the project goals and outcomes were communicated effectively. There were 43.75% and 12.5% of respondents that indicated the degree of effective communication of the project goals and outcomes was “A great deal” and “A lot” respectively.

The remaining 37.5% and 6.25% of respondents rated the extent of effective project communication as “A moderate amount” or “A little” respectively. When asked to what degree the project contributed to improving communications within the subtropical banana industry 18.75%, 43.75% and 37.5% indicated “A great deal”, “A lot”, and “A moderate amount” respectively. These results indicate that while the project was perceived as effectively communicating its goals and outcomes and increasing communication between stakeholders within the industry, there is room for improvement.

Respondents were asked whether they believe the project produced enough extension materials and activities with 60% replying in the affirmative. As a result, although project goals and outcomes are communicated quite effectively, more work needs to be undertaken to develop practical tools and extension activities to engage with growers and industry stakeholders directly. Despite this 75% of respondents indicated that they have made changes to the way they farm as a result of the information communicated by BA16007 (subtropical). This indicates that although more extension material and activities may be required in future projects to engage more deeply with growers, the information being generated is resulting in on-farm practice change.

Two open questions asked respondents which aspect of the project were done well, and which could be improved upon. The table below lists some these responses. Please note that answers have been entered randomly in this table and a response in the left column is not necessarily from the same respondent as the response in the right column on the same row.

Table 3: Answers from respondents to the questions "What aspects of the project were done well?" and "What aspects of the project could be improved?"

What was done well?	What could be improved?
"Grower relationship building, encouraging grower networking and improving researcher-grower networks."	"More defined structure of project activities could have improved the overall direction of the project and objectives."
"All aspects of the projects directly benefited all growers that were willing to listen and learn."	"More data on individual's farm practices and marketing would help to inform research and trials/demos."
"The whole project"	"Establishing more direct contact with growers via electronic communications. Stronger links with wholesalers in order to connect growers to outcomes"
"Building relationships with growers, disseminating information, building cohesion and enthusiasm in young growers. Liaising with growers about issues."	"Extension of agronomic issue for NSW bananas. Pest and disease guide. IPM for NSW bananas. Whole number of issues that could be addressed as well as pack grades and reject categorising."
"Consultation across states. Support for the on-ground surveys from the tech team. Interaction with growers."	"Greater focus on achieving project goals and continuing to improve relationships with NQ industry."
Consistency"	More on farm work with growers
"Establishing a subtropical NextGen growers' group and linking them to NQ growers. Field day to get subtropical growers interested in new varieties. Data on reject fruit on farm. Nutrition workshop would have been very useful but Covid19 prevented it happening when originally planned."	"Categorisation of defects not always accurate. Collection should have been done on a weekly/fortnightly basis in order to incorporate a more accurate account of the various defects."
"The banana quality issues poster."	"Less red tape."
"We really need these projects."	"Handouts at the start of the project to support growers undertaking their own activities after the researcher had done the survey."
"Communication among young growers"	"Extension person should have been at all BGA meetings."
"Communication with young grower groups Roadshows."	"More resources produced for growers, i.e it's good to know why fruit is being rejected but growers need help with able to change/modify practices to prevent rejects from occurring."

## 2018 National Banana Roadshow Series (NSW events only) – Attendance and evaluation survey

The 2018 National Banana Roadshow events held in NSW were held at Murwillumbah (24<sup>th</sup> of July) and Coffs Harbour (26<sup>th</sup> of July). A survey was conducted at the beginning and the end of each event to collect data regarding the quantity and background of attendees and to provide them with the opportunity to evaluate the events.

### Attendance data

Both the Murwillumbah and Coffs Harbour events had 21 attendees each (growers, service providers and industry representatives only) with the largest proportion of attendees at each event being growers. This highlights the importance of these events as an opportunity for direct engagement and communication with growers.

Of the people that attended 48% and 29% at the Murwillumbah and Coffs Harbour events respectively indicated that it was the first Banana Roadshow event they had attended. This result reflects the work undertaken by the QDAF and NSW project staff, amongst others, to promote, connect with and encourage growers and industry stakeholders to attend and participate in the event.

The value of these events is again highlighted by the proportion of participants that indicated they would attend a similar event again. At the Murwillumbah and Coffs Harbour events, 85% and 95% of attendees respectively indicated that they would return to a similar event.

### Evaluation

As stated, a survey was conducted at the beginning and end of the events to determine changes in attendees' level of understanding regarding current research and development projects as a result of attending the roadshow event. The table below presents the shift in attendees' knowledge from commencement of the event compared to its conclusion. As can be seen there is a large shift in understanding for attendees at both events with people indicating that by the end, they had a much better understanding of the research and development projects being undertaken. This emphasises the importance of these events as a vehicle through which efficient and effective communication with a large audience of industry stakeholders can be achieved.

*Table 4: How do you rate your current level of knowledge of the latest? – A comparison of attendees' responses for the prior to and following the Murwillumbah and Coffs Harbour Roadshow events*

<b>Location</b>	<b>Survey Timing</b>	<b>None/Nothing at all</b>	<b>Limited/Very Little</b>	<b>Okay/Some Idea</b>	<b>Great, I know about most/Good understanding</b>	<b>I know so much I should be running the show/I'm across them all</b>
<i>Murwillumbah</i>	<i>Beginning</i>	3%	7%	70%	17%	3%
	<i>End</i>	0%	4%	22%	67%	7%
<i>Coffs Harbour</i>	<i>Beginning</i>	10%	30%	30%	30%	0%
	<i>End</i>	0%	6%	17%	67%	11%

A total of 200 attendees from both the Murwillumbah and Coffs Harbour events were also asked to rate the overall quality of the events on a scale of 1 to 9 (1 = Very poor and 9 = Excellent). The responses for attendees at the NSW events are shown in the figure below. A total of 84% of respondents rated the events as either a 7, 8 or 9 demonstrating the high regard attendees have for the events.



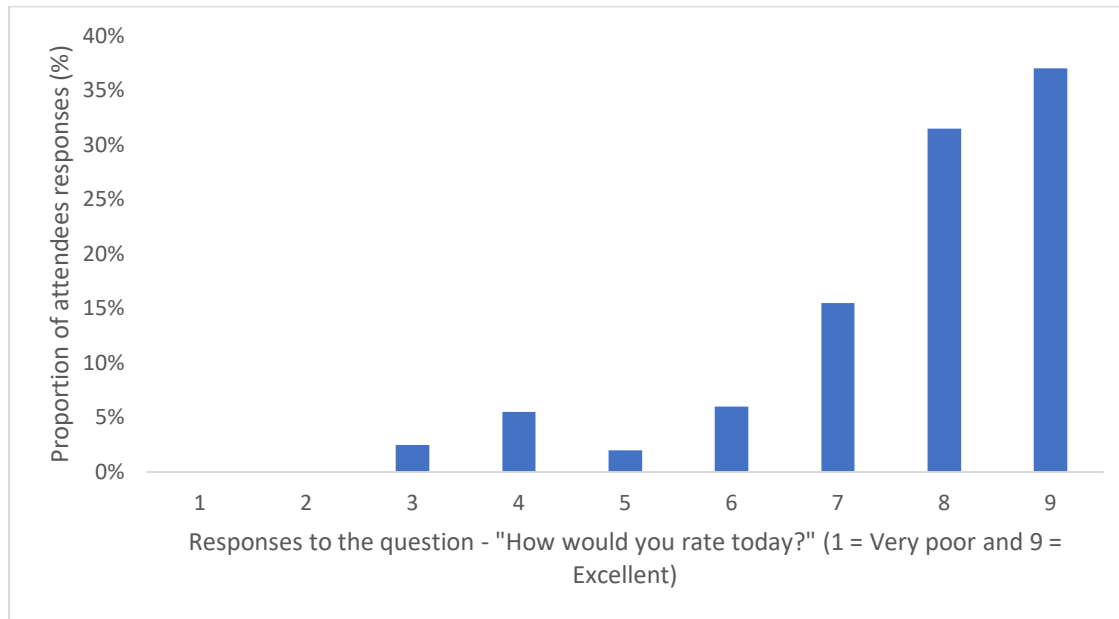


Figure 7: Overall rating of the Murwillumbah and Coffs Harbour 2018 Roadshow events

Attendees were also asked whether they believe that the information they gained from the events would lead to on-farm practice changes. At the Murwillumbah and Coffs Harbour events 48% and 75% of attendees indicated that they would make changes to their practices as a result of attending the Roadshow events. This result emphasises the importance of these events in driving the adoption of innovative or novel practices by growers and other industry stakeholders.

When asked whether they would recommend the event to other industry stakeholder 96% of attendees at the Murwillumbah event and 100% from Coffs Harbour stated they would. This is a testament to the value of these events as perceived by growers and industry stakeholders.

The results from these surveys reinforce the importance and value of the NSW Banana Roadshow events as perceived by the industry and justify the continued investment and development of future events.

## Recommendations

- This project demonstrates the importance of investing in programs that encompass research, development and extension to enable clear, efficient and coordinated communication of project research outcomes through the development of extension activities and materials to growers and industry stakeholders.
- The establishment of a project reference group composed of growers and other industry representatives is vital to ensuring that the goals of the project are appropriate and considered valuable, and that the delivery and communication of those goals is done in such a way that it meets the needs of a varied audience.
- The results obtained from the packed product and reject fruit analyses studies has enabled the identification of the most common causes of fruit defects within the subtropical growing regions. Future projects should build on these findings through the development of appropriate extension materials and events to encourage growers to address the causes of fruit defects through practice change.
- Continued monitoring of packed product and reject fruit should be undertaken to assist in monitoring fruit quality, not only in NSW but for the industry nationally. This would allow us to determine whether the recommendations and extension activities generated through this research are leading to the adoption of innovative solutions and ultimately, practice change by growers.
- Through consultation with growers, and in consideration of biosecurity best management practices, on farm innovation and demonstration trials should be developed to address the common causes of subtropical fruit defects.
- The continued success of the Subtropical NextGen growers' group is vital to the long-term sustainability of the subtropical industry. As such, time and resources should be willingly invested to ensure its growth and continued success.
- The development of effective channels of communication with the subtropical NextGen growers' group needs further work and should explore parallel avenues of communication that encourage increased engagement.
- Establishing and maintaining one-on-one connections with growers and building connectivity through this network with other industry stakeholders is vital for the effective and efficient dissemination of important information, obtaining feedback or reflections from industry participants and promoting adoption of innovative ideas and technology.
- Attendance by project staff at Banana Grower's Associations help maintain and strengthen links between growers and other industry stakeholders and should be continued during future projects.
- Continued investment in industry-wide events such as the Australian Banana Congress and the National Banana Roadshow series should be ensured. These events represent the unique opportunity to gather members of the Australian banana industry, both regionally and nationally, to build and strengthen working relationships, share information and evaluate the future needs and priorities of the industry.
- Linkages and collaboration with other industry projects should be expanded and reinforced to maximise the return-on-investment achieved by research and development ventures through the sharing of skills, knowledge, resources and access to varied channels of communication.
- Engagement with the industries communication project and other vehicles of communication

need to be maintained as they are vital for maximising accessibility to project outputs and the promotion of events not only for industry stakeholders but also the general public.

## Refereed scientific publications

Not applicable

## Intellectual property, commercialisation and confidentiality

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

## Acknowledgements

This project would not have been possible without the guidance and support provided by the project reference group members Stephen Spear, Valerie Shrubbs, Annie Van Blommestein, Amy Spear, Leanne Davis, Rosie Goodwin, Bianca Cairns, Tegan Kukulies, Melinda Simpson, Zac McKeever and Paul Shoker.

The project also needs to acknowledge the support provided by the team at Golden Dawn Fruit Wholesalers and from D&D Ripeners and all NSW banana growers who participated in the packed product analysis.

The reject fruit analysis would not have been achievable without the participation of WA DPIRD staff Valerie Shrubbs, Annie Van Blommestein and Brett Renton and through collaboration with the Sweeter Banana Co-operative and WA banana growers. The NSW and QLD subtropical banana growers that participated in the study were also instrumental to its success.

The project would not have been successful without collaboration with QDAF staff Tegan Kukulies, Ingrid Jenkins, Shanara Veivers, Wayne O'Neill, Jennifer Cobon and Stewart Lindsay.

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This project was funded by Hort Innovation, using the banana research and development levy and co-investment from the New South Wales Department of Primary Industries and WA Department of Primary Industries and Regional Development. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

## Appendices

Appendix 1 – Packed Product Poster

Appendix 2 – Subtropical Packed Product Analysis Webpage article

Appendix 3 – Subtropical Reject Fruit Analysis Webpage article

Appendix 4 – Example of Project Reference Group meeting agenda

Appendix 5 – Example of Project Reference Group meeting minutes

Appendix 6 – Example of Packed Product Analysis grower report

Appendix 7 – Example of Reject Fruit Analysis grower report

Appendix 8 – Packed Product Analysis Workshop presentation

Appendix 9 – National Banana Roadshow presentation

Appendix 10 – Packed Product Analysis research poster – Australian Banana Industry Congress

Appendix 11 – Reject Fruit Analysis research poster – Australian Banana Industry Congress

Appendix 12 – Reject Fruit Analysis Australian Bananas magazine article

Appendix 13 – Monitoring and Evaluation Plan

Appendix 14 – Program Logic



# Common Banana Quality Issues



### 1. Pesticide Marks

White powdery residue on the surface of the peel from talc-based powder pesticide application. Caused by failing to properly wash fruit.



### 2. Misshapen Fruit

Fingers with an irregular shape including fruit that is too straight or arched, ridged or pinched. No double pulped or fused fruit.



### 3. Cut/Hole/Puncture

Physical damage that is deep enough to expose pulp. This may be caused by a knife, animal, bird or insect.



### 4. Cigar End Rot

Fungus causes dry rot at the flower tip end of the finger with infection extending 10 to 20 mm into fruit. Affected area is blackened, becoming grey to white due to spores resembling ash on the end of a cigar.



### 5. Neck Damage

Minor neck creasing that does not break the skin resulting from twisting or bending during post-harvest handling and packing. The damage becomes darker over time.



### 6. Flower Thrips

Egg laying on the surface of young fruit results in scarring seen as minute raised black spots. Scarring may become less noticeable as fruit matures but if damage is severe, it may result in fruit being classed as defective.



### 7. Corky Scab

Scarring from feeding by Flower Thrips results in slightly raised grey-brown to grey-silver areas on the skin. This develops into corky brown raised scabs, often on the cushion end and neck, but may be present on other areas.



### 8. Rust Thrips

Reddish brown discolouration of the peel, which may become dark brown to black over time. Occurs between the fingers but severe damage may cover a large area of the fruit surface and cause superficial cracks in the peel.



### 9. Animal Scratches

Scratches and superficial punctures caused by a bird or bat landing on the bunch to feed on flower nectar.



### 10. Caterpillar Damage

Irregular, smooth or scabby brown superficial scarring of fruit, often accompanied by holes and frass. Caused by the larval stage of various moths grazing on fruit peel.



### 11. Soldier Fly Damage

Shallow dark brown cracked scarring caused by larvae feeding on the peel. Most often found between fingers where eggs are laid. Scarring may also occur from a chemical secreted with the eggs during laying.



### 12. Sap Stains

Light brown to black marking as a result of sap not being washed off fruit after harvest or from sap pooling in the bottom of a carton.



### 13. Abrasion and Rub

Dry, brown and calloused to fresh, wet appearing, black patches on the peel. Caused by rubbing of bract, flower tip, leaf, bag or adjacent fruit against the peel or poor post-harvest handling.



### 14. Bruising

Occurs when enough impact or compression forces are applied to fruit. Appears as a flat, sunken or partially broken area of peel which will darken and become increasingly obvious as fruit ripens. Predominantly caused by poor post-harvest handling.



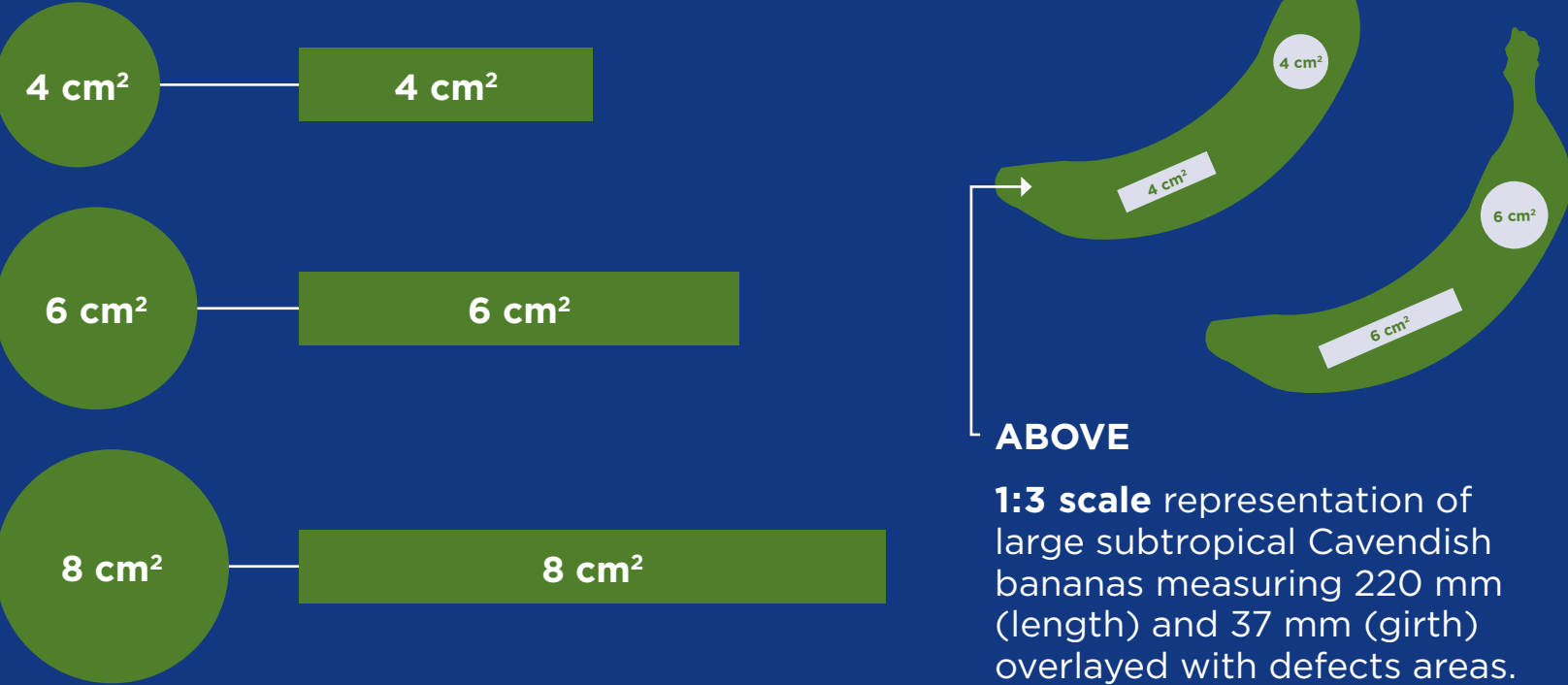
### 15. Maturity Bronzing

Bronze to brown discolouration of mature bananas with finely cracked, scabby peel. Uncertainty remains regarding the cause of this pre-harvest disorder.

## Fruit Defect Type and Packing Tolerance

GENERAL APPEARANCE	
DEFECT	DEFECT TOLERANCE*
1. Pesticide mark	None allowed
2. Misshapen fruit	Max 10% of fruit sampled
MAJOR DEFECT (Total major defects must not exceed 2% of total fruit sampled)*	
DEFECT	DEFECT TOLERANCE*
3. Cut/Hole/Puncture	Any finger affected will qualify the whole cluster as major defect
4. Cigar End Rot	
MINOR DEFECT (Total minor defects must not exceed 10% of total fruit sampled)*	
DEFECT	DEFECT TOLERANCE*
5. Neck Damage	1 finger per cluster
6. Flower Thrips	Greater than 2 fingers affected will qualify the whole cluster as minor defect
7. Corky Scab	
8. Rust Thrips	
9. Animal Scratches	
10. Caterpillar Damage	Less than 4 cm <sup>2</sup> /cluster
11. Soldier Fly Damage	
12. Sap Stains	
13. Abrasion and Rub	
14. Bruising	Less than 6 cm <sup>2</sup> /cluster
15. Maturity Bronzing	Less than 8 cm <sup>2</sup> /cluster

## Defect Area



## Cluster Characteristics

CLUSTER SIZE	Defined as having 3 to 8 fingers	
FINGER LENGTH	To determine the banana length correctly, measure the outer curvature of the finger from pulp to pulp.	
	Check your relevant retailer length requirements to ensure fruit are within specification.	
FINGER GIRTH	Using callipers, measure at right angles to the curve of the fruit at a point one third from the flowering end.	
	Check your relevant retailer girth requirements to ensure fruit are within specification.	
CARTON WEIGHT	Gross carton weight must allow for moisture loss and weight of the carton.	
	Below is a guide to gross carton weights for 13 kg of bananas.	
	<b>Carton Style</b>	<b>Gross Weight</b>
	Flat pack non folded	13.895 kg
	Flat pack folded	14.105 kg
	Corner-post non folded	13.775 kg
	Corner-post folded	13.805 kg
	Weights guide provided by Golden Dawn Fruit Wholesalers	

NSW DPI would like to acknowledge the support provided by Golden Dawn Fruit Wholesalers, D&D Ripeners, Matt Weinert, Leanne Davis, Michael Davy and all NSW Banana growers whose fruit was evaluated as a part of the study.



# Subtropical packed product analysis

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 [betterbananas.com.au/2020/05/25/subtropical-packed-product-analysis/](https://betterbananas.com.au/2020/05/25/subtropical-packed-product-analysis/)

## Is reject fruit causing growers to leave money on the table?

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Supplying consumers with good quality fruit all year round is at the top of the list for many banana growers, especially in a competitive fresh fruit market. To do this however it's important to understand why some fruit sent to market may not be up to spec.

## About the study

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In Coffs Harbour NSW, a packed product analysis was carried out to provide a clearer picture. It looked at fruit after ripening to see what issues were causing fruit to be rejected at retail outlets. The findings from this study provide growers and industry with information that can assist in recognising and addressing the most common reasons for fruit being rejected.

Fruit was assessed at Golden Dawn, a major banana ripening and wholesale company in the Coffs Harbour region. Assessments were made on fruit supplied by 12 banana growers, consisting of 71 cartons that contained a total of 709 clusters.



Sydney retail display of Lady Finger fruit

Fruit was checked against the most recent specifications released for Woolworths subtropical Cavendish produce, issued December 2014. These specifications have the most lenient criteria compared to other retailers. In broad terms, the specs state that *'total minor defects should not exceed 10% of consignment'* and *'total major defects must not exceed 2% of consignment'* with a *'combined total not to exceed 10%'* of clusters with a defect. If defect levels are found higher than this, retailers are well within their rights to pay suppliers less for the fruit or reject the consignment entirely. This is what could have happened to the fruit that was assessed as part of this study.

As an example, the potential loss of this consignment could be as much as \$1420 (71 cartons @ \$20/carton price).

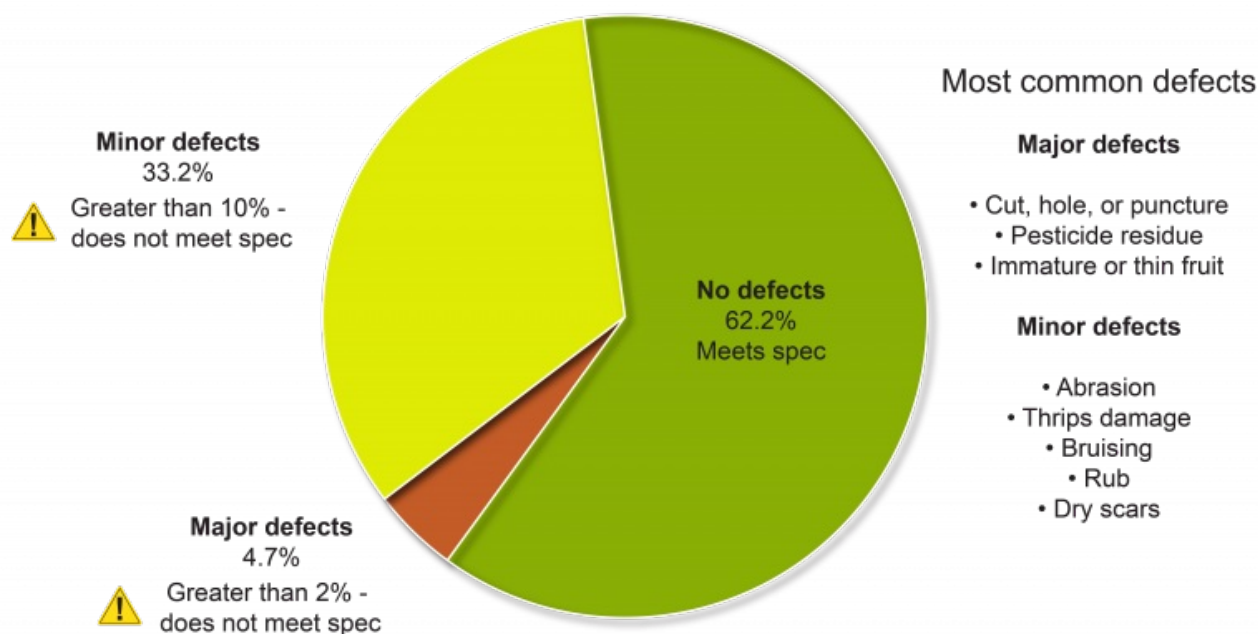


This doesn't include any additional costs associated with packing or getting the fruit to market, such as transportation costs.



## Results

The results showed that 38% of all clusters inspected were deemed to have either a major or minor defect, more than 3 times above the levels specified by Woolworths. Figure 1 below provides a breakdown of that percentage and lists the most common defects found.



Results of fruit assessment showing percentage of clusters with major and minor defects. Assessment based on a consignment of 71 cartons.



Cuts, holes or punctures were the most common major defect identified during the study and accounted for 45% of all major defects assessed.

The findings of this study suggest that at present there is too much fruit with major or minor defects that is being packed, increasing the risk of consignments being rejected or their value reduced. As a result growers are potentially leaving money on the table.

However, the good news for growers is, there are opportunities to improve quality by taking a closer look at the defects found in this study. This includes simple and cost-effective changes that can be made in the paddock, in the pack shed and in the supply chain. All of these can increase profitability for growers and further improve the quality of fruit we see on retail shelves.

A new banana packing poster is now available for subtropical banana growers. The poster highlights some of the most common banana defects identified in this study and provides a guide to help growers determine whether they should be packed or rejected. See below for details on how to get a copy.

More detailed information on the types of defects found in the study, as well as management strategies are available via the links below.

## More information...

- [Major defects](#)

- Minor defects

## Video – Developing a standard industry banana carton

A poster is now available showing common quality issues and packing guidelines for subtropical banana growers. To receive a hard copy or for more information contact NSW DPI Industry Development Officer Tom Flanagan on (02) 6626 1352 or email [tom.flanagan@dpi.nsw.gov.au](mailto:tom.flanagan@dpi.nsw.gov.au)

# Common Banana Quality Issues

**1. Pesticide Marks**  
White powdery residue on the surface of the peel from liquid-based powder pesticide applications. Caused by failing to properly wash fruit.

**2. Misshapen Fruit**  
Finger with an irregular shape including fruit that is too straight or curved, ridged or pinched. No dislike pulled or fused fruit.

**3. Cut/Hole/Puncture**  
Physical damage that is deep enough to expose pulp. This may be caused by a knife, pin, insect or insect.

**4. Cigar End Rot**  
Finger curled dry rot at the flower tip and/or the finger with infection extending to its 20 mm into fruit. Infected areas are blackened, becoming hard and brittle due to lignification and the loss of a cigar.

**5. Neck Damage**  
Minor neck cracking that does not break the integrity of the finger or the cluster. Caused by handling during post-harvest handling and packing. The damage becomes darker over time.

**6. Flower Thrips**  
Dry lesions on the surface of young fruit results in scarring caused by thrips feeding on the young fruit. Scarring may become more noticeable as fruit matures but if damage is severe, it may result in fruit being classed as defective.

**7. Corky Scab**  
Scarring from the dry to flower. Thrips results in slightly raised grey-brown to greyish black on the skin. This develops into corky brown raised lesions on the surface and neck, but may be present on other areas.

**8. Rust Thrips**  
Rust-like brown discoloration of the peel, which may become dark brown to black over time. Occurs between the finger but swelling damage may cover a large area of the fruit surface and cause superficial cracks in the peel.

**9. Animal Scratches**  
2 scratches and superficial scratches caused by a bird or bat landing on the bunch to feed on flower nectar.

**10. Caterpillar Damage**  
Irregular smooth or slightly brown, superficial scoring of fruit, often accompanied by holes and stems. Caused by the larvae stage of various moths grazing on fruit pulp.

**11. Soldier Fly Damage**  
Shallow dark brown circular scarring caused by larvae feeding on the pulp of off-harvested or over-ripe fruit. The larvae are not consumed but the dark brown holes are consumed with the pulp during eating.

**12. Sap Stains**  
Light brown to black markings as a result of sap not being washed off fruit after harvest or from sap pooling in the bottom of a carton.

**13. Abrasion and Rub**  
Dry, brown and coloured to black, wet scarring. Black scarring on the peel. Caused by rubbing of fruit, finger to finger, or against fruit against the peel or poor post-harvest handling.

**14. Bruising**  
Occurs when a rough impact or compression force is applied to fruit. Appears as a flat, uniform or partially broken area of peel which will darken and become increasingly obvious as fruit ripens. Indirectly caused by poor post-harvest handling.

**15. Maturity Bronzing**  
Brown to brown discoloration of mature bananas with these colored, slightly peel. Unusually remains regarding the cause of this pre-harvest disorder.

### Fruit Defect Type and Packing Tolerance

GENERAL APPEARANCE	
DEFECT	DEFECT TOLERANCE*
1. Pesticide mark	None allowed
2. Misshapen fruit	Max 10% of fruit sampled
<b>MAJOR DEFECT</b> (Total major defects must not exceed 2% of total fruit sampled)*	
DEFECT	DEFECT TOLERANCE*
3. Cut/Hole/Puncture	Any finger affected will qualify the whole cluster as major defect
4. Cigar End Rot	
<b>MINOR DEFECT</b> (Total minor defects must not exceed 10% of total fruit sampled)*	
DEFECT	DEFECT TOLERANCE*
5. Neck Damage	1 finger per cluster
6. Flower Thrips	Greater than 4 fingers affected will qualify the whole cluster as minor defect
7. Corky Scab	
8. Rust Thrips	
9. Animal Scratches	Less than 4 cm <sup>2</sup> /cluster
10. Caterpillar Damage	
11. Soldier Fly Damage	
12. Sap Stains	
13. Abrasion and Rub	Less than 8 cm <sup>2</sup> /cluster
14. Bruising	Less than 8 cm <sup>2</sup> /cluster
15. Maturity Bronzing	Less than 8 cm <sup>2</sup> /cluster

### Defect Area

4 cm<sup>2</sup> — 4 cm<sup>2</sup>  
6 cm<sup>2</sup> — 6 cm<sup>2</sup>  
8 cm<sup>2</sup> — 8 cm<sup>2</sup>

1:8 scale representation of large subtropical Cavendish bananas measuring 220 mm (length) and 37 mm (girth) overlaid with defect areas.

### Cluster Characteristics

**CLUSTER SIZE** Defined as having 3 to 8 fingers

**FINGER LENGTH** To determine the banana length correctly, measure the distal curvature of the finger from pulp to pulp.

**FINGER GIRTH** Using callipers, measure at right angles to the curve of the fruit at a point one third from the flowering end.

**CARTON WEIGHT** Gross carton weight must allow for moisture loss and weight of the carton.

Below is a guide to gross cart weight for 10 kg of bananas:

Carton Style	Gross Weight
Flat pack non-ridged	13.855 kg
Flat pack ridged	14.555 kg
Corner-pressed non-ridged	13.775 kg
Corner-pressed ridged	13.405 kg

\*Note: This is the maximum allowed defect tolerance for Cavendish bananas. For other banana varieties, the tolerance may vary. The defect tolerance is based on the total weight of the fruit, not the weight of the carton.

NSW DPI would like to acknowledge the contributions made to this study by Geoff Bridgfoot, Paul Gibbins, Paul Thorburn, Kaye Adriaansz from Golden Dawn, Dave Norberry from D&D Ripeners, all NSW banana growers that supplied fruit.

This research has been funded as part of the Subtropical Banana Development and Extension Program (BA16007), which is funded by Hort Innovation, using the banana research and development levy and co-investment from the New South Wales Department of Primary Industries. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

**Hort  
Innovation**  
Strategic levy investment

**BANANA  
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**Primary Industries and  
Regional Development**



Department of  
**Primary Industries**

# Results from the Subtropical packed product analysis

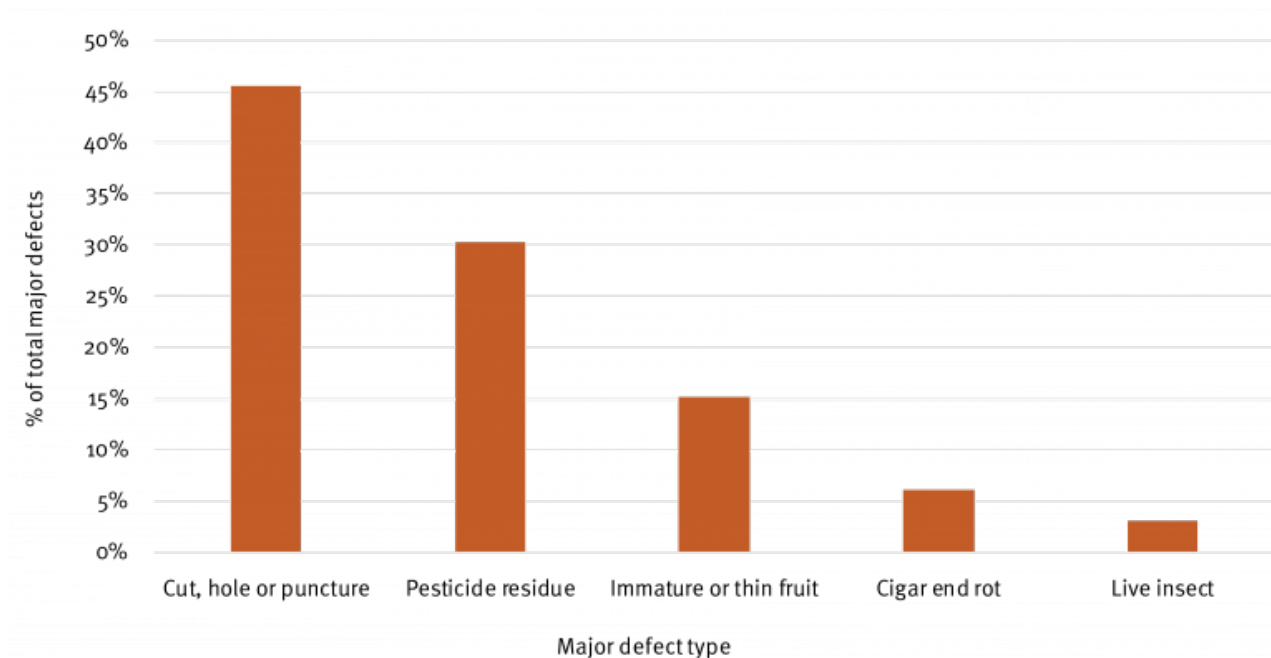
[betterbananas.com.au/2020/05/25/results-from-the-subtropical-packed-product-analysis-major-defects/](https://betterbananas.com.au/2020/05/25/results-from-the-subtropical-packed-product-analysis-major-defects/)

## Major defects

Let's take a closer look at the major defects found as part of the Subtropical packed product analysis. Results showed that 4.65% of clusters in the consignment had a major defect. This is over the Woolworths' specifications requiring no more than 2% of clusters with major defects per consignment. This could result in the consignment being rejected by the retailer. Although this number may sound small, the potential financial impact to growers is much larger, and that's not even taking into account minor defects.

For example, if you were to receive \$20 per carton for a consignment of 71 cartons, the total value is equal to \$1,420. A grower could risk a reduction in the value or the complete rejection of their consignment in this instance. Further, the value of this potential loss doesn't include any additional costs associated with packing or getting the fruit to market, such as transportation costs.

So, what were the major defects found and which were more common? The answer to those questions is presented in the figure below. All five of these are largely associated with poor post-harvest handling and packing procedures.



Proportion of major defects (4.65% of consignment) identified during the packed product analysis.



## Cut, hole or puncture

**Physical damage that is deep enough to expose pulp. This may be caused by a knife, animal, bird or insect.**

Cuts, holes or punctures were the most common major defect identified during the study and accounted for 45% of all major defects assessed.



## Pesticide residue

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**White powdery residue on the surface of the peel from talc-based powder pesticide application.**

Pesticide residue was identified as the second most common major defect and can be avoided by ensuring fruit are washed thoroughly prior to packing.



## Cigar end rot

**Fungus causes dry rot at the flower tip end of the finger with infection extending 10 to 20 mm into fruit. Affected area is blackened, becoming grey to white due to spores resembling ash on the end of a cigar.**

The fourth most common major defect, Cigar end rot can be managed by implementing appropriate best management practices.

A cut, hole or puncture through to the pulp of the fruit was the most common major defect found in the study. There are a wide range of reasons that the pulp may become exposed before or after harvest such as de-leafing, de-handing, poor handling following harvest or animal and insect damage. Care needs to be taken to ensure that any affected fingers are found and removed prior to packing.

White residue from talc-based pesticides was the next most common major defect with immature or thin fruit, cigar end rot and live insects within a carton following in that order. It is possible to reduce the frequency of these issues with appropriate post-harvest handling and packing strategies. For example, washing fruit thoroughly prior to packing will remove any pesticide residue, whereas increased screening for underdeveloped fruit, or using callipers to check girth, would prevent thin and immature fruit from being packed. When applied to the data from this study, employing these two simple strategies could reduce the occurrence of major defects by 45%.



*\*Fruit in this study was assessed against the most recently released Woolworths subtropical Cavendish produce specifications, issued 9 December 2014. Always make sure you're referring to the latest specifications relevant to your business.*

## More information...

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- [Subtropical packed product analysis](#)
- [Minor defects](#)

### [Video – Developing a standard industry banana carton](#)

A poster is now available showing common quality issues and packing guidelines for subtropical banana growers. To receive a hard copy or for more information contact NSW DPI Industry Development Officer Tom Flanagan on (02) 6626 1352 or email [tom.flanagan@dpi.nsw.gov.au](mailto:tom.flanagan@dpi.nsw.gov.au)

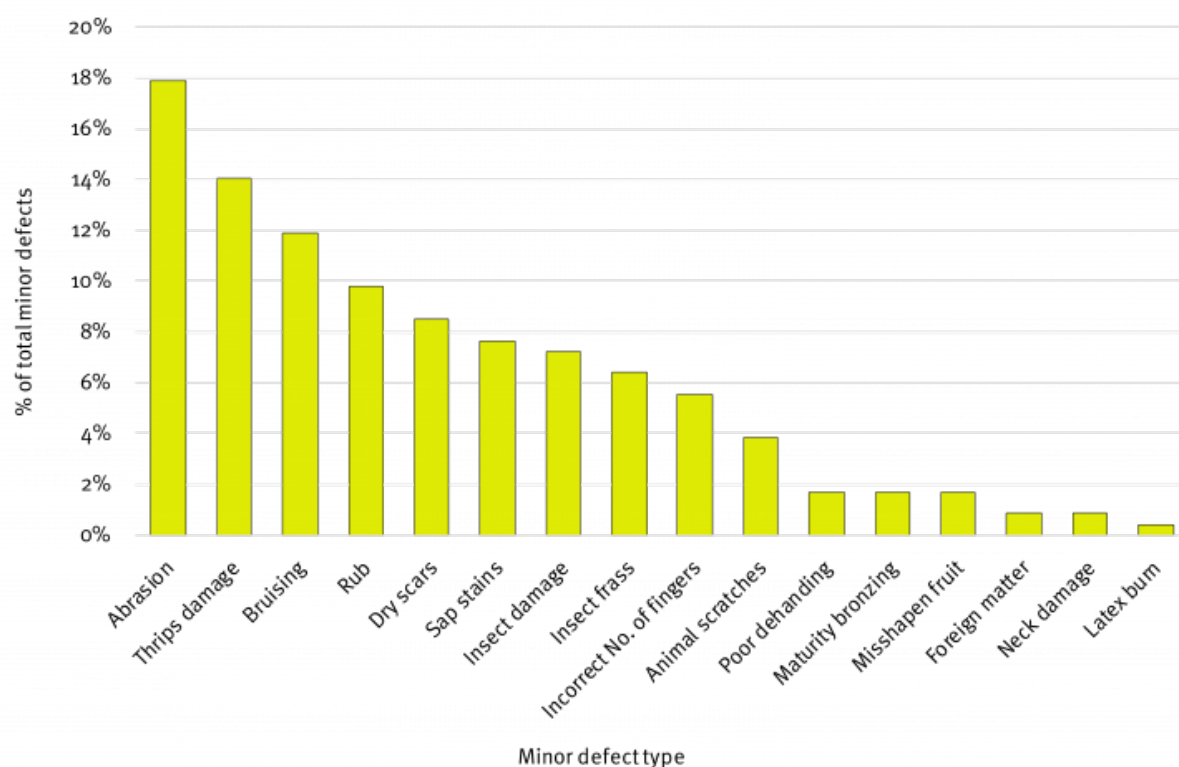
# Results from the Subtropical packed product analysis

[betterbananas.com.au/2020/05/25/results-from-the-subtropical-packed-product-analysis-minor-defects/](https://betterbananas.com.au/2020/05/25/results-from-the-subtropical-packed-product-analysis-minor-defects/)

## Minor defects

There was a far greater number of minor defects than major defects found as part of the Subtropical packed product analysis. Results showed that of the 709 clusters, 235 or 31.15% had a minor defect. This is again over Woolworths specifications requiring no more than 10% of clusters with minor defects per consignment.

The figure below shows 16 minor defects found in the study and lists them from the most common on the left through to less common on the right.



Proportions of minor defects (31.15% of consignment) identified during the packed product analysis.

The six most common minor defects which accounted for almost 70% of clusters included, abrasion, thrips damage, bruising, damage caused by rub, dry scars and sap stains.

Broadly speaking these minor defects can be addressed through altering in-crop management and handling practices, early identification of pests and establishing effective control methods and post-harvest handling and packing procedures.



Abrasion damage



Damage caused by flower rub (insert bag rub)

[Previous](#)

[Next](#)

## Abrasion and rub

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**Dry, brown and calloused to fresh, wet appearing, black patches on the peel. Caused by rubbing of bract, flower tip, leaf, bag or adjacent fruit against the peel or poor post-harvest handling.**

Abrasion and rub damage to fruit was the most common minor defect identified during the study. An accurate assessment of the reasons for abrasion and rub damage in your paddock will help guide which strategies are appropriate to reducing its impact.



Damage caused by Flower thrips



Damage caused by Rust thrips

[Previous](#)

[Next](#)

## Thrips damage

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The damage caused by Flower and Rust Thrips can be significant. It was the second most common minor defect found during the packed product analysis. Effective management of these pests is possible through consistent crop monitoring and putting in place effective control strategies.





Damage causing bruising

## Bruising

**Occurs when enough impact or compression forces are applied to fruit. Appears as a flat, sunken or partially broken area of peel which will darken and become increasingly obvious as fruit ripens.**

Bruising proved to be a very common minor defect identified in this study and can be reduced by evaluating and adapting post-harvest handling strategies and equipment.

There are a broad range of reasons why physical damage may occur to bunches, such as abrasion, bruising, rub and dry scars. Some of these may be easily avoided and there are others that cannot be prevented. Rub, abrasion and dry scars caused by wind are not easily preventable. However, the use of clips-slips can be used to improve fruit quality, by placing between hands to reduce abrasion and rub of the bract, flower tip or adjacent fruit against the peel. Undertaking a cost-benefit analysis on the use of clips-slips may be a worthy exercise for the subtropical banana industry, as higher prices for blemish free fruit may very well outweigh the cost of use.

Post-harvest handling is one area where small changes to equipment, techniques or practices can have large impacts on fruit quality. Changes to post-harvest handling on your farm should be investigated to determine whether small, cost-effective changes can



be easily implemented to help decrease defects, increasing quality and ultimately profitability.

Thrips damage was the second most common minor defect found in this study and included damage from rust thrips and flower thrips, including corky scab. Effective management of these pests is possible through consistent crop monitoring and putting in place effective control strategies. Monitoring and control strategies for thrips species vary and should be tailored to your specific conditions before being applied on-farm.

Sap stains are another minor defect that can be easily addressed with changes to post-harvest handling techniques and equipment. Packing too quickly, allowing de-handled clusters to sit for too long, failing to wash fruit in a trough and a lack of paper/plastic sheets between fruit in cartons are a few factors that can increase the likelihood of sap stains. These can be addressed simply by training fruit packers or making changes to equipment and packing processes. Watch the '[Developing a standard industry banana carton](#)' video for some handy information on best practice packing standards.

*\*Fruit in this study was assessed against the most recently released Woolworths subtropical Cavendish produce specifications, issued 9 December 2014. Always make sure you're referring to the latest specifications relevant to your business.*

## More information...

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- [Subtropical packed product analysis](#)
- [Major defects](#)

### Video – Developing a standard industry banana carton

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# Subtropical banana reject analysis

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 [betterbananas.com.au/2020/05/22/subtropical-banana-reject-analysis/](https://betterbananas.com.au/2020/05/22/subtropical-banana-reject-analysis/)

## What causes fruit to be rejected?

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Having less reject fruit, and consequently more marketable fruit, is a priority for many subtropical banana growers. To achieve this, the first step is to understand the causes of rejects before fruit leaves the farm gate. By identifying the main reasons for fruit rejection, we can focus our efforts on addressing the most common and impactful quality issues faced by growers.

## About the study

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In a study carried out in the subtropical growing regions of NSW and WA, reject fruit was collected from 16 NSW packing sheds and 6 WA growers. Fruit was assessed to determine why the grower had thrown them into the reject pile. Growers included in the study were located from Coffs Harbour in the south through to Tweed Heads in northern NSW and in Carnarvon in WA. Varieties assessed in the study included Cavendish, Lady Finger, Ducasse and Little Gem. This article will focus on the results for Cavendish and Lady Finger due to their dominance in the industry. A total of 3469 Cavendish and 1189 Lady Finger fruit that did not make the grade were evaluated over the course of the study between June 2018 and May 2019.



Reject fruit collected from growers was evaluated and categorised into 1 of 36 different defect type categories

Reject fruit were assessed and separated into three general defect categories; Pre-harvest physical defects, pest and disease related defects and post-harvest physical defects. These three defect categories were further broken into 36 different defect types which are listed in the table below.

The results of this study, in addition to discussion with growers, will assist the industry in prioritising research, development and extension activities most beneficial for increasing fruit quality and profitability in subtropical growing regions.

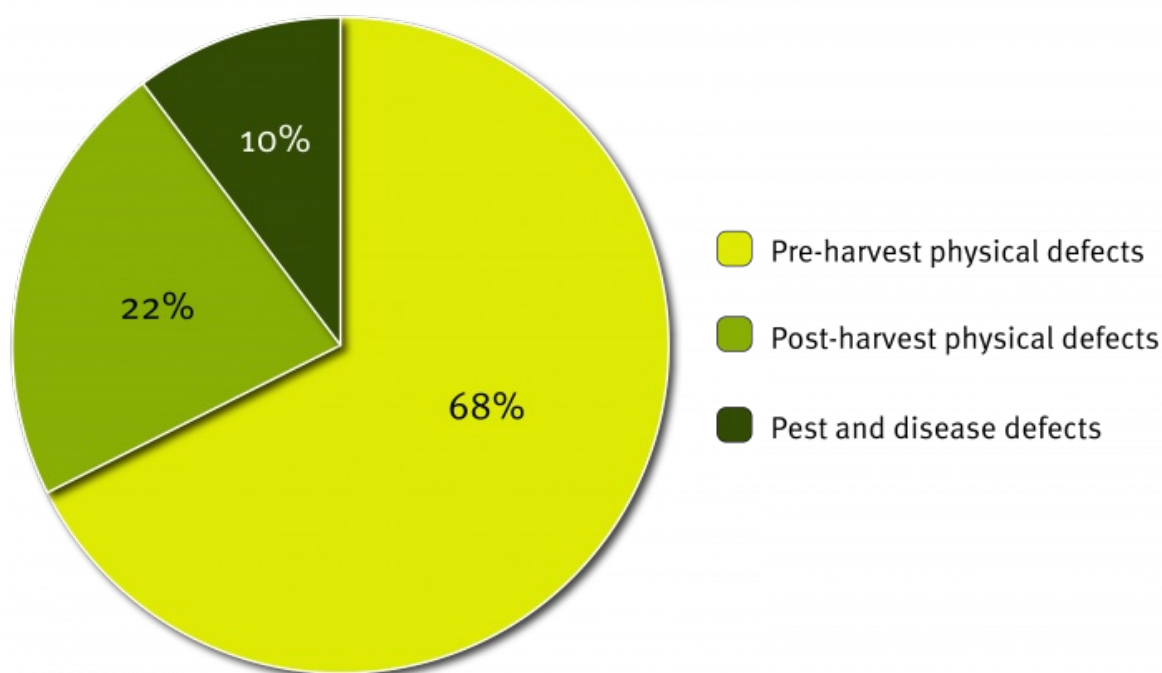
Defect Type	Defect Category		
	Pre-harvest physical defects	Pest and disease defects	Post-harvest physical defects
	Animal damage	Caterpillar damage	Bruising
	Bell injection damage	Cigar end rot	De-handing damage
	Blemish/dry scars	Corky scab	Mechanical damage
	Doubles/fused	Flower thrips	Neck damage
	Early ripening	Fruit spotting bug	Over grading
	Immature fruit	Grasshopper	Sap stains
	Maturity bronzing	Mite	
	Misshapen fruit	Mokillo	
	November dumps	Rust thrips	
	Pruning damage	Scab moth	
	Rat damage	Silvering thrips	
	Rub	Soldier fly	
	Skin latex scald	Speckle	
	Split fruit	Sugarcane bud moth	
	Spray burn		
	Sunburn		

Defect categories and defect types assessed during the reject analysis

## Let's take a look at the results...

To begin with, let's look at which defect categories the reject fruit fell into for both Cavendish and Lady Finger bananas. This will help us determine whether most of the fruit damage is occurring pre-harvest, post-harvest or as a result of pest and disease damage.

From the graph below we can see that for both Cavendish and Lady Finger most defects are associated with pre-harvest physical defects (68%), with post-harvest physical defects (22%) and pest and diseases defects (10%) following in that order. Based on this we can conclude that **pre-harvest physical defects** accounted for the majority of rejections and that concentrating resources on addressing these defects could result in the greatest gains.



Proportion of rejects that fall within the three defect categories

The table below combines the reject data for both Cavendish and Lady Finger and ranks the 15 most prevalent defect types. Rows are colour coded to indicate which category the defect types fall under.

Defect Type	No. of fruit affected	Percentage of total rejected fruit
Misshapen	755	15.00%
Rub	640	12.71%
Bruising	481	9.56%
Animal damage	362	7.19%
Immature fruit	338	6.71%
Doubles/fused	276	5.48%
De-handing damage	239	4.75%
Split fruit	175	3.48%
Blemish/dry scars	168	3.34%
Mechanical damage	166	3.30%
Sunburn	161	3.20%
November dumps	153	3.04%
Pruning damage	153	3.04%
Rust thrips	132	2.62%
Neck damage	96	1.91%

The 15 most prevalent defect types from the combined Cavendish and Lady Finger reject data

It must be noted that the high proportion of rejects resulting from misshapen fruit for both Cavendish and Lady Finger bananas is believed to be associated with the dry conditions experienced across the NSW growing regions during the study. Further reject analyses under 'normal' growing conditions or over a longer period would need to be

undertaken to confirm this result.

Now let's take a closer look at which defect types were most common for both Cavendish and Lady Finger bananas. By examining the results in more detail, we will be able to determine which of the defect types are responsible for the largest proportion of reject fruit. Growers are then able to use this list to focus their efforts on specific causes of defects that could offer the greatest reduction in rejects for the smallest effort or cost.



This image provides an example of misshapen Lady Finger fruit evaluated in the study

## More information...

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A poster is now available showing common quality issues and packing guidelines for subtropical banana growers. To receive a hard copy or for more information contact NSW DPI Industry Development Officer Tom Flanagan on (02) 6626 1352 or email [tom.flanagan@dpi.nsw.gov.au](mailto:tom.flanagan@dpi.nsw.gov.au)



# Common Banana Quality Issues



**1. Pesticide Marks**  
White powdery residue on the surface of the peel from fungicide or insecticide applications. Caused by failing to properly wash fruit.



**2. Misshapen Fruit**  
Finger with an irregular shape including fruit that is too straight or curved, tapered or pinched. No disease caused or fixed fruit.



**3. Cut/Hole/Puncture**  
Physical damage that is deep enough to expose pulp. This may be caused by a knife, pin, insect, or insect.



**4. Cigar End Rot**  
Fungal disease dry rot at the flower tip and of the finger with infection extending to 10-20 mm into fruit. A black area is developed, becoming more white due to bacteria reabsorbing ash on the end of a finger.



**5. Neck Damage**  
Minor neck cracking that does not break the skin resulting from handling or bending during post-harvest handling and packing. This damage becomes darker over time.



**6. Flower Thrips**  
Dry lesions on the surface of young fruit results in scarring which is more visible on the green fruit. Scarring may become necrotic as fruit matures but if damage is severe, it may result in fruit being classed as defective.



**7. Corky Scab**  
Scarring from feeding by Flower Thrips results in slightly raised dry lesions to grey or black on the skin. This develops into corky brown raised lesions on the peduncle and neck, but may be present on other areas.



**8. Rust Thrips**  
Reddish brown discoloration of the peel, which may become dark brown to black over time. Occurs between the fingers but swelling damage may cover a large area of the fruit surface and cause superficial cracks in the peel.



**9. Animal Scratches**  
It scratches and superficial punctures caused by a bird or bat landing on the bunch to feed on flower nectar.



**10. Caterpillar Damage**  
Angular, smooth or slightly brown, superficial scarring of fruit, often accompanied by holes and stems. Caused by the larval stage of various moths grazing on fruit peel.



**11. Soldier Fly Damage**  
Shallow dark brown circular scarring caused by larvae feeding on the peel just after harvest or on green ripening fruit. The larvae are not visible on the peel and the damage is not associated with the eggs during laying.



**12. Sap Stains**  
Light brown to black marking as a result of sap not being washed off fruit after harvest or from sap pooling in the bottom of a carton.



**13. Abrasion and Rub**  
Dry, brown and coloured to black, wet scuffing, black scuffing on the peel. Caused by rubbing of fruit, finger tips, wet fruit or damaged fruit against the peel or poor post-harvest handling.



**14. Bruising**  
Occurs when enough impact or compression forces are applied to fruit. Appears as a flat, sunken or partially broken area of peel which will darken and become increasingly obvious as fruit ripens. Indirectly caused by poor post-harvest handling.



**15. Maturity Bronzing**  
Brown to brown discoloration of mature bananas with these colored, slightly peel. Unusually remains regarding the cause of this pre-harvest condition.

## Fruit Defect Type and Packing Tolerance

GENERAL APPEARANCE	
DEFECT	DEFECT TOLERANCE*
1. Pesticide mark	None allowed
2. Misshapen fruit	Max 10% of fruit sampled
MAJOR DEFECT (Total major defects must not exceed 2% of total fruit sampled)*	
DEFECT	DEFECT TOLERANCE*
3. Cut/Hole/Puncture	Any finger affected will qualify the whole cluster as major defect
4. Cigar End Rot	
MINOR DEFECT (Total minor defects must not exceed 10% of total fruit sampled)*	
DEFECT	DEFECT TOLERANCE*
5. Neck Damage	1 finger per cluster
6. Flower Thrips	Greater than 4 fingers affected will qualify the whole cluster as minor defect
7. Corky Scab	
8. Rust Thrips	
9. Animal Scratches	
10. Caterpillar Damage	Less than 4 cm <sup>2</sup> /cluster
11. Soldier Fly Damage	
12. Sap Stains	
13. Abrasion and Rub	Less than 8 cm <sup>2</sup> /cluster
14. Bruising	
15. Maturity Bronzing	Less than 8 cm <sup>2</sup> /cluster

## Defect Area



## Cluster Characteristics

CLUSTER SIZE	Defined as having 3 to 8 fingers
FINGER LENGTH	To determine the banana length correctly, measure the outer curvature of the finger from pulp to pulp.  Close your carton length measurement to match the banana length.
FINGER GIRTH	Using callipers, measure at right angles to the curve of the fruit at a point one-third from the flowering end.  Close your carton girth measurement to match the banana girth.
CARTON WEIGHT	Gross carton weight must allow for moisture loss and weight of the carton.  Below is a guide to gross cartons in kilograms for 10 kg of bananas: Carton Style      Gross Weight Flat pack non folded      13.855 kg Flat pack folded      14.505 kg Corner pack non folded      13.775 kg Corner pack folded      13.405 kg *Always use a gross weight to calculate net weight. The defect specifications outlined are based on the World Health Organisation's Food and Drug Administration (FDA) standards.

NSW DPI would like to acknowledge all growers who agreed to participate in the study, Matt Weinert, Leanne Davis from NSW DPI and Valerie Shrubbs, Anastasia Van Blommestein and Brett Renton from WA DPIRD for undertaking the research.

This research has been funded as part of the Subtropical Banana Development and Extension Program (BA16007), which is funded by Hort Innovation, using the banana research and development levy and co-investment from the New South Wales Department of Primary Industries and WA Department of Primary Industries and Regional Development. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

**Hort  
Innovation**  
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Regional Development





Department of  
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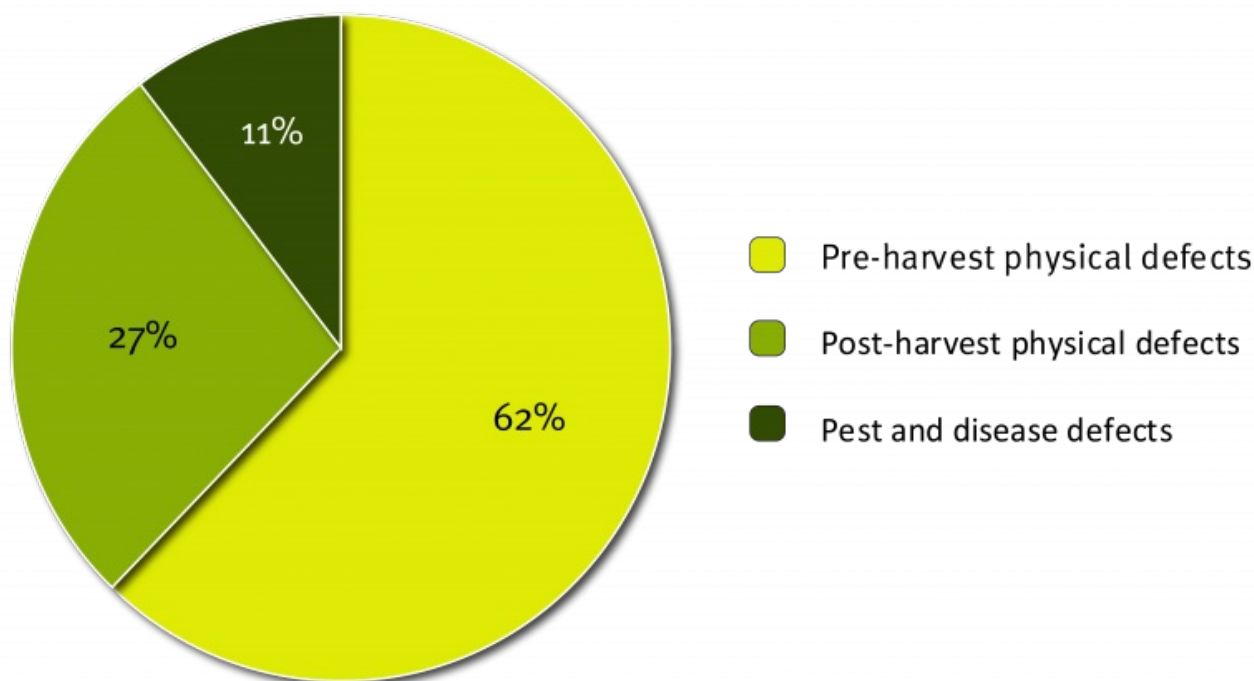
# Results for Cavendish rejects – Better Bananas

[betterbananas.com.au/2020/05/24/results-for-cavendish-rejects/](https://betterbananas.com.au/2020/05/24/results-for-cavendish-rejects/)

## Results for Cavendish fruit rejects

### *Subtropical banana reject analysis*

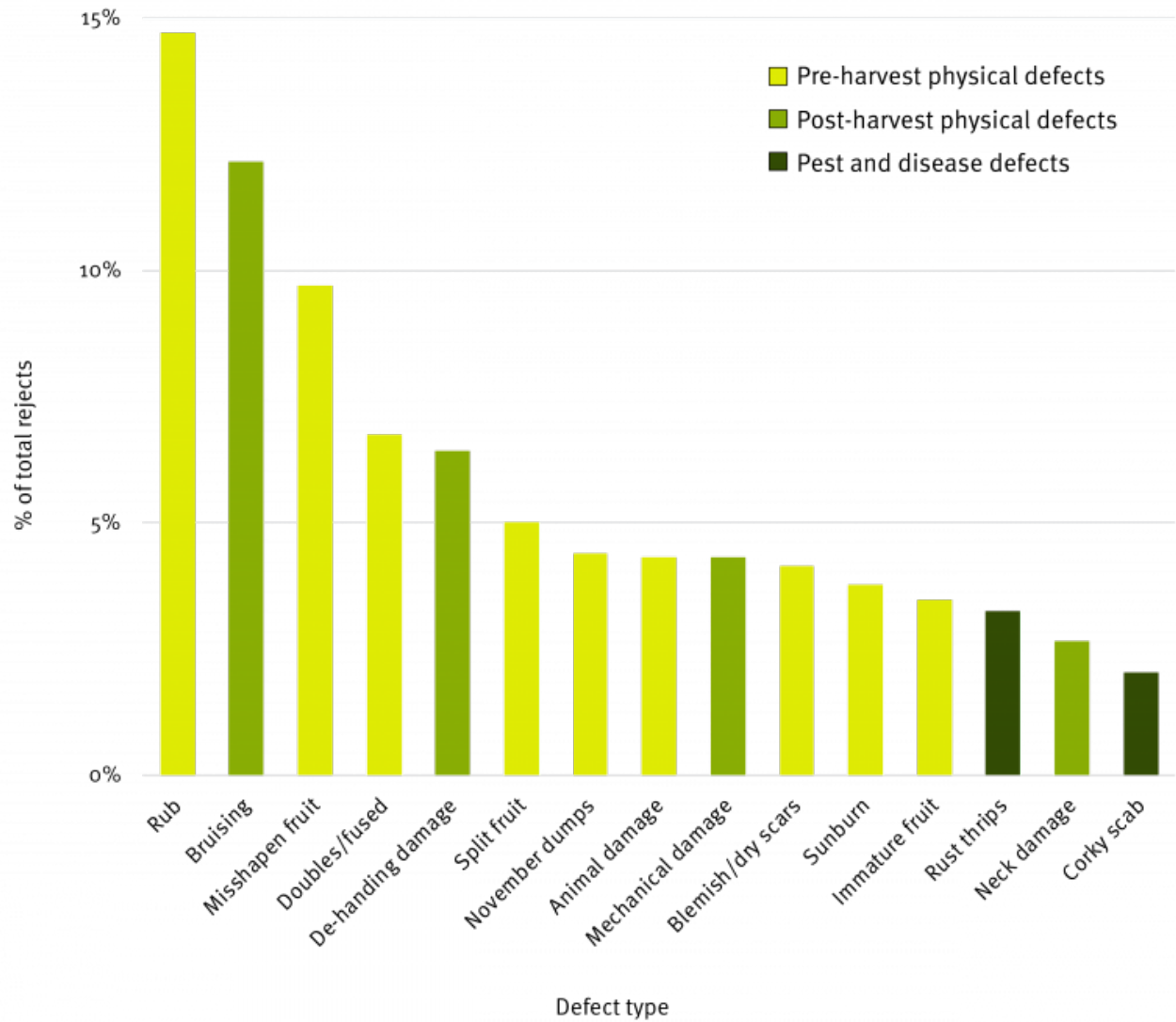
The following are the results for reject Cavendish fruit, assessed as part of the Subtropical Banana Reject Analysis. The figure below shows the proportion of reject Cavendish fruit that fell into each of the three defect categories. As you can see 62% of all reject Cavendish fruit was due to pre-harvest physical defects. This was a far greater percentage than either post-harvest defects (27%) or pest and disease defects (11%). This gives us a good indication where the majority of the damage is occurring and highlights an opportunity for growers to greatly reduce rejects by addressing pre-harvest physical defects.



Proportion of Cavendish fruit rejects that fall within the three reject categories

Although this chart provides us with a start, it does not give us the most complete picture. It does not tell us which specific defect types are causing the most rejects or where best to focus efforts to reduce the number of reject fruit. Taking a closer look, the graph below shows the 15 most common defect types in descending order from left to right across all three defect categories, which accounted for 90% of all reject Cavendish fruit in the study.

## Most common defects for reject Cavendish fruit



Proportion of defect types contributing to Cavendish fruit rejects across all three defect categories

□

Bruising of fruit is mainly caused through poor post-harvest handling and was one of the most common reasons for the rejection of fruit by growers



Damage caused by the rubbing of fruit against bags, bracts or other fruit accounted for a large proportion of the rejected fruit assessed in the study

It must be noted that the high proportion of rejects resulting from misshapen fruit is believed to be associated with the dry conditions experienced across the NSW growing regions during the study. Further reject analyses under 'normal' growing conditions or over a longer period would need to be undertaken to confirm this result.

Within this list there are some defect types that can be relatively easily improved with changes to pre or post-harvest practices, such as bruising and de-handing damage. Some other defects such as misshapen fruit, fused fruit and November dumps are caused or attributed to factors that we have limited control over (e.g. environmental conditions). This list provides us with the information we need to be able to prioritise the development of research, development and extension activities aimed at reducing Cavendish rejects in the subtropics.

## More information...

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- [Subtropical banana reject analysis](#)
- [Results for Lady Finger fruit rejects](#)

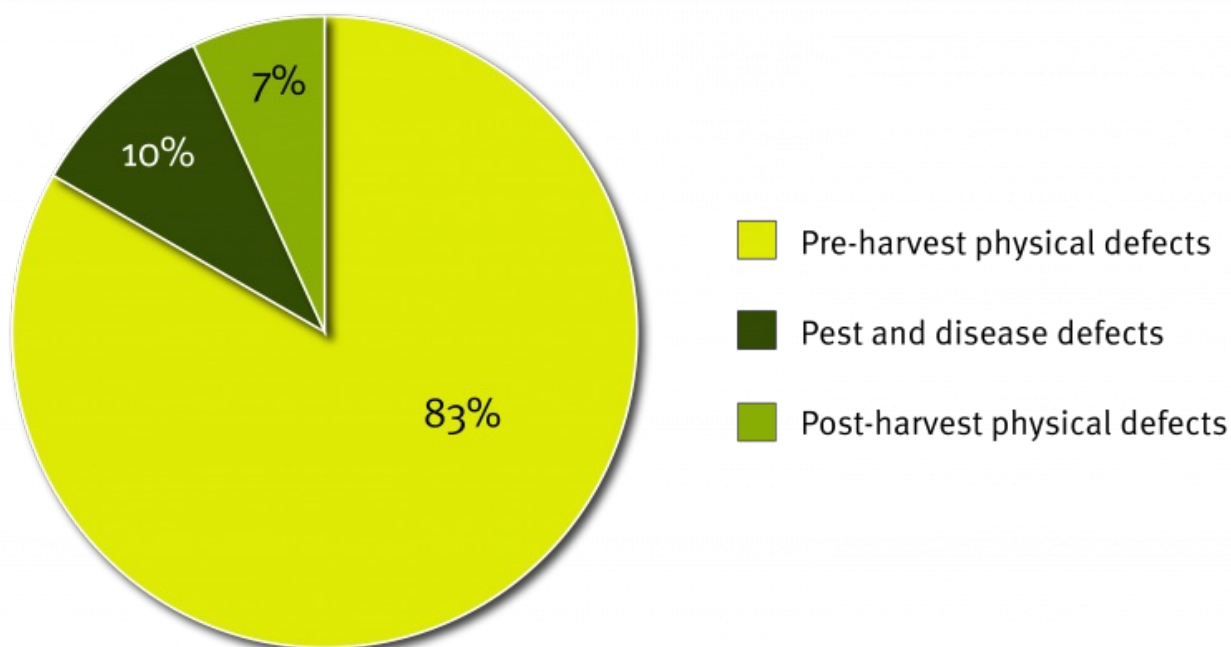
A poster is now available showing common quality issues and packing guidelines for subtropical banana growers. To receive a hard copy or for more information contact NSW DPI Industry Development Officer Tom Flanagan on (02) 6626 1352 or

# Results for Lady Finger fruit rejects

[betterbananas.com.au/2020/05/25/results-for-lady-finger-fruit-rejects/](https://betterbananas.com.au/2020/05/25/results-for-lady-finger-fruit-rejects/)

## *Subtropical banana reject analysis*

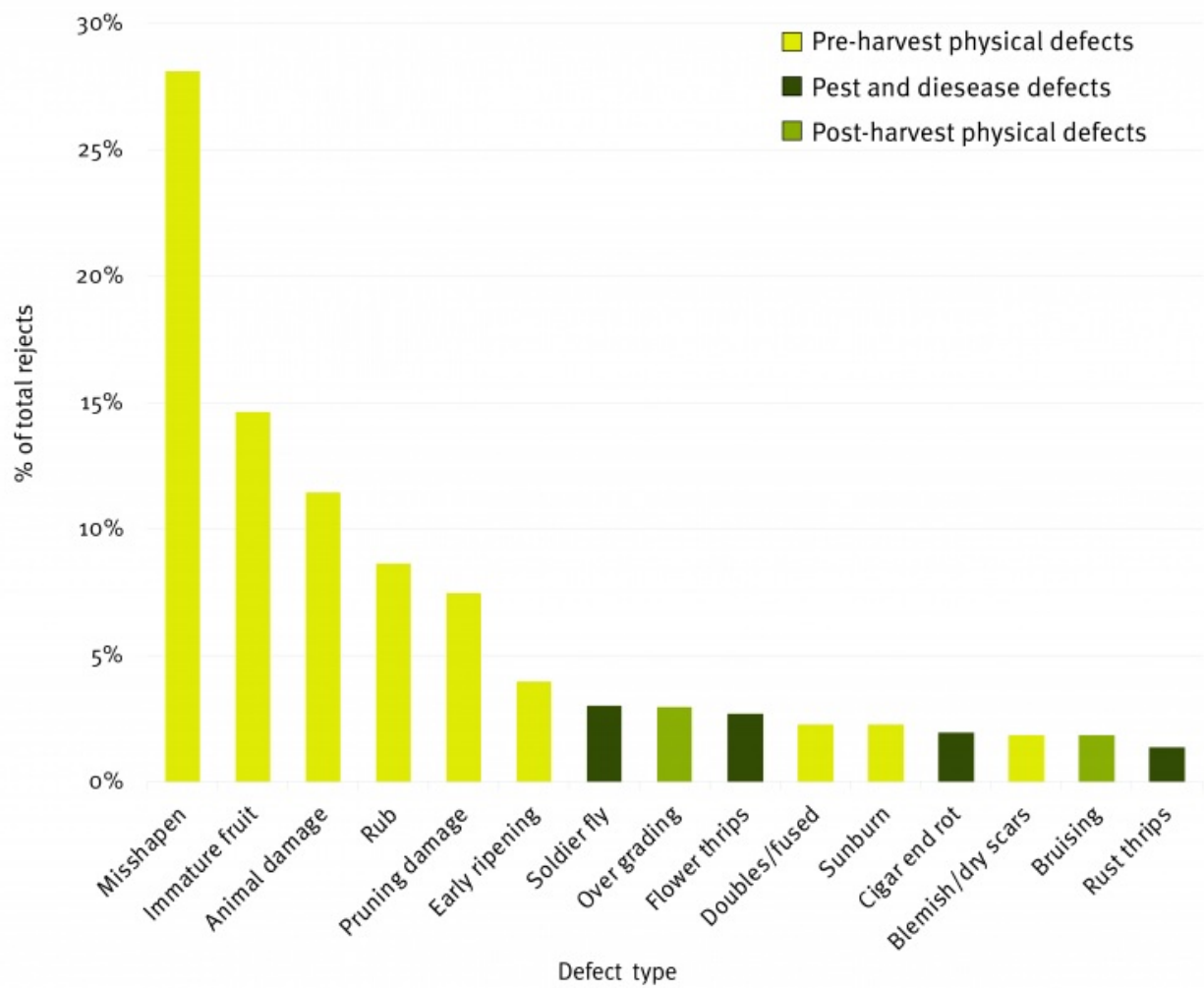
The following are the results for reject Lady Finger fruit assessed as part of the Subtropical Banana Reject Analysis. The figure below shows the proportion of reject fruit that fell within each of the defect categories. As can be seen, pre-harvest physical defects were responsible for the rejection of 83% of all Lady Finger fruit assessed. Pest and disease defects accounted for 10%, whilst post-harvest defects were the cause of 7% of reject fruit. As was the case with results from the Cavendish assessment, pre-harvest defects again offers the greatest opportunity for improving fruit quality and reducing the number of rejected fruit.



Proportion of Lady Finger fruit rejects that fall within the three defect categories

Let's take a closer look at the defect types resulting in the rejection of Lady Finger bananas. The graph below shows the 15 most prevalent defect types resulting in rejection of Lady Finger bananas. In descending order from left to right they account for almost 90% of all reject fruit for this variety. Again, there are several defects that cannot be prevented or doing so would require too much time and resources to make it financially beneficial. For example, misshapen fruit and doubles or fused fruit cannot be prevented to a large degree as they are caused by factors beyond our control. However, animal damage, rub, pruning damage and damage caused by bunch pests are issues that could be addressed through changes to on-farm practices.

### Most common defect types for reject Lady Finger fruit



Proportion of defect types contributing to Lady Finger fruit rejects across all three defect categories





Animal damage was one of the largest causes of fruit rejection, contributing significantly to the total number of defects found for both Lady Finger and Cavendish fruit



The image provides an example of misshapen Lady Finger fruit evaluated in the study



The damage caused by Rust Thrips can be significant, highlighting the importance of having effective management strategies in place to manage this bunch pest

It is worth noting that misshapen fruit occurs more commonly in Lady Finger than Cavendish due to varietal differences in fruit development. However, it is believed that the dry conditions experienced across the NSW growing regions during the study



significantly worsened the problem, contributing to the high proportion of rejects resulting from misshapen fruit. Further reject analyses under 'normal' growing conditions or over a longer period would need to be undertaken to confirm this result.

The aim of this reject analysis study was to identify the predominant causes for rejection of fruit by growers within our subtropical banana growing regions. With a better understanding it will now allow resources to be best prioritised to address, demonstrate &/or trial innovative practices to reduce these defects. Overall reducing the quantity of fruit rejected through the implementation of cost effective practices will increase profitability.

## More information...

- [Subtropical banana reject analysis](#)
- [Results for Cavendish fruit rejects](#)

A poster is now available showing common quality issues and packing guidelines for subtropical banana growers. To receive a hard copy or for more information contact NSW DPI Industry Development Officer Tom Flanagan on (02) 6626 1352 or email [tom.flanagan@dpi.nsw.gov.au](mailto:tom.flanagan@dpi.nsw.gov.au)

# Common Banana Quality Issues

**1. Pesticide Marks**  
Yellow circular marks on the surface of the peel from two-faced chemical sprays. No damage to the fruit.

**2. Misshapen Fruit**  
Finger with an irregular shape, including fruit that is too short or too long, or too thick or too thin. No damage to the fruit.

**3. Cut/Hole/Puncture**  
Physical damage to the peel caused by a knife, animal, bird or insect. No damage to the fruit.

**4. Cigar End Rot**  
Fungus caused by rot at the base of the finger, often appearing as a dark, sunken area. No damage to the fruit.

**5. Neck Damage**  
Minor neck cracking that does not break the skin, resulting from bending or bending during ripening. No damage to the fruit.

**6. Flower Thrips**  
Egg laying on the surface of young fruit results in staining and dark, sunken areas. No damage to the fruit.

**7. Corky Scab**  
Scoring from feeding by flower thrips results in slightly raised, brown, scaly areas on the peel. No damage to the fruit.

**8. Rust Thrips**  
Reddish brown discoloration of the peel, which may become dark brown to black over time. No damage to the fruit.

**9. Animal Scratches**  
Scratches and superficial punctures caused by a bird or cat landing on the bunch to feed on flower nectar. No damage to the fruit.

**10. Caterpillar Damage**  
Irregular, smooth or scaly brown superficial staining of fruit, often accompanied by holes and frass. No damage to the fruit.

**11. Soldier Fly Damage**  
Shallow dark brown cracked scarring caused by larvae feeding on the peel. No damage to the fruit.

**12. Sap Stains**  
Light brown to black staining as a result of sap not being washed off fruit after harvest or from sap oozing in the bottom of a carton. No damage to the fruit.

**13. Abrasion and Rub**  
Dry, brown and calloused to flesh, wet scuffing, black staining on the peel. No damage to the fruit.

**14. Bruising**  
Occurs when a rough impact or compression force is applied to fruit. No damage to the fruit.

**15. Maturity Bronzing**  
Brown to brown discoloration of mature bananas with thin, cracked, scaly peel. No damage to the fruit.

### Fruit Defect Type and Packing Tolerance

DEFECT	DEFECT TOLERANCE*
1. Pesticide marks	None allowed
2. Misshapen fruit	Max 10% of fruit sampled
<b>MAJOR DEFECT (Total major defects must not exceed 10% of total fruit sampled)*</b>	
3. Cut/Hole/Puncture	Any finger affected will qualify the whole cluster as major defect
4. Cigar End Rot	Any finger affected will qualify the whole cluster as major defect
<b>MINOR DEFECT (Total minor defects must not exceed 10% of total fruit sampled)*</b>	
5. Neck Damage	1 finger per cluster
6. Flower Thrips	Greater than 2 fingers affected will qualify the whole cluster as minor defect
7. Corky Scab	Less than 4 cm <sup>2</sup> /cluster
8. Rust Thrips	Less than 4 cm <sup>2</sup> /cluster
9. Animal Scratches	Less than 4 cm <sup>2</sup> /cluster
10. Caterpillar Damage	Less than 4 cm <sup>2</sup> /cluster
11. Soldier Fly Damage	Less than 4 cm <sup>2</sup> /cluster
12. Sap Stains	Less than 4 cm <sup>2</sup> /cluster
13. Abrasion and Rub	Less than 4 cm <sup>2</sup> /cluster
14. Bruising	Less than 4 cm <sup>2</sup> /cluster
15. Maturity Bronzing	Less than 4 cm <sup>2</sup> /cluster

### Defect Area

4 cm<sup>2</sup> 4 cm<sup>2</sup>  
6 cm<sup>2</sup> 6 cm<sup>2</sup>  
8 cm<sup>2</sup> 8 cm<sup>2</sup>

1:8 scale representation of large subtropical Cavendish bananas measuring 220 mm (length) and 32 mm (girth) overlaid with defects areas.

### Cluster Characteristics

**CLUSTER SIZE** Defined as having 3 to 8 fingers

**FINGER LENGTH** To determine the banana length, or width, measure the outer curvature of the finger from pulp to pulp.

**FINGER GIRTH** Using callipers, measure at right angles to the curve of the fruit at a point one-third from the flowering end.

**CARTON WEIGHT** Gross carton weight must allow for moisture loss and weight of the carton. Net weight is a guide to the weight of the fruit.

Carton Style	Gross Weight
Flat pack non folded	13.85 kg
Flat pack folded	14.25 kg
Corner post non folded	12.75 kg
Corner post folded	13.65 kg



## BA16007 - subtropical Project Reference Group Meeting

**Date:** Thursday 28/03/19

**Time:** 3.00-4.00pm (NSW), 2.00-3.00pm (QLD) and 12.00-1.00pm (WA)

**Location:** Coffs Harbour, NSW DPI Office  
(Level 1, Forestry Corporation Building, 30 Park Avenue, Coffs Harbour,  
entrance off Gordon Street)

### Agenda items

1. Staff changes
2. Project progress
  - a. Milestone changes
    - i. Upcoming - MS104
  - b. Reject and packed product analysis update
  - c. Young growers group
  - d. Workshops
3. Carnarvon and Bundaberg project components
4. Project Budget
  - a. Underspend
5. Other items
  - a. Attendance at BGA meetings
  - b. Board visit to Coffs Harbour

### Milestones

#### Upcoming

104	31/05/2018	Reject analysis completed and results reported at industry workshop, workplan for the remainder of the project developed and approved by the PRG, demonstration trials commenced, 2018 roadshows in subtropical regions, subtropical NextGen growers exchange, attend BGA meetings, demonstration trials established, completed trials analysed and reported to PRG, 2019 industry congress, subtropical NextGen growers activity conducted	Second round of reject and downgrade analysis completed, data collated and presented to PRG, complete list of demonstration trials prioritized and developed, information shared with BA16001 to help prioritise project trials, and report written for banana industry media and proposed electronic portal, first demonstration trials established, assistance provided for 2018 roadshows in subtropical regions, attend BGA meetings, demonstration trials established and results of completed trials reports at biannual meeting and at the 2019 banana industry congress
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## Minutes

### BA16007 - subtropical Project Reference Group Meeting

Date: Thursday 28/03/19

Time: 3.00-4.00pm (NSW), 2.00-3.00pm (QLD) and 12.00-1.00pm (WA)

Location: Coffs Harbour, NSW DPI Office  
(Level 1, Forestry Corporation Building, 30 Park Avenue, Coffs Harbour,  
entrance off Gordon Street)

Dial in numbers: [1800 672 949](tel:1800672949) PIN 7539 0826 1222#

Attendees: Leanne Davis, Stephen Spear, Matt Weinert in Coffs Harbour  
Bianca Cairns, Tegan Kukulies, Rosie Godwin, Amy Spear, Paul Shoker  
dialled in

Apologies: Zac McKeever

### Agenda items

#### 1. Staff changes

- Leanne Davis has been employed as a technical assistant on a full time basis until November 2019 to replace Mick Davey who was employed part time in the project.
- This was made possible by the budget underspend from the project starting late and several months without anyone employed in the position.

#### 2. Project progress

##### Milestone changes

- As per the discussions at the September PRG, Milestones 103 and 104 were combined and the new milestone is due on 31/05/19. The milestone is included at the bottom of the page.
- At this stage we are on track to meet the majority of the milestone
- There are no standout issues to work with to instigate demonstration trials.
- There is a range of insect pest damage we could develop some extension materials with in conjunction with the national plant protection project, which currently has trials on bunch pests, grubs and thrips underway.
- Two abstracts, one for the packed product analysis (PPA) and one for reject analysis (RA) have been submitted for congress.
- IDO attended and presented at the two NSW and the Carnarvon roadshows
- IDO on 2019 Australian Bananas Congress organising committee.
- Reports on PPA and RA and a workplan for the remainder of the project will be submitted with the milestone

### Reject analysis

- Reports for the reject analysis and packed product analysis progress were sent out with the meeting agenda.
- Fruit of 14 different growers across the Richmond, Tweed, Coffs and Nambucca regions at 7 different time periods has been assessed. It's been difficult to get back to the same growers each time particularly due to the extremely dry conditions and a short supply of fruit.
- Having Leanne on board with her contacts in the Tweed region from working in the Bunchy Top project has made it easier for us to get fruit from the Tweed.
- 35 different reasons for fruit to be rejection have been identified. If the top 5 reasons for each grower only are included there are still 30 different reasons!
- The biggest issue seems to be rough handling or mechanical damage. It's sometimes difficult to determine exactly where the damage occurs by the time we get to look at the fruit.
- Miss-shapen fruit is a big issue and includes overly curved fruit from back hands (caused when bunches don't emerge properly, especially in Lady Fingers, and symptomatic of the dry conditions) and fruit with the pinched end.
- Determining a cause of the pinched end is difficult as multiple causes listed in the literature. Fruit was tested for element (nutrient) deficiencies – there were no differences – and for disease through the QDAF Mareeba Plant Pathology lab but came back negative.
- Soldier Fly seems to be an issue during the cooler months
- Thrips (flower, rust and scab) are also an issue, growers are reluctant to bell inject, partly because some sell bells. IDO has spoken to Richard Piper about Thrips management.
- There is some interesting information to develop some extension products, but don't really have enough data at the moment and we would like to continue the reject analysis, particularly with the growers we have already assessed.
- All growers will get a report that includes all the data and images for the reject analysis work we are doing and Leanne is well advanced with the format for this.

Stephen Spear suggested to conduct more RA and PPA to develop a seasonal summary of issues

### Packed product analysis

- Packed product analysis has only been undertaken at Golden Dawn in Coffs Harbour in September 2018 and February 2019 using Woolworths Coffs harbour specifications.
- PAA is time consuming, especially repacking the boxes without damaging fruit and limited by the fruit availability.
- Not been able to get access to ripened fruit from Tweed growers to assess
- 12 growers fruit analysed with 4 growers fruit done twice. In three of those 4 growers their fruit quality improved from September 2018 to February 2019



- A workshop was held on December 7th at Golden Dawn in Coffs with 20 growers in attendance. Stephen Spear commented the workshop was well attended and well received
- From the workshop it seems growers didn't actually know what specifications to pack to and there needs to be better packing specification information.
- Will continue the RA and PPA in early May.

Mark Hickey suggested to do RA and PPA on fruit harvested and packed on the same day to determine if there were similarities.

a. Young growers group

- Reasonable communication between the young growers through the Tweed BGA Face Book page and the Coffs young growers group, however this is definitely less during the busy summer period.
- We have a plan to take the growers to Tully show, July 27 and 28. There is definitely interest in this trip and we'd like to meet with the NQ NextGen group in the days before the show and Greg Bradshaw from PW Chew has agreed to help but waiting for congress to be over and the busy summer period before I progress this any further. Will discuss this with Tegan post congress.
- Airfare and accommodation would be subsidised, the extent would depend on numbers.
- Options to visit would be South Johnstone Research station to view variety trials and biosecurity procedures and attendees would be required to report back to their BGAs.

Tegan Kukulies commented that it is important to understand what growers want to get out of the trip and to have goals and this makes reporting easier.

Stephen Spear suggested the visit may need to visit the Atherton tablelands to see Lady Finger production and that making attendees report back to BGAs might be hard to enforce.

b. Workshops

- The packed product analysis workshop in Coffs on December 7 was well received.
- There was excellent support from Golden Dawn who have asked us to comment on a new product specification for Coffs fruit for Coles.
- A grower in the Richmond has built a new packing trailer with new pads and has reported significantly less reject fruit after this.

Stephen Spear commented that there was a good roll up and that growers took lots away. The difference between the NQ and Coffs fruit was stark as the Coffs fruit was quite dull.

3. Carnarvon and Bundaberg project components

- Bundaberg really is too problematic, it's just a long way to travel for limited results.
- PPA could be done on some Bundaberg fruit at Golden Dawn.

- For Carnarvon the project took a very long time to contract due to machinery of government changes post-election and Annie Van Blommestein who originally was going to undertake the work is on maternity leave.
- RA was undertaken at the sweeter banana in early March with rub, fused fruits and rough handling being the key issues.
- Two more rounds of RA will be undertaken in Carnarvon and we will assess the results.

#### 4. Project Budget

##### a. Underspend

- The budget is tracking well now that we've signed off on the variation and employed Leanne.

#### 5. Other items

##### a. Attendance at BGA meetings

- IDO attended the February Coffs and Nambucca BGA meetings and also the Tweed one on March 13.

##### b. Board visit to Coffs Harbour

- IDO facilitated I was the ABGC board visit to Coffs harbour.
- Stephen Spear commented that the trip went well and the board learned a lot

##### c. Coffs Bypass

- Inquiries re the effect of the Coffs Bypass have recommenced post the NSW election and this may end up taking a bit more of my time in the coming 12 months.

##### d. HARPS

- Stephen Spear asked about growers experience with HARPS in the different region and commented that some Coffs Growers won't undertake HARPS due to the expense.

- e. Stephen Spear asked about feeding bananas, treated with Protak (Prochloraz) fungicide to manage post-harvest rots, to cattle as it's listed on the label to not graze or feed clippings of turf sprayed with Protak to cattle. This will be followed up.

## Milestones

### Upcoming

104	31/05/2018	Reject analysis completed and results reported at industry workshop, workplan for the remainder of the project developed and approved by the PRG, demonstration trials commenced, 2018 roadshows in subtropical regions, subtropical NextGen growers exchange, attend BGA meetings, demonstration trials established, completed trials analysed and reported to PRG, 2019 industry congress, subtropical NextGen growers activity conducted	Second round of reject and downgrade analysis completed, data collated and presented to PRG, complete list of demonstration trials prioritized and developed, information shared with BA16001 to help prioritise project trials, and report written for banana industry media and proposed electronic portal, first demonstration trials established, assistance provided for 2018 roadshows in subtropical regions, attend BGA meetings, demonstration trials established and results of completed trials reports at biannual meeting and at the 2019 banana industry congress
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Matt Weinert



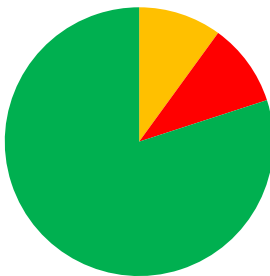
# Packed Product Analysis Report

Grower: [REDACTED]

Date: 18/09/2018

Variety: Cavendish clusters

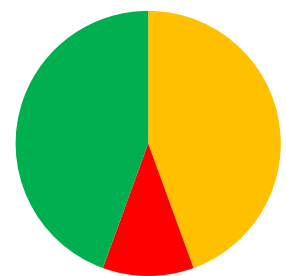
**Box 1**



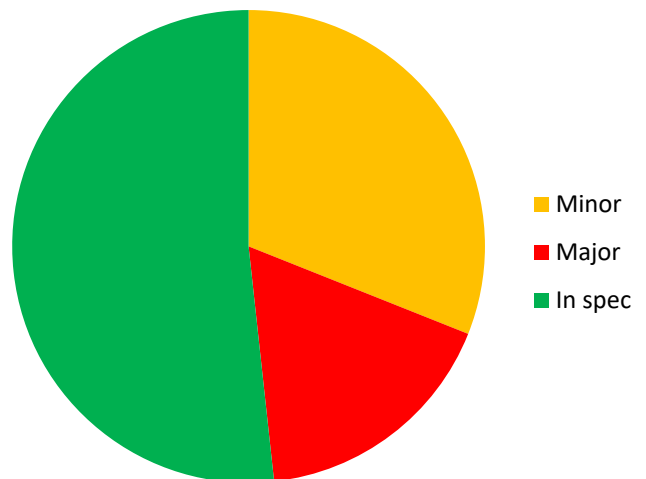
**Box 2**



**Box 3**



**Average Defects**



## **SUMMARY**

Over all 3 cartons: 50% of items are in spec. (90% required)

Individually: All 3 cartons are out of spec due to poor quality (and 1 with mixed maturity).

## **Important Issues**

Box 1 – Thrips

Box 2 – Blemish, cut, Thrips

Box 3 – Thrips, frass, mixed maturity



Thrips



Blemish, cut,  
Thrips



Thrips, frass,  
mixed maturity

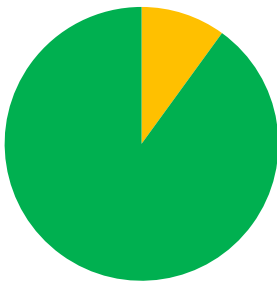
# Packed Product Analysis Report

Grower: [REDACTED]

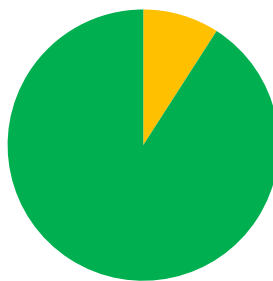
Date: 7/2/2019

Variety: Cavendish clusters

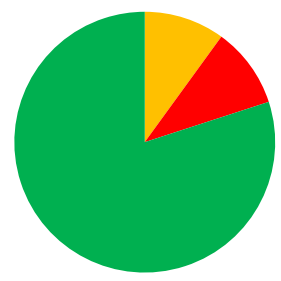
**Box 1**



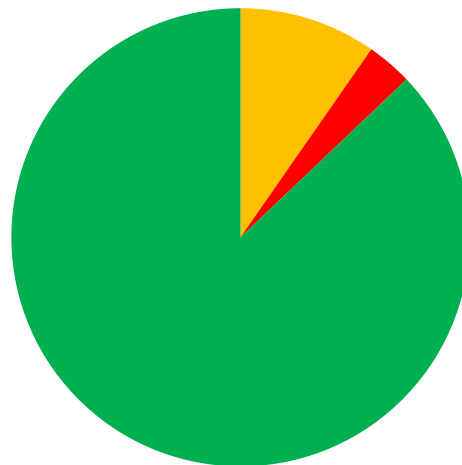
**Box 2**



**Box 3**



**Average Defects**



## **SUMMARY**

Over all 3 cartons: 87% of items are in spec.  
(90% required)

Individually: 1 carton is out of spec due to quality.

■ Minor  
■ Major  
■ In spec

## **Important Issues**

Box 1 – Abrasion, sap

Box 2 – Old scars, sap, cockroach egg

Box 3 – Sap, insect damage





Abrasion, sap



Sap,  
cockroach  
egg



Sap, insect  
damage

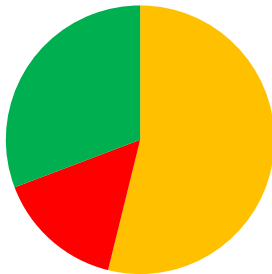
# Packed Product Analysis Report

Grower: [REDACTED]

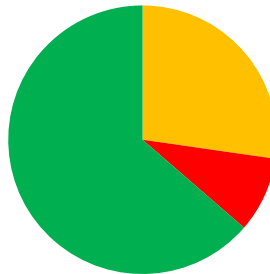
Date: 1/5/2019

Variety: Cavendish X-large clusters

**Box 1**



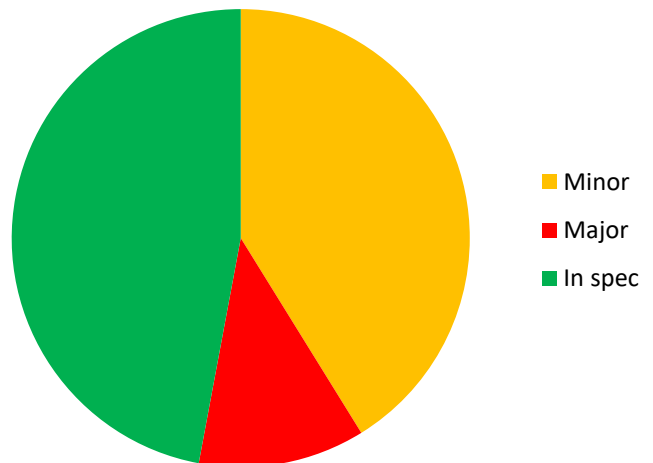
**Box 2**



**Box 3**



**Average Defects**



## SUMMARY

Over all 3 cartons: 48% of items are in spec. (90% required)

Individually: All 3 cartons are out of spec due to low quality and 1 is also due to being underweight.

## Important Issues

Box 1 – Sap, rub

Box 2 – Flower Thrips, sap

Box 3 – Sap, flower Thrips



Sap, rub



Flower  
Thrips, sap



Sap

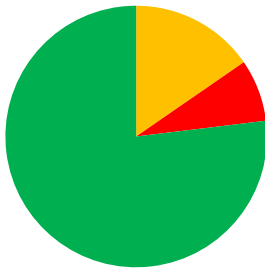
# Packed Product Analysis Report

Grower: [REDACTED]

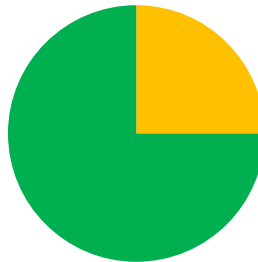
Date: 6/8/2019

Variety: Cavendish X-large clusters

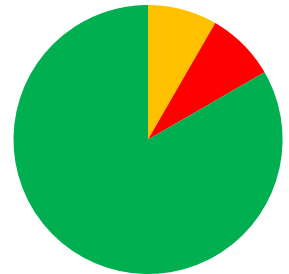
**Box 1**



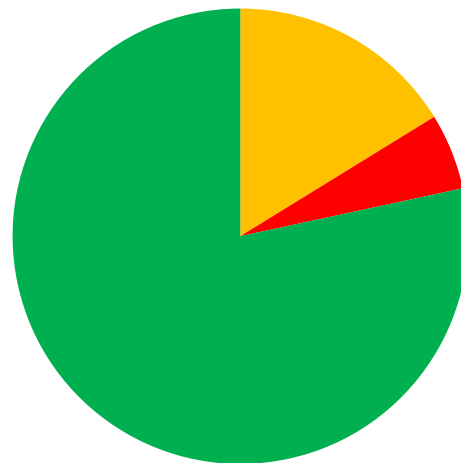
**Box 2**



**Box 3**



**Average Defects**



■ Minor  
■ Major  
■ In spec

## SUMMARY

Over all 3 cartons: 83% of items are in spec. (90% required)

Individually: All 3 cartons are out of spec due to low quality and boxes 1 and 3 are underweight.

## Important Issues

Box 1 – Abrasion, flower Thrips

Box 2 – Insect damage, abrasion

Box 3 – Insect damage, flower Thrips





Abrasion,  
flower Thrips



Insect  
damage,  
abrasion



Insect damage



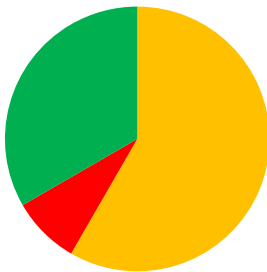
# Packed Product Analysis Report

Grower: [REDACTED]

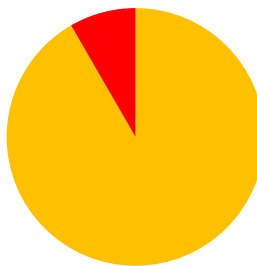
Date: 7/8/2019

Variety: Cavendish X-large clusters

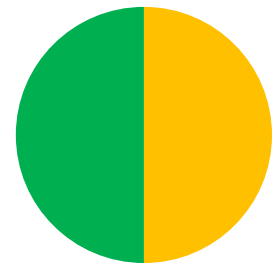
**Box 1**



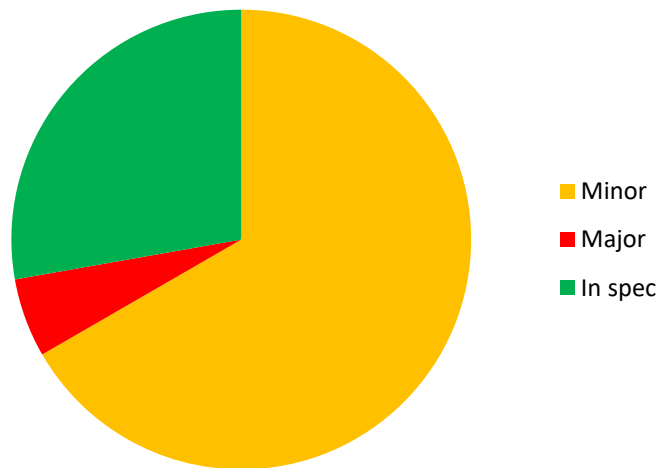
**Box 2**



**Box 3**



**Average Defects**



## SUMMARY

Over all 3 cartons: 29% of items are in spec. (90% required)

Individually: All 3 cartons are out of spec due to low quality (and boxes 1 and 2 are underweight).

## Important Issues

Box 1 – Insect damage and frass

Box 2 – Abrasions, insect frass

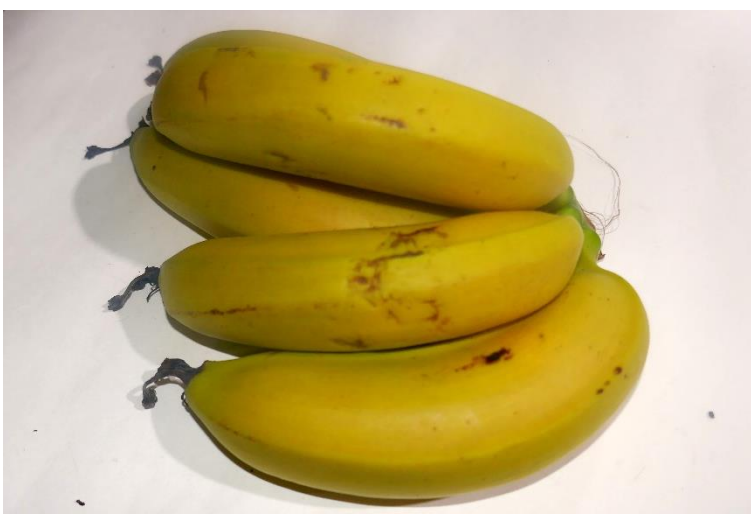
Box 3 – Abrasions, corky scab



Insect  
damage and  
frass



Abrasions,  
insect frass



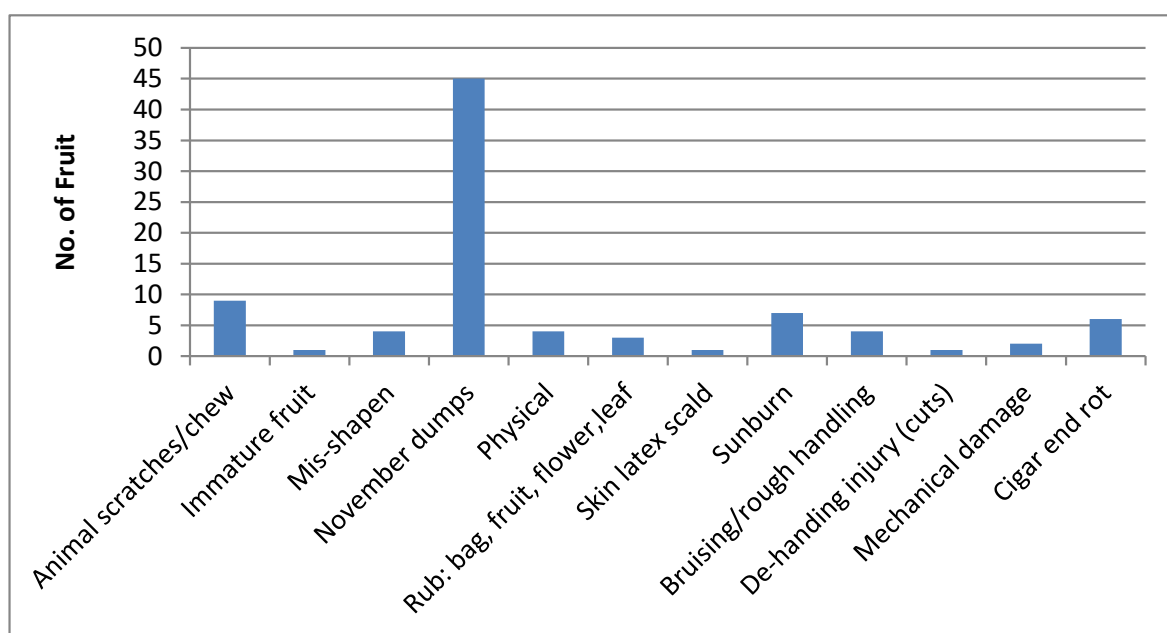
Abrasions,  
corky scab

## Reject Analysis Report 1 - 2019

Grower: XXXXXXXXXX  
 Date: 29/01/2019  
 Variety: Cavendish

	Reject Category	No. of fruit	% of total
Physical Pre Harvest defects	Animal scratches/chew	9	10.3%
	Immature fruit	1	1.1%
	Mis-shapen	4	4.6%
	November dumps	45	51.7%
	Physical	4	4.6%
	Rub: bag, fruit, flower,leaf	3	3.4%
	Skin latex scald	1	1.1%
	Sunburn	7	8.0%
Physical During or Post Harvest defects	Bruising/rough handling	4	4.6%
	De-handing injury (cuts)	1	1.1%
	Mechanical damage	2	2.3%
Insect/Biological defects	Cigar end rot	6	6.9%
Total		87	100%

Top 3 Reject Issues: **November dumps**  
**Animal scratches/chew**  
**Sunburn**



### Top 3 Reject Issues



**November dumps**



**Animal scratches/chew**



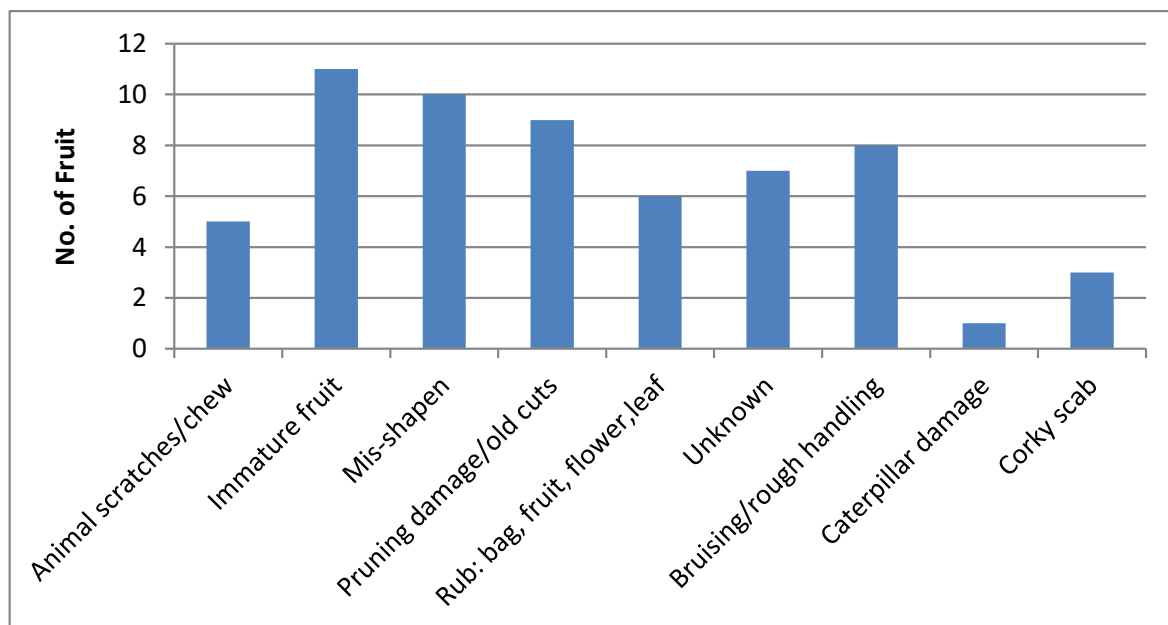
**Sunburn**

## Reject Analysis Report 1 - 2019 cont.

Grower: XXXXXXXXXX  
 Date: 29/01/2019  
 Variety: Ducasse

	Reject Category	No. of fruit	% of total
Physical Pre Harvest defects	Animal scratches/chew	5	8.3%
	Immature fruit	11	18.3%
	Mis-shapen	10	16.7%
	Pruning damage/old cuts	9	15.0%
	Rub: bag, fruit, flower, leaf	6	10.0%
	Unknown	7	11.7%
Physical During or Post Harvest defects	Bruising/rough handling	8	13.3%
Insect/Biological defects	Caterpillar damage	1	1.7%
	Corky scab	3	5.0%
Total		60	100.0%

Top 3 Reject Issues: **Immature fruit**  
**Mis-shapen**  
**Pruning damage/old cuts**





### Top 3 Reject Issues




**Immature fruit**



**Mis-shapen  
pinched**




**Pruning damage/old cuts**




Department of  
Primary Industries

# Coffs Harbour banana packed product analysis

Matt Weinert  
Leanne Davis



Strategic levy investment



1

## Thanks to

NSW DPI – Mick Davy  
NSW growers  
Golden Dawn – Geoff Bridgfoot, Paul Gibbins,  
Paul Thorburn, Kay Adriaansz  
D&D Ripeners – Dave Norberry

2

## What's the issue?

Poor quality fruit!

Knockbacks from retailers and loss of stores  
5 Coles stores lost recently with management  
changes

3

## Packed product analysis

Use the Woolworths Coffs Harbour specs


Unpack boxes and check if clusters are within specs  
3 cartons from growers prior to despatch from  
ripeners

Results presented today are anonymous

Initial data only


4

## Product specifications



**BANANA**  
Coffs Harbour  
Conventional Hybrid  
Ripened

**Produce Specifications**



**BANANA**  
Ripened  
Lady Finger  
One

**Produce Specifications**

5

## Key issues checked

MAJOR DEFECTS	
INSECTS	With obvious live insects or other pests.
DISEASES	With fungal diseases or soft rot or other diseases, black and red, brown rot.
PHYSICAL / PEST DAMAGE	With splits, holes, deep bruises or cuts through the peel into the pulp.
SKIN MARKS / BLEMISHES	With severe or numerous marks.
TEMPERATURE INJURY	With excessive scattered brown spots/leaves (senescent spotting). With dull, grayish, or blackened peel, or brown under-peel discoloration (chilling injury). With dark, water-soaked areas (freezing injury). With translucent pitting or blackening of skin, or translucent cores in fruit (heat damage).

MINOR DEFECTS	
PHYSICAL / PEST DAMAGE	With dry brown scab / speckling (insect damage); or with scars (due to hail, bird damage) affecting areas >2 sq cm (per cluster). With reddish-brown patches (Banana rust) affecting areas >2 sq cm (per cluster). With dark sap stains affecting >4 sq cm (per cluster).
PHYSIOLOGICAL DISORDERS	With reddish-brown discoloration >4 sq cm (maturity bronzing) (per cluster).
SKIN MARKS / BLEMISHES	With superficial bruises (<1mm deep), abrasion or rub damage (tan/brown/black) affecting >4 sq cm (per cluster).

6

Key issues checked

TOLERANCE PER CONSIGNMENT

Total minor defects (within allowance limit) to be < 2 defects per item
Total minor defects (outside allowance limit) must not exceed 10% of consignment.
Total major defects must not exceed 2 % of consignment.
Combined Total not to exceed 10%.

PACKAGING & LABELLING

Packaging as per Woolworths requirements.
Labelling to identify grower or agents name/brand (plus growers name/code if via an agent), address, contents, grade/class, size and minimum net weight.
Bulk Loose Product to identify 'Packed On' date (eg. Pled DCHMMYY) on outer carton, product not to exceed 15 days (ideal 14 days) from Date of Packing upon receipt.
Pre Packed Product to identify 'Best Before' date on retail unit and outer pack.
'Best Before' date not to exceed 10 days from date of packing while providing not less than 6 days clear shelf life prior to expiry date.

Blemish Measurement Guide

0.5 cm²

1 cm²

1.5 cm²

2 cm²

2.5 cm²

3 cm²

5"

12.00

10"

0

1

2

3

4

5

6

7

8

9

10

7

Grower 1

Box 1

Box 2

Box 3

Average

Minor

Major

In spec

Major Defects

deep cut/hole into pulp

abrasion/deep bruising

8

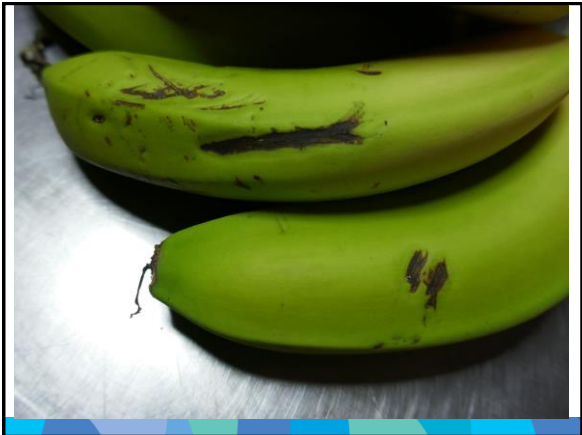
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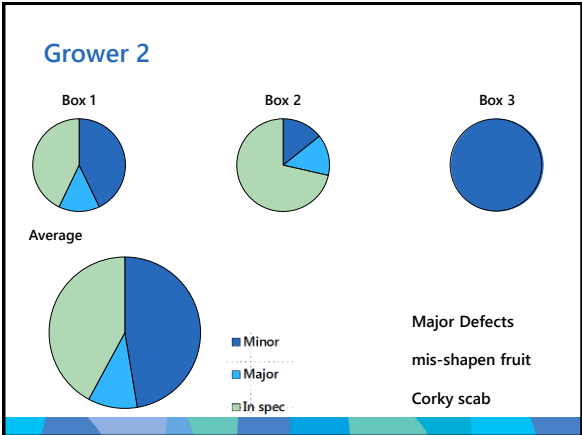
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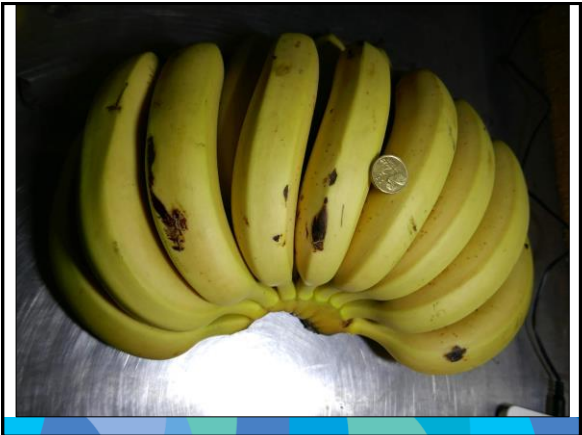
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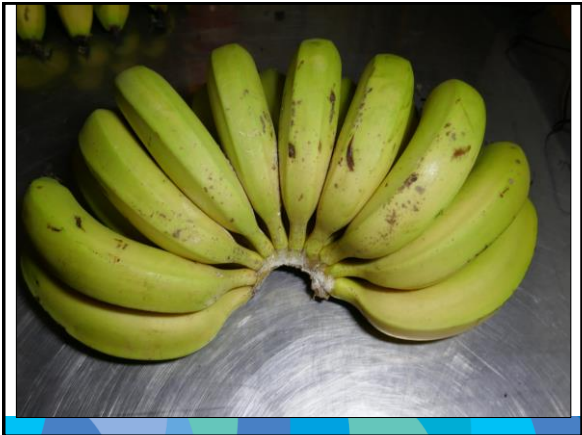
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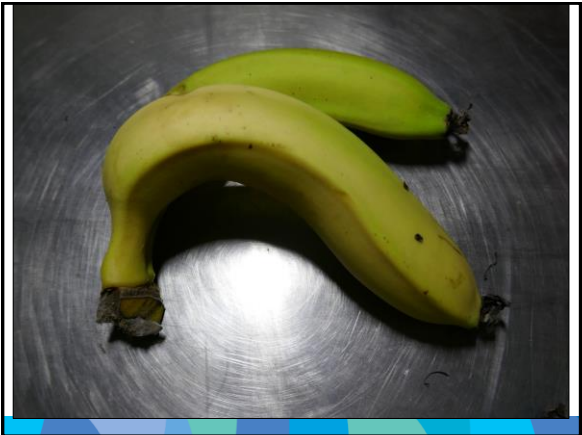
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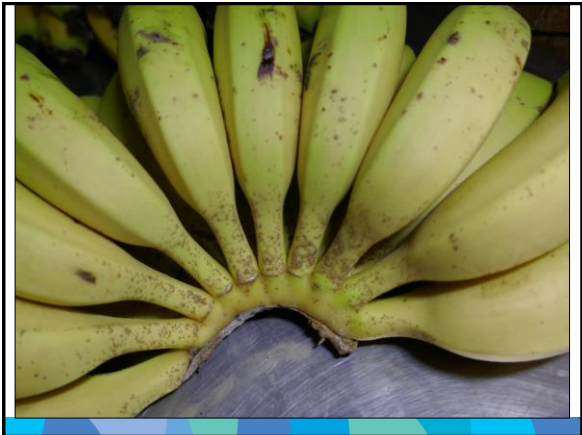


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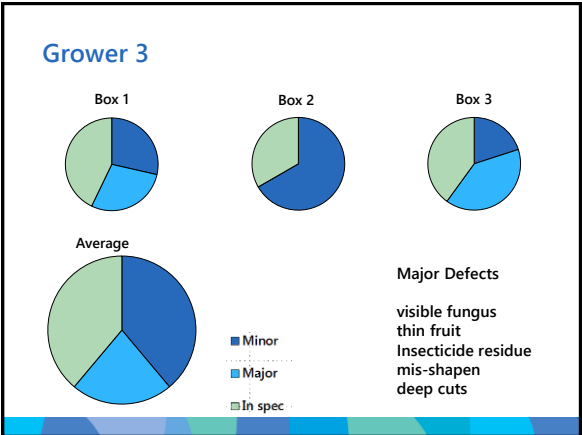


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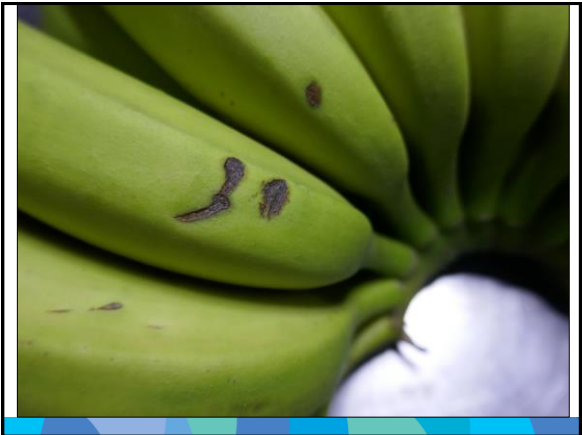
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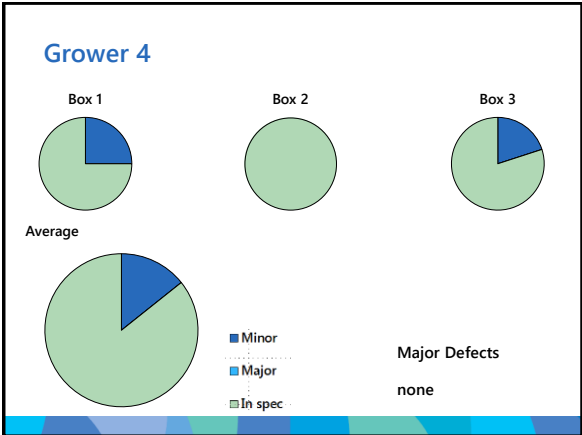
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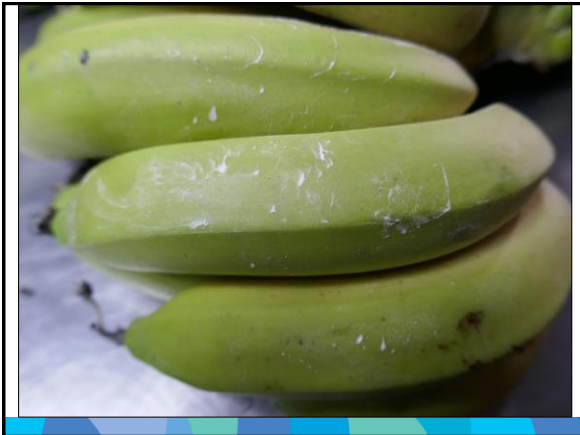


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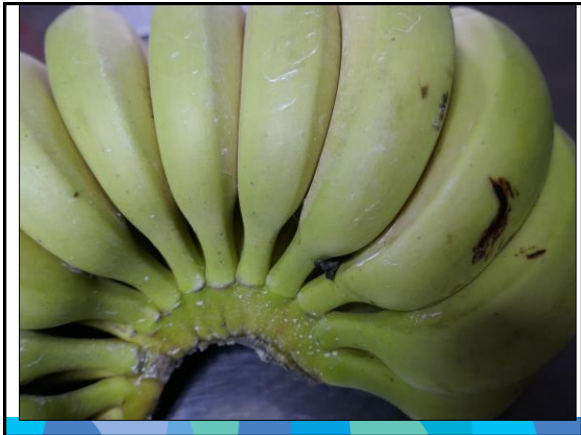


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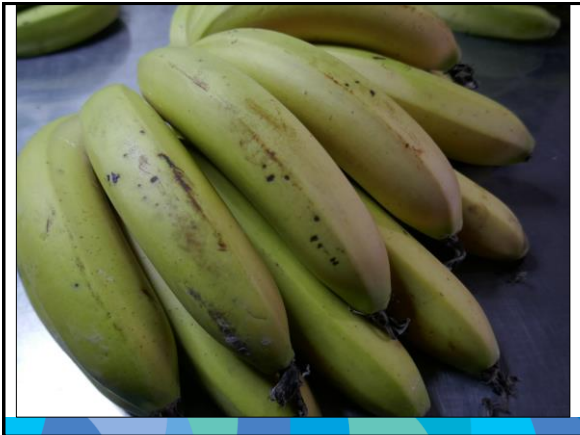




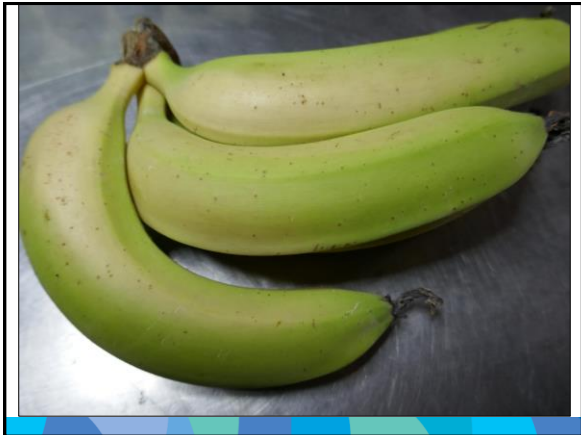
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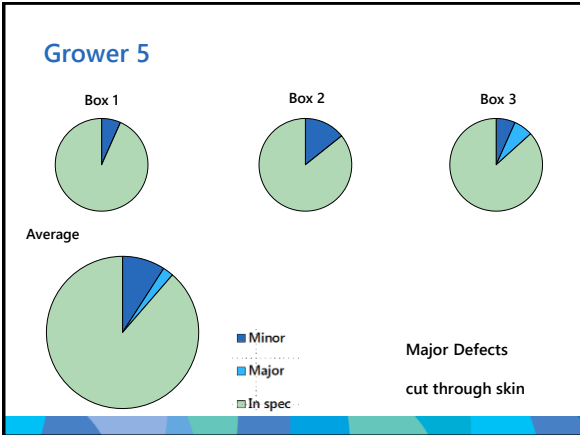
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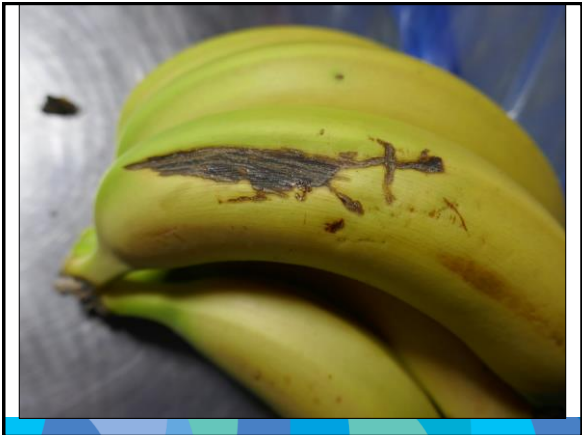
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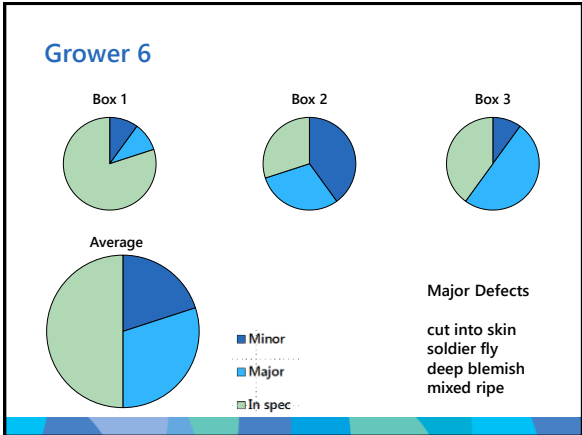
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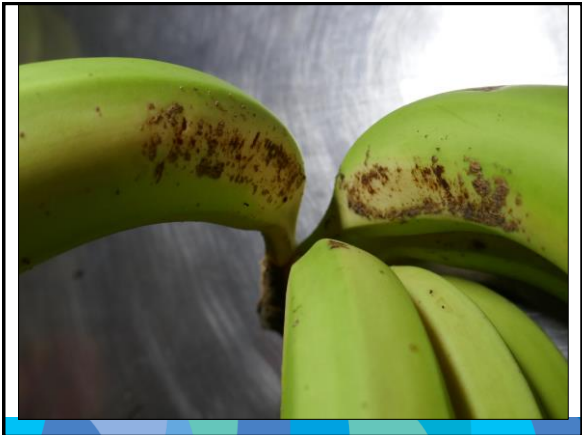
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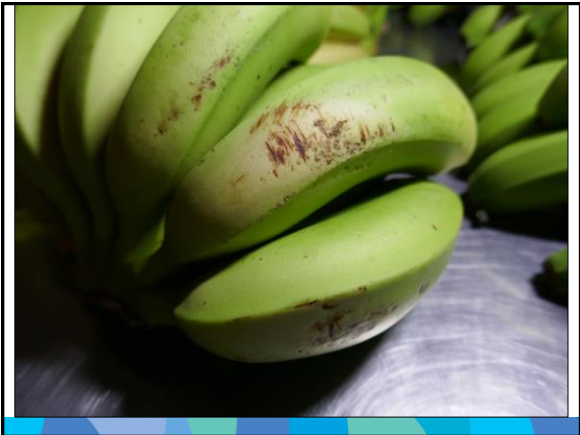
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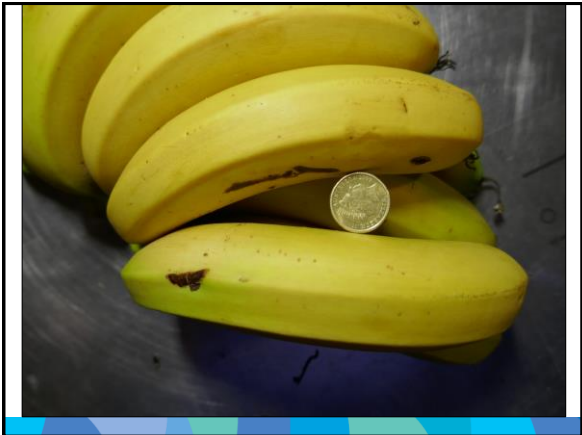
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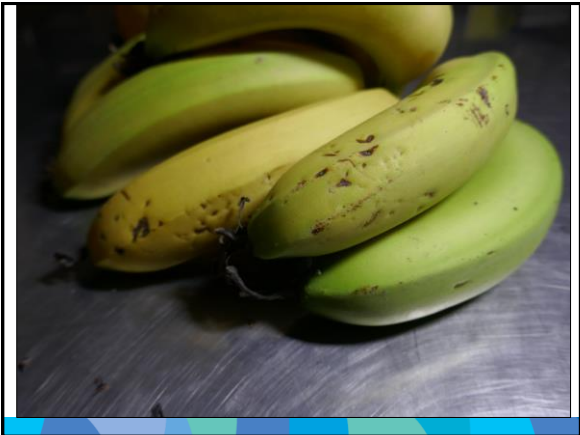
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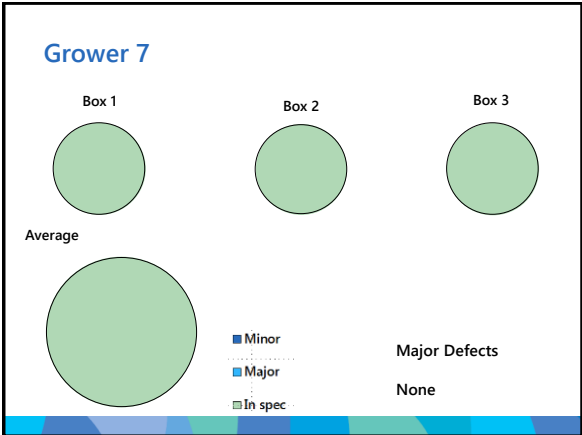
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43



44



45



Department of  
Primary Industries

## Subtropical development and extension project

Matt Weinert  
 Valerie Shrubb  
 Annie Van Blommestein


 Strategic levy investment




 GOVERNMENT OF  
WESTERN AUSTRALIA


 Department of  
Primary Industries and  
Regional Development


 Queensland  
Government

1

## Thanks to

NSW DPI – Mick Davy  
 NSW growers  
 Golden Dawn – Geoff Bridgfoot, Paul Gibbins,  
 Paul Thorburn, Kay Adriaansz  
 D&D Ripeners – Dave Norberry

2

## Project components

Subtropical NextGen  
 Reject and packed product analysis  
 Demonstration trials and extension materials

3

## Subtropical NextGen

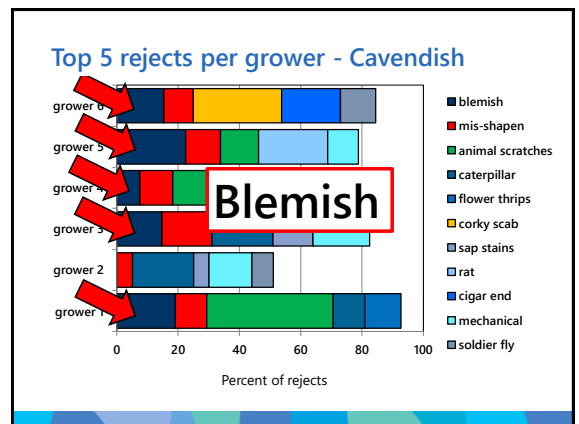


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## Reject analysis

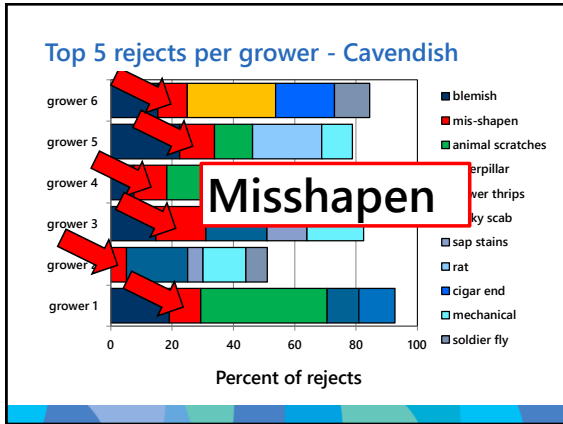
50 - 100 fruit per grower – everything but  
 premium fruit  
 Identify what the cause of the reject is  
 Aim to develop information packages and  
 demonstrations to reduce reject fruit

5

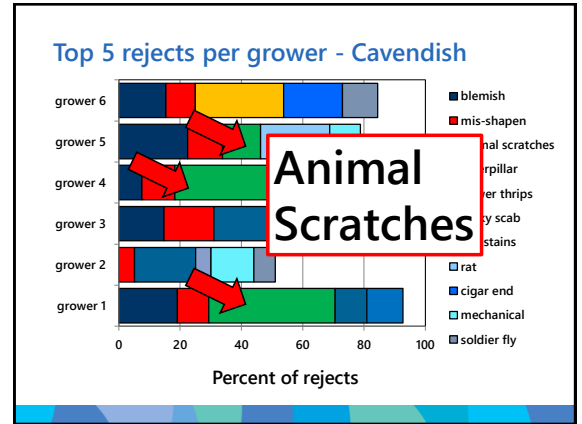


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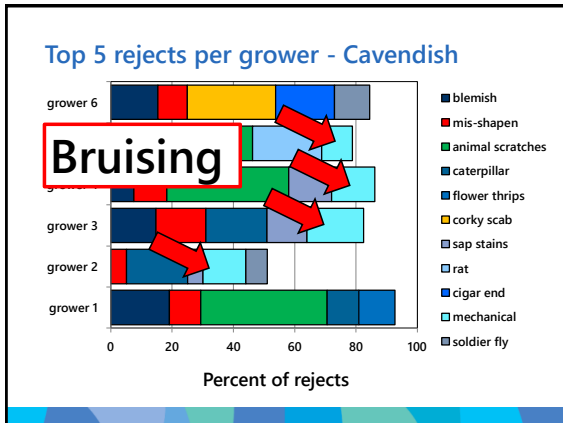




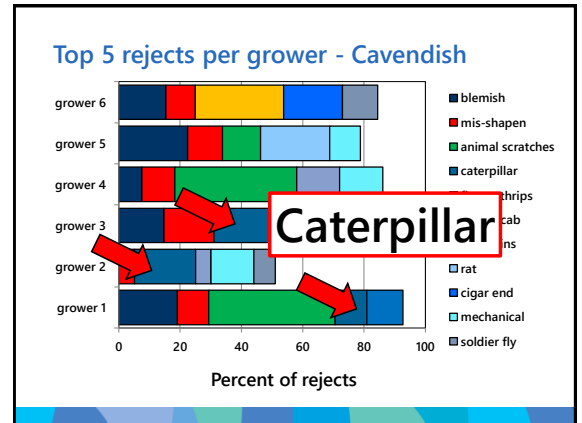
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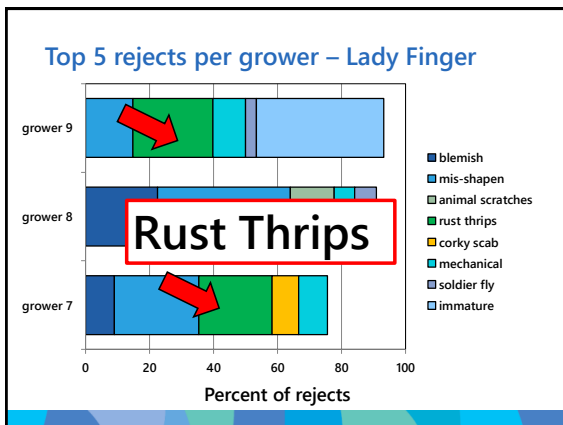
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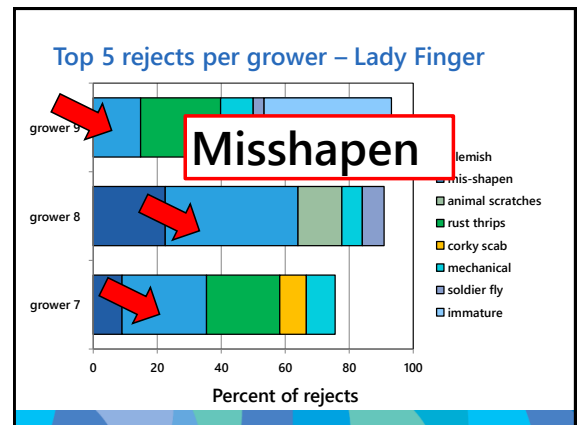
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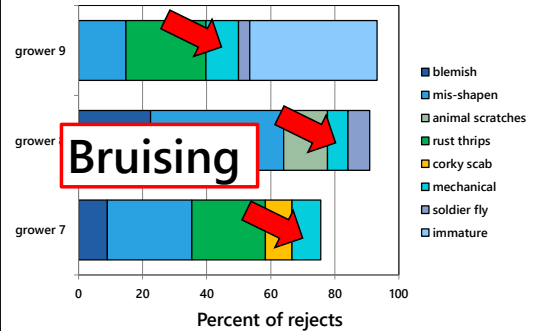
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### Misshapen fruit



13

### Top 5 rejects per grower – Lady Finger



14

### Packed product analysis

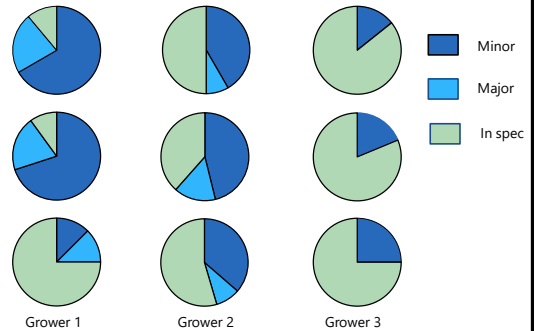
Use the Woolworths Coffs Harbour specs

Unpack boxes and check if clusters are within specs

Initial data only

15

### Packed product analysis – Cavendish Coffs



16

### Major defects



17



18



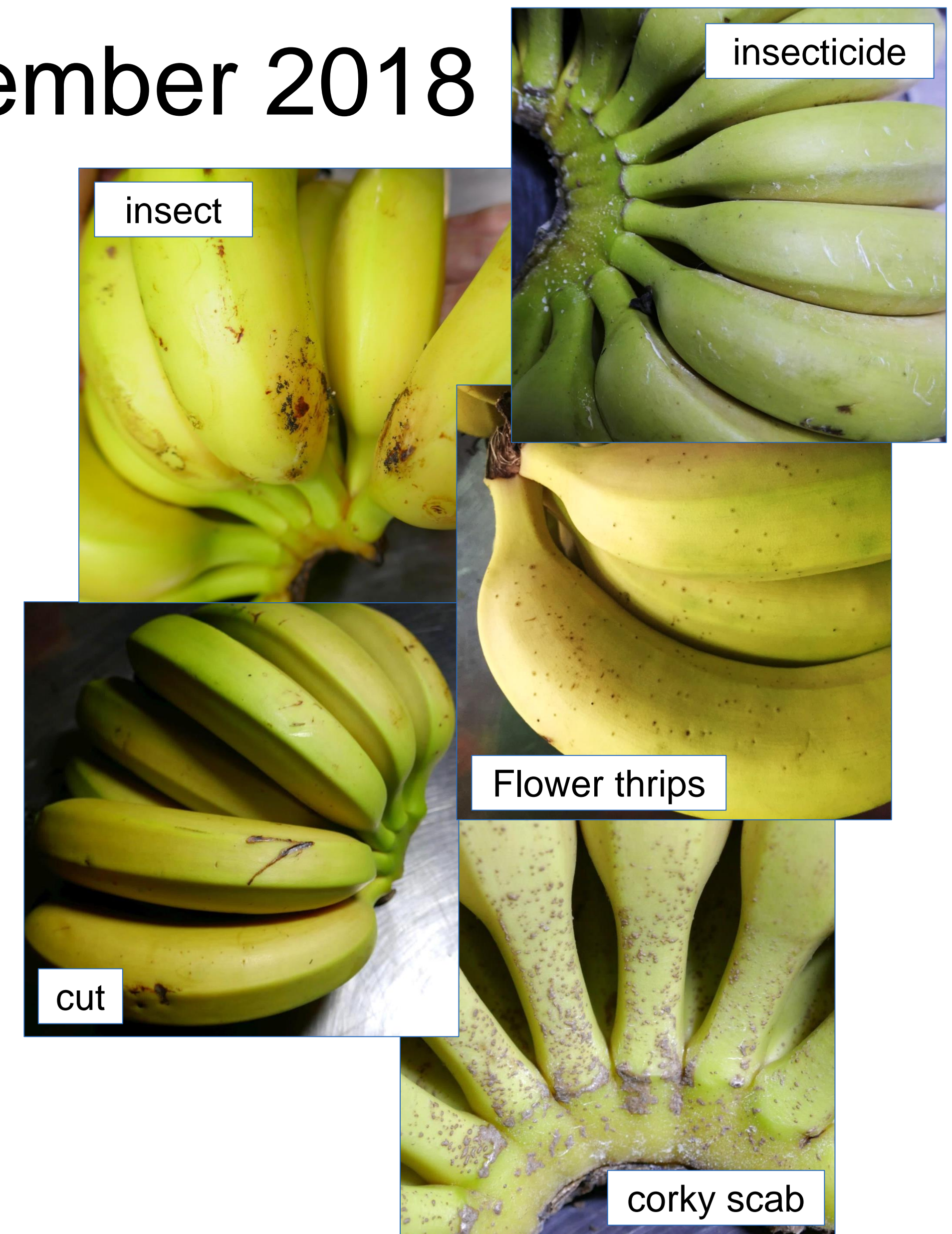
# Can we meet the grade?

## Packed product analysis of NSW fruit

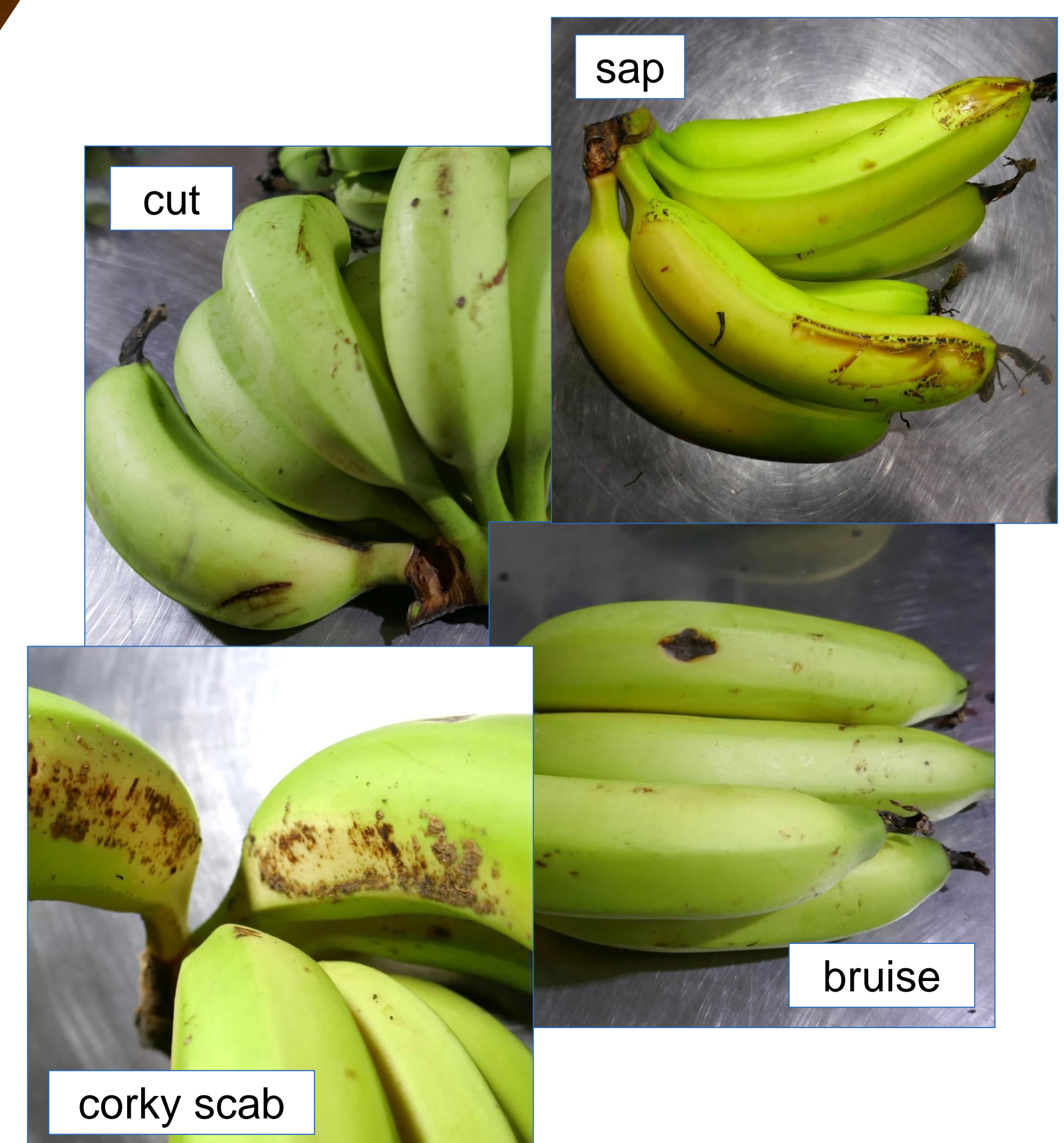
### Why?

Subtropical banana quality can be poor at retail  
Poor quality fruit drives prices down  
Marks on fruit may develop during ripening  
Are growers packing to retail outlet standards?

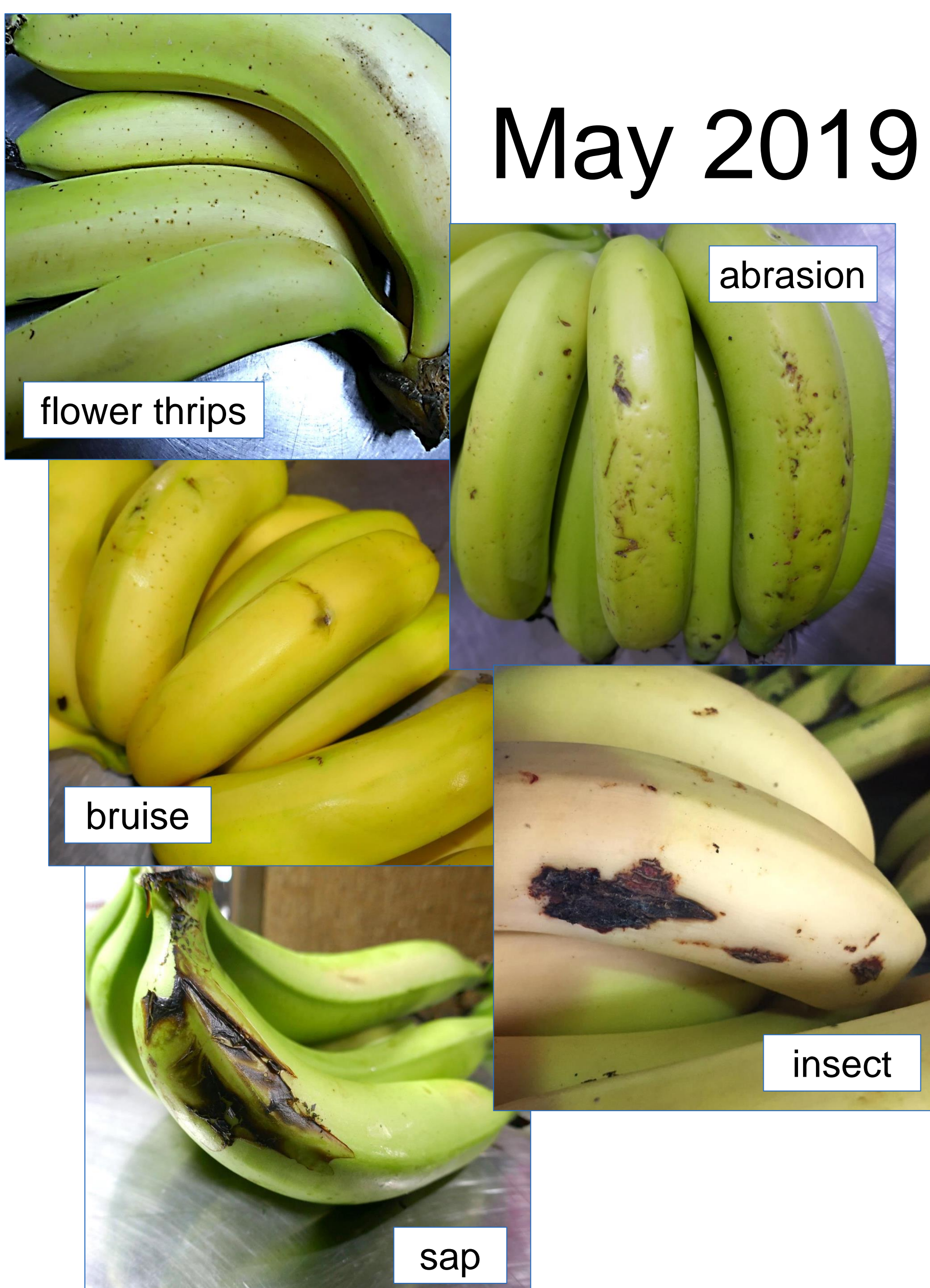
September 2018



February 2019



May 2019



### Where to?

Feedback to growers and wholesalers  
Develop packing specifications poster  
Grower workshops to report results  
Work with the supply chain to improve fruit quality

Images are the major defect categories for each month the packed product analysis was conducted



# War on Waste

## What does reject analysis of NSW growers' fruit tell us?

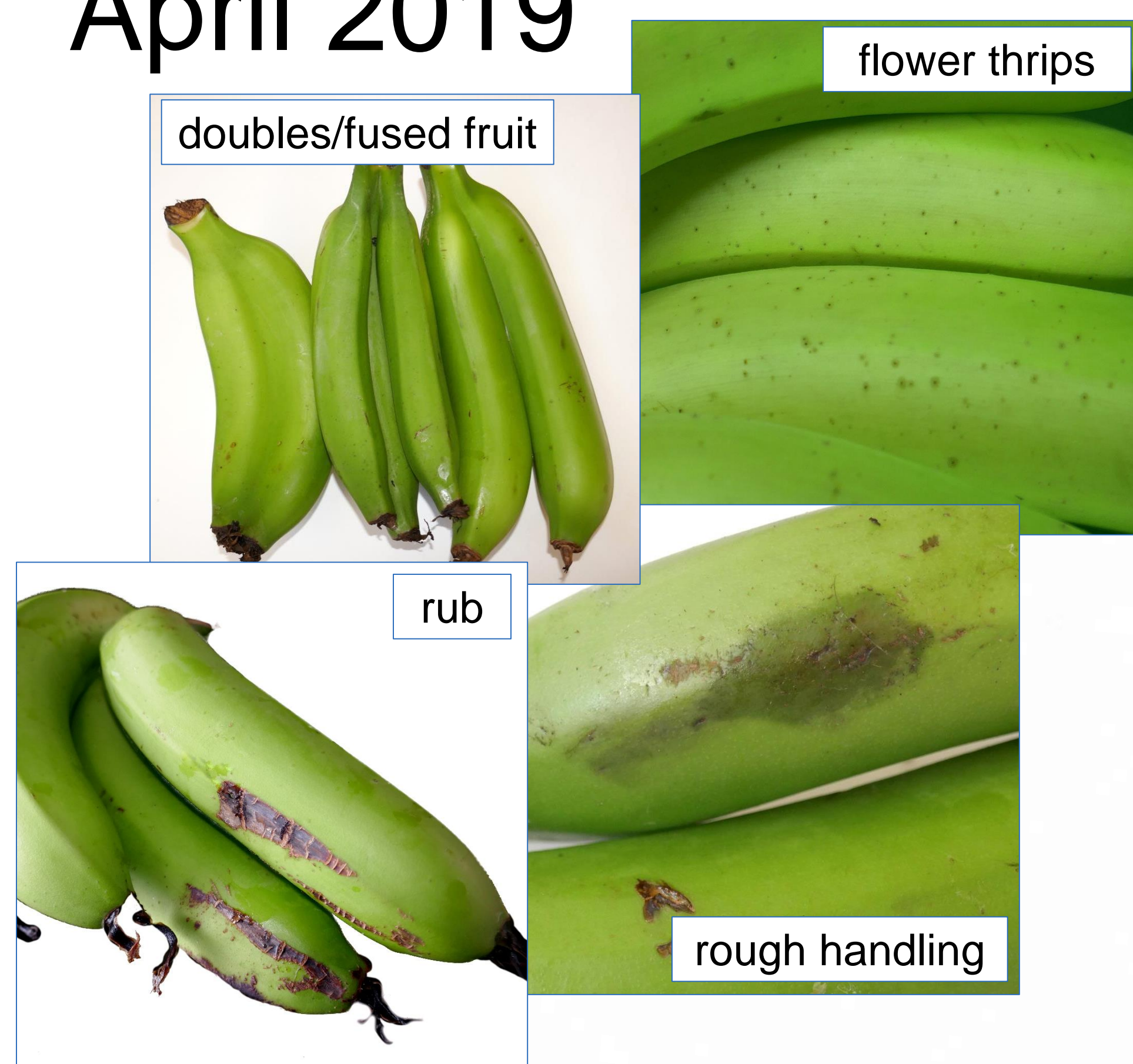
### What are we doing?

Reject analysis allows us to identify specific reasons for fruit rejection/downgrade

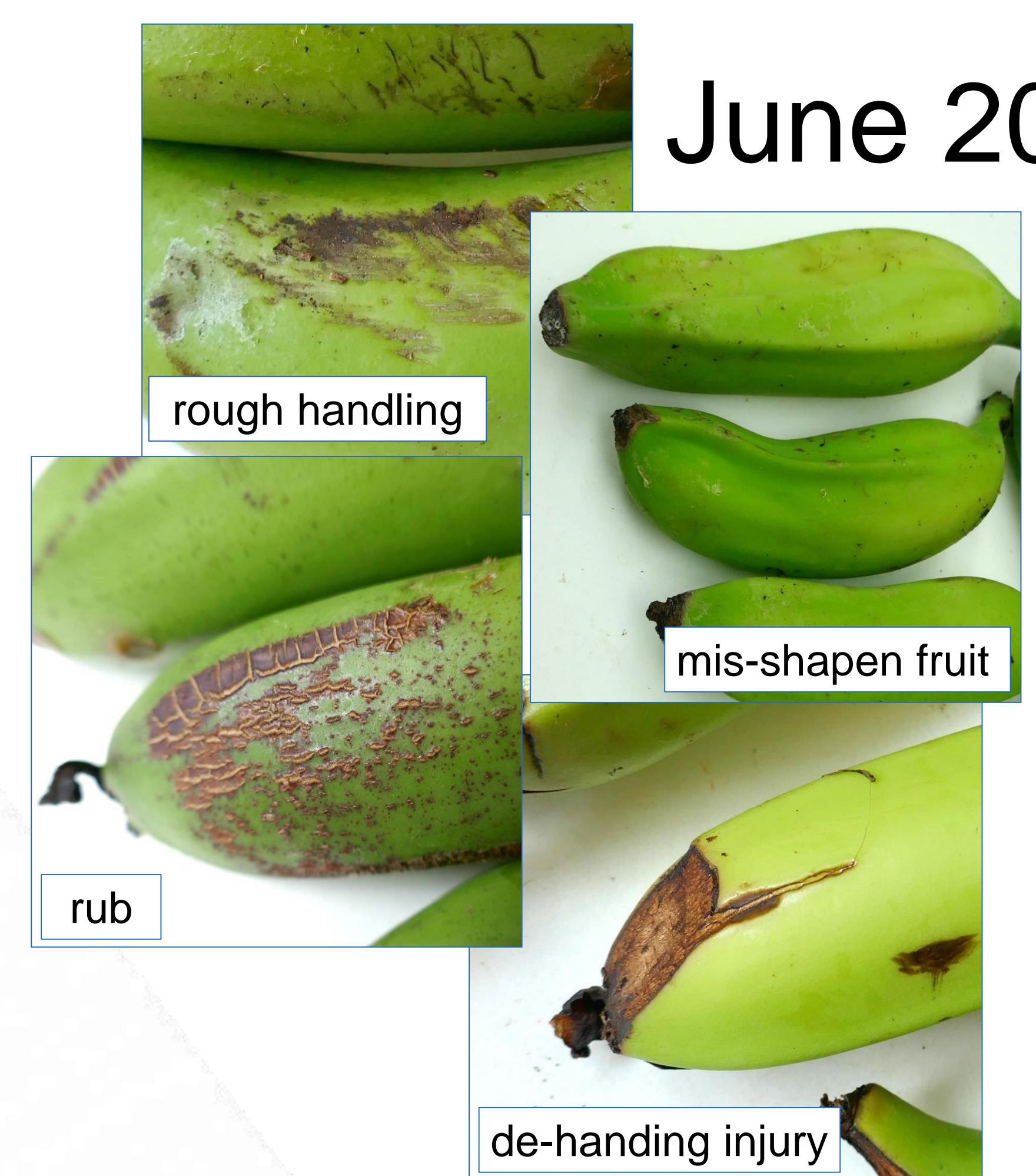
Collect 50-100 fruit from grower reject piles

Identify and quantify the cause of the reject

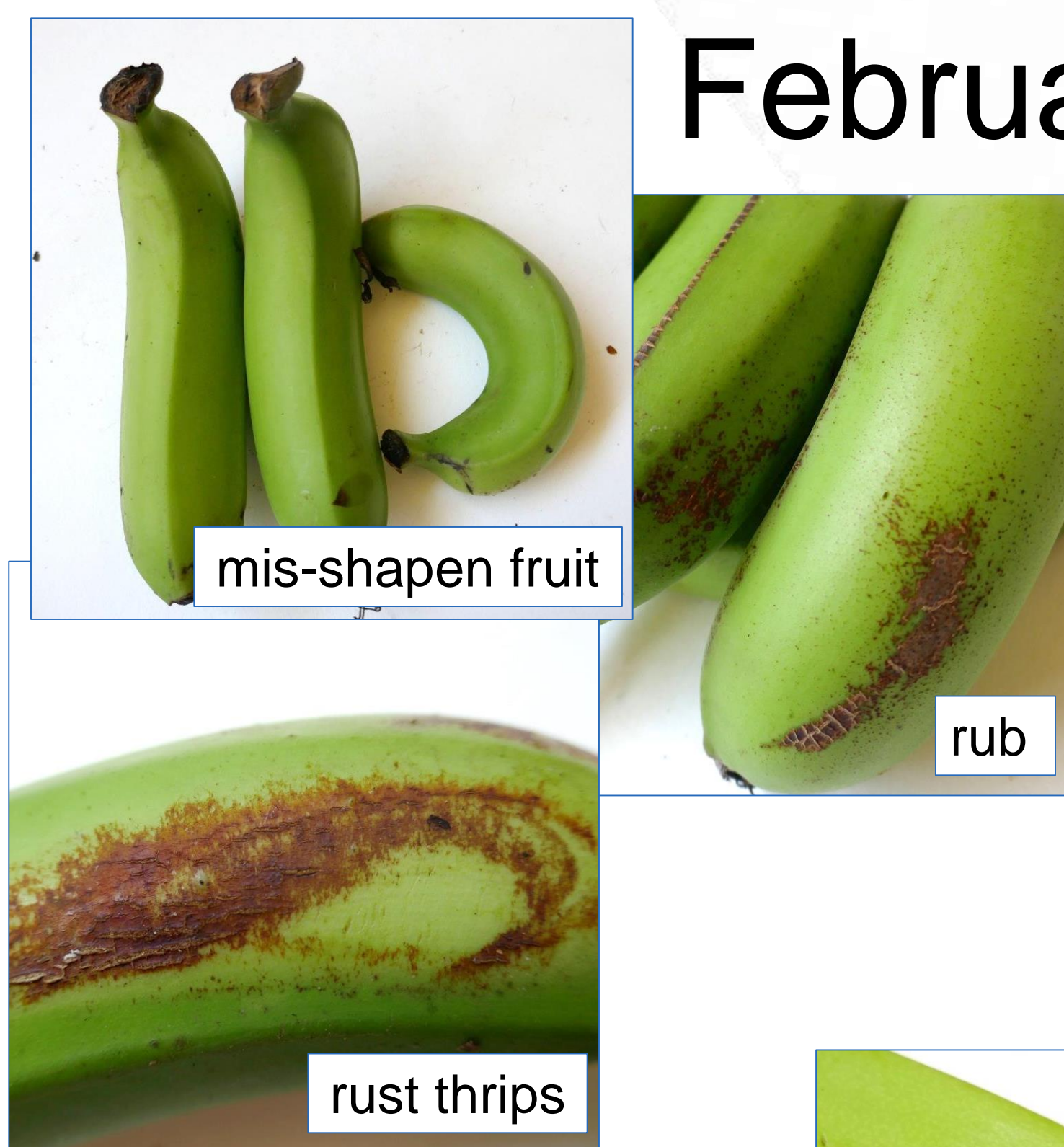
April 2019



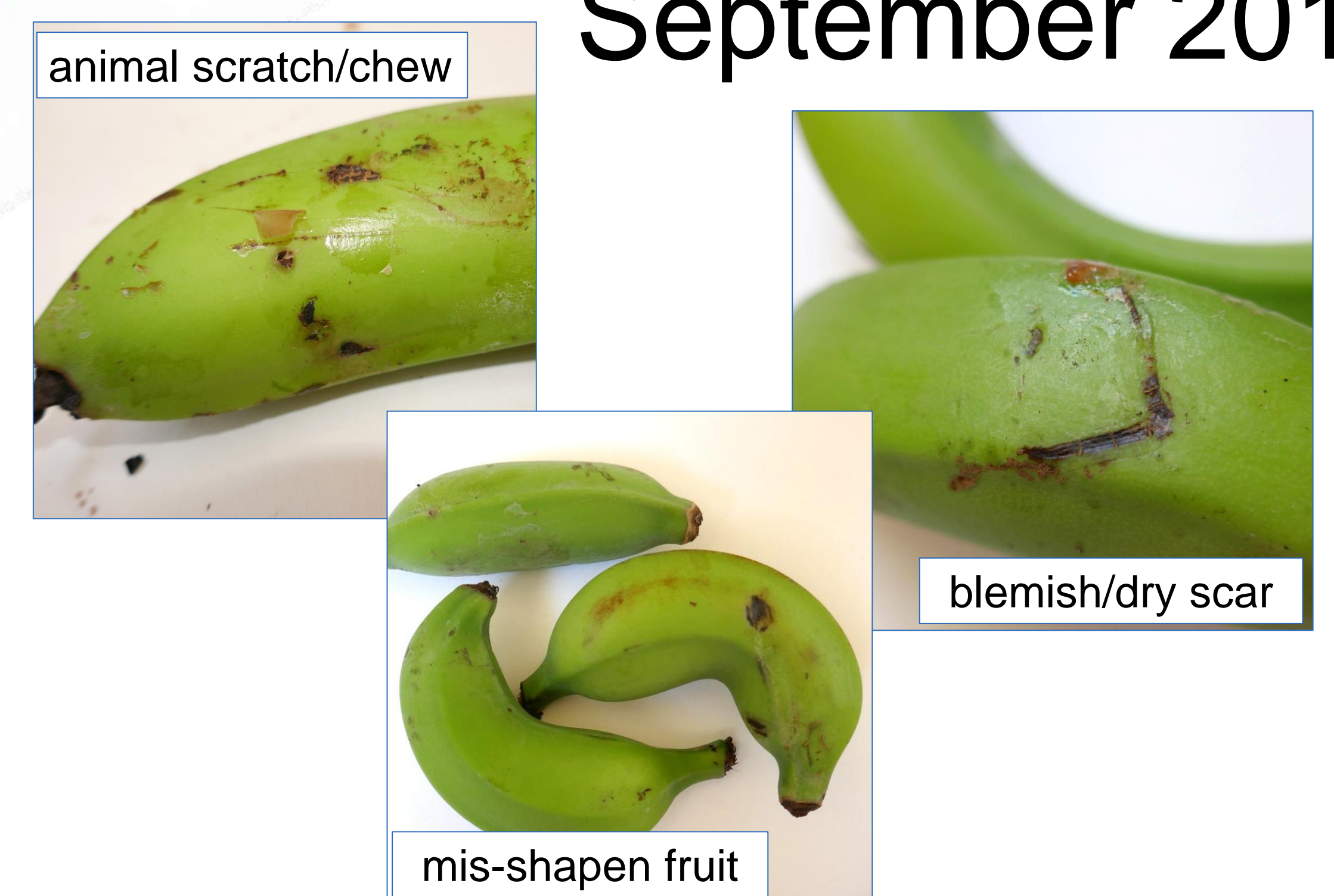
June 2018



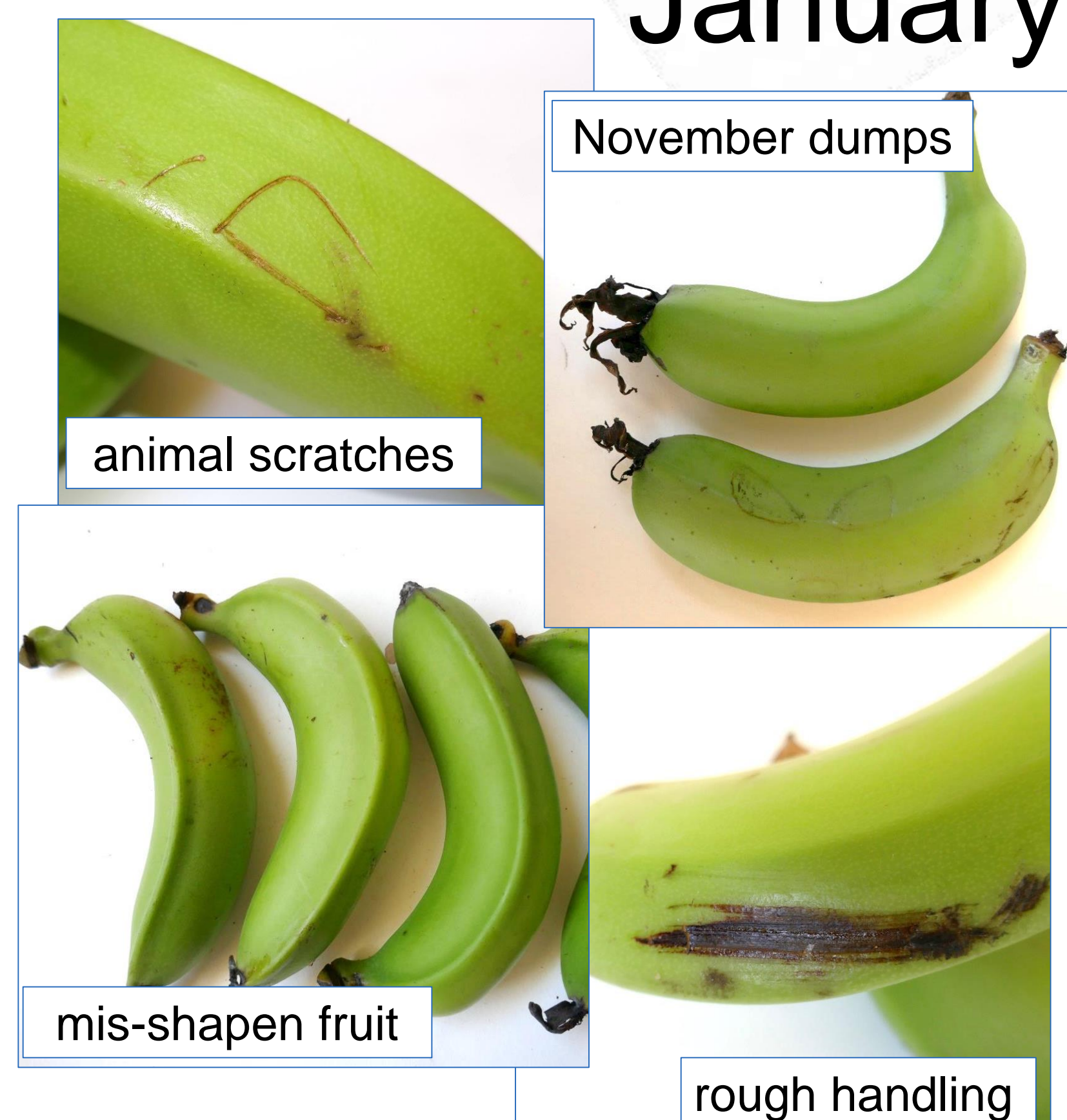
February 2019



September 2018



January 2019



### Where to now?

Finalise reject analysis

Provide feedback to growers

Undertake demonstration trials

Work on issues growers can change

Develop extension materials

Images are the major reject categories for each month the reject analysis was completed



# REJECTS AND REACHING-OUT



Industry Development Officer Matt Weinert with New South Wales grower and Tweed BGA chair Colin Singh.

## Industry Development Officer Matt Weinert explains how his new extension project will benefit subtropical banana growers.

Matt Weinert wants to rifle through your reject bin. Yes literally!

Banana Industry Development Officer with the NSW Department of Primary Industries (DPI), Mr Weinert is keen to get a better understanding of why growers are throwing out bananas as part of a new extension project, funded by the Hort Innovation banana fund—BA16007 Subtropical.

Through a reject and downgrade analysis of fruit, Mr Weinert aims to help growers reduce waste and improve the packout of premium fruit.

He said growers don't always see what's causing their fruit to be rejected, so he plans to look at bananas in reject bins and qualify the damage.

"Growers make the most money on premium fruit and improving premium packouts is one of the best ways to improve profitability. We will also look at fruit that have been ripened by regional wholesalers to find out if there is anything that is causing that fruit to be out of spec for the retailers," he said.

This research is just one component of the new project covering the area from Bundaberg in Queensland to Macksville in New South Wales, as well as Carnarvon in Western Australia.

Valerie Shrubbs from the Department of Primary Industries and Regional Development in WA and Annie von Blumenstein from the Sweeter Banana Co-Operative will undertake the project work in Carnarvon.

Mr Weinert said, "It's great to have Valerie and Annie involved in the work in Carnarvon, as it means we can cover off the whole Australian subtropical industry."

"We also want to work with growers in south-east Queensland and Bundaberg as well.

"The second part of the project involves a young growers group similar to the NextGen group in North Queensland, but with subtropical growers. Ultimately we want to link the subtropical and tropical groups as well.

"The idea is just to get growers in the different subtropical producing regions talking to each other and sharing their issues and ideas. A bit like crowdsourcing, often growers are able to solve their own problems when they get together!"

Young growers are already connecting through social media in both the Tweed and Coffs Harbour areas, so Mr Weinert hopes to expand on those existing relationships.

"One thing I really enjoy doing in my job is connecting people and focusing enthusiasm," he said.

"We want growers to drive it, but the idea would be to get the growers to meet each other, maybe visit packing sheds, even visit other industries. Once the group is operating we want the growers to drive the agenda."

The project's final component is a series of workshops, including one on nutrition.

"This would build on the previous workshops on this topic. We're interested in rolling out some of the project work from the nutrition workshops to be run in North QLD under Reef Trust III funding as well," said Mr Weinert.

"The idea would be to ask growers to bring leaf and soil analyses along to the workshop so we can work through the results to help them understand the role of the different fertilisers and hopefully help them determine how much to apply and when."

A workshop focusing on nematodes is also proposed.

"Nematodes are a big issue in the subtropics. As part of the Improved Plant Protection for the Banana Industry project, we recently undertook some nematode soil analyses, with the QDAF nematologists in Brisbane and would like to share the findings at the workshops."

Email [matt.weinert@dpi.gov.au](mailto:matt.weinert@dpi.gov.au) for more information on BA16007 Subtropical.



# BA16007 - Subtropical Project Monitoring and Evaluation Plan

## 1. Program logic

A Project program logic framework was developed and is included in this milestone report.

## 2. Project M&E Scope

### a) Audience

Audience	Information needed
<b>Primary</b>	
Project team	<ul style="list-style-type: none"> <li>• Project progress against objectives in annual work plans:               <ul style="list-style-type: none"> <li>– Production and submission of milestone reports</li> <li>– PRG meetings held</li> <li>– Production of key project documents and reports</li> </ul> </li> <li>• Number of reject, downgrade and packed product analyses conducted and demonstration trials undertaken</li> <li>• Number of growers and industry stakeholders engaged by the project especially the Subtropical NextGen</li> <li>• Project expenditure aligned with budget allocations.</li> <li>• Project communication               <ul style="list-style-type: none"> <li>– Number of extension and communication materials produced</li> <li>– Number of growers and industry stakeholders engaged by the project</li> </ul> </li> <li>• Number of growers and industry stakeholders engaged by the project</li> </ul>
Hort Innovation	<ul style="list-style-type: none"> <li>• Project progress against objectives in annual work plans               <ul style="list-style-type: none"> <li>– Production and submission of milestone reports</li> <li>– Annual review of work plans</li> <li>– Production of key project documents</li> <li>– Number of PRG meetings</li> </ul> </li> <li>• Number of reject, downgrade and packed product analyses conducted and demonstration trials undertaken</li> <li>• Number of growers and industry stakeholders engaged by the project especially the Subtropical NextGen</li> <li>• Project expenditure aligned with budget allocations</li> <li>• Project communication               <ul style="list-style-type: none"> <li>– Number of extension and communication materials produced</li> <li>– Number of growers and industry stakeholders engaged by the project</li> </ul> </li> </ul>
<b>Secondary</b>	
Project Reference Group	<ul style="list-style-type: none"> <li>• Project progress against objectives in annual work plans               <ul style="list-style-type: none"> <li>– Production and submission of milestone reports</li> <li>– Report to PRG on project progress</li> <li>– Annual review of work plans</li> <li>– Production of key project documents</li> </ul> </li> <li>• Number of reject, downgrade and packed product analyses conducted and demonstration trials undertaken</li> </ul>

	<ul style="list-style-type: none"> <li>• Number of growers and industry stakeholders engaged by the project especially the Subtropical NextGen</li> <li>• Project expenditure aligned with budget allocations</li> <li>• Project communication <ul style="list-style-type: none"> <li>– Number of extension and communication materials produced</li> </ul> </li> </ul>
Project partners/R&D agencies	<ul style="list-style-type: none"> <li>• Project progress against objectives in annual work plans: <ul style="list-style-type: none"> <li>– Production and submission of data and progress for milestone reports</li> <li>– Annual review of work plans</li> </ul> </li> <li>• Number of reject, downgrade and packed product analyses conducted and demonstration trials undertaken</li> <li>• Number of growers and industry stakeholders engaged by the project especially the Subtropical NextGen</li> <li>• Project expenditure aligned with budget allocations:</li> <li>• Project communication</li> </ul>
ABGC	<ul style="list-style-type: none"> <li>• Project progress against objectives in annual work plans <ul style="list-style-type: none"> <li>– Production and submission of milestone reports</li> <li>– Annual review of work plans</li> </ul> </li> <li>• Project communication <ul style="list-style-type: none"> <li>– Number of extension and communication materials produced</li> <li>– Number of growers and industry stakeholders engaged by the project</li> </ul> </li> </ul>

#### b) Key evaluation questions

Key evaluation questions	Relevant?	Project-specific questions
<b>Effectiveness</b>		
<p>To what extent has the project achieved its expected outcomes?</p> <p>(Effectiveness = the extent to which an intervention – a project – has attained, or is expected to attain, its intended outcomes)</p>		<p><i>Overarching</i></p> <p>Has the overall program improved the viability of the Australian subtropical banana industry through an improved understanding of what is caused reject fruit and has systems and tools developed to underpin this improvement?</p>
		<p>Has this theme project contributed to improving communications across the subtropical banana industry to improve its viability?</p> <p>Has the project improved communications and cooperative work practices between researchers and linked the subtropical industry with the national RD &amp; E program in the plant protection area?</p> <p>To what extent has this project contributed to ensuring RD&amp;E outcomes from BA16001 and BA16007- tropical were effectively delivered to the subtropical banana industry?</p>
<b>Relevance</b>		

How relevant was the project to the needs of intended beneficiaries?  (Relevance = the extent to which the expected outcomes of an intervention are consistent with beneficiaries' requirements, government priorities etc).		To what extent has the project met the communication and RD&E needs of industry levy payers to improve the viability of and communication within the subtropical banana industry?
<b>Process appropriateness</b>		
How well have intended beneficiaries been engaged in the project?  (Process appropriateness = the extent to which a project/program is operating as intended?)		Were target engagement levels of industry levy payers and RD&E providers achieved?  Have regular project updates been provided to the PRG and through linkages with internal project networking, industry communication and extension projects?
To what extent were engagement processes appropriate to the target audiences of the project?		How accessible were the extension events to subtropical industry levy payers?  Did the project engage with subtropical industry levy payers through their preferred learning styles?
<b>Efficiency</b>		
What efforts did the project make to improve efficiency?  (efficiency = the extent to which an intervention produces outputs and outcomes without wasting time, money, effort or other resources)		Has this project achieved planned objectives while maintaining expenditure in line with budgeted allocations?
<b>Other (if any)</b>		Has this project with increased collaborations between national RD&E providers to benefit the Australian subtropical banana industry?

### c) M&E budget

There is no specific M&E budget for this project. Evidence of project delivering against outcomes will be collected during the life of the project through workshop evaluations, a mid-term informal evaluation with the PRG and an end of project survey.

### 3. Performance expectations, data collection and analysis

#### Project monitoring plan

Logic level	What to monitor	Performance expectations (KPI's) and/or monitoring questions	Data collection – method (eg. Survey) and source (eg. growers)	Timing of, and responsibility for, data collection
<b>Foundational activities</b>				
Contract agreement signed	Contract finalisation		Monitoring of departmental correspondence (project leader)	Project leader (once)
Establishment of Project Reference Group (PRG)	Formation of PRG		PRG meeting minutes (Project leader)	Project leader (3 times per year)
<b>Activities &amp; outputs</b>				
Active and engaged Project Reference Group	PRG meeting activity	Number of PRG meetings and communications	PRG meeting minutes (project leader)	Project leader (biannually)
Production of key project documents (KPD's)	Production of KPD's	Submission and acceptance of KPD's	Record-keeping (project team)	Project leader (annually)
Extension activities for Australian subtropical banana industry stakeholders eg. Field days, Roadshows, Australian Banana Industry Congress, Australian Bananas articles	Participation levels in activities	Extension activity participation (number of growers/industry stakeholders)	Record-keeping (project team)	Project leader (annually)
Where possible, contribute to the scientific community through conference presentations and scientific publications	Production of technical reports and scientific publications on trial results	Number of presentations, publications & reports	Record-keeping (project team)	Project leader (annually)
Contribute to milestone and final reports	Production of reports	Number of reports submitted on time and accepted	Record-keeping (project team)	Project leader (annually)

Intermediate outcomes				
The subtropical Australian banana industry has ready access to R&D outcomes that improve knowledge and adoption of new practices	Changes in knowledge	Increased knowledge/use of information by growers/stakeholders	Event questionnaire (growers/industry stakeholders)  Case studies (growers/industry stakeholders)	Project leader (annually)
The project team understands the project direction and expectations	Changes in knowledge	Increased knowledge/use of project information by delivery partners	Event questionnaire (project team)  Mid-term review with the PRG.	Project leader (annually)
End of project outcomes				
Outcomes from levy funded projects, especially BA16001 and BA16007 – tropical are more effectively delivered to the subtropical banana industry by developing linkages with the national RD&E program.	Changes in knowledge and practices through adoption	Increased knowledge/use of information by growers/stakeholders	Event questionnaires (growers/industry stakeholders)  Project workshops and case studies (growers/industry stakeholders)  End of project survey	Project leader (annually)  Project leader (at project end)



## 4. Evaluation

### Additional evaluation data requirements

Key evaluation questions	Data collection requirement	Source and method
To what extent has the project achieved its expected outcomes?	Number of growers involved, eg subtropical NextGen group Growers using techniques developed from reject analysis and demonstration trials	Data collected during the project and mid- term end of project online survey
How well have intended beneficiaries been engaged in the project?	Attendance at workshops Involvement in subtropical NextGen	Data collected during the project and mid- term end of project online survey
To what extent were engagement processes appropriate to the target audiences of the project?	Attendance at workshops Involvement in subtropical NextGen	Data collected during the project and mid- term end of project online survey
How relevant was the project to the needs of intended beneficiaries?	Uptake of project outcomes to improve packout Less fruit consignment downgrades Growers selling into new markets	Data collected during the project and mid- term end of project online survey

## 5. Reporting, learning and improvement

### Project progress reporting

Report type	To whom	Timing
Milestone reports	Hort Innovation	6 monthly
Final reports	Hort Innovation	End of project
Articles	Industry magazine	Annually
Written updates	PRG	Monthly
Verbal (face to face and teleconference)	PRG	Annually

### Project continuous improvement activities

Continuous improvement process	Details	Timing
Project team meetings	Meeting of project and theme leaders to discuss project activities, progress against objectives and reporting activities	Six monthly
Project reference group meetings	Meetings between project team members, Hort	Biennially

	innovation and industry representatives to gain feedback on project activities and refine methodology	
Project monthly reports	A informal nmonthly report on project activities will be emailed to the PRG	Monthly

## Situation

Good communication & coordination between R&D providers, project team members, the project reference group (PRG) and growers is required to achieve project outcomes; Lack of cohesion and communication across the diverse subtropical production regions can limit project outcomes; The project is across a large geographical area with RD&E providers from several organisations and growers across multiple states; This is of concern to RD&E providers to the Australian banana industry; Banana growers and national and state governments invest significantly in R,D&E expecting improved outcomes; Development and extension of research outputs has improved outcomes for growers

