

## **Final Report**

# **Avocado Retail Sampling**

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Applied Horticultural Research

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Avocado Retail Sampling – AV18006

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## Summary

Improving avocado fruit quality is essential in order to continue to grow demand for Australian avocados. During summer, avocados are mostly supplied by Western Australia. The gap between demand and what WA can supply is filled by imported fruit from New Zealand. During October and November 2018, anecdotal evidence suggested that rots were a major issue in avocados on the Australian market, with many fruit failing to meet consumer expectations. Poor retail quality reduces current and future sales, and erodes consumer confidence in avocados generally.

This study has investigated and measured fruit quality at retail for Australian and New Zealand avocados. Fruit was sampled at retail stores in Brisbane and Sydney in late December 2018 and early January 2019. In total, 31 samples (310 fruit) of New Zealand fruit from five suppliers/exporters and 32 samples (320 fruit) of Australian fruit from six suppliers/packhouses were assessed for internal quality.

Overall, 22% of the New Zealand fruit had significant damage (mainly rots), compared to 10% of Australian fruit (mainly bruising).

**Fruit rots:** Twenty percent (20%) of New Zealand fruit had significant flesh rots ( >10% flesh volume) compared to 1.6% of Australian fruit.

In the New Zealand fruit, 54% had some level of body rots and 36% had some stem-end rot. Seventeen percent (17%) also had vascular browning. This compares to 10% of Australian fruit with body rots, 4% with stem-end rots and 6% with vascular browning.

**Bruising:** Most of the damage in Australian fruit was due to bruising. Nearly 8% of the Australian fruit was bruised (> 10% flesh volume) compared to only 1% of New Zealand fruit.

**Fruit age:** New Zealand fruit averaged 25 days from harvest to stage 5 ripe, compared to 22 days for Australian fruit. Four New Zealand and one Australian sample reached or exceeded 30 days from harvest. Fruit age did not correlate well with the level of fruit rots, suggesting other factors were contributing to the rot problem.

Above average rainfall and flooding events earlier in the New Zealand growing season were likely to be the underlying cause of the high incidence of rots in New Zealand fruit. Delays during transport and ripening, due to quarantine intervals may have also contributed. However, severity of rots can also be induced by many other pre- and postharvest practices. It is essential that growers and packers follow postharvest best practice to try and minimise this issue.

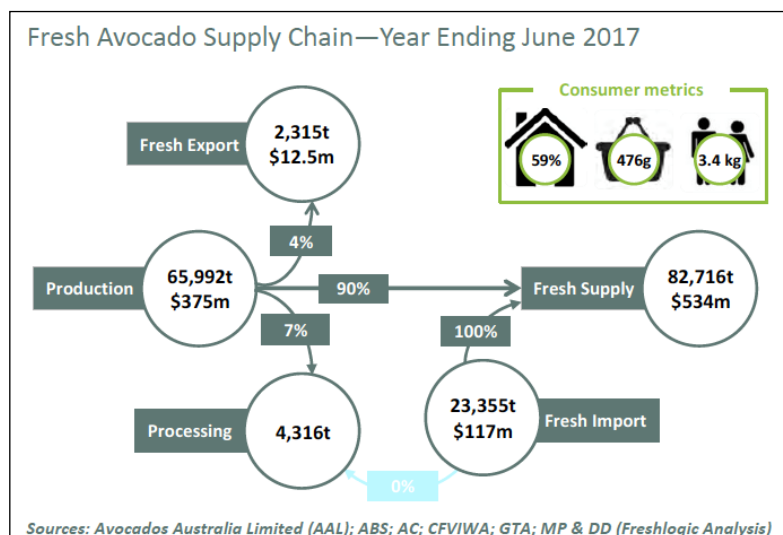
Mature, late season fruit tends to be more susceptible to rots than earlier season fruit. If possible, fruit which has a higher disease load should be harvested and ripened first. Fruit grown in the drier climate of south west WA is likely to have a lower disease load than that from New Zealand, so could potentially be allowed to mature longer. It is also recommended that a continuous quality monitoring program is established. This would allow early identification of fruit retail quality issues, enabling avocado supply-chain members to rectify the problem.

## Keywords

Avocado; quality monitoring, retail, sampling; rots; bruising; fruit quality.

## Introduction

Fruit quality is one of the biggest issues currently facing the avocado industry. Domestic consumption of avocados will need to increase from the current level of 3.4 kg (Horticulture Innovation Australia Limited, 2018) to 5.5 kg per capita over the next 4–5 years to meet supply, based on current plantings. If this does not occur, the prices growers receive will drop, seriously threatening the viability of the industry. At the same time, imports of avocados are increasing, rising from \$64 million in 2016 to \$117 million in 2017 (Horticulture Innovation Australia Limited, 2018), and new exporters are seeking access to Australia.



Surveys of avocados at retail over recent years have consistently found that 20–25% of fruit in stores have significant levels of bruising, internal rots, or other disorders. Poor fruit quality reduces consumer satisfaction (Gamble et al., 2010) and decreases sales. Conversely, consumers will buy more fruit than they currently do if the quality is consistently high, and the fruit is presented correctly. Consumer research (AV15011) has shown that consumers will buy 30% more fruit if they are presented with sorted, good quality, ripe fruit compared to variable or poor quality fruit.

With market supply increasing, improving quality is essential in order to continue to grow demand for Australian avocados.

Summer avocado supply in Australia is mostly from Western Australia and New Zealand. Anecdotal evidence during October and November 2018 suggested that poor retail quality of avocados was a major issue. Poor retail quality reduces current and future sales, and erodes consumer confidence in avocados generally.

This study has investigated and measured the retail quality of Australian and New Zealand avocados.

## Methodology

### Retail sampling

Retail sampling was conducted in a selection of Coles, Woolworths and Aldi stores in Sydney and Brisbane (Table 1). Independent stores were also sampled in Brisbane, as Australian avocados were unavailable at Coles, Woolworths or Aldi in Brisbane.

Premium, mainstream and budget stores were sampled in locations ranging from the outer to inner suburbs in Sydney and Brisbane. Sampling was undertaken on 18–19 December 2018 (Sydney – round 1, and Brisbane) and 3 January 2019 (Sydney – round 2). A total of 31 stores stocking New Zealand fruit, and 32 stores stocking Australian fruit were covered. In the first round of sampling, a larger proportion of New Zealand samples were taken in Brisbane due to the limited number of stores stocking Australian fruit (Table 2).

Sampling covered five different New Zealand suppliers/exporters, and six different Australian packhouses/suppliers (Table 3).

*Table 1. Retailers sampled in Sydney and Brisbane*

Retailer	Number of Sydney stores (Round 1)	Number of Sydney stores (Round 2)	Number of Brisbane stores	Total
Coles	10	7	6	23
Woolworths	8	10	6	24
Aldi	4	4	2	10
Independent			6	6

*Table 2. Number of Australian and New Zealand samples taken in Sydney and Brisbane*

Country of origin	Number of samples in Sydney (Round 1)	Number of samples in Sydney (Round 2)	Number of samples in Brisbane	Total
Australia	15	11	6	32
New Zealand	7	10	14	31

*Table 3. Number of samples collected by supplier/packhouse*

Supplier/packhouse	Number of samples collected
NZ 1	4
NZ 2	13
NZ 3	5
NZ 4	4
NZ 5	5
AU 1	5
AU 2	7
AU 3	5
AU 4	1
AU 5	6
AU 6	7
<b>Total</b>	<b>62*</b>

\*Note: one sample less than the total number, as one sample was not able to be traced to a supplier/packhouse.

Ten (10) fruit from each store were randomly selected at each sampling time (630 fruit in total, from 63 stores). Where possible, fruit were selected from trays which had not yet been displayed, or only just placed on display. This avoided sampling fruit damaged by consumer squeezing. The sample of 10 fruit was compiled from three separate trays, taking three fruit from the first two trays and four from the last tray. Fruit were selected in a diagonal pattern on each tray so as to include from the edges and middles of trays.

Where possible, fruit were selected at ripeness stages 3–4 (breaking to firm-ripe), to avoid fruit becoming over-ripe before assessment. Fruit sampled in Brisbane were mostly stages 2–3, to account for the extra time to transport the fruit to the lab in Sydney.

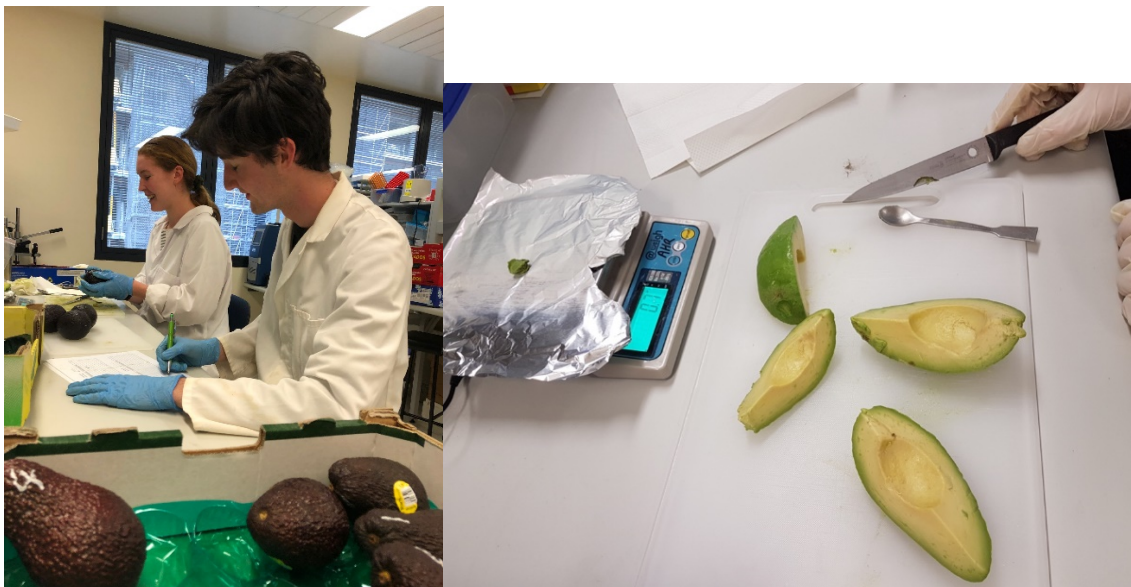
Country of origin, pack-date and brand were recorded, and a photograph of the fruit and trays was taken. Fruit sampled in Sydney were carefully placed into avocado trays, and taken back to the AHR laboratory in air-conditioned vehicles. Fruit sampled in Brisbane were stored in styrofoam boxes with cooler blocks, then transported to Sydney the following day.

Fruit were held in the laboratory at ambient temperature, for a minimum of 24hrs, or until fruit reached stage 5 ripe.

### Sample assessment

Internal flesh was assessed for damage after a minimum of 24hrs from store sampling, or once fruit reached stage 5 ripe. Fruit were quartered, peeled and flesh examined for signs of rots, bruising or other internal defects (as per the International Avocado Quality Manual). Rotten and bruised flesh was scooped out and weighed using an analytical balance. The remaining fruit flesh was also weighed, allowing calculation of the percentage of rotten or bruised flesh per fruit.

A photo of each cut sample was taken.



*Fruit were quartered and skin peeled to assess internal flesh for damage. Rotten, bruised or discoloured flesh was separated from the edible part, with each part weighed to calculate percentage damage.*



## Results and discussion

### Flesh rots

Twenty percent (20%) of New Zealand fruit had significant flesh rots (>10% flesh volume) compared to 1.6% of Australian fruit (Figure 1). The rots were a combination of stem-end and body rots, and were present in fruit from all New Zealand suppliers. The incidence of rots in New Zealand fruit was highest from Brisbane stores, although New Zealand samples purchased in Sydney stores also had a higher incidence of rots than Australian fruit.

Above average rainfall and flooding events earlier in the New Zealand growing season were likely to be the underlying cause of the high incidence of rots in New Zealand fruit. Delays during transport and ripening, due to quarantine intervals may have also contributed. However, severity of rots can also be induced by many other pre- and postharvest practices.

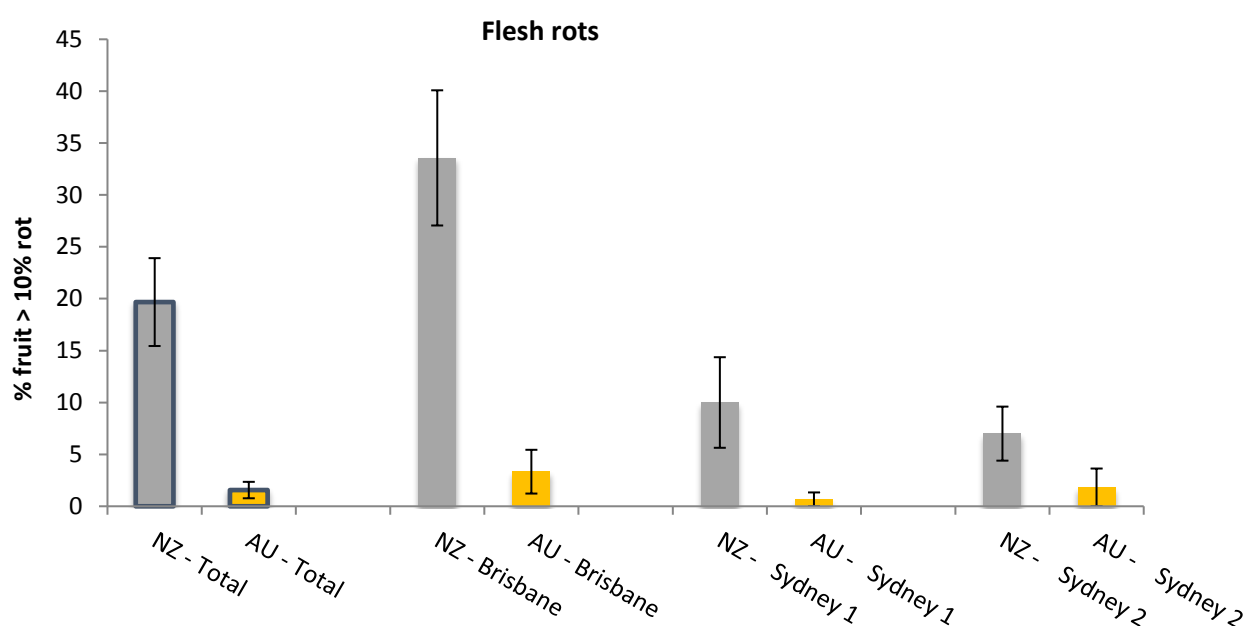


Figure 1. Percentage of fruit with more than 10% flesh rots from three sampling events of Australian and New Zealand avocados in Brisbane and Sydney retail stores. Vertical bars represent the standard error of the mean.

### Flesh bruising

Most of the damage in Australian fruit was due to bruising. Nearly 8% of the Australian fruit was bruised (> 10% flesh volume) compared to only 1% of New Zealand fruit. This was the result of the higher levels of bruising in Australian fruit purchased in Brisbane (Figure 2). The Brisbane fruit was mostly purchased directly off loose displays at independent retailers, rather than out of trays. This was due to the general lack of Australian fruit at the major retailers in Brisbane at the time of sampling. The increased bruising in this fruit is therefore likely to be the result of consumer (and potentially store staff) handling.

Flesh bruising was less of an issue when compared to rots (Figure 3). Furthermore, most bruising tends to occur at the point of retail, and is less likely the result of supply chain handling.

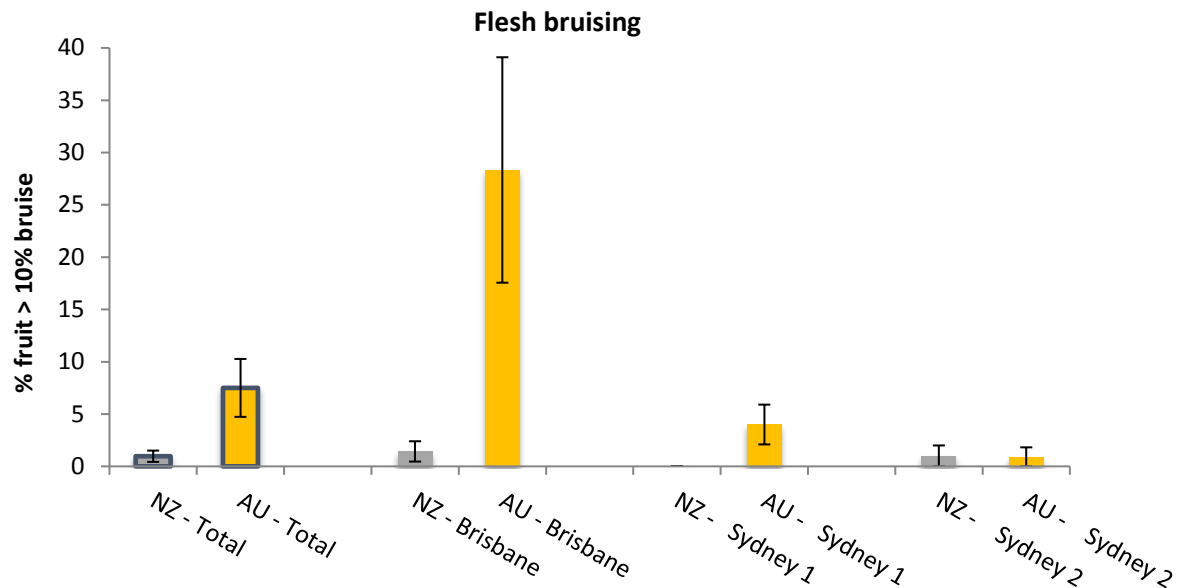


Figure 2. Percentage of fruit with more than 10% bruised flesh from three sampling events of Australian and New Zealand avocados in Brisbane and Sydney retail stores. Vertical bars represent the standard error of the mean.

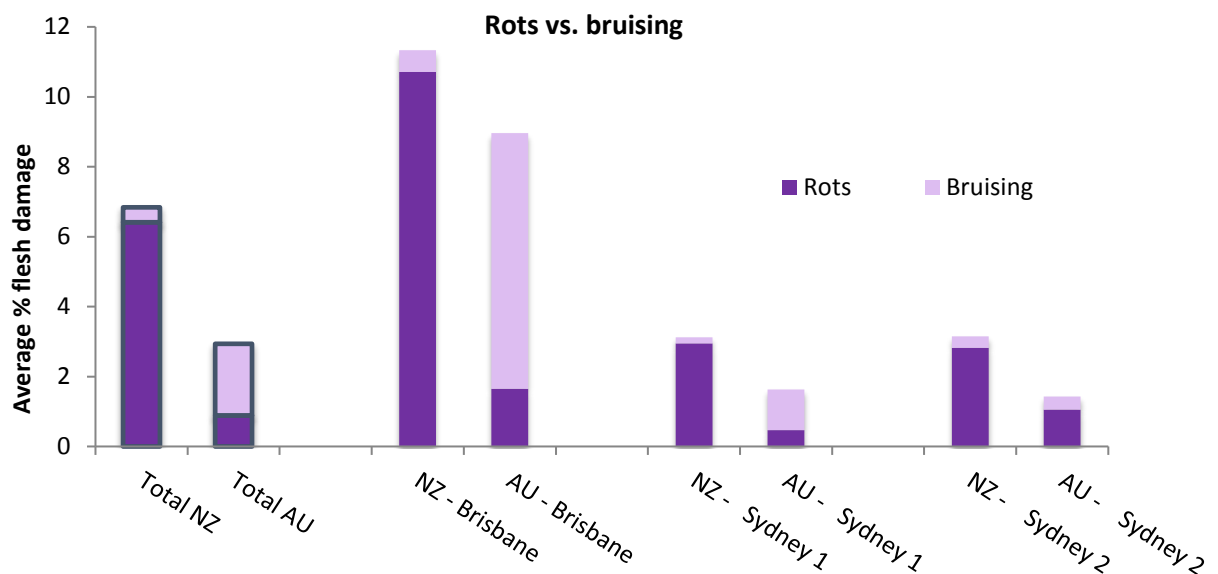


Figure 3. Average level of flesh rots and bruised flesh from three sampling events of Australian and New Zealand avocados in Brisbane and Sydney retail stores.

### Total flesh damage

Overall, 22% of the New Zealand fruit had significant damage (mainly rots), compared to 10% of Australian fruit (mainly bruising) (Figure 4). Fruit with more than 10% flesh damage is likely to reduce future purchases by consumers (Gamble et al., 2010).

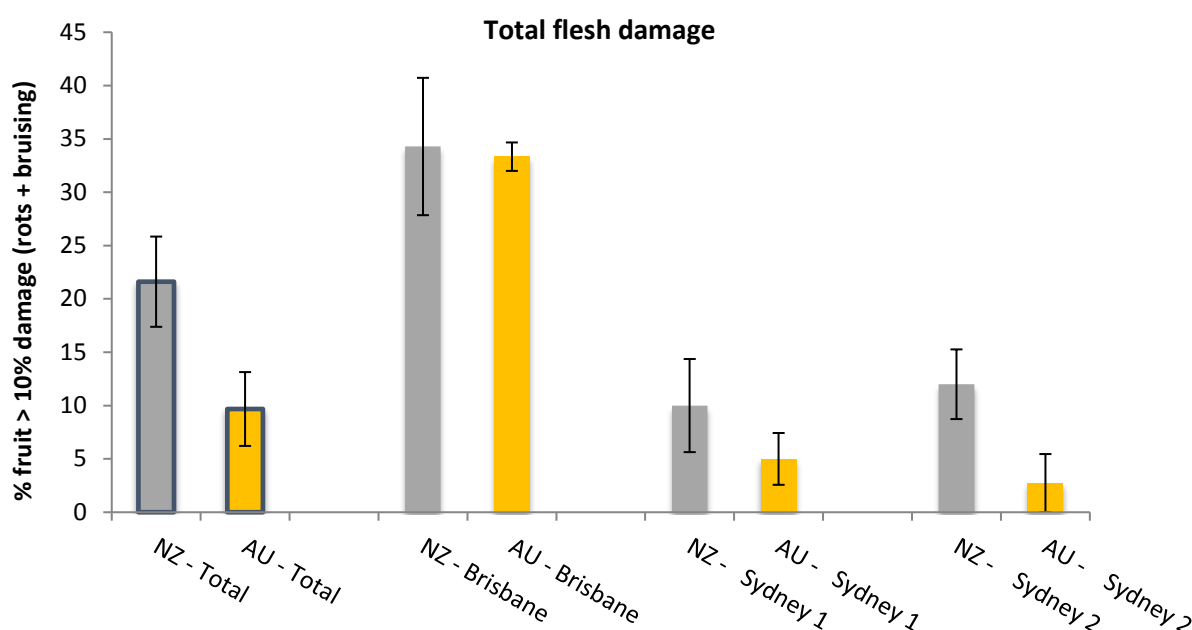


Figure 4. Percentage of fruit with more than 10% flesh damage from three sampling events of Australian and New Zealand avocados in Brisbane and Sydney retail stores. Vertical bars represent standard error of the mean.

### Incidence of flesh defects

The level of any particular flesh defect in fruit is presented in Figure 5. In the New Zealand fruit, 54% had some level of body rots and 36% had some stem-end rot. Seventeen percent (17%) also had vascular browning.

This compares to 10% of Australian fruit with body rots, 4% with stem-end rots and 6% with vascular browning.

This reinforces the idea that New Zealand fruit growing conditions were very conducive to rots during the season. Vascular browning tends to be associated with stem-end rot.

Some New Zealand fruit were also affected by diffuse discolouration, which is a symptom of chilling injury. This suggests that some New Zealand fruit were stored at, or left to ripen below, optimal temperatures.

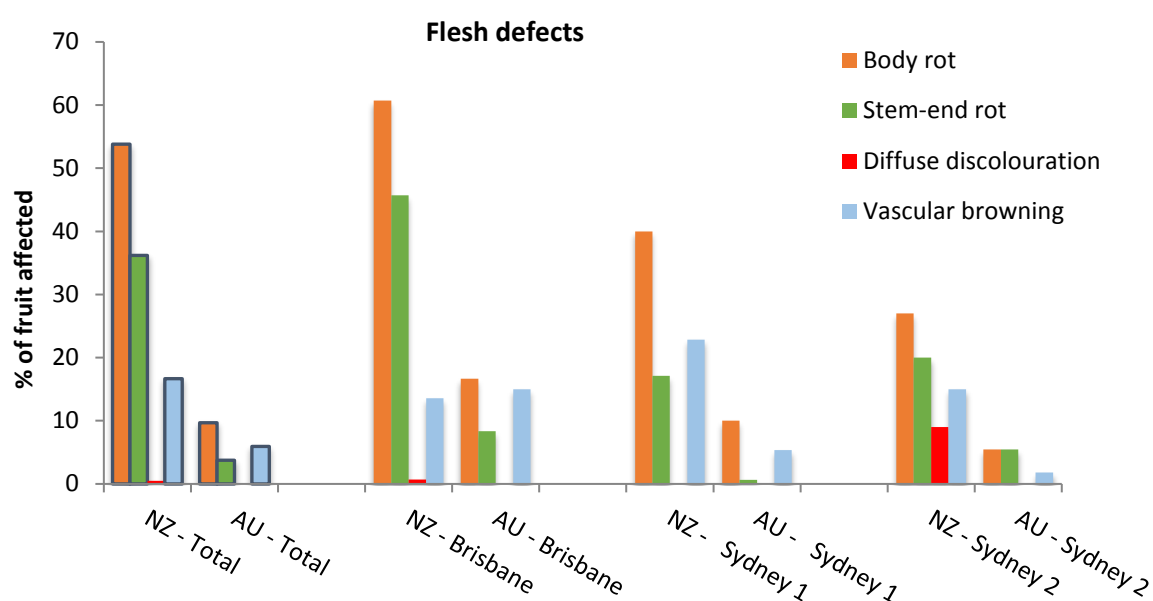


Figure 5. Incidence of any internal fruit defects from three sampling events of Australian and New Zealand avocados in Brisbane and Sydney retail stores.



*Figure 6. Severe stem-end and body rots in New Zealand fruit (top), and a near perfect sample of Australian fruit (lower). Note: photos of all samples are available on request.*

### Fruit age

Australian best practice standards recommend a maximum of two-weeks' storage before fruit are ripened, which suggests that fruit should be ready to eat within approximately three weeks from harvest. However, New Zealand fruit had been held an average of 25 days from harvest, by the time the fruit reached stage 5 ripe, compared to 22 days for Australian fruit. Four New Zealand and one Australian sample reached or exceeded 30 days from harvest.

In this study fruit age did not tend to correlate with the level of flesh rots, suggesting that other factors such as preharvest conditions and management, and other supply chain practices had the major influence on quality (Figure 7).

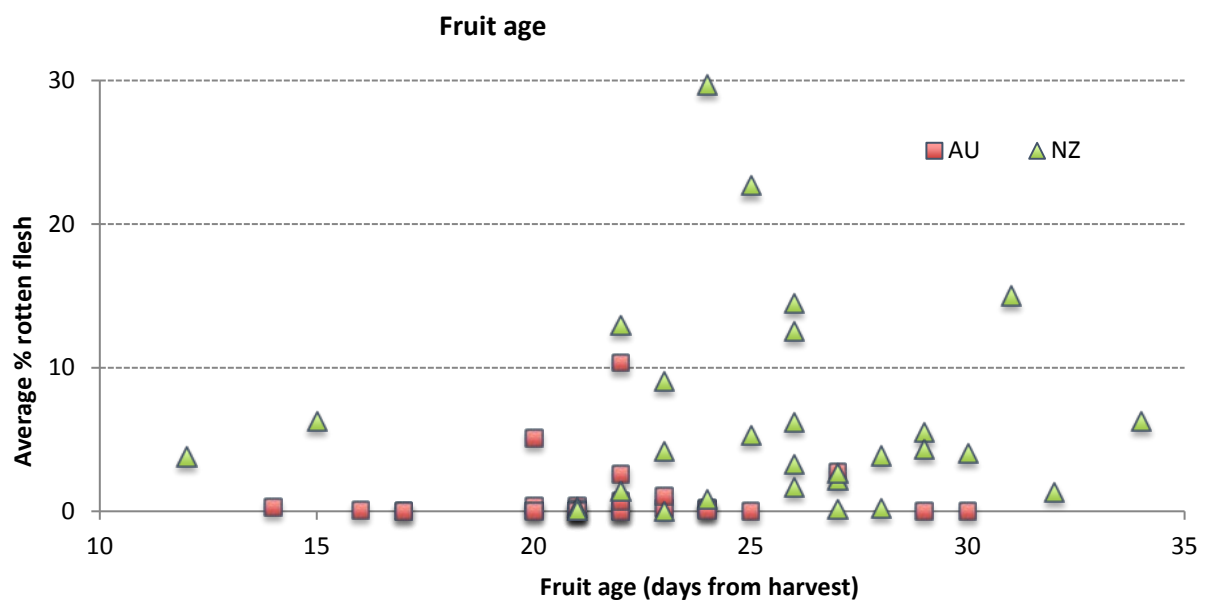


Figure 7. Scatter plot of fruit age and level of rotten flesh in samples of Australian and New Zealand avocados.

#### Quality by supplier/packhouse

Fruit from all New Zealand suppliers had consistently higher levels of rots compared to that of Australian suppliers (Figure 8). New Zealand fruit quality issues are therefore likely to be an industry wide problem, rather than the result of a particular supplier. One NZ supplier (NZ 5) had particularly high levels of rots. This may be related to those samples coming from Brisbane, which had more severe rots than samples taken in Sydney.

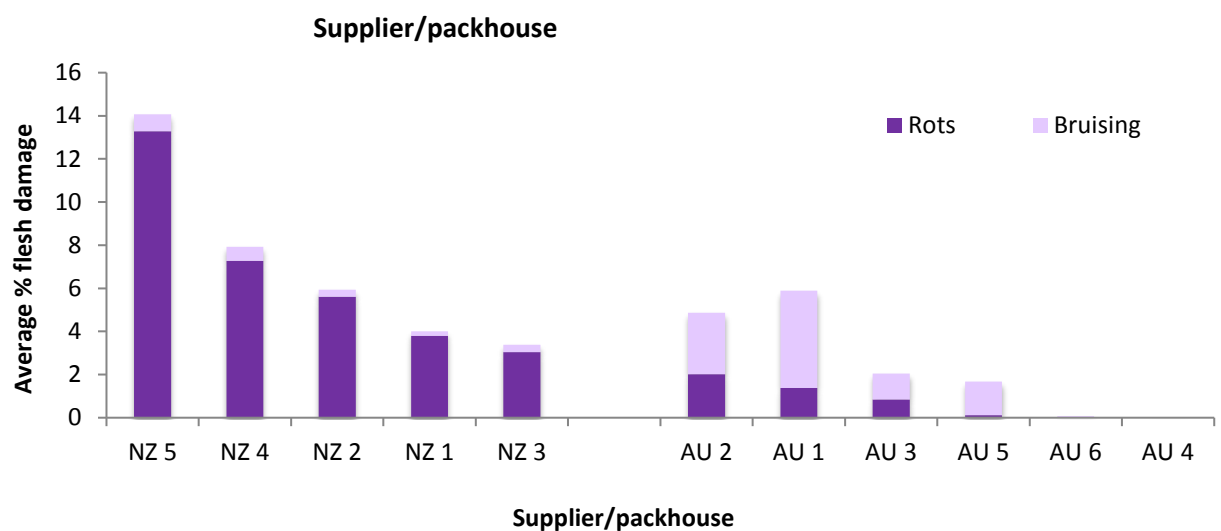


Figure 8. Average level of rotten and bruised flesh from different New Zealand and Australian avocado suppliers/packhouses.

## Conclusions

Sampling of Australian and New Zealand avocados has identified a significant quality issue with New Zealand fruit in December 2018 and January 2019, mostly due to fruit rots. As the issue was present across different NZ suppliers, the underlying cause is likely to be pre-harvest conditions rather than postharvest practices. However, poor postharvest practices may have exacerbated the issue.

Winter 2018 rainfall in the Bay of Plenty, NZ (the major avocado growing region) was above normal (123% of average), and some major flooding events also occurred (NIWA, 2018). Spring rainfall was close to normal.

The wet conditions earlier in the growing season were likely to have been a contributing factor in the high incidence of rots in fruit from NZ this season. Rain increases the inoculum load in the orchard, increasing the likelihood of pre-harvest infection with fungi causing stem-end and body rots. Continual rainfall can also hinder grower efforts to maintain an effective fungicide program, which is necessary to help reduce fruit infection in the orchard.

The October–November port strike in Sydney likely contributed to the early anecdotal reports of poor quality fruit. Although the fruit in this study were unaffected, wholesalers have suggested that continuing transport delays and increased fruit fumigation (causing temperature fluctuations pre-ripening) may have contributed to the observed issues with imported avocados.

The average severity of flesh rots varied from 3–13% of flesh, across all New Zealand suppliers. In addition, there were two samples of New Zealand fruit which were near perfect quality. This variability suggests that although the underlying cause of the rots is likely to be pre-harvest related, differences in postharvest management may have contributed to the variability in level of rots. Temperatures through the cool chain; ripening practices; fumigation; days that fruit were held ripe; and time from harvest; are all likely to have contributed to the severity of rots.

## Monitoring and evaluation

As this was a small project carried out over a period of three weeks, no formal monitoring and evaluation plan was required.

The project objective was to conduct an assessment of avocados in retail supermarkets in multiple states of Australia to review the quality of Australian and New Zealand sourced avocados at point of sale. This objective was successfully achieved, with a snapshot of avocado quality collected in Brisbane and Sydney on three separate occasions. After the first two sampling events, an interim report was provided to Hort Innovation and an avocado industry representative for feedback before sampling continued. They were both pleased with the results of the first two rounds of sampling.

## Recommendations

### 1. Implement a regular quality monitoring program at retail

Implementing a regular quality monitoring program would allow for earlier detection of quality issues, such as those identified in this report. As soon as issues are identified, actions could be taken to limit the severity of the issue. This could mean reducing the time fruit is held in the supply chain and adjusting ripening temperatures.

A regular quality monitoring program could also be used to provide feedback to suppliers.

### 2. Follow postharvest best practice to limit the development of rots in New Zealand fruit

Although growing conditions may have predisposed New Zealand fruit to high levels of disease, there are steps that can be taken postharvest to limit rot development. These include:

- Applying postharvest fungicides within 24hrs of harvest

- Using sanitisers in bin dumps
- Removing field heat as soon as possible after harvest
- Keeping fruit at the recommended storage temperature (5°C) through the cold chain
- Not exceeding maximum recommended storage times before ripening
- Ripening fruit at 16–18°C, and maintaining air circulation through trays
- Minimising the interval between ripening and retail

### **3. Supply Australian fruit late in the season**

As the season continues, fruit become more mature on the tree. Late season, over-mature fruit tend to be more susceptible to rots. Current Australian supply is less predisposed to rots than New Zealand supply, so it would be more appropriate for supply late in the season.

## **Refereed scientific publications**

None to report.

## **References**

Gamble, J.; Harker, F. R.; Jaeger, S. R.; et al. (2010). Postharvest Biology and Technology 57(1)35-43

Horticulture Innovation Australia Limited (2018). Australian Horticulture Statistics Handbook, Fruit 2016/17

NIWA (2018). New Zealand Seasonal Climate Summary. Retrieved from <https://www.niwa.co.nz/climate/summaries/seasonal>.

Supply Chain Quality Improvement – Retailer Point of Purchase Improvements (AV15011) Final Report

## **Intellectual property, commercialisation and confidentiality**

No IP or commercialization issues to report.