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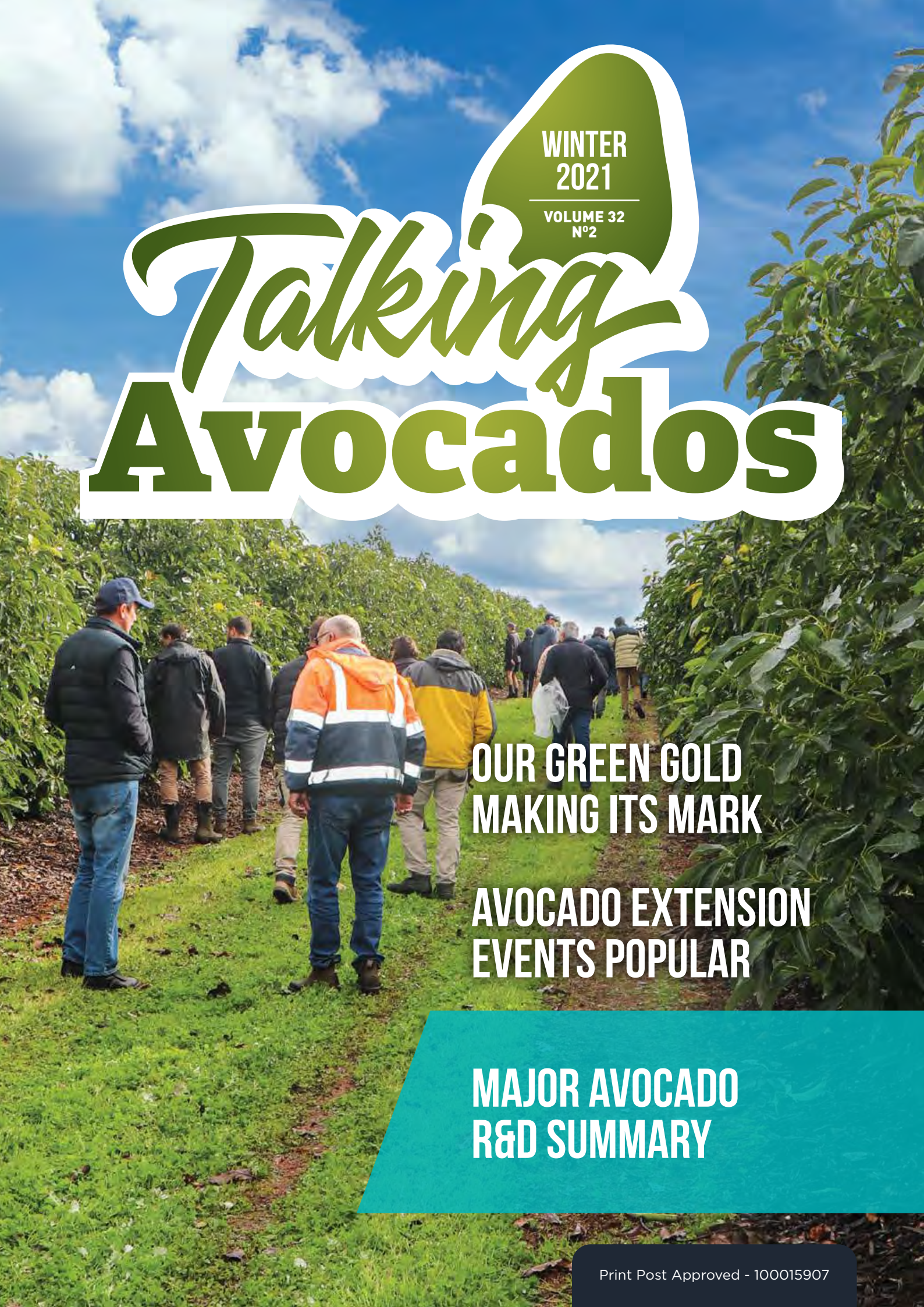

OUR GREEN GOLD MAKING ITS MARK

AVOCADO EXTENSION EVENTS POPULAR

MAJOR AVOCADO R&D SUMMARY

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Hort Innovation
Strategic levy investment

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Avocados Australia

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COVER IMAGE: The Avocado Regional Forums are once again proving popular, even organising in-person events in a pandemic year continue to provide challenges. Our cover shot this year is from the Western Australia regional forum, held in June. Read more on page 21.

CHAIR'S PERSPECTIVE

Jim Kochi, Avocados Australia Limited

I know that improving how we do things is a regular topic of conversation and thought for avocado growers, and the current bumper crop is going to make that even more important than ever.

We all know the immediate price implications of the current level of market supply, but we need to make sure the short term isn't blinding us of some medium to longer term opportunities.

What's opportunity one? The currently high supply levels. While we've definitely seen a drastic drop in $/tray to us as growers, all that fruit had to go somewhere, and it has. It's gone into shopping baskets, it's gone on smashed avo in cafes (well, when people can frequent their local cafes), and it's going into our export markets. Not only are our avocado lovers hopefully eating more avocados, but I'd also like to think that people who want to be avocado lovers but who can't usually afford to be, are picking up a taste for our green gold. If you're on minimum wage, a $4 avocado really is a luxury. A $1 avocado is affordable nutrition for the family, and based on feedback from several retailers, the number of buyers has certainly increased.

And opportunity two, I hear you ask? That's the levy system we've all supported to make sure our "luck" continues. As you know, all commercial avocado growers pay the national levies – 2.9¢/kg for research and development (don't miss the major wrap up of current efforts from page 37), and 4.5¢/kg for marketing (page 34).

In 2019/20, $2.9 million of our levies were received by Hort Innovation for R&D work, and a further $4.5m for marketing.

Now, the latest Avocado Fund financial report isn't out yet, but let's take a look at what's been happening between March and July 2021, compared to the same period last year.

In 2020, we sent 6.8 million trays to market in those five months. In 2021, we've sent 8.1 million and that's somewhere in the region of 29.5 million kilograms, which is going to generate an increased level of funding for our R&D and marketing efforts.

So, what's this mean? In the past, I've had any number of people tell me how lucky the avocado industry is. My message is "follow the money". The more money you have, the luckier you get. That's what makes avocados so successful, the amount of money that growers have agreed to invest in their own industry.

There's no luck about it. Growers have made the investment and the industry has spent it as wisely as we can. The growth, the returns, the results: this is what makes us different from other industries.

That said, we cannot rest on past achievements. We have to evolve, and one evolution we're going to need to make is ramping up our marketing for 12 months of the year, not just at strategic times.

We know our consumers love their avocado in summer but given the increased production levels, we need them to love avos just as much in autumn, winter and spring.

The only reason we've concentrated on marketing at strategic times previously, is that summer is the time of the highest consumption. We need to take the current opportunities to secure increased consumption all through the year. Lucky indeed.

CEO'S REPORT

John Tyas, Avocados Australia Limited

I had hoped that by now, we would be in a much more stable situation, with regard to COVID-19. That is clearly not to be, for some time yet.

COVID-19 continues to challenge our industry (and all other sectors), making it difficult to secure workers, adding extra requirements on freight, on event organisation and countless other every day tasks.

Research and development

We know everything has had to "find a way" in the pandemic, and the levy funded R&D work is no exception. As you will see in our major R&D summary (from page 37), there is a lot still going on to help us improve our production, meet consumer expectations, extend our international marketshare and keep industry up-to-date.

The most recent levy receipt information (for 2020/21) is not yet available, but since the 2010/11 financial year, growers have paid more than $20 million toward R&D, and this has been bolstered by contributions from the Australian Government. Our annual R&D summary is your chance to see an overview of the work being done on your behalf, via the funds managed by Hort Innovation.

Avocado supply

We all knew the day would come when our domestic production took a significant jump. None of us expected this to happen during a pandemic, leading to a series of lockdowns in our major foodservice markets around the country. Whilst returns to growers this year are very challenging, the good news about a 65% increase in supply, is that the retail prices are encouraging our infrequent avocado purchasers to add an avo or two to their baskets. You can read more on the marketing efforts on page 34. Also, we are seeing a significant increase in exports this year with Australian avocados supplied at more globally competitive prices. Hopefully we will see flow on benefits for future years with new consumers of Australian avocados here in Australia and in our key export markets.

New faces at Avocados Australia

As you will read on page 28, we have a new Export Development Manager, Flora Zhang, who has taken over the reins from Joy Tang who was not able to commit to a full time role. Joy helped develop our current export program and set a foundation for the ongoing work of market development and access.

For those who visit the Brisbane office, there will be another new face, with Louise Dunker joining the team as the Administration and Accounts Manager. Louise replaces Jayne Weedon, who has left to pursue part-time opportunities.

It's always sad when good people move out of the industry, but it's also an excellent opportunity for us to bring in people with new ideas and new skills, as we keep moving the Australian avocado industry forward.

New industry players

Do you know a new grower who isn't receiving industry communication or doesn't have access to our extensive best practice information? We encourage you to recommend they subscribe (for free) to the fortnightly *Guacamole* newsletter, for the monthly *Avo Alerts*, and for this magazine.

Encourage new members of our industry to make contact via admin2@avocado.org.au or by calling 07 3846 6566 for more information about our various publications and activities.

AROUND AUSTRALIA

TRISTATE

By Kym Thiel

By the time we all read this I imagine harvest is well and truly underway in the Tristate. Fruit quality at time of writing (mid-July) is looking very good on the tree but it is the current market conditions that is of a concern for all growers.

With tray returns earlier in the year bordering on the cost of production, it is imperative we have our market and crop estimation information correct so we – as a whole – can make informed decisions about when to pick and how much. This leads me to the industry funded *Infocado* program and upgrades/roll out that are occurring at the moment. The Tristate has always been a region with a lot of small grower/packers with a poor participation rate. Personally, it is frustrating as I can see how important accurate information is in successfully marketing a crop especially in high volume years such as this. Therefore, if you do not currently contribute, I strongly encourage you to get involved. For further information please contact Daniel or Amanda at the Avocados Australia office on 07 3846 6566.

Many growers have said to me that this season is just a blip, and we will be okay when volumes return to normal. I think it is more likely that this *is* the "new normal". Trees can quite often produce two big crops in a row before having an off year and the current tree health indicates to me that this is very much possible. Export demand has been high and is something that we must all pursue to help keep our domestic market as buoyant as possible. Unfortunately, the size profile that is being sought after makes it difficult to supply but I am sure as we work on these markets, volumes will continue to build.

Finally, if you are receiving this and are not a current financial member of Avocados Australia, I strongly encourage you to join and help supply a united industry voice. In situations like we have encountered this season an industry body is more important than ever as it has the ability to lobby and work on your behalf on issues which, as individuals, we cannot achieve. One of these, and the most visible, that you may have seen is the current marketing campaign which although overseen by Hort Innovation, it was Avocados Australia and the marketing SIAP (strategic investment advisory panel) that had the ability to direct further funds etcetera and make "on the run" calls as far as ramping up activity has gone. As growers in this region, no matter how big or small, I strongly encourage you to get involved and begin contributing factual information and becoming members for the benefit of all.

CENTRAL NEW SOUTH WALES

By Ian Tolson

What a difference a year makes! Last year, even though COVID-19 had us in lockdown, avocado prices were quite high and the demand for fruit still strong. This year, the predicted production increase has hit, large quantities of fruit being despatched each week and prices well below that of previous years.

COVID-19 continues to disrupt our lives. With lockdowns in place and again stifling the food service industry, coupled with the predicted increase in production arriving, the lower grade fruit is struggling to find a buyer.

Retail customers can still be faced with issues when purchasing an avocado. Ready to eat fruit has on numerous occasions not been available for purchase. At other times, removing the top layer of trays from the display revealed some ripe to ripening fruit. Hard green fruit that may be ripe in a week is not appealing to the consumer. Avocados should be the same as any fresh produce item in the store, able to be bought and eaten on the same day.

The price point of $1.00 per piece should have demand strong. Quality ready to eat, easily accessible fruit is the way forward in such challenging times.

If prices experienced this season are here to stay, growers will need to strive for their orchard to produce the best possible quality to maximise returns.

Farms across the area affected by the flood in March are recovering. Some farms have stumped trees, others have removed and replanted trees. Loss of production on those orchards is not ideal; thankfully no orchard was totally destroyed.

When we reached mid-July, growers across the region were reluctant to commence harvesting. Most will ease into the season within the next few weeks (the end of July and into August).

SUNSHINE COAST

By Robert Price

We are now reminiscing about those times when we had an "average" year, in terms of climatic conditions, crop production and market reliability. While there are always yearly variations, recently the swings seem to have been more acute.

This season in the Sunshine Coast, conditions have been relatively mild, barely any frosts although rainfall is below average. In fact, SEQ Water has already cut the Mary Valley 2021-2022 water usage down to 80% of allocation. What lies ahead if there is another year of below average rainfall?

On top of the vagaries of nature, the pressures on avocado producers with the growing oversupply of fruit driving the returns to growers down are likely to continue over the coming years gives rise for the majority of levy payers to deliberate on how to survive economically. This was to be expected, going on statistics related to new plantings over the last six or so years. So, what can growers do to help make their business viable?

Work has been done by Avocados Australia in conjunction with Hort Innovation on export market development where progress is ongoing and is reported in *Guacamole* and here in *Talking Avocados*. This project has made some headway in an extremely competitive world market, which is encouraging.

Another development is the lifting of the moratorium on genetically modified crops (GM) in New South Wales on 1 July. This follows South Australia also lifting the ban in 2020. So, every mainland state allows GM crops. Most of the GMO crops grown today were developed to help farmers prevent crop loss. The three most common traits found in GMO crops are: 1) resistance to insect damage, 2) tolerance to herbicides, and 3) resistance to plant viruses. For GMO crops that are resistant to insect damage, farmers can apply fewer pesticides to protect the crops. GMO crops that are tolerant to herbicides help farmers control weeds without damaging the crops.

Australia has been slow in lifting bans, but now work can begin on sourcing plants that have resistance to avocado fungal diseases, particularly Phytophthora. In addition to cutting down on chemical use the cost saving this type of development is ongoing.

In concert with GM technology is development of other cost saving technologies. I read a report by Nuffield Australia 2018 scholar and avocado grower Matthew Fealy, which was supported by Woolworths. It covers a wide range of issues and amongst the topics it covers the importance of Automation in the horticultural industry and the reasons it is economically important for the food producers. You can read the full report at *bit.ly/Fealy18*.

As we have witnessed this season the impact of lack of labour for food producers has cost them a lot of money. The worry is that this is a worldwide trend and requires careful research and planning to manage the impending crisis.

TAMBORINE AND NORTHERN RIVERS

By Tom Silver

The 2021 harvest for our region is well underway and for some may be even starting to wrap up. To go from last year's record high prices to this year's lows has been incredibly hard for growers already struggling with sickening trees from the earlier rain and flooding.

Though there has been a long expected reduction in farm gate price with the extreme amount of new plantings, no industry players expected it to go so bad so quickly.

This season has highlighted the importance of market information and the need for all growers to *contribute* to *Infocado*. I know some readers will dismiss this and say *Infocado* is inaccurate, a waste of time and allows the big retailers to manipulate the market, but *Infocado* is ours and relies upon accurate input from all of us to give the best indicator of how the market is going to handle.

The cumulative effect of 30 three pallet a week growers, or a couple of 50 pallet a week growers, not entering data into *Infocado* diminishes our ability to know what's coming through and therefore prepare for production spikes.

A wise old market player once told me, "Tom, if you want to keep demand up, you need to under supply the market by

Tamborine Northern Rivers Director Tom Silver started his Sharwil harvest in July, supplying to local foodservice outlets and Brisbane stores.

two pallets a week", so when an unexpected 150 pallets shows up, what hope is there? Please remember also that Avocados Australia goes to great lengths to make sure the quarterly forecast is as accurate as possible and the best information for what fruit is to be supplied; the weekly forecast, due to the large amount of data that needs to be tabulated, is best used as a guide as to what was supplied in the previous week, and how different growing regions are tracking.

I can assure you the staff members at Avocados Australia are working hard to get a handle on the market dynamics, export shipments are increasing, and levy funded 'call to action' advertising managed through Hort Innovation, although slow to start, is now happening. This year's avocado crop is set to increase production by 65% on last year, it is a massive increase. I truly hope that by the time this goes to print the market may have improved.

On another topic, the local water supply authority, Rous Water, has recently closed public submissions on the future water supply options for the Northern Rivers. Previous to the public submission process, Rous Water, with a slim majority voted to remove the long-proposed Dunoon Dam as a water supply option, instead relying upon water efficiency, water reuse and ground water extraction.

Water usage modelling for the region suggests that demand will exceed supply by 2030, and the shortfall by the year 2060 will be 5.6 gigalitres.

I do not want to go into the politics of building a new dam vs other supply options, except to say it boggles my mind that in an area that successfully fought off CSG mining and the bottled water industry, our elected representatives think it is okay to pump a potential 5.6 gigalitres out of already over allocated aquifers, to the detriment of the environment and existing ground water users.

Thankfully there has been no catastrophic weather events since those earlier in the year, just small but regular top ups. The August winds arrived in mid-July, unfortunately knocking plenty of fruit off. Trees at this stage look to be budding up well for next year, which reminds me of my favourite farming mantra, "there's always bloody next year"!

WESTERN AUSTRALIA

By Brad Rodgers

I would like to start by saying farewell to Jayne Weedon and Liz Singh. Jayne was a great help to me when I came on board, getting up to speed with the workings of Avocados Australia and the Board, and Liz has been instrumental in arranging our various regional forums, and preparing technical materials on a range of topics for growers.

Moving on from staffing changes, I can sum up the weather in three words: wet, wet, and wet. It has been unbelievable here in Western Australia. Unless anyone in the west has been living under a rock, they would know this is one of the wettest starts to winter we have had for quite some time. This is confirmed when some of the Bureau of Meteorology radar tools are offline due to excessive activity, as we all try and check for updates. As I write this, haven't heard weather causing too many problems with current crop, however, the associated wind could impact some of the heavier crop loads.

As I mentioned in previous *Talking Avocados*, this year we will exceed parity between production and consumption. This, of course, will put export more squarely in most growers and marketers' minds. We will need to expand existing export markets and Japan will be tested this year at a much higher level than 2020. (Read more on exports on page 28.) To support this, research is underway to find out why our international customers like Aussie Avo's so much (read more on page 44) and look to leverage that across all export markets. This work is funded by your avocado levies.

As everyone knows, labour will end up being a problem, but the level of the problem is yet to be determined fully. Hopefully, the new Seasonal Agriculture Worker Visa will be in place by the end of the year, as this may give us a significant boost. This visa, once implemented, will be extended to all 10 ASEAN countries, for example Thailand, Malaysia, Vietnam and the Philippines. If this is in place by the end of the year, it may give us a significant boost.

The good news about a strong supply, both this year and in the coming years as younger orchards like mine come into full production, is that consumers will get used to including more avocados in their weekly shops and this should help us increase domestic consumption over the medium to long term.

We were fortunate to have the two regional days in late June (more on page 21) and lockdowns didn't impact these days for those travelling. The days went very well, with increasing numbers at the WA events reflecting the ongoing industry growth. Between the two days, we had more than 140 growers and industry members, at the forums and the associated visits to five orchards. It's been great to see many new growers take up membership after seeing the work of Avocados Australia.

Finally, good luck to all Western Australia growers for this coming record season.

SOUTH QUEENSLAND

By Daryl Boardman

South Queensland is in the thick of the region's 2021 harvest at the moment, and yields, fruit size and quality are good. It would be an understatement to say that prices are, however, disappointing.

COVID-19 is having a much bigger effect on pricing and returns than most of us realise, due to the lack of foodservice. It's a perfect storm of increased production and a huge loss of people to buy our avocados, particularly the off-the-top lines that can go to foodservice. It's not helpful to the industry when our two largest foodservice markets – Melbourne and Sydney – are both locked down at the same time.

The other tough note is staff. Everyone discussing how bad the labour shortage is, as well as the quality of labour. I would fully support any move by our various governments to make it easier for those on either pensions or unemployment measures to be able to pick up extra work without jeopardising their government support services. I'd also encourage growers to make sure they are both advertising in the Harvest Trail (this is where the government staff go to check on demand) and promoting the existing financial incentives. For example, in Queensland, not only can new employees potentially access the Federal assistance (including relocation assistance) but also the #pickqld incentives. The Queensland Government is offering payments of up to $1,500 on top of wages, and I've heard there's been some good interest from workers, which is encouraging.

Visit *avocado.org.au/about/positions-vacant/* for links and more information.

Apart from that, harvest is going well, and current conditions mean that next season is shaping up well, with reasonable rainfall and a kind winter setting the scene for a good 2022.

Can I also say, it's been good to see more growers and packers embracing exports. Obviously, some of the current interest is due to necessity, as we need to expand our markets to accommodate both our increased production volumes and the COVID-19 driven vagaries of the domestic market.

It's also been good to see how well received the industry's new promotions have been. I know a lot of you voted in the recent Channel 7 competition, where the *Our Green Gold* advertisement was up for the station's "best ad of the Olympics". Given a win would provide an additional $1 million in promotions on 7, I know we're all hoping for the best possible outcome there. Stay safe everyone.

CENTRAL QUEENSLAND

By Eric Carney

One season is ending with another upon us. As of writing this in mid-July, our region is certainly experiencing some challenging times. Less than two weeks ago water allocations were announced and those on the north side using the Kolan sub scheme received 98% and for those on the south side using the Burnett sub scheme, they received 22% allocation. Bore allocations, for some, was

also disappointing at 25%. Whilst 22% allocation for Burnett irrigators is better than the 14% estimated, it is still a crushing reality and a position where growers cannot farm as normal.

There are a myriad of actions growers are taking to conserve water even further than they already do: converting to drip, ramping up mulching programs, investing further in moisture monitoring etc.

Although conservation is useful it does not come near to close enough to bridging the water deficit for the farms solely reliant on scheme water. Some farms are aggressively altering their pruning programs to reduce canopy size, thereby potentially reducing tree water demand. There are also several farms that sadly, have had to make the hard decision to remove trees completely. There are still many farms (or parts of farms) that have yet to decide or enact their decisions on how to deal with significantly less water.

As if water issues weren't enough of a challenge for some of the growers, the region has also been grappling with extremely low returns for their fruit this season. I doubt 12 months ago many growers anticipated returns in the teens for premium fruit.

Comparing volumes of fruit dispatched from 2020 vs 2021 we can see some impressive numbers went through the system in 2021. Specifically, when comparing the period from the first week in May to the week ending 9 July (10 weeks) in 2020 that figure was 2,484,207 trays. For the same time frame in 2021… drum roll…. it is a massive 4,054,531. That's an increase of 63%.

As an average, over the same time frame, less than 250k trays went through each week for 2020. By comparison, in 2021 the average was over 400k each week!

To me, this highlights why contributions to the *Infocado* system are paramount. Accurate, comprehensive forecast data allows for a better, more accurate picture of the season ahead, which in turns allows the marketers to formulate plans to best handle a season where we are nearing a doubling of volume in a single year.

NORTH QUEENSLAND

By Jim Kochi

Well, it happened as predicted. My forecast for the North Queensland crop in the Spring 2020 edition of *Talking Avocados* was between five and six million trays, or a supply line of around 217,000-261,000 trays per week across a 23-week supply period.

The reality turned out to be, according to *Infocado* week 18 of 2021 (26 April-2 May) the reported despatch was 400,149 trays and NQ supplied 63% of that. That is, NQ supplied about 252,091 trays and Central Queensland most of the rest. In past years I have watched the *Infocado* reports with trepidation when the numbers went into the 300K mark, and I was expecting a nasty response from the market under normal conditions but made nastier due to the COVID-19 conditions prevailing in the major markets of Brisbane, Sydney and Melbourne.

I have written many times before about the importance of providing the market with timely supply forecasts so that the major retailers can plan their marketing programmes to manage the flow of the supply. These things take time to plan and to execute and it takes at least a month of planning to get marketing programmes in place. Programmes like retail pricing, multi-buys, in-store promotions, catalogue promotions and also the avocado industries' own social media presentations, and mainstream media promotion presentations.

It is just TOO LATE to react to a flood of supply when the truck doors are opened in Brisbane, Sydney and Melbourne. We now know what did happen to the market on week 18 of 2021 (26 April-2 May) and the following weeks of this supply season. For the record, the average retail price dropped from $2.06/piece to $1.67, $1.50, $1.31, $1.00 per piece (Premium count 16) as each week followed up to week 28 (5 July-11 July).

A disappointing fact is that the participation of North Queensland growers in contributing data to *Infocado* is not as high as it could be and therefore the data is not as accurate as it should be. Simply and sadly, the North Queensland data is underestimated and under-reported.

For the record, I am not psychic, but I do submit my data to *Infocado* and have done since day one, and I believe in the power of *Infocado* and I use that information to understand what happens in the market and why it happens. I provide our information weekly and quarterly to support our understanding of the market and to support our industries' decisions on where to direct levy funds in the R&D and Marketing programmes.

I appeal to all North Queensland growers, and all growers generally, to get involved in this wonderful programme that is exclusive to our industry and the envy of many other horticulture industries in Australia. If any grower wishes to discuss this further, please feel free to call or email. My contact details are inside the front cover of *Talking Avocados*, or call the Avocados Australia office.

NEWS

Data News

Exceptional Shepard quality followed by a challenging start to Hass season

Adam Goldwater, Applied Horticultural Research

Shepard quality at retail was excellent this year. Overall, 97% of Shepard fruit was deemed acceptable to consumers (<10% internal defects) from February to May.

This result was well above the industry's 90% acceptable fruit target, and sure to please consumers and encourage repeat purchases.

Shepard quality was similar out of both North and Central Queensland growing regions, with 97% and 98% acceptable fruit respectively. Overall, flesh defects were minimal, with bruising and stem-end rot the key issues, albeit at low levels (Figure 2).

These results are based on a total of 92 (920 fruit) Shepard samples collected between February and May 2021 from major and independent retail shelves in Brisbane, Sydney, Melbourne, Adelaide and Perth.

The exceptional Shepard quality was likely aided by the rapid flow of fruit through the supply chain, with an average of 14 days from packing to display at retail. It is widely recognised that as the time between harvest and ripening increases, so does the risk of rots and internal disorders in the ripened fruit. In the Shepard samples collected this season, only 7% exceeded best practice of 21 days from packing to display at retail.

Figure 1. A typically flawless sample of Shepard purchased from retail during February to May 2021.

Hass quality – May-June 2021

Unfortunately, as of July, fruit quality has been in decline since monitoring of the Queensland Hass season began in May. Acceptable fruit quality started off at 85% in May, declining to 72% in June. June was the lowest quality level recorded for any month in the past year. Quality was consistently poor (71-76% acceptable) in all three retail markets sampled in June, including Brisbane, Sydney and Melbourne.

In June, bruising was the largest contributor to fruit damage, at 13.6% of fruit, up from the 12-month average of 6.3%. Additionally, body rots, vascular browning and flesh discolouration all increased significantly from the 12-month average (Figure 3).

Fruit age and quality

An increase in defects including body rots, vascular browning and flesh discolouration could be related to older fruit at retail in June. Fruit age of Australian Hass at retail has increased to 16 days from packing in June compared to 13 days based on the 12-month average. On average this is the oldest Australian Hass fruit that we have sampled during the past 12 months.

The more time in the system from packing to retail, the greater the risk of rots and storage defects. This is clearly demonstrated through data collected to date in this project, where the level of fruit with major rots increases consistently as fruit age increases (Figure 4). For example, fruit that was 15-20 days old had 4.3% major rots, whereas that level of rots almost doubled to 8.2% when fruit age increased to 20-25 days.

Although the large volumes of fruit this season are a challenge, moving fruit through the supply chain as quickly as possible can help improve fruit quality.

Potential causes of increased bruising

The increase in bruising is concerning. Previous research (AV12009) suggests that the predominant cause of avocado flesh bruising is from handling by produce staff and consumers at retail point of sale. The recent increase in bruising could be due to an increase in handling of fruit at retail, although this has not been assessed in the project.

There are also factors which increase fruit susceptibility to bruising. These include earlier maturity fruit (lower % dry matter), fruit softening, and increasing fruit age (AV10019). In June, it took an average of 3 days extra for fruit to reach the point of retail, compared to the 12-month average for Australian Hass. Furthermore, fruit purchased in June was likely to be early to mid-maturity. Therefore, both fruit age and maturity could have contributed to increased bruise susceptibility in June.

More information

As the Hass season continues, we hope to see quality lift, returning to the industry target of 90% acceptable fruit. For up-to-date retail quality data, and more in-depth analysis, visit the Avocados Australia Best Practice Resource at *avocado.org.au/bpr/*, go to the 'Retail' tab, and select 'Retail Quality'.

For further details, contact project leader Adam Goldwater at Applied Horticultural Research (AHR) on 0466 080 693 or *adam.goldwater@ahr.com.au*.

Acknowledgement

The *Monitoring avocado quality in retail* (AV19003) project has been funded by Hort Innovation, using the avocado research and development levy, and contributions from the Australian Government.

Hort Innovation Strategic levy investment | AVOCADO FUND

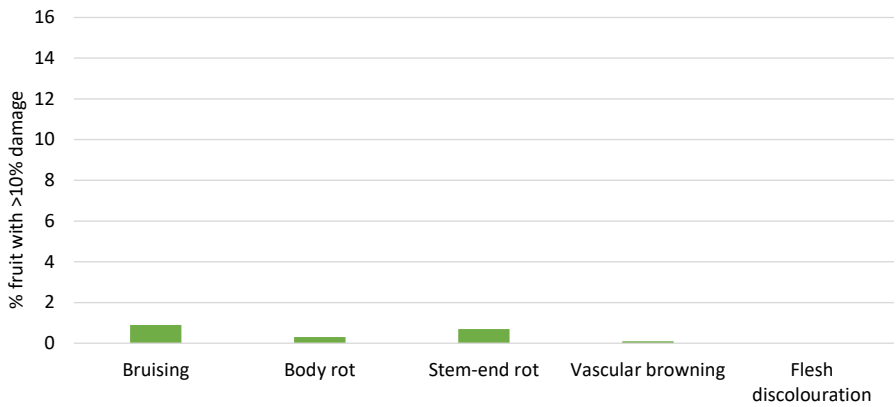

Figure 2. Types of defects causing unacceptable Shepard avocados at retail: February to May 2021.

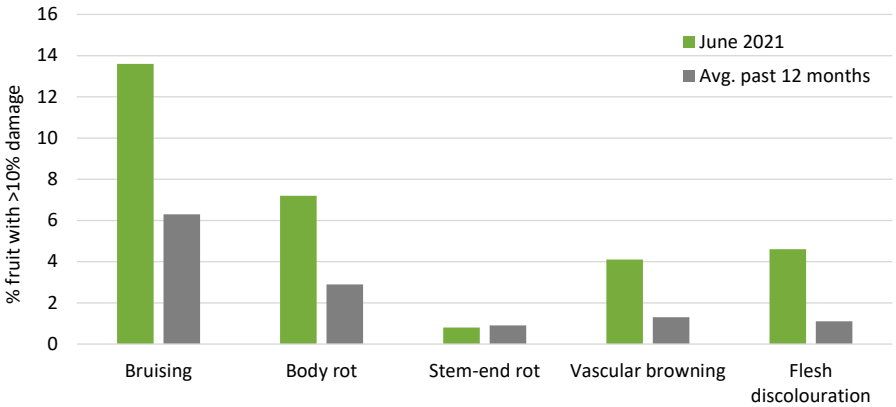

Figure 3. Defects causing unacceptable Hass avocados at retail in June 2021 (green columns) compared with 12-month average (grey columns).

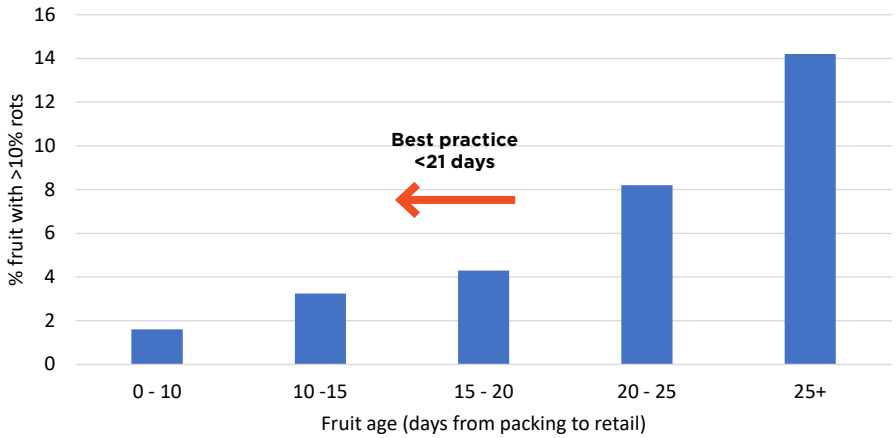

Figure 4. Effect of fruit age on flesh rots: as days from packing to retail increases, so too does the level of fruit with rots >10% of flesh. Data based on 560 samples (5,600 fruit) of Hass and Shepard collected from May 2020 to May 2021 in AV19003.

AvoData: tracking fruit flow

Daniel Martins, Avocados Australia Data Analyst

High quality data plays a major role assisting the industry to deliver high quality avocados to market and to support profitable supply chains for stakeholders.

Since 2007, the *Infocado* report informs industry of avocado volumes dispatched and forecast to be supplied. Short-term data is reported on a weekly basis and seasonal data is reported every quarter.

This data assists the industry to:

- supply avocados more consistently throughout the year, anticipating and minimising gluts and shortages of fruit
- optimise fruit quality at retail level, as with too high or too low volumes, the likelihood of quality issues tend to increase
- maintaining a more stable market by optimising supply, and
- schedule industry marketing activities in line with supply dynamics.

Industry engagement

For the Australian avocado industry to fully utilise the potential of *Infocado*, its data needs to be of the best possible quality. It is therefore fundamental that it ticks all the data quality boxes.

There are six commonly recognised data quality dimensions:

- Accessibility: Is the data easily available to those who need it?
- Timeliness: Is the data easily available when it is needed?
- Consistency: does the data conflict with other data?
- Validity: Does the data meet industry requirements to be useful?
- Accuracy: does the data correctly describe what it is purported to measure?
- Completeness: Are there any substantial gaps?

When it comes to accuracy, we have checks in place to ensure that the information we report is as accurate as possible. We regularly check our weekly forecasts relative to historical data, relative to seasonal data, and relative to regular engagement with our participating packers.

Our seasonal supply data is checked against levy receipt data from the federal government. Infocado and levy volumes are consistently within a narrow margin from each other. Differences can often be attributed to the timing of when levy collection figures are reported.

On completeness: Industry representation is currently at a very high level with the seasonal data at more than 90%. This data includes both the seasonal forecasts supplied by packers directly into the online system and additional data that is collected from other packers by our staff via phone and email. However, with regards to our weekly data, we only report volumes that have been entered directly on line and there are regional differences, and a couple of our regions that need focus: See Figure 1 below.

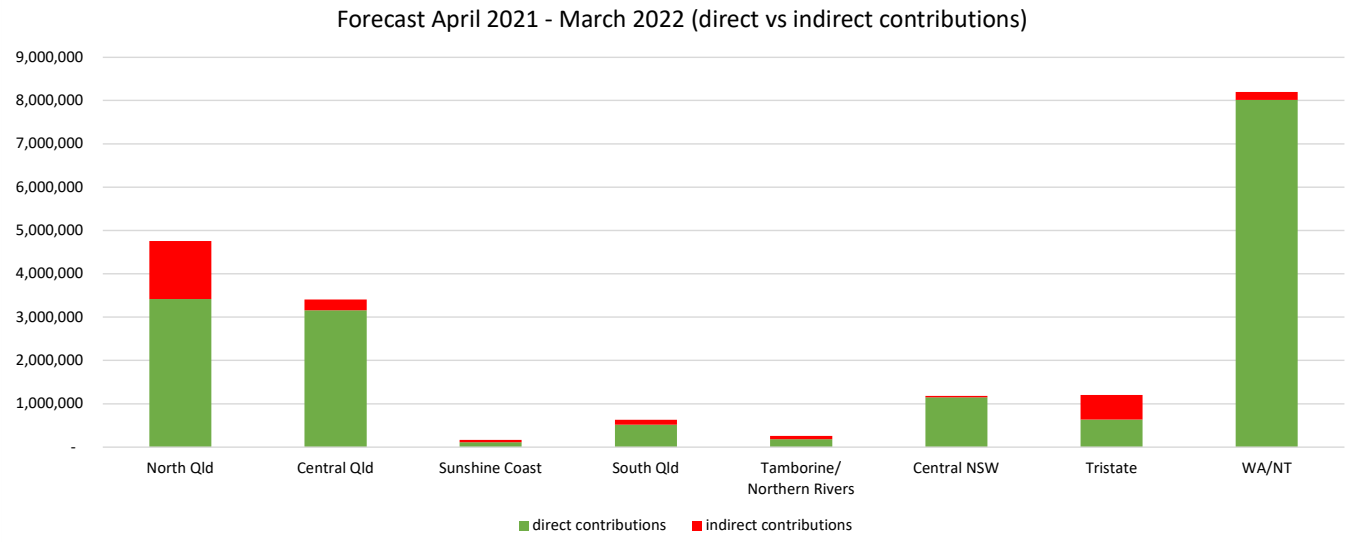

Figure 1.

This chart shows by region, the relationship between data that is contributed directly (the green part), and the proportion of data from those who do not contribute directly yet (the red part).

The green, directly contributed part, is what information the weekly report is comprised of. The Quarterly Report is comprised of direct contributions, in addition to the red, indirectly contributed part, so it is as close as possible to a complete picture of the entirety of the supply to the Australian market.

For the weekly data to be as complete and useful as possible, we need to bridge the gap between the data in these two reports, for that, we want to encourage all non-contributing packhouses to get on board.

With the aim to onboard new users in these regions, we are scheduling regional visits with interested packers where we can explain the new system face-to-face, demonstrate the benefits of participation, show how easy it is to participate and provide hands on training.

Furthermore, we are incorporating new system features that will further simplify the data entry process. These features will become available to all users in the spring of 2021.

More information

If you are a packer who does not yet participate in *Infocado* and you would like to schedule a meeting to receive hands on training, please contact Daniel Martins at data@avocado.org.au or 0458 004 198.

Acknowledgement

The *Avocado industry and market data capture and analysis* (AV20000) project has been funded by Hort Innovation, using the avocado research and development levy, and contributions from the Australian Government.

Hort Innovation
Strategic levy investment

AVOCADO FUND

Global win for Aussie tree crop map

Craig Shephard and Joel McKechnie, researchers from the University of New England's Applied Agricultural Remote Sensing Centre (AARSC), have won first place for their Australian Tree Crop Map Dashboard at the 2021 Esri User Conference, putting their work "on the map" as the global standard.

"We're showing the world that the research tools and applications we're producing here in Australia is of the highest standard, the Map Gallery is central to the Esri conference," Mr Shephard said.

"It's one of the most wide-ranging and comprehensive collections of GIS work in the world, it can indicate trends and influences shifts in technical and cartographic practice."

The Esri User Conference (Esri UC) is the world's largest event dedicated to geographic information system (GIS) technology with 50,000 delegates attending this year's event. It is held in the United States every July at the San Diego Convention Centre in San Diego, California. The Esri UC dates back to 1981.

Craig and Joel started developing the Australia Tree Crop Map Dashboard (ATCM Dashboard) in 2020, as part of the *Multi-scale Monitoring Tools for Managing Australian Tree Crops: Phase 2* research project. This research is driven by the support of Hort Innovation and six Australian industries: avocado, citrus, macadamia, mango, banana and olive.

The ATCM Dashboard was developed in response to the industry's needs to better understand the extent (area and location of production) of their commercial operations >1ha. The tool is freely available and interactively summarises the extent of avocado, citrus, macadamia and mango orchards, banana plantations and olive groves, and supports these industries to make informed and timely decisions around biosecurity and natural disaster responses.

"This really is a career highlight for Joel and I, having our work recognised at Esri US is the pinnacle. It puts our research centre (AARSC) and UNE on map, so to speak," Mr Shephard said.

The long-term vision for UNE's Applied Agricultural Remote Sensing Centre is to establish Australian agriculture as a global leader in the adoption and utilisation of spatial technologies. Whilst the development of the ATCM Dashboard provides the participating industries with an immediate tool for better understanding industry extent (area and location of production) and improved preparedness to biosecurity threats and natural disasters, the full potential is yet to come.

This essential base layer of data will ultimately support decision making processes related to traceability, resource management and yield forecasting as well as major national initiatives such as water security, soil health and carbon storage.

More information

All applications developed by Craig Shephard and Joel McKechnie as part of *Multi-scale Monitoring Tools for Managing Australian Tree Crops: Phase 2* can be viewed here: *une.edu.au/webapps*.

Acknowledgement

Multi-scale Monitoring Tools for Managing Australian Tree Crops: Phase 2 is a part of the Rural R&D for profit scheme. This project is being funded by Hort Innovation using the citrus levy. Professor Andrew Robson the Director of the Applied Agricultural Remote Sensing Centre is the project lead with Craig Shephard and Joel McKechnie managing the mapping component and outputs of this research. The team is also involved in AV18002, funded by the Hort Innovation Avocado Fund, and contributions from the Australian Government.

Hort Innovation

The work of Joel McKechnie and Craig Shepard to map a range of Australian tree crops, including avocados, has received international recognition.

HAWK

Your Business – Our Focus – Working Together

Fibre Packaging for a Sustainable Future

Hawk Group is a family-owned company that manufactures moulded fibre fruit packaging from its purpose-built facility in Hastings, New Zealand.

With our origins dating back to the early 1970's and now spanning three generations, the family's industry knowledge and experience of fibre recovery, recycling and moulded fibre manufacturing has seen Hawk become an industry leader in their field. Hawk currently supplies more than 80% of NZ's apple and avocado trays and has also had a successful presence in the Australian market through the supply of apple trays since 2016.

One of our primary goals is to make it easy for our customers to work together with us. As such, service excellence is at the forefront of our offering. Continuous improvement across product, service, systems, and strong industry understanding are areas we strive to excel in every day. Our trays are specifically designed for the protection of fruit during the packing, storage, and transport process - from packhouse to end customer. From consignment stock and virtual inventory management to tray design, marketing and automation - we have built an offering that supports all aspects of our customer's operations.

Energy efficiency and sustainability are key drivers in our manufacturing process. This is the best strategy to future proof not just our business, but our customer's business also. All products are made from 100% recycled paper. We do not use any bleaches, pigments, biocides, or toxic chemicals in our manufacturing. Our products are recyclable and compostable after end-use. Hawk is compliant with internationally recognised standards including HACCP Food Safety, ISO 9001:2015, ISO45001:2008 and FSC Chain of Custody Certification. Certificates are available to view or be downloaded from our website. For avocado, we have a full count range available from fruit size 16 to 30. We also have a full range of RDT trays for plastic crates available if required.

Please contact us or view our website for full product specifications at **www.hawk.net.nz.**

We are here to help and answer all of your questions! Our Australian representative, Craig Fraser, can be reached on 041 931 1191 or call **freephone 1800 845 256** or email ***sales@hawk.net.nz***.

Craig is happy to meet personally with you and discuss in more detail how Hawk can benefit your business.

Avo Connections success for Avocados Australia

Avocados Australia's special side event to Hort Connections drew a full house of industry members on 7 June, 2021.

Avocados Australia CEO John Tyas said it was the first time the organisation, a Hort Connections industry partner, had held a side event at the major national conference.

"We were over-subscribed with interested attendees, keen to know more about the latest in industry marketing, retail, supply chain quality and export," Mr Tyas said.

"The event provided a great opportunity for people to join key industry stakeholders from across the supply chain and hear the latest in industry, marketing, retail and supply chain R&D developments and improvements, including our export markets and the extensive update of our *Infocado* system."

Hort Innovation Marketing Manager Adele Nowakowska provided an update on the new Australian Avocados campaign, Our Green Gold.

The new campaign, featuring well-known comedian Nazeem Hussain, aims to connect emotionally with Australian avocado consumers, and ultimately to increase the frequency of purchase.

"In a year when supply is forecast to increase by 65% (compared to the previous 12 months), the timing and goal of this campaign could not be more important," Mr Tyas said.

"This year's Hass crop is of excellent quality, and we've had good growing conditions across most of our production regions, so it's definitely the time to celebrate Our Green Gold."

(You can watch the new Our Green Gold ad here *bit.ly/AusAvos2021*.)

Other speakers at the event included Woolworths's Jessica Loader, who provided an update on retail activities and avocados.

The Queensland Department of Agriculture and Fisheries' Noel Ainsworth provided valuable insights into fruit quality and supply chain temperatures from grower to ripening/wholesale after sampling numerous supply chains for a two-year period.

Applied Horticultural Research's Adam Goldwater followed with an update on the retail performance of avocados after sampling carried out in metropolitan stores during the past 12 months.

"Given the response, we will definitely look at how we can be a part of the Hort Connections shoulder program in future years."

More information

You can find recordings of some of the presentations in the BPR Library, under Event Proceedings: *avocado.org.au/bpr/*.

It was a (COVIDsafe) full house at the first Avocados Australia Avo Connections, a shoulder event at the annual Hort Connections conference in June.

Avocados Australia Market Development Manager Hayleigh Dawson (centre) catches up with the head of Woolworth's Fruit and Veg Paul Tuner, and Tayla Field from One Harvest, during the 2021 Hort Connections.

Avocados Australia CEO John Tyas (right) with Woolworths' Alex Doyle and Jessica Loader. Jessica was one of the key event speakers at the Avocados Australia Avo Connections.

Greenskins' Robert Gray with Avocados Australia Director Daryl Boardman and Australian Avocados Marketing Manager Adele Nowakowska. Adele provided an overview of the exiting new Our Green Gold campaign at the Avo Connections.

Nelson Dicheira (Borderland), Will Randall (Lava Valley), Richard Clayton (Mackays), Kyra Braund (Mackays) and Jess Randall (Lava Valley), at the Avo Connections event.

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Jump aboard the AvoBus

Liz Singh, Avocados Australia Industry Development Manager

The Avocado industry development and extension (AV17005) team have been making up for lost time with trips to Mildura (Tristate), Pemberton and Wanneroo (Western Australia).

Tristate Regional Forum

The Tristate Regional Forum held in Mildura on Wednesday, 5 May, was the final Regional Forum in this growing region for the project *Avocado industry development and extension* (AV17005), as the project enters its final 18 months.

Kym Thiel, the Avocados Australia director for the Tristate, said that it was going to be a big year for growing region.

John Tyas (Avocados Australia CEO) said while production was on track, 2021 was likely to be the most challenging year since 2011 for the Australian avocado market.

"Good communication is key to ensuring accurate forecasts to ensure supply meets demand for Australian consumers," he said.

John went on to describe the marketing strategies in place to drive demand including the brand new *Our Green Gold* video (you can read more on the marketing on page 34).

John Agnew (Queensland Department of Agriculture and Fisheries, QDAF) has been monitoring fruit quality in the supply chain nationally, and demonstrated that quality fruit needs quality handling, transport, storage and ripening to ensure quality fruit on the consumer's plate. Generally, the fruit out of the Tristate was considered good quality (>90% of fruit with <5% rots) but there were still improvements to be made in reducing the variability in quality between consignments, farms and pack-shed and reducing departure temperatures.

Adam Goldwater (Applied Horticultural Research) has been monitoring fruit quality available to consumers at retail, including the quality of fruit originating from Chile and New Zealand. Adam encouraged growers to access the "Online Quality Dashboard" in the Retail module of the Avocados Australia Best Practice Resource: *avocado.org.au/bpr/*.

Nutrition was the hot topic for the Tristate event, with Lisa Fyffe (Ripe Horticulture), Harley Smith (CSIRO), Simon Newett (QDAF) and a number of growers making connections between nutrition, carbohydrate levels and fruit quality.

Lisa told growers there was no magic recipe to providing nutrition to avocado trees, but you could improve it through scientific measurements (eg leaf and soil tests) and practical in-field assessment (eg shoots, roots, yield). The more assessments you do, the more success you will have.

Lisa spoke specifically about nitrogen and building carbohydrates before flowering which provided Harley Smith with the perfect opportunity to explain how nutrition can be used to manipulate tree carbohydrate levels and potentially how these levels impact yield and fruit quality (read the results of his latest project on page 66). Simon Newett reported the outcomes of a literature review that identified how nutrition best practice can be improved to help improve fruit quality. The ratio between nitrogen and calcium in determining fruit quality was a big outcome of the report.

Western Australia

In Western Australia, the project team hosted two regional forums: Pemberton on Tuesday, 22 June and Wanneroo on Thursday, 24 June.

Brad Rodgers, one of the Avocados Australia WA directors welcomed participants back to the physical forums in Pemberton and spoke about the significant harvest projected for WA this year. While it is exciting to see progress, it is going to come with challenges as well.

Flies, pollinators & avocado pests

Dr David Cook (DPIRD) fascinated forum participants with the potential of flies for pollinating in the delivery of the results to date of project *Managing Flies for Crop Pollination* (PH16002). David spoke about how flies could be alternate pollinators to the increasingly endangered bee, with their hairy bodies perfect for collecting and transferring pollen for pollination. David's project has identified three possible fly species that could be easily mass-reared and managed for the perfectly sized pollination labour hire (read more on page 64).

Joshua Kestrel is also keen on improving pollination through his PhD project using environmental DNA (or eDNA) to determine the species of native pollinators that are supporting the avocado pollination process. Joshua monitored avocado flower visitors with three methods, a camera, a pan trap and eDNA. The results met in the middle with all three methods correctly identifying Honeybees and Hoverflies. The project will continue in the 2021 flowering period examining flower visiting insects and how they vary with adjacent land use. Joshua is looking for some more monitoring sites in the Pemberton/Manjimup region, if you can assist, please get in contact with Joshua on 0479 155 025 or *joshua.kestel@postgrad.curtin.edu.au*.

Ian Newton (QDAF) said the results were in from the survey conducted by the project *Review and extension of avocado pests and their management* (AV19001). The most common pest reported by growers in eastern Australia was the fruit spotting bug, while for Western Australia, garden weevil took the prize and in Tristate region there was no definable top pest. Ian spoke about the most commonly used chemicals and the risks of resistance, access to chemicals, MRLs (maximum residue limits) and exotic pests if we don't start to improve our pest management. Ian recommended that all growers should attend the spray and integrated pest management (IPM) workshops due to run soon as part of this project.

Irrigation

David Rowe (DPIRD) spoke about the high-density planting trial under netting at AvoWest orchards, examining protected cropping changes to environmental conditions and the impact on tree function and productivity. David indicated that collecting information on the environment and tree function under the netting could provide data for industry to advance best practice management through trigger points for soil moisture, solar radiation, wind speed, vapour pressure deficit and evapotranspiration. This project is partially funded by the Hort Innovation Small Tree Initiative.

The highlights of the May Avocado Irrigation Summit were delivered by Simon Newett (DAF). Read more about this event and its outcomes on page 25.

Field tours

It was all about the AvoBus in Pemberton with 115 participants rolling up to investigate canopy management. Participants visited Kim and Claire Skoss' orchard to investigate the management of tall older trees and the difficult decisions that sacrifice yield to bring tree height back to ensure adequate light interception and fruit set lower in the tree profile. Travis Luzny had taken another approach cutting the trees right back and Brad Rodgers said he never went into his young orchard without a set secateurs handy.

Wanneroo participants got the opportunity to visit the high-density planting trial under netting at AvoWest orchards and examine high-density plantings at The Avocado Grove.

More information

Check the fortnightly *Guacamole* newsletter and the events calendar at avocado.org.au for future dates. If you would like more information on the project, contact Avocados Australia Industry Development Manager Liz Singh, 0499 854 111 or idm@avocado.org.au (Mon-Thurs 9am-3pm), or at DAF, contact Simon Newett, simon.newett@daf.qld.gov.au or 07 5381 1326, or Bridie Carr, bridie.carr@daf.qld.gov.au or 07 5381 1327. You can also find the presentations in the BPR Library, under Event Proceedings, avocado.org.au/bpr/.

Acknowledgement

The *Avocado industry development and extension* (AV17005) project has been funded by Hort Innovation, using the avocado research and development levy, co-investment from the Queensland Department of Agriculture and Fisheries, and contributions from the Australian Government.

Arthur Tsanakaliotis (Demou), Tracey Zara (Zara Farms) and Andrew Nicholds (Olive Grove) at the Tristate Regional Forum in May, held in Mildura.

Avocados Australia Tristate Director Kym Thiel and Dan Dalzell in Mildura for the Tristate Regional Forum.

Glen Goldup (Goldup Farms), Andrew Donaldson (Cottrell Farms), Rohan Ashley (Mildura Fruit Company) and Shane Singh (AgriHort Solutions) at the Tristate Regional Forum.

Marcus and Warren Wilton (Avogo Orchards) with Paul Martin (Hawk Brook Chalets, centre) at the Pemberton forum in Western Australia.

Bec and Troy Andrich (BILTAR) with Bernie Zahra (Nufarm) and Zac Starkie (Farmlink Rural) at the Pemberton forum.

Masami and Peter Whild, Whild Avocados, enjoying part of the orchard walk for the Pemberton Regional Forum.

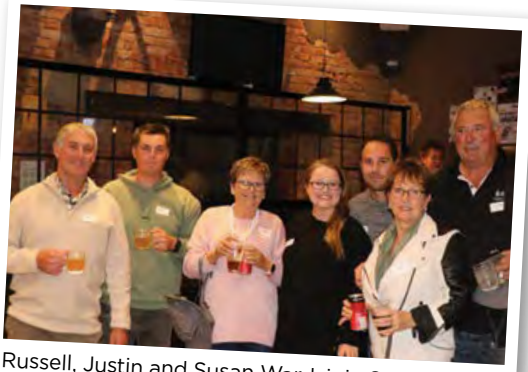
Sam Rees, Alan Blight and Adrian Harley hosted participants of the Wanneroo Regional Forum at Avowest in June.

Growers Gavin Ghilarducci and Frank Arena catch up during the orchard walk afternoon of the Wanneroo Regional Forum.

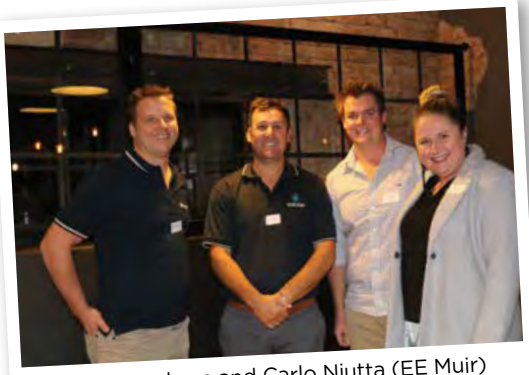
Garret Keals with Tuula Karjalainen, Craig Duncan, and Helen Duncan of the Avocado Grove, during the Wanneroo Regional Forum in WA. The Duncan family hosted visitors at their orchard as part of the event.

Tristate Member event success

Avocados Australia members joined their Board and staff representatives in Mildura on 4 May, for a member dinner. The attendees were welcomed by Avocados Australia Tristate Director Kym Thiel, and had the chance to hear directly from CEO John Tyas, Market Development Manager Hayleigh Dawson and from event sponsor, EE Muir. "These exclusive events provide our members with the chance to hear not just the very latest industry news, but to ask in-depth questions of their Board and staff," John Tyas said.



Russell, Justin and Susan Ward, join Sarah Tucker-Boehm and Aaron Boehm (Parkes Lane Produce), Dawn and Mark Boehm (Boehm Trust) at the Tristate member event.



Wayne Mattschoss and Carlo Niutta (EE Muir) chat with Ryan and Tracey Marr (Marrbiz) during the Avocados Australia member event in Mildura.

John Poggioli and Peter Henry from Netafim at the Avocados Australia member event in the Tristate.

Trevor Radloff (Ellerslie Producers), Craig Thiel (Golden Hill Packing) and Anthony Fulwood (GB Fulwood & Co) at the Tristate member event in May.

2021 Avocado Irrigation Summit

Liz Singh, Avocados Australia Industry Development Manager

Avocado growers, horticultural consultants and irrigation advisors pushed the boundaries to improve irrigation best practice for the whole avocado industry at the 2021 Avocado Irrigation Summit on May 19 and 20, 2021. The Avocado Irrigation Summit is the first of three Advanced Management Workshop activities in the *Avocado Industry Development and Extension* project (AV17005).

The Australian avocado industry is facing a future with challenges in water availability, salinity, and climate variability. "Best Practice" is a term that is often attached to production management with no definition or measurement upon which to benchmark. To advance industry irrigation practices, the Avocado Irrigation Summit participants got to work on defining current practices, identifying knowledge gaps, and determining future research and technology requirements.

A survey of domestic irrigation practices was presented, and it was agreed that Australian growers could make advancements in irrigation efficiency by:

- being aware of readily available water calculations for different soil types
- measuring the water infiltration rate in their orchards
- regularly checking irrigation uniformity
- improving irrigation system maintenance, eg cleaning of lines
- conducting predictive irrigation scheduling rather than reactive
- using plant water use technology as well as soil moisture, and
- matching irrigation scheduling to tree function demand.

International irrigation practices highlighted that Australia is not alone in facing such challenges. Israel has long-term water availability and water quality issues that have forced the adoption of drip irrigation and plant/soil moisture technology to improve water use efficiency. California is facing similar water quality issues with water chloride content varying from 40ppm to over 150ppm. The Californian industry is faced with high water costs and the need to convert to saline tolerant rootstocks which are still in the pipeline.

The 2020 Avocado Irrigation Literature review demonstrated research is already available to advance irrigation practices for improved water use efficiency. For example, did you know that avocado flowers have stomata and increase the tree surface area for water loss? They have a high transpiration rate and can account for approximately 13% of tree water use during this period. (Whiley et al. 1988). Research is often conducted and forgotten but the collection of information in the literature review provides the opportunity to make connections between maximising water use efficiency and yield potential.

The key presenters were Udi Gafni, an avocado consultant from Israel and Dr Michael Forster from Edaphic Scientific Australia. Mr Gafni spoke about his experience with growing avocados in Israel with drip irrigation and provided good insight for growers who might be considering conversion from a sprinkler to drip irrigation. This talk was recorded and presented to industry under the AvoGrow Webinar Series banner and can be viewed in the BPR Library under Event Proceedings.

Dr Forster spoke about the need to understand what the technology is telling you and how to read it to ensure the best outcomes. Plant-based, water use technology like sap flow meters and dendrometers are becoming more practical to use and provide an insight into meeting tree water demands. Used in combination with soil moisture probes, technology if used correctly can

The participants of the first irrigation summit, held in Brisbane, Queensland in May.

provide a comprehensive concept of crop water use efficiency.

The outcomes of the Avocado Irrigation Summit will be submitted to Hort Innovation for further assessment but some of the considerations made by participants include:

- working with irrigation at a regional level
- developing case-studies with growers
- providing irrigation master classes
- working with cost benefit analysis based on farm scale
- examine sap flow and soil oxygen research
- drip versus sprinkler comparisons
- environmental impacts on tree function, and
- drought tree management.

Keep an eye out for the full report coming soon.

More information

All materials developed for the 2021 Avocado Irrigation Summit are available to read in the BPR Library under Event Proceedings.

If you would like more information on the project,
contact Avocados Australia Industry Development
Manager Liz Singh, 0499 854 111 or *idm@avocado.org.au*
(Mon-Thurs 9am-3pm), or at DAF, contact Simon Newett, *simon.newett@daf.qld.gov.au* or 07 5381 1326, or Bridie Carr, *bridie.carr@daf.qld.gov.au* or 07 5381 1327.

Acknowledgement

The *Avocado industry development and extension* (AV17005) project has been funded by Hort Innovation, using the avocado research and development levy, co-investment from the Queensland Department of Agriculture and Fisheries, and contributions from the Australian Government.

Queensland Government

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AVOCADO FUND

Life after farming

It is difficult for many growers to imagine their lives any other way, but when hard times hit "there is life after farming" as Phillip Mansell told participants at the Childers *Managing avocados with less water* event in May.

Phillip Mansell was a fourth-generation farmer from a pioneering family in the Mildura Tristate region. He grew up on a dried fruit property and in 1982 worked with his father to develop the Back O' Bourke horticultural operation in Bourke NSW, optimising opportunities for an early niche market.

The Back O' Bourke property cropped approximately 135ha of table grapes, 100ha of citrus and 100ha of annual cropping, primarily melons. Irrigation water was supplied from the Darling River, with all development plans carefully mapped around the water licenses.

Phillip and his family had the skillset and the vision. They maximised water use efficiency through heavy investment in technology, installing modern integrated water distribution systems using programmable logic controllers (PLC) systems. **But it wasn't enough!**

In the period 2001-2006, drought reduced available water in the Darling River system and water allocations were limited. Phillip was caught between keeping his crop assets alive and keeping the business afloat. Phillip went through the process of ranking patches based on water-use versus financial value for short, medium, and long-term profit profiles. He implemented early pro-active decisions such as tree skeletising, understanding that reactive decisions would be harder to make and more extreme.

"There is no right or wrong way to manage reduced water allocations, you just need to be prepared to accept the consequences of the decisions made," Phillip told attendees at the Central Queensland event.

"As farmers, we think out of the box and find alternative solutions to new problems and that is a force that strengthens our resolve in hard times."

Phillip had to find his political voice to demonstrate that decisions made in government departments were not practical or relevant to the business his family had built to provide fresh produce to Australian families. He worked hand-in-hand with his financial lender and was up front with the challenges they faced. Phillip faced reality when he realised that he was no longer running a farming operation, but the farm was running him. With no outside interests to act as a distraction, he was a 4th generation farmer, responsible for a vision, staff and their families and his family inheritance. The pressure was too much, and he suffered severe depression.

When the darkness was finally fading and light was seeping through, the government cut their water license by 67% with no compensation and no exceptions. Phillip and his family had borrowed money from the bank in good faith and with every expectation to pay it back, but this was the final blow and the Back O' Bourke business was declared bankrupt. A dispute between Phillip and the receiver manager finally saw Phillip and his family leave their family home behind with a bitter taste in their mouths.

The farm was their superannuation policy and they had not planned for anything else, so it was time to start again. Phillip was offered some work in Sydney, his wife went back to work to support the family but farming was still in his blood. Phillip and his family, with the help of family, friends and business connections, embarked on a new farming adventure but it wasn't what Phillip had hoped it would be and he found that the bitter taste in his mouth lingered. It was time to change direction and leave farming behind completely.

"It was exceptionally hard to make this decision and the emotional roller coaster that followed was extreme but once the decision was made the emotions rolled over me but you find new opportunities that you could not see before," Phillip said.

"No-one on their death bed wishes they had worked more, or had more money, it is all about family, friends and enjoying successes when they happen."

Phillip is now self-employed using skills developed as a farmer to build small mechanical and electrical projects and running a part-time adventure tourism operation. Phillip is the living proof that hard times in farming can be soul destroying but there is definitely life after farming, if you choose it.

Avocados Australia arranged a special event for Central Queensland growers reliant on the Paradise Dam in May. On hand to provide advice on handling avocados with less water and business decision making were Avocados Australia Director Eric Carney, Phillip Mansell (formerly of Back O' Bourke), Avocados Australia Industry Development Manager Liz Singh and Agriculture Victoria's Jeremy Giddings.

What's happening with export?

Flora Zhang, Avocados Australia Export Development Manager

New Export Development Manager

First, greetings to all avocado growers and avocado friends out there!

I am so excited to have this opportunity to join Avocados Australia and be able to share my export experiences to drive further growth with exporting avocados from Australia to the world.

The Australian horticulture industry is such a vibrant and exciting sector.

My previous experience in the Australian horticulture industry has included export marketing, export business development and supply chain management internationally with a focus on some key export regions for Australian produce such as north Asia, southeast Asia, middle east, and Europe, for both the macadamia and almond industries.

I am keen to apply my experiences to formulate the next avocado export strategic plan, deliver a series of export capacity building programs, assist with market access, and help maintain and develop our existing markets.

I grew up in China and went to university at Monash University's Malaysia campus, gaining a degree in Business & Commerce in 2014. After moving to Melbourne, I completed a Master of Economics at Monash in Victoria. Since then, I have also completed a Graduate Diploma of Law, specialising in international trade at QUT, and I am an accredited mediator for both commercial and family matters for dispute resolution.

New export project

The new *Avocado market access and trade development* project (AV20004) is now well underway.

In-line with expected production growth, this new Avocados Australia-managed project will continue to drive growth in new and existing export markets, but also through complementary projects that we manage, resourced via alternative funding sources such as the Australian Governments' PASE and ATMAC programs.

In the next 6 months, avocado export work will be focusing on three main tasks: export awareness and capacity building, and case study development.

Stakeholder feedback has highlighted the increasing interest amongst stakeholders for face-to-face forums to increase industry capacity to participate in exporting, and we will facilitate this (COVID permitting).

Regional export forums will be held in six regions during the life of the project (12 forums in total), focussed on general export capacity building across the industry nationally, alongside regionally-specific content. For regions that have access to protocol markets, the export forums will incorporate specific training for protocol requirements and will be delivered each year.

A series of three economic case studies (drawing on other industries and relevant avocado industry data) will be developed to demonstrate the potential benefits of increasing exports. These case studies will be published in the Avocados Australia BPR, widely communicated and provide important content for the awareness and capacity building forums.

I am also working closely with Hort Innovation at the moment to develop a marketing and promotion program for Japan this season.

More information

Contact Flora Zhang on *export@avocado.org.au* or call 0499 600 613.

Acknowledgement

The *Avocado market access and trade development* project (AV20004) has been funded by Hort Innovation, using the avocado research and development levy, and contributions from the Australian Government.

Hort Innovation Strategic levy investment | AVOCADO FUND

Flora Zhang has joined the Avocados Australia team, as the new Export Development Manager.

For the year ending June 2021, exports of Australian avocados had reached 3,191 tonnes worth AU$22.21 million. While this was 21% lower than last year, unit values were 13% higher (although the overall value decreased by 11% for the period).

According to the latest import/export report, Hong Kong was the lead market for the year, followed by Singapore and Malaysia. The June 2021 report also shows the start of a trend: while airfreight continues to be the major channel, sea freight is now part of the mix. In June, sea freight accounted for 16% of shipments.

You can find the monthly import/export reports in the BPR Library, under Exports.

Setting the export pace

Flora Zhang, Avocados Australia Export Development Manager

The 2021/22 export season to Japan got off to a good start, with the Japanese agriculture department (MAFF) accepting the full complement of Australian growers and packhouses who applied for accreditation.

To help industry prepare for the application and audit process, Avocados Australia held a workshop in Western Australia in June, showcasing the industry's new online export registration system, and export materials.

Funded as part of two grants (worth $109,176 in total) under the Package Assisting Small Exporters (PASE) extension program from the Australian Government, Avocados Australia worked to help reduce the burden on exporters.

Via one of the grants, we worked with Australian Table Grape Association to tailor their existing online export system to avocados, replacing the time-consuming manual recording process.

The new online system now also allows the Department of Agriculture, Water and the Environment (DAWE) to access individual applicants to vet all registrations, schedule physical audits and communicate to applicants the outcomes of the accreditation process that would allow growers the ability to export to specific countries.

As part of a June workshop, held both online and in-person for potential exporters from Western Australia and the Tristate, we also launched the new export materials developed as part of the second PASE project.

"The new resources developed by Avocados Australia clearly step through what avocado growers and packhouse staff must do to meet Japanese and New Zealand avocado import requirements," Federal Agriculture Minister David Littleproud said.

"These resources have also been designed to accommodate future expansion into new markets, so they stay relevant."

Currently Japan and New Zealand are the only protocol markets open to Australian avocados, but it is expected that as additional, new market access is secured subsequent modules could be created.

Josh Franceschi from The Avocado Collective said there was a pool of growers keen to export their avocados to Japan and they were assisting them with their registration.

"The successful PASE project was great at providing very clear information to help explain the requirements and saved us lots of time with onboarding new growers," he said.

"We've been exporting to Japan for a few years now and the application process has been always done manually.

"The new online registration program developed through the successful PASE project provides us with a one stop online solution to gather and upload all the required information digitally."

More information

For more information on both the online registration system, and the protocol market materials, please visit *avocado.org.au/best-practice-resource/export/japan-registrations/*.

Department of Primary Industries and Regional Development (DPIRD) Senior Trade Consultant Ariel Yesberg, DPIRD Principal Trade Consultant Fiona Goss, Avocados Australia CEO John Tyas, DPIRD Manager for Primary Industries Trade I-Lyn Loo and Avocados Australia Export Development Manager Flora Zhang in Western Australia on 1 June, presenting a hybrid in-person/online registration workshop for WA and Tristate exporters and growers.

A special workshop was held in Western Australia on 1 June, to prepare industry for the upcoming Japan export season. The attendees included eight packhouses and 18 growers.

Reaching our international consumers

Flora Zhang, Avocados Australia Export Development Manager

Under the Taste Australia banner, Australian avocados are being actively promoted in both Singapore and Malaysia this year.

The campaign objective is to increase awareness and consideration of Australian avocados amongst target consumers in key export markets, at the moment this is Singapore and Malaysia, through an influencer activation program.

This will include influencer engagement, media activity and partnerships with strategic retail businesses.

In Singapore, nine influencers with a combined 1+ million followers are sharing content on Instagram, promoting the value of fresh Australian avocados, their health benefits, and the application of avocados in local cuisine.

The outreach continues with local media and partnerships in Singapore. This includes both media releases, and working with local foodie platforms to create new video recipes.

In Malaysia, 16 influencers will post content promoting Australian avocados, encouraging consumers to include avocados in their diet. The influencers are a range of food enthusiasts, health and fitness advocates, and parents.

The PR campaign also extends to more traditional media, and also partnerships with three foodservice businesses: Avocadian, the Fish Bowl, and Nourish Me Asia.

This is only the start of the industry's export marketing efforts, and more of our international consumers in more of our markets will be included in future activities.

Acknowledgement

The *Avocado market access and trade development* project (AV20004) has been funded by Hort Innovation, using the avocado research and development levy, and contributions from the Australian Government. The industry's marketing program is funded by Hort Innovation, using the avocado marketing levy.

Hort Innovation Strategic levy investment | AVOCADO FUND

Social media influencers across Singapore and Malaysia, including @urbanladiesg, have been sharing the benefits of Australian avocados with their followers, using the @AussieAvoChallenge hashtag.

Lovacados set sail for Asia a year early

Costa Avocados have sent their first ever sea-freight container of avocados to Asia in a major milestone for the Food Agility CRC's *Improving Avocado Exports* project.

It was the first time Costa had sent a shipment of their premium Lovacados to Singapore by sea freight. The order of 3,200 trays left Brisbane in May and arrived in Singapore in June, and there have since been 12 more containers shipped to locations across Asia including Malaysia, Hong Kong, and Indonesia (as at 21 June 2021).

These shipments mark a major milestone for Food Agility's *Improving Avocado Exports* project in collaboration with Costa and the Queensland Department of Agriculture and Fisheries (DAF). The project aims to develop data models that will identify the lead indicators of avocado robustness at various stages of the supply chain and determine if and when an avocado is suitable for export.

"Thanks to our efforts promoting the Lovacado brand overseas, demand has grown to the point where we could no longer send small orders by air – we need to ship much larger orders by sea," Costa Avocado Quality Control Manager Shara Jones said.

Avocados Australia CEO John Tyas said it was great to see the industry move to sea freight.

"This change means larger volumes can be exported, with better quality management during transit," Mr Tyas said.

For Costa, the trial has been a win-win, not only from increased exports sales, but also by delivering a significantly higher level of supply chain control for factors such as temperature than is available through traditional air freight.

"Thanks to new best-practice export guidelines created by DAF through the research project, we are also able to amend the atmosphere of the shipping containers to prevent premature ripening and ensure that the avocados arrive in correct condition," Ms Jones said.

"We're very excited to have this level of control. It's going to enable us to deliver the right quality of fruit year-round, please customers in different markets, and reduce complaints and returns."

The shift to sea freight is happening a year ahead of schedule, having been brought forward by a bumper avocado crop.

"This year's larger crop and the very large sizes that have been produced have given us an exciting opportunity to increase our overseas sales quickly. Ultimately, we'd like to export a greater percentage of our overall production, including our Shepard variety and mid-size avocados," Ms Jones said.

"We are learning along with our export partners so we can grow together in the future – and grow our overseas consumer base."

In addition to the best-practice guidelines being developed by DAF, the *Improving Avocado Exports*

Checking off the first sea freight containers of Lovacados are (from left) Avocados Australia CEO John Tyas, export trader Dan Green, Queensland Department of Agriculture and Fisheries principal horticulturist (supply chains) Jodie Campbell, and Costa Avocado Quality Control Manager Shara Jones.

project team are also working to refine their understanding of the factors affecting avocado robustness – and their parameters. More controlled atmosphere trials on mature fruit were planned in June/July, to determine if the fruit would survive the three-week journey by sea. The team is also working on how to measure a greater range of factors.

"We know that factors like fruit turgidity are extremely important to determining robustness and shelf-life, but we don't know how to measure that yet," Ms Jones said. "And if you can't measure it, you can't manage it! Watch this space."

Although the project is still in its early stages, Ms Jones said Costa was already seeing a positive impact for its business. The company has learned a great deal from DAF's Costa-specific best-practice guidelines, for example, especially in the ways they differ from domestic guidelines.

Meanwhile, the Queensland University of Technology research team, have been laying the groundwork to deliver game-changing data modelling.

"QUT are like a breath of fresh air," Ms Jones said. "They are helping us build a decision aid tool and watching each stage come together is incredibly exciting."

What was most pleasing, Ms Jones said, was that the benefits of this research would be shared with the entire Australian avocado industry.

"We're getting Costa-specific best practice guidelines, but as part of the project, DAF will create industry-wide guidelines as well. We believe that increasing exports from Australia as a whole is vital because local consumption is stable. For our industry to grow, we have to look overseas.

"A rising tide lifts all boats. Promoting supply chain excellence for all avocado producers will be fantastic for Brand Australia, and for all producers."

More information

You can read more about the project here: *foodagility.com/research/improving-avocado-exports*.

WA officially free of Queensland fruit fly

Western Australia has been declared free of Queensland fruit fly (Qfly) after a successful 15-month campaign to eradicate the destructive pest from the Perth metropolitan area.

The Western Australian Government invested more than $13.5 million into the eradication efforts to protect the State's $1 billion horticulture industries and access to vital export markets.

A team of more than 550 with the Department of Primary Industries and Regional Development worked closely with communities in and around Dalkeith and Coolbellup to carry out more than 173,000 property and baiting inspections, and collected and disposed of more than 35,000 kilograms of at-risk fruit.

Agriculture and Food Minister Alannah MacTiernan said it was a mammoth effort.

"The success of these recent Qfly campaigns saved the State's horticulture industry and economy an estimated $38 million annually in lost production and market access," she said.

"These responses are a timely reminder of the importance of not bringing fruit and vegetables into WA, which might carry Qfly as well as other pests and diseases.

"We all have a role to play in keeping our community pest-free to support our local growers."

More than 54.5 million sterile Qfly were released across both areas to prevent potential breeding and eradicate any surviving Qfly after baiting.

The final Quarantine Area Notice for Coolbellup and surrounds ended on Monday, May 24, meaning all restrictions for the movement and management of fruit in the Perth metropolitan area have been removed.

Qfly monitoring traps will remain in place in both areas, as part of the State's permanent early warning trapping grid.

More information

Any unusual pest activity can be reported via MyPestGuide app or by contacting the Pest and Disease Information Service on (08) 9368 3080 or *padis@dpird.wa.gov.au*.

Our Green Gold message connecting with consumers

Adele Nowakowska, Hort Innovation

It's been a big year for our new campaign, *Our Green Gold*, with an excellent response to date.

The new brand positioning and messaging for Australian Avocados, designed to drive mass awareness to drive avocado demand, is working.

Early consumer research around the campaign, which launched in May, has found that 1 in 4 Australians recall the Australian Avocados logo, and 40% recalled seeing the Our Green Gold campaign, when prompted (campaign stills).

Our Green Gold is memorable

A range of individual campaign executions had similar recall rates, ranging from out-of-home activations (such as billboards) and individual digital activities, the research by Fiftyfive5 found.

Of those surveyed before and during the campaign, 34% claimed the main message of the campaign was that avocados are Australian (this jumped to 71% immediately after being shown the full television commercial).

This is excellent news, as comments included acknowledging avocados as "an Aussie icon", "avocados are grown here", and "avos are the new Australian emblem".

The research also found that 80% of the survey group found the campaign enjoyable, 65% thought it was aimed at "people like me", and it gave 60% of people a better opinion of Australian avocados.

Price is a purchase trigger

What you want to read about is purchase intent, and this early feedback is very encouraging. Of the respondents, 90% said they were likely to purchase an avocado (or two) on their next shopping trip.

A range of purchase triggers remained fairly stable for the survey group, including a love for the taste of avocado, and wanting to be healthy, but the current retail prices definitely seem to have a part of play. We saw post-campaign purchase triggers including "they were on special" and "they're good value for money" jump (from 22% to 35%, and 15% to 28% respectively).

Barriers remain but messaging is working

Among non-purchasers, our June consumer research found that there is headway to be made with those who don't think about avocados in the store, who don't feel confident about preparing an avocado, or who can't find one that's "ripe enough" when in store.

Our pre and post campaign testing found that an increased number of respondents thought avocados were suitable for a variety of meals and occasions, that they're great for everyday meals, and that they make meals more exciting, as well as being a distinctly Australian food.

In all, the Fiftyfive5 research found 22% of shoppers were more likely to buy avocados as a result of the campaign, and that improving reach remains the largest opportunity to increase this impact.

Campaign reach

On this front too, we have good news. The commercial aired as part of the Channel 7 Olympics coverage (a perfect fit for Our Green Gold), and was seen almost 3.7 million times by Australian viewers before the Games even ended.

Based on the Fiftyfive5 research, it's likely 80% of those who have seen it found it enjoyable, and 60% will have a better opinion of Australian avocados. They're also likely to perceive avocados as versatile, everyday, and exciting, as well as distinctly Australian.

Community outreach

We know that 2021 has been a tough year for events, so as part of *Our Green Gold* we have "officially unofficially" sponsored three sporting clubs or events. In 2021, that is the Jamberoo Ice Hockey team in South Australia, Queensland's Blackbutt Avocado Festival (this event has sadly been postponed by COVID-19 but they're planning to be back bigger than ever in 2022), and the Leederville Sporting Club in Western Australia.

The groups received a sponsorship pack including an *Our Green Gold* uniform and a supply of Hass avocados.

Acknowledgement

This activity is managed by Hort Innovation, on behalf of the industry, and is funded by the avocado marketing levy. You can find links to a range of the online content via our industry marketing blog at *bit.ly/AusAvos2021*, including the new *Our Green Gold* ad featuring popular Australian comedian Nazeem Hussain. (For National Avocado Day, Nazeem channelled his inner celebrity chef to share an avocado egg salad with his Insta followers, check it out on the marketing blog!)

Hort Innovation
Strategic levy investment

AVOCADO FUND

The *Our Green Gold* campaign did its bit to support the Australian Olympics effort to paint the country in green and gold, in August.

In celebration of National Avocado Day (31 July), Australian Avocados gave social media fans the chance to win a year's supply of Australian avocados (one tray a week). To be in the running, avo lovers simply had share their best avo hack.

Consumers at IGA stores nationwide, and Foodland stores in South Australia, saw a lot of the *Our Green Gold* messaging in July, as part of an Australian Avocados-supported sales challenge with Metcash. The store teams were encouraged to celebrate the avocado with great in-store displays, with prizemoney and a trophy on offer. (You can check out some of the entries at *bit.ly/AusAvos2021*.)

There's been a large PR push with the *Our Green Gold* campaign, including with MiNDFOOD, to showcase three new recipes from the Australian Avocados team. It's estimated the recipes for herb crusted polenta pizza base topped with avocado and pesto, grilled halloumi and dukkah crumbed avocado salad with a buttermilk dressing, and avocado and za'atar grilled chicken wrap, could have been seen more than 726,000 times by avocado lovers.

RESEARCH AND DEVELOPMENT

Avocado R&D investment overview

Funded by your grower levies and contributions from the Australian Government, the industry's research and development activities are extensive.

The industry has long invested in research and development programs to support the sustainable development of the industry.

Hort Innovation manages these funds, investing in projects addressing the industry's strategic priorities. The Australian Government also provides additional funding for avocado R&D through Hort Innovation.

The levy provides essential resources for ongoing avocado R&D and has helped to address various industry issues over many years.

Avocados Australia plays a key role in supporting Hort Innovation with its delivery of the avocado levy-funded R&D program, to ensure it continues to meet the needs of the industry.

This includes identifying R&D priorities, providing strategic advice through advisory panels, assisting with project planning and project reviews. With its extensive networks across the industry and R&D community, Avocados Australia assists Hort Innovation to deliver the best possible R&D outcomes from the levy.

Avocados Australia also collaborates with relevant agencies to undertake some R&D activities for industry that align with our capabilities and priorities. This may be as a service provider to Hort Innovation, or through other funding sources such as government grants.

Currently, Australian avocado growers pay a levy of 2.9c/kg for research and development. You can find out more about your levies here:

avocado.org.au/industry-programs/levy-information/.

Investments are aimed at addressing levy payer priorities as set out in the Avocado Strategic Investment Plan 2017-2021.

In the following pages, you will find summaries of projects undertaken in the last 12 months, funded through a variety of mechanisms, including funding secured by Hort Innovation through successful applications for Australian Government grants.

AV	Projects funded through avocado levies, with contributions from the Australian Government
MT	Multi industry projects to which avocado levies may have contributed, along with those of other industries
Hort Frontiers	Hort Innovation's strategic partnership initiative, where projects use funding from a range of co-investors – which sometimes includes levies. These projects are typically focused on big-picture and longer-term issues critical to the future of Australian horticulture as a whole. This includes the Pollination Fund (PH), Advanced Production System Fund (AS), and Asian Markets Fund (AM)
ST/AI	Projects funded by Australian Government grants, or across industry funding

Not all the projects we've included in this report are funded via the Avocado Fund (or Hort Innovation), but all are of interest to the industry.

We have marked projects involving investments from the Hort Innovation Avocado Fund with this icon . This means these projects include funding from the avocado R&D levy.

The current projects are reported on under the strategic investment plan objectives. Please note some projects meet more than one objective.

The Avocado Strategic Investment Plan 2017-2021 addresses the industry's major opportunities and challenges under four key outcomes:

- by 2021, increase domestic demand for Australian avocados by 20%
- by 2021, over 90% of avocados received by consumers will meet or exceed their expectations of quality
- by 2021, over 10% of production will be exported to markets where customers have a willingness and a capacity to pay a premium for Australian avocados
- by 2021, productivity (marketable yield per hectare) has improved by 15% on average, without increased production costs per kilogram.

You can find full details of the strategic investment plan online: *avocado.org.au/industry-programs/about-industry-programs/*. This strategic plan is currently being renewed.

Acknowledgement

Information for this summary has been drawn from a variety of sources, including the Hort Innovation website (*horticulture.com.au* – search via the project code for the latest information), directly from researchers, from various editions of this magazine, and final reports.

Hort Innovation

Hort Innovation Strategic levy investment | AVOCADO FUND

hort frontiers Strategic partnership initiative | POLLINATION FUND

hort frontiers Strategic partnership initiative | ASIAN MARKETS FUND

hort frontiers Strategic partnership initiative | ADVANCED PRODUCTION SYSTEMS FUND

Objective 1:

By 2021, increase domestic demand for Australian avocados by 20%

Avocado industry and market data capture and analysis (AV16006)

Service Provider	Avocados Australia Limited
Project Leader	John Tyas
Start Date	21/04/2017
End Date	31/07/2020
Funding	Hort Innovation Avocado Fund

COMPLETED PROJECT

Avocados Australia successfully facilitated and delivered AV16006, a program conceived to support both short and longterm business level and industry level planning and decision making across the Australian avocado industry. This has entailed provision of robust industry data to underpin effective supply chain management.

The suite of reports and insights developed throughout this project were provided to industry on a regular basis to assist with business and industry planning and management. For individual businesses, the data has provided:

- information on current plantings and therefore likely future production levels by region/time of year
- average productivity levels by variety by region as a benchmark for comparison
- a rolling 12 month forecast of supply of avocados into the Australian market to assist with planning harvest, logistics and marketing
- weekly reports which show volumes of avocados supplied into the domestic market in the past week and the forecast volumes to be supplied in the next four weeks. This data has assisted suppliers and traders to monitor and moderate the flow of avocados through the supply chain to minimise the risk of over or under supply, therefore optimizing quality at retail level and value back through the supply chain
- insights into export market opportunities and an understanding of global competitors.

For the broader industry, the data has provided:

- long term production forecasts to guide industry strategic plans, R&D and marketing investments
- data to monitor industry performance and progress over time
- seasonal crop forecasts to assist with timing marketing and promotion activities.

You can find more information about *Infocado*, *OrchardInfo* and retail price reporting here: *avocado.org.au/our-programs/supply-chain-data/*.

The final report can also be found in the Avocados Australia BPR: *avocado.org.au/bpr/* and you can read more about the new data project in this R&D summary, and on page on this page.

Avocado industry and market data capture analysis (AV20000)

Service Provider	Avocados Australia Limited
Project Leader	John Tyas
Start Date	07/09/2020
End Date	31/07/2023
Funding Type	Hort Innovation Avocado Fund

This investment is delivering high quality industry data to the avocado supply chain, to support businesses in their decision making. Key activities this project is responsible for include:

- maintenance of *Infocado*, the industry's system for monitoring volumes of avocados dispatched and forecast to be supplied, with weekly and quarterly reporting
- maintenance of *OrchardInfo*, which is used to monitor industry productive capacity and inform medium-long term production outlooks, with reports distributed to contributors
- other relevant local data collection, analysis and reporting for the industry, including to identify and understand trends, supply, demand and price relationships – publications include the yearly *Facts at a Glance* fact sheet, and
- global trade data analysis.

To improve the process further, a user-friendly upgrade to the data collection and reporting platform is being introduced (funded by Avocados Australia), making contribution of data from industry to the project simple. The ideal project outcome is 100% industry participation in the project, improving data reliability. Packers that don't currently participate in the *Infocado* program are encouraged to get involved (*admin2@avocado.org.au*). The benefits of having access to the data collected by this project could make a significant difference to the way you run your business and market your fruit.

Read more about the latest project activities on page 14.

Educating health professionals on the nutrition and health benefits of avocados (AV20003)

Service Provider	Bite Communications
Project Leader	Andrea Brydges
Start Date	1/2/2021
End Date	1/2/2024
Funding Type	Hort Innovation Avocado Fund

This new investment is delivering evidence-based information about Australian avocados to health and food service professionals in Australia. By improving the awareness, knowledge and attitude of health professionals to the nutrition and health benefits of avocado, they will be encouraged to recommend avocado to their clients, or include avocado in their menus, and ultimately help to drive Australian avocado purchase and consumption.

The project team will undertake a range of activities, including:

- establishing a digital hub that houses nutritional resources on avocados, including recipes, meal plans and local and international research on health benefits
- conducting a systematic literature review on avocados and health outcomes. This research will underpin all other project activities
- communicating with health professionals via a range of channels such as roundtable discussions, media releases, social media toolkits, a quarterly e-newsletter and participating in conferences. The project team will also work collaboratively with relevant professional associations and health influencers
- holding farm tours to connect health professionals to the source and to showcase growing regions, varieties and the breadth of the avocado industry.

Consumer behavioural and retail data (MT17015)

Service Provider	Nielsen
Project Leader	Chanel Day
Start Date	2/4/2018
End Date	30/11/2021
Funding Type	Hort Innovation Avocado Fund

This multi-industry investment is tasked with providing regular consumer behaviour data and insight reporting to a range of industries, including the avocado industry. This information is intended to assist growers and supply chain partners in decision-making for their businesses and, for the wider industry, the data and insights are available to support strategic activities, as well as Hort Innovation Avocado Fund marketing plans.

The latest report covers the 52 weeks to 21 March 2021. At the time, the report showed avocados were growing fast in dollar terms (up 9.9%), but declining in volume sold (-4.8%). It should be noted, this preceded the start of the bumper 2021 harvest, when retail prices fell to $1/avocado.

About three-quarters of Australian households continue to buy avocados as at 21 March 2021.

You can access the reports here: *harvesttohome.net.au/fruitmushroomnuts/latest-highlights/avocados* and levy payers can request access to more detailed reports.

This program is a strategic levy investment using across-industry funds, including the Avocado Fund.

Category and consumer impact monitor (ST19031)

Service Provider	FiftyFive5
Start Date	May 2020
End Date	September 2020
Funding	Hort Innovation risk management reserves
	COMPLETED PROJECT

During 2020, Hort Innovation worked with research company Fiftyfive5 to provide the Australian horticulture sector access to regularly updated information about consumer attitudes and behaviours during the time of COVID-19 disruption, through Fiftyfive5's Category and Consumer Impact Monitor. You can read the reports here: *bit.ly/ST19031*.

Across the nine months that the monitor was running, they found the biggest concern Australians had was around their ability to find a job (50%). A similar proportion were worried about experiencing future waves and these concerns translated into concerns about health and wellbeing for themselves and their families. These concerns had a profound impact on shopping and consumption behaviour.

Between March and December, on average 39% more Australian grocery buyers reported buying more fresh produce as part of their shop, and being grown in Australia became significantly more important (compared to the start of the pandemic).

This Category and Consumer Impact Monitor activity was funded through Hort Innovation's risk management reserves (which includes avocado levy funds), as part of the organisation's response to assist the horticulture sector through the effects of COVID-19, drought, floods and bushfires.

The final report can also be found in the Avocados Australia BPR Library: *avocado.org.au/bpr/*.

Nutrition analysis of across horticultural commodities (ST19036)

Service Provider	Curtin University
Project Leader	Associate Professor Lucinda Black
Start Date	01/04/2021
End Date	31/03/2022
Funding	Hort Innovation Avocado Fund

Australia currently lacks up-to-date food composition data for many horticulture commodities, so this project is providing new composition data that reflects current growing conditions. This information will improve the ability of the horticulture sector to promote the nutritional benefits of produce and assist consumers and health professionals to identify sources of key nutrients.

The project team will develop a sampling plan in liaison with Food Standards Australia New Zealand (FSANZ) for updating the Australian Food Composition Database with accurate, reliable and representative information. This includes calculating the percentage of the daily intake for nutrients and energy that will be obtained from consuming one serving of the food.

The updated data will benefit a variety of stakeholders, including:

- horticulture growers and other industry participants to identify, label and promote commodities as valuable sources of key nutrients
- consumers to identify and select good sources of key nutrients
- health professionals to recommend horticultural produce based on nutrient content and to develop appropriate public health nutrition messages
- health researchers to estimate and optimise intakes of nutrients from plant food
- food regulatory bodies to monitor relevant nutrients in the food supply.

This project involves levy investment from a number of funds, including the Avocado Fund.

Objective 2:

By 2021, over 90% of Avocados received by consumers will meet or exceed their expectations of quality

Monitoring avocado quality in retail (AV19003)

Service Provider	Applied Horticultural Research (AHR)
Project Leader	Adam Goldwater
Start Date	20/12/2020
End Date	20/12/2022
Funding	Hort Innovation Avocado Fund

Avocado supply continues to increase, so customer satisfaction with Australian avocados is critical to help demand meet this increased supply, as poor fruit quality reduces consumer satisfaction and sales.

Retail avocado quality monitoring started in May 2020, and has so far assessed more than 5,000 fruit. Feedback reports were provided to suppliers and retailers, with both groups responding positively and identifying improvement opportunities.

Regular assessments are made at retail stores in Sydney, Melbourne, Brisbane, Perth and Adelaide (at the same stores each time to reduce variability).

Feedback is provided to growers, packers, retailers, and marketing groups through real-time reports on fruit quality at retail. The reports are a one-page PDF summary, that compares the quality of the supplier/retailer's sample with weekly and long-term industry averages. This continuous feedback mechanism enables problems to be addressed in real-time to help improve the quality of avocados.

Additionally, monthly summaries are provided to the wider industry, in the Avocados Australia Best Practice Resource, in the Retail module: *avocado.org.au/best-practice-resource/retail/retail-quality/*.

Data collected will provide significant insights into how fruit quality is affected by factors such as retail display formats, fruit age, ripeness on display, type of retailer, and price.

You can watch a recording of the May 2021 Avo Update webinar featuring both AV18000 and AV19003 in the BPR here: *avocado.org.au/bpr-articles/avo-update-webinar-quality-2021/*.

Read more on the latest retail monitoring results on page 11.

Implementing best practice of avocado fruit management and handling practices from farm to ripening (AV18000)

Service Provider	Queensland Department of Agriculture and Fisheries
Project Leader	Noel Ainsworth
Start Date	07/02/2019
End Date	03/01/2022
Funding	Hort Innovation Avocado Fund

This project is helping the avocado industry achieve further improvements in fruit quality, by facilitating the adoption of better practices – from what happens on the farm through to dispatch from the ripener.

The project team are looking at the current level of quality-related best practice adoption in the industry and where improvements can be made, with a focus on those practices that are known to impact on fruit quality, as revealed by previous levy-funded R&D.

These insights are then being used to deliver knowledge and technical support to growers, packhouse operators, transporters and ripeners. This is occurring through workshops and training activities, as well as the development of two supply chain case studies. Here, the project team will be working with two chains to monitor current performance, implement improvements, and measure the benefits.

The project team continue to consider a range of recommendations raised at project workshops, including the introduction of tracebacks to investigate consignments with serious fruit quality problems, monitoring firmness data using Bareiss durometers, collecting NIR-based dry-matter data (you can read more about that on page 71), and collecting benchmark information from preharvest spray diaries for anthracnose management. For more information, please contact Noel Ainsworth, Principal Supply Chain Horticulturist, Department of Agriculture and Fisheries on 0409 003 909 or *noel.ainsworth@daf.qld.gov.au*.

If you didn't get a chance to see the updates at the Avo Connections in June, or at the wholesaler workshops in Western Australia in June, or the regional forums in the Tristate (May) and South Queensland (March), you can watch a recording of the May 2021 Avo Update webinar featuring both AV18000 and AV19003 in the BPR here: *avocado.org.au/bpr-articles/avo-update-webinar-quality-2021/*.

Improved fruit robustness and quality in avocado supply chains (mineral nutrition) (AV19004)

Service Provider	Queensland Department of Agriculture and Fisheries
Project Leader	Daryl Joyce
Start Date	19/06/2020
End Date	14/11/2020
Funding	Hort Innovation Avocado Fund

COMPLETED PROJECT

This short project ran during 2020 to examine pre-harvest mineral nutrition and the effect this has on post-harvest fruit, to provide avocado growers with proven methods to ensure a consistent supply of quality fruit reaches consumers.

The project generated evidence-based recommendations for enhancing avocado fruit robustness at harvest and this information will assist avocado growers in improving their postharvest fruit quality.

The research team conducted a desktop study of more than 180 scientific and technical articles to combine current knowledge on pre-harvest mineral nutrition and management strategies that could improve avocado post-harvest storage and handling outcomes in an Australian production environment.

The final report and technical summary for this project can be found in the BPR Library.

Objective 3:

By 2021, over 10% of production will be exported to markets where customers have a willingness and capacity to pay for a premium for Australian avocados

Avocado export readiness and market access (AV17000)

Service Provider	Avocados Australia
Project Leader	John Tyas
Start Date	01/11/2018
End Date	20/10/2020
Funding	Hort Innovation Avocado Fund

COMPLETED PROJECT

Avocados Australia successfully delivered AV17000 to ensure the avocado industry is prepared to export, maintains a robust industry capacity to pursue new and improved market access, and provide necessary support to the government in their market access negotiations.

The project continued pursuit of the industry market access and market maintenance goals in line with the *Avocado Export Strategy*.

Over the life of the project, the project team delivered the following key achievements:

- a well-informed avocado industry and increased awareness of export opportunities and requirements as a result of the targeted education and communication provided through this project
- a workable market access protocol negotiated for a new market, Japan. Negotiations continue for a market improvement protocol for Thailand, and a new market access application to India
- utilisation of the new market access protocol to Japan by growers and exporters in Western Australia.

Australian avocado exports have increased on average 32% per year over five years to a record level of 4,272 tonnes in 2019. It increased 71% from the previous year and was valued at AU$24.55 million in 2019.

AV17000 also supported various other projects, including AM17010, MT18017 and AV16006, coordinated the avocado industry's participation in international trade shows such as Asia Fruit Logistica, and representatives took part in the July 2019 in-country market study to India.

The final report can also be found in the Avocados Australia BPR: *avocado.org.au/bpr/* and you can read more about the new export project in this R&D summary, and on page 28.

Avocado market access and trade development (AV20004)

Service Provider	Avocados Australia
Project Leader	John Tyas
Start Date	09/02/2021
End Date	05/02/2024
Funding	Hort Innovation Avocado Fund

Beginning in 2021, this investment is tasked with bolstering industry readiness, knowledge and technical capabilities around export, and delivering work to improve and maintain international market access. Specifically, the project supports the role of an Export Development Manager who will work to help avocado growers and exporters take advantage of existing, new and emerging export opportunities.

At a broad level, project work for the Export Development Manager will involve promoting an export culture within the avocado industry and building capacity, and maintaining and improving trade development and market access.

This work will include developing market access business cases, supporting technical market access protocols, ensuring industry access to up-to-date MRL data, and supporting the Taste Australia International Trade Program.

Avocados Australia has employed a new Export Marketing Development Manager, Flora Zhang, to undertake this work. You can read more about current activities on page 28.

Developing a unique selling proposition for Australian avocados (AV20001)

Service Provider	Fiftyfive5
Project Leader	Cori Hodge
Start Date	17/3/2021
End Date	1/8/2021
Funding	Hort Innovation Avocado Fund

COMPLETED PROJECT

This project will help the Australian industry understand consumer preferences for Australian avocados in export markets, develop a unique selling proposition (USP) to set Australian avocados apart from competitors, develop a unique value proposition statement, and develop buy Australian (Why Australian avocados?) positioning statement, brand attributes and story.

Updates from this project will be provided in future editions of *Talking Avocados*, and via AV20004.

Taste Australia trade shows (AM17010)

Service Provider	Hort Innovation
Project Leader	Brei Montgomery
Start Date	This is an ongoing project
Funding	Hort Innovation Asian Markets Fund

The avocado industry has a presence at key international trade shows, including Asia Fruit Logistica in Hong Kong and FoodEx in Japan, under the Hort Innovation Taste Australia banner. (COVID-19 permitting, of course.)

These events did not occur in 2020, and are likely to be online in 2021.

However, via the Taste Australia activities, there has been various in-country promotional activities for Australian avocados (MT18017).

Taste Australia is the whole-of-horticulture brand used by industry and Hort Innovation to help increase the profile, sales and consumption of premium Australian horticulture products in key export markets, particularly Asia and the Middle East.

Through Taste Australia, Hort Innovation undertakes export market development activities including trade shows, trade missions and retail marketing activities.

This investment is a parent program, under which further event-specific Taste Australia investments may sit.

Taste Australia retail program (MT18017)

Service Provider	Pico Pte Ltd
Project Leader	Laura Davies
Start Date	11/4/2019
End Date	15/12/2021
Funding	Hort Innovation Asian Markets Fund

This multi-industry investment is targeting key international retailers with training and educational resources about selecting, storing, handling and displaying Australian fresh produce in store, including avocados, apples and pears, citrus, table grape and vegetables.

This work is an R&D component of Hort Innovation's Taste Australia retailer engagement efforts in international markets. Other R&D work under the Taste Australia banner includes Taste Australia trade shows (AM17010) – a parent program that supports attendance at relevant international trade shows, to further develop export opportunities in key Asian and Middle Eastern markets.

Taste Australia is the whole-of-horticulture brand used to increase the profile, sales and consumption of premium Australian horticulture products in export markets.

Objective 4:

By 2021, productivity (marketable yield per hectare) has improved by 15% on average without increased production costs per kilogram

Avocado industry development and extension (AV17005)

Service Provider	Queensland Department of Agriculture and Fisheries
Project Leader	Simon Newett
Start Date	20/04/2019
End Date	31/03/2022
Funding	Hort Innovation Avocado Fund

After a year of delivering extension to the avocado industry via computer, the AV17005 delivery team is back on the road connecting growers and industry members with current and relevant information to support the informed decisions required to achieve productive orchards producing quality avocado fruit for consumers.

The project is co-delivered by the Queensland Department of Agriculture and Fisheries (DAF) and Avocados Australia with collaboration from the Western Australian Department of Primary Industries and Regional Development (DPIRD).

The Regional Forums program is as popular as ever, bringing expertise to the growing regions and investigating management strategies in field. The project delivers eight Regional Forums per year, one per growing region.

Newcomers and industry members are supported with the two-day AvoSkills workshops that unpacks avocado management practices from planting through to harvest. The 2021 Central Queensland AvoSkills will be rescheduled, after it was cancelled due to COVID-19.

Advancing the industry is addressed by the Advanced Management Workshops, with the first Irrigation Summit delivering on advancing irrigation management practices for whole of industry. Read the Avocado Irrigation Literature Review and a review of domestic and international irrigation practices in the BPR Library.

The team is currently working on a canopy management video, and a new spotting bug management poster is available for collection from relevant regional forums. The team has also extensively updated the spotting bug information in the BPR Growing module (*avocado.org.au/best-practice-resource/growing/*), based on the new content generated for the poster.

Capital city wholesaler meetings keep agents and wholesalers up-to-date with recommended fruit handling procedures, while growers and industry members receive monthly reminders for orchard action through the *Avo Alerts*. (Are you a grower who isn't receiving the monthly orchard tasks Alerts? Email *admin2@avocado.org.au*.)

Growers are encouraged to get in touch with the project team, your feedback makes this project better: Bridie Carr at *Bridie.Carr@daf.qld.gov.au* and Simon Newett at *Simon.Newett@daf.qld.gov.au*. Read more on page 21.

Independent mid-term review of AV17005 (AV20002)

Service Provider	Coutts J&R
Project Leader	Jeff Coutts
Start Date	30/10/2020
End Date	15/1/2021
Funding	Hort Innovation Avocado Fund

Forty-five key growers and industry members assisted Coutts J&R evaluate the mid-term outcomes of *Avocado Industry Development and Extension* (AV17005) in December 2020.

The key findings indicated that the project is effectively on track to achieve its expected outcomes, already accomplishing an improved understanding and awareness of topics/issues as well as strengthening the industry's social connections, quality of fruit and future economic benefits of adopting best practices.

The reviewers found AV17005 to be relevant, widely distributed, well organised and valuable; proactively meeting the needs of the Australian avocado industry. High quality outcomes included effectively and appropriately engaging stakeholders, with the combined resources of Avocados Australia and the Department of Agriculture and Fisheries ensuring delivery is efficient and effective.

The flexibility of the team during COVID-19 with the delivery of the AvoGrow webinar series introducing a new delivery technique was liked by industry and recommended as a continuing project focus.

The project targets change management, and some growers are planning to implement changes based on information and activities run by the project. Growers have expressed a desire for more advanced/in-depth technical information. The project team acknowledged that there is room to improve in terms of the level of technical information delivered to the top tier of the industry in particular and it is a focus moving forward.

Overall, the project team (Simon Newett, Bridie Carr, John Tyas, Liz Singh and Amanda Madden) were commended for effective joint management, project delivery and a well organised approach to targeting priorities and different segments of the industry – as well as its proactive response to COVID-19.

Avocado industry capacity building – Western Australia (AV17006)

Service Provider	Department of Primary Industries and Regional Development, Western Australia
Project Leader	Rohan Prince
Start Date	30/06/2018
End Date	31/05/2023
Funding	Hort Innovation Avocado Fund

This investment supports the role and activities of a Western Australia Avocado Research Officer (Declan McCauley, at DPIRD), to help develop the capacity and productivity of the state's avocado industry.

Declan is tasked with delivering best practice management information to growers and other industry participants in Western Australia, supporting national development activities within the region (such as forums and workshops), and helping address identified orchard productivity issues in the state through research activities.

Over the last year, the project team have made progress on the following activities:

- a desktop study into weather conditions that may have affected avocado fruitset during the spring of 2019 was performed to compare weather, temperature and other environmental conditions for three major avocado growing areas. Unfortunately, given the current understanding of avocado flowering and fruit set requirements, it was not possible to pinpoint a reason for the poor fruit set without performing more extensive measurements, and
- capacity building activities included a series of presentations on phytophthora root rot (AV16007) and six-spotted mite (AV19002) that were hosted in December at DPIRD station in Manjimup.

The lifespan of the project has been extended to allow for an investigation into irregular bearing and sustainable crop load management in avocado.

The research will produce recommendations to growers on sustainable crop load management and on the adoptability and use of current monitoring technology to facilitate decision making toward more efficient orchard management. The extension will also further develop capabilities for the industry by generating industry and scientific publications. Examples of technology being evaluated include dendrometers, whole tree monitoring with autonomous stations, and leaf chlorophyll meters.

Implementing precision agriculture solutions in Australian avocado production systems (AV18002)

Service Provider	University of New England
Project Leader	Andrew Robson
Start Date	01/06/2019
End Date	30/03/2022
Funding	Hort Innovation Avocado Fund

The national mapping of commercial avocados orchards has progressed with new data published to the Australian Tree Crop Map and draft mapping available for review via the Industry Engagement Web App for a number of regions, as ground-truthing continues.

An Australian Tree Crop Severe Weather web app was also developed that overlays BOM information with commercial orchard locations, supporting the rapid identification of severe weather risks across the industry.

You can view both the tree crop and the severe weather maps here: *une.edu.au/webapps*.

Additionally, a prototype of the avocado yield forecasting app, CropCount, was successfully tested on orchard blocks in the Bundaberg and Mareeba region in Queensland, allowing growers to assess fruit number and fruit size per tree in the orchard using high resolution satellite imagery and compare this to harvested yield.

Results confirmed the app's potential benefit for the industry, with grower feedback from the prototype being used to further develop this technology as the team continues to investigate commercialisation pathways.

Work to further develop the remote sensing climate-based yield prediction model continued, with measurements taken from sensors on individual trees to be matched with final yield, to provide further insight into the influence of temperature and relative humidity on fruit number and size.

You can read more about the latest from the tree crop team on page 16.

Multi-scale Monitoring Tools for Managing Australian Tree Crops: Phase 2 (ST19000)

Service Provider	University of New England
Project Leader	Andrew Robson
Start Date	27/11/2019
End Date	31/01/2023
Funding	Australian Government's Rural R&D for Profit

Multi-scale Monitoring Tools for Managing Australian Tree Crops: Phase 2 is a part of the Australian Government's Rural R&D for profit scheme. This project is being funded by Hort Innovation and involved the avocado, banana, citrus, macadamia, mango and olive funds in Phase 1.

The overarching program is continuing the development, trial and extension of technology-based crop mapping and monitoring tools to help growers in predicting fruit quality and yield, and monitoring tree health – including in the early detection of pest and disease outbreaks.

On a wider, whole-of-sector scale, the program is also further developing the Australian Tree Crop Rapid Response Map, which can be used to assist in biosecurity and disaster response efforts. The map has already been put to work in 2017 with Cyclone Debbie, and during and following the 2019/20 bushfires.

This multi-scale monitoring tools project involves some nine sub-projects sitting under an overarching project ST19000, with a variety of teams all being led by Hort Innovation. Professor Andrew Robson the Director of the Applied Agricultural Remote Sensing Centre is the project lead with Craig Shephard and Joel McKechnie managing the mapping component and outputs of this research. (Check AV18002 for more, too). And you can read more about the latest from the tree crop team on page 16.

Maximising yield and reducing seasonal variation (AV16005)

Service Provider	CSIRO
Project Leader	Harley Smith
Start Date	31/5/2017
End Date	30/08/2021
Funding Type	Hort Innovation Avocado Fund

This project is developing the knowledge and tools needed to manipulate and maximise avocado tree yields, to help improve production and profitability in the industry.

Specifically, the project is looking at resource competition between shoots and fruits, potentially opening the door for new methods of reducing fruit drop. Because vegetative shoot growth coincides with fruit development in avocado

trees, competition exists for carbohydrates, other nutrients and hormones necessary for maintaining growth. This competition can impact on the early stages of fruit development, resulting in fruit growth cessation followed by abscission – a key event that limits avocado production.

The research is also looking at how high, sustainable production can be achieved from year to year, through progressing the understanding of high-yielding tree development.

Field trials for 2020-2021 will address the physiology of fruit abscission and the potential for practical applications for managing fruit drop. The trials include:

- drought stress-fruit abscission trial with the aim of linking changes in tree carbohydrate status with fruit abscission
- fruit growth trial utilising fruit dendrometers to characterise changes in fruit growth rates with abscission and determine if they can predict fruit abscission events
- analysis to determine if fungal infections are involved in avocado fruit abscission and, if so, evaluate which pathogens are involved and whether fungicide treatments can reduce impact.

Carbohydrates monitoring to predict yield and understanding fruit set (AV19006)

Service Provider	CSIRO
Project Leader	Harley Smith
State Date	18/6/2020
End Date	31/5/2021
Funding Type	Hort Innovation Avocado Fund

COMPLETED PROJECT

The project team recently completed AV19006, in which non-destructive methods to monitor tree carbohydrate status in avocado were reviewed.

Based on seasonal fluctuations in carbohydrate reserves, it was previously proposed that tree carbohydrate status is a major factor that influences flowering, fruit set and fruit retention and, therefore, is an important determinant for predicting and maximising yield. The first objective of the work was to perform a 'desktop' analysis to review non-destructive approaches that might be developed for estimating tree carbohydrate levels in avocado.

Near-infrared (NIR) reflectance spectroscopy was identified as the technology with the greatest potential as a non-destructive approach to measure non-structural carbohydrates (NSC) in avocado and a successful proof-of-concept undertaken. This assessment used a laboratory-based system with controlled lighting conditions. Developing a commercially viable tool for growers would require several further steps.

You can read a full report on this study on page 66.

Improving avocado orchard productivity through disease management (AV16007)

Service Provider	The University of Queensland & Murdoch University
Project Leader	Dr Elizabeth Dann & Giles Hardy
Start Date	09/11/2017
End Date	05/11/2021
Funding	Hort Innovation Avocado Fund

The overall objective of this Hort Innovation funded project is to minimise the effect of high priority diseases such as Phytophthora root rot (PRR) and fruit diseases anthracnose and stem end rot for the Australian avocado industry.

The AV16007 Murdoch University project team held a mixed in person/virtual update on their work with the use of phosphite treatments for Phytophthora in December 2020. The session also included an update on six-spotted mite (AV19002) and future Phytophthora management.

Developing a better understanding of the pathogens that impact on the avocado industry, their pathogenicity, tolerance to phosphite, the effect of the microbial community upon the pathogens, the best assessment tests to determine the amount of disease in avocado plants and the development of effective management tools will enhance economic returns to the industry, reduce the threats of invasive pathogens, and make the industry more environmentally sustainable.

The University of Queensland team has had a number of advances with regard to AV16007 this year, as it continues to monitor phosphonate residues in fruit, explore biofumigation for Phytophthora infested replant sites, field trials to assess the efficacy of new treatments on soil health, yield and quality, and an investigation into a range of fungi associated with stem end rot, branch cankers, and graft and branch dieback.

This has included an exploration of panicle dieback that occurred in the Bundaberg/Childers growing area in Queensland, during the 2019 and 2020 flowering. Rather than a death or blight of flowers themselves, which occurs less commonly, the main yield-limiting symptom was dieback, which became apparent 6-8 weeks after peak flowering. At this time, flowers had well and truly abscised or set, and fruitlets were mostly pea to olive sized, and up to golf ball sized. Dieback in these fruiting shoots caused disrupted water flow to developing fruitlets, which shrivelled and turned black eventually abscising to leave the 'skeleton' of the inflorescence.

Researchers have received reports, photos and samples from North Queensland and south-west Western Australia, so the problem is certainly not confined to Central Queensland. Read the latest panicle dieback article here: *avocado.org.au/public-articles/panicle-and-shoot-dieback/*.

Understanding the mode of action of phosphite in avocado for enhanced management of Phytophthora root rot (AV19005)

Service Provider	The University of Queensland
Project Leader	Dr Elizabeth Dann
State Date	30/6/2020
End Date	22/5/2022
Funding	Hort Innovation Avocado Fund

This project is improving industry understanding on the mode of action of the fungicide phosphite, and its translocation in avocado trees, so that applications of phosphite can become more targeted and effective, resulting in healthier and more productive orchards.

In the Summer 2021 edition of *Talking Avocados*, the team outlined some key messages for growers, from work carried out to date:

- use phosphonates as part of an integrated management strategy for Phytophthora root rot
- keep up the recommended phosphonate applications and monitoring – visit *avocado.org.au/bpr/* for details, including an informational video
- phosphonates are stable, long-lived and highly mobile within the tree, with tissue fluctuations related to resource sink strengths, and
- beware of non-registered products with claimed efficacy against Phytophthora.

In April 2021, AV19005 and AV17005 worked together to run an avocado phosphorous acid workshop in Mareeba (North Queensland), attended by 75 industry members.

Key research components include:

1. mode of action studies. Various experiments will investigate the activation of the inherent defence response in avocado roots by phosphite application, and the contribution of this indirect effect compared with direct fungicidal action. Glasshouse studies will also look at relative curative (post-infection by Phytophthora) and preventative (pre-infection by Pc) effects of phosphite applications, and whether applications improve plant growth (including the strength and volume of the root flush) in the absence of Phytophthora
2. translocation, storage and re-translocation of phosphite with carbohydrates (eg starch and soluble sugars) in various avocado tissues throughout the season
3. field trials to inform timing of applications to maximise efficacy and minimise residues in fruit at commercial maturity. Three trials have already been established in North Queensland, southern Queensland and south-west Western Australia, and baseline (pre-application) sampling occurred prior to the first phosphite applications. Each site will essentially have untreated control trees, sprays targeting either summer or autumn/winter root flushes and sprays targeting both root flushes. Comprehensive sampling of roots, fruit and other tissues occurred in July (post-autumn/winter sprays) for all trials, and will be analysed for phosphorous acid.

This project complements existing research into Phytophthora root rot conducted by levy-funded project *Improving avocado orchard productivity through disease management* (AV16007).

National tree crop intensification program (AS18000)

Service Provider	Queensland Department of Agriculture and Fisheries
Project Leader	Ian Bally
Start Date	June 2020
End Date	May 2025
Funding Type	Hort Innovation Advanced Production Systems Fund

This project aims to arm growers with the tools they need to produce more fruit and nuts per hectare. The five-year $28 million National Tree Crop Intensification in Horticulture Program will develop the needed systems to increase the intensity of orchards whilst improving production, quality and profitability outcomes for growers.

For avocado growers, the project is delivering new knowledge that supports the need to change traditional growing systems to increase yields and orchard profits. The project will deliver:

- improved understanding of factors underlying productivity
- industry awareness of management systems, scion and rootstock selections and their suitability for intensive orchard systems
- understanding of canopy management and light relations which may be applicable in conventional orchards
- understanding of establishment costs and relative economic performance of intensive production systems.

The program is being led by the Queensland Department of Agriculture and Fisheries, New South Wales Department of Primary Industries and Plant & Food Research, in Australia and New Zealand. Collaborators include South Australian Research and Development Institute (SARDI), Queensland Alliance for Agriculture and Food Innovation, Western Australia Department of Primary Industries and Regional Development and Food Innovation, University of Adelaide, the University of California Davis, and the Centro de Investigación y Tecnología Agroalimentaria de Aragón (CITA), Institut de Recerca i Tecnologia Agroalimentàries (IRTA) from Spain.

The projects relevant to avocados include a continuation of previous trials investigating rootstock, growth regulator soil drenching and two-dimensional versus three-dimensional trellis systems; investigations of new tree shapes; strategies to improve crop load; improved understanding of root/

canopy relationships; trial and demonstration of high-density plantings under netting in Western Australia; modelled economic performance of intensive production systems.

By the conclusion of the project, the project team will be able to provide the avocado industry with recommendations on rootstock and scion options supporting intensification, and plant density, tree structure, training and pruning for intensive systems.

The program is closely linked to the National Tree Genomics program (AV17000) also underway in the Hort Innovation Advanced Production Systems Fund. By working together, the programs are collectively gaining new knowledge in areas of shared interest and increasing the efficiency of delivery outcomes.

You can read more about this project on the Hort Innovation website at bit.ly/3CwBSN3, or in the Autumn 2021 edition of *Talking Avocados*.

You can also read the final report for AI13004 in the BPR Library.

National tree genomics program (AS17000)

Service Provider	The University of Queensland and Queensland University of Technology
Project Leader	Professor Robert Henry, Professor Roger Hellens, Dr Craig Hardner
Start Date	21/06/2019
End Date	01/12/2023
Funding	Hort Innovation Advanced Production Systems Fund

This program is about harnessing genetic technologies for the benefit of Australian tree crop industries. Crops that will be used as case studies in the program include almond, avocado, citrus, mango and macadamia.

These technologies can be developed and used in breeding (to deliver cultivars with key productivity and profitability traits) and to deliver improved management techniques, however, this is an area that's still in its infancy for tree crops, due to their unique challenges such as long generation times.

This program involves separate components working together to deliver a deeper understanding of the relationship between tree crop traits (phenotypes) and their underlying genetics (genotypes) and genetic mechanisms. This will then feed into the ultimate development of tools and opportunities for

rapidly and more efficiently addressing current and future needs of industry. Each program component is developing a genetic toolbox for this use, with a genomics toolbox, a genotype prediction toolbox and a phenotype prediction toolbox.

Managing flies for crop pollination (PH16002)

Service Provider	Department of Primary Industries and Regional Development, Western Australia
Project Leader	Dr David Cook
Start Date	01/05/2017
End Date	01/09/2023
Funding	Hort Frontiers Pollination Fund

PH16002 is now nearly half-way into its five-year duration. This project will identify flies useful as alternate pollinators to bees, given the global decline in bees and constant threat of a pest and/or disease entering Australia, threatening their viability and you can read the latest from the project on page 64.

The project started by first identifying the best candidate fly species for various crops via surveys of field populations of flies visiting crops at the time of flowering. Once the fly species and their crop preferences have been determined, the project focus will turn to developing novel technologies to mass rear candidate fly species for use in horticultural settings.

This project is part of the Hort Frontiers Pollination Fund and involves levy funds from the avocado industry. It is looking into the potential of using flies as alternative crop pollinators, including considering the effectiveness of specific fly species in pollinating avocado.

Strengthening and enabling effective pollination for Australia (PH15000)

Service Provider	Plant and Food Research NZ
Project Leader	Lisa Evans
Start Date	26/6/2016
End Date	30/5/2022
Funding Type	Hort Frontiers Pollination Fund

This project is delivering sustainable pollination services for Australian crops by improving the understanding of pollination requirements. It is also looking at key threats to honey bees and providing crop-specific resources to encourage growers to improve their pollination practices.

Information regarding best practice is currently limited for many crops and, in particular, little is understood about the degree to which crops are dependent on managed versus

feral honey bees or other, unmanaged pollinators for this ecosystem service.

In July 2020, the project released a pollination brochure for avocados, and you can read it here: *bit.ly/PH15000avo*.

Increasing yield and quality in tropical horticulture with better pollination, fruit retention and nutrient distribution (PH16001)

Service Provider	University of Sunshine Coast
Project Leader	Stephen Trueman
Start Date	23/06/2017
End Date	01/07/2023
Funding Type	Hort Frontiers Pollination Fund

This program aims to increase the productivity, profitability and global competitiveness of Australia's horticultural industries by helping to optimise crop pollination efficiency. Key objectives are to increase yield and quality through better understanding of crop nutrition during crop pollination and through improved understanding of the effects of cross pollination on fruit quality.

This project includes work on avocados, the Autumn 2021 edition of *Talking Avocados* featured an article from the project team, assessing the contribution of self-pollination and cross-pollination to avocado production in two Queensland orchards.

Researchers found almost a 50/50 mixture of self-pollinated and cross-pollinated Hass fruit in the two orchards. However, the percentage of self-pollinated fruit increased from 37% to 75% as they moved from the edge to the middle of the wide Hass blocks.

The results indicated that pollen vectors were only partly effective in transporting Shepard pollen into the middle of Hass blocks that were 22-26 rows wide. This might affect tree yield, because researchers expected that pollination and fruitset would be greatest when female-stage flowers of the Type A cultivar Hass have the greatest possible access to pollen from the male-stage flowers of Type B cultivars such as Shepard. Further research is warranted to determine whether yields are lower in the middle than at the edge of wide Hass blocks.

The project team will develop non-destructive tools (using hyperspectral imaging) and produce guidelines to help growers maximise crop pollination efficiency, optimise fertiliser applications and increase fruitset.

You can read the full article in the Autumn 2021 edition.

Stingless bees as effective managed pollinators for Australian horticulture (PH16000)

Service Provider	University of Western Sydney
Project Leader	James Cook
Start Date	22/09/2017
End Date	30/08/2022
Funding	Hort Frontiers Pollination Fund

This project is examining Australia's native stingless bees for their suitability as alternative pollinators to honey bees in horticulture crops.

While honey bees are excellent pollinators in many situations, their availability as both managed and wild pollinators faces various threats and horticultural industries need to consider alternative pollinators, investigate their performance in different crops, and find better ways to propagate and deploy them.

Among the leading alternative pollinator candidates are stingless bees, which live in large colonies like honey bees, pollinate a wide variety of plants, and can be kept in managed hives.

In looking at stingless bees, this investment is conducting studies across a range of fruit and vegetable crops – testing first if the bees visit the flowers and transport the crop pollen. Where they do, the effectiveness of stingless bee pollination and its impact on crop set, yield and quality is set to be examined. For the most promising crop/bee combinations, the project team will then conduct studies of the potential of stingless bees to be effectively managed pollinators in glasshouse conditions.

Specific crops involved in field work includes avocado, almond, lychee, macadamia, mango, and vegetable crops.

A range of factsheets have been developed including on safeguards for pollination services, and encouraging wild pollinators into the orchard. Find them here: *westernsydney.edu.au/hie/topics/supporting_healthy_bees_and_healthy_crops*.

eDNA analysis of plant-pollinator relationships to improve Hass avocado production in south-west Western Australia (PH19007)

Service Provider	Curtin University
Project Leader	Paul Nevill
Start Date	26/11/2020
End Date	30/11/2023
Funding Type	Hort Frontiers Pollination Fund

Inadequate pollination has been identified as one of the main contributors impacting fruit production in avocados, an issue experienced in south-west Western Australia.

This project is using a method known as eDNA metabarcoding to determine which insect species and native plants are supporting successful avocado pollination. This approach uses small regions of DNA which have low intraspecific variation (that is, variation within a species) but high interspecific variation (that is, variation between different species), to allow for identification at the species level. By classifying pollinators and the plants upon which they rely, this research has the potential to identify and protect relevant co-plant species which support these economically important orchards.

This work is predominantly being undertaken by a PhD student at Curtin University, Joshua Kestel, who is working closely with the Hort Frontiers Pollination Fund project *Managing flies for crop pollination* (PH16002) and is also linked to South West Catchment Council pollination project.

Joshua presented the initial findings of his study at the WA Pemberton Avocado Regional Forum in June 2021 (you can find his presentation in the BPR Library, under Event Proceedings).

To maximise the value of Joshua's research for the avocado industry, the research team is seeking orchard sites in the Manjimup/Pemberton regions during the 2021 flowering period.

Growers who volunteer their properties will have vane traps installed to examine the insect diversity visiting avocado flowers. Josh will be on farm regularly to check traps and to investigate the impacts adjacent land uses have on avocado pollination success. All results will be made available to orchardists who take part in the study.

Contact Joshua on 0479 155 025 or *joshua.kestel@postgrad.curtin.edu.au*.

Managing vegetation on farm targeting pollinators and farm resilience

Service Provider	South West Catchments Council (SWCC)
Project Leader	Wendy Wilkins
End Date	2023
Funding Type	National Landcare Program
Funding	Hort Frontiers Pollination Fund

This Western Australian project is not funded via Hort Innovation or grower levies, but is of interest to the state's avocado industry.

Data collected via PH19007 will inform the South West Catchment Council's project to develop best management practices to enhance pollination in avocados. This will include the development of plant species lists to attract and keep pollinators in the orchard, mowing strategies and the management of pesticide use.

One of the key aspects of the pollination and resilience project is developing personalised management plans with farmers to boost productivity through revegetation. A unique plant species mix is selected based on productivity objectives, rather than purely biodiversity objectives. An example is increasing productivity by improving habitat for honey bees and other crop-pollinators.

SWCC is developing a flowering calendar that describes which plants are in flower at different times of year to assess existing vegetation, identify gaps in pollinator food sources and develop revegetation plans.

To demonstrate the concept, SWCC has started working with a commercial orchard in Balingup, a mixed broadacre farm at Boscabel, north-west of Kojonup, and several beekeepers.

SWCC has also been trialling the use of drones to collect insects in a large commercial orchard. The trials aim to find out if drones can be used to monitor insect populations under commercial conditions and to see if this form of insect monitoring is cost effective when compared to standard sweep netting techniques.

This project is supported by the South West Catchments Council with funding from the Australian Government's National Landcare Program SmartFarms Partnership Grant, and you can find out more at *swccnrm.org.au*.

Enhanced National Bee Surveillance Program 2016-2021 (MT16005)

Service Provider	Plant Health Australia
Project Leader	Sharyn Taylor
Start Date	12/12/2016
End Date	12/12/2021
Funding	Hort Frontiers Pollination Fund

The National Bee Pest Surveillance Program (NBPSP) is an industry/government biosecurity partnership between pollination-reliant industries, all state and territory governments, the Australian Government, port staff and beekeepers.

The program delivers nationally coordinated bee pest surveillance activities which support the early detection of, and thus the chance of successfully eradicating, high priority pest incursions of the honey bee industry.

Surveillance activities undertaken every six weeks by the NBPSP continue to confirm Australia's freedom from exotic viruses, bees, and pests. You can find out more at *planthealthaustralia.com.au/national-programs/national-bee-pest-surveillance-program/*.

Several levy industries are contributors to this work, including the Avocado Fund.

AgriFutures Plan Bee

Service Provider	AgriFutures Australia
Start date	February 2020
End date	June 2023
Project Leader	Paul Blackshaw
Funding Type	Australian Government Department of Agriculture, Water and the Environment

This is not an avocado R&D levy funded project. AgriFutures Australia received funding for this project from the Australian Government Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program. Partner organisations have made additional cash and in-kind contributions.

Using innovative breeding technologies, this project will help secure Australia's honey bee population and transform their performance. The focus is on identifying and selecting traits of importance to beekeeping, horticulture and broadacre industries (dependent on pollination services) and will develop a national database to assist beekeepers choose their breeding stock according to these traits.

Through research, partnerships and education the project will generate gains for beekeepers in honey production and improve productivity and profitability for primary producers in pollination-dependent industries.

Extensive research into current honey bee breeding programs, including into the needs of beekeepers and agriculture, will lead to identification of the genetic traits that drive economic performance through honey production, bee health and pollination efficiency.

Education within this project will focus on removing barriers to the adoption of improved selection procedures and delivering extension programs that increase the capacity and skills of queen bee producers, beekeepers and pollination contractors.

It's program partners include the University of Sydney, Wheen Bee Foundation, NSW DPI, Australian Genetics & Breeding Unit (UNE), Better Bees WA, and is further supported by Costa, Olam, Monson's Honey and Pollination, Beechworth Honey, South Pacific Seeds, Queen Bee Breeders Association, and the Australian Honey Bee Industry Council.

Read more at *agrifutures.com.au/partnerships/rural-rd-for-profit-program/plan-bee/*.

Development and implementation of protocols to enable importation of improved honey bee genetics to Australia (MT18019)

Service Provider	CSIRO
Project Leader	John Roberts
Start Date	28/06/2019
End Date	15/12/2021
Funding	Hort Innovation Avocado Fund

The overall objective of this project is to develop a framework for the effective importation of desirable honey bee germplasm into Australia that mitigates the risk of exotic pests and pathogens with a focus on viruses. This will enable safe access to Varroa-tolerant germplasm, which is a priority strategy for Australia's Varroa preparedness.

During 2020/21, the project team, in partnership with Arista Bee Research (Netherlands), continued to make progress despite challenges related to COVID-19.

The team successfully imported bee semen with Varroa Sensitive Hygiene (VSH) genetics and inseminated domestic queens reared from hygienic colonies. Several Arista-semen queens are now being maintained and monitored and show good productivity, with daughter queens also being reared to further secure the imported genetics.

From this importation, the team demonstrated that virus testing can be carried out effectively to reduce the risk of unwanted viruses being introduced with imported bee semen. Updated virus testing protocols were developed, strengthening Australia's virus testing capability to support future imports.

This project involves contributions from the avocado, almond and melon funds.

Avocado sunblotch viroid survey (AV18007)

Service Provider	The University of Queensland
Project Leader	Andrew Geering
Start Date	21/06/2019
End Date	22/06/2021
Funding	Hort Innovation Avocado Fund

COMPLETED PROJECT

Substantial progress has been made, with the completion of sample tests from major nurseries along the eastern seaboard of Australia for avocado sunblotch viroid (ASBVd).

The major intervention point to control ASBVd is at the nursery stage, as the viroid is transmitted at very high rates through seed and can be multiplied if infected budwood is used for propagation or grafting tools become contaminated with sap from an infected tree.

A new avocado plant health scheme operated under the Nursery Industry Accreditation Scheme Australia has commenced, requiring that plants be tested for ASBVd.

The team have completed diagnostic testing on 2,496 plants representing 10 different cultivars from six major nurseries, with all plants demonstrated to be healthy. This result provides great confidence that the avocado industry is well on the journey to achieving freedom from ASBVd.

Good progress has also been made to develop a statistical approach for the retrospective certification of avocado orchards as being free of ASBVd. Specialised modelling work has created a simple-to-use computer program that estimates the levels of confidence that ASBVd will be detected, given nominated incidences of infection and rates of sampling.

The project team continue to engage with industry to share findings as they become available.

Xylella coordinator (MT17006)

Service Provider	Wine Australia
Project Leader	Dr Greg Chandler
Start Date	14/05/2019
End Date	31/01/2022
Funding	Hort Innovation Avocado Fund

This multi-industry and multi-sector investment supports the role and activities of a national Xylella coordinator, through the Plant Biosecurity Research Initiative (PBRI).

Xylella fastidiosa (Xf) is an exotic bacteria that prevents a plant from feeding by impeding the movement of rising sap. While Australia is currently free from the pathogen, it has the potential to threaten more than 350 commercial, ornamental and native plant species across the country.

The coordinator role includes developing R&D priorities and projects to help protect Australia's horticulture and wine sectors from Xylella.

Industry and community awareness has grown greatly due to direct engagement by the Xylella coordinator, Craig Elliot. Craig has been working with a wide range of stakeholders on Xylella awareness, including on workshops to test response readiness in various industries and regions. This has primarily been with olives and wine to date.

This project is a multi-industry and multi-sector/organisation investment, with funding from a range of levy industries, including the Avocado Fund.

Improving preparedness of the Australian horticultural sector to the threat potentially posed by *Xylella fastidiosa* (a severe biosecurity risk) (MT17006)

Service Provider	Plant Biosecurity Research Initiative
Project Leader	Dr Greg Chandler
Start Date	14/05/2019
End Date	14/03/2023
Funding	Hort Innovation Avocado Fund

Xylella fastidiosa is the #1 plant pest in the world, and ranks #1 on Australia's Top 42 list of exotic High Priority Plant Pests. This bacterium can infect more than 590 plant species ranging in severity from severe to symptom-less. As recently as April 2021, Australia's border biosecurity intercepted packages of known Xylella plant hosts (although they were not infected with Xylella).

In avocado, Xylella can cause chlorotic mottling, marginal scorch and leaf deformation, defoliation, and branch dieback. It is vectored by xylem-feeding, sap-sucking insects where it persists in the xylem in varying concentrations. It is the restriction or blocking of these water-conducting cells that makes *Xylella fastidiosa* (Xf), and its sister species, *X. taiwanensis*, so devastating to plants.

It is extremely difficult to detect in its early stages of infecting plants and can take anywhere from a few months to several years to become apparent to the naked eye.

While some of the work of this project has been impacted by travel restrictions imposed because of COVID-19, progress has been made on securing Australian-based specimens to allow for better and faster diagnostic testing. Work is also progressing on the development of a field surveillance procedure so government inspectors or industry members can have a "lab" that fits in their vehicles, to allow for in-field testing of suspect materials.

MT17006 is a multi-industry and multi-sector/organisation investment, with funding from a range of levy industries, including the Avocado Fund.

There is also work ongoing via a different project (ST19018, not involving the Avocado Fund), to identify which Australian insects would potentially carry and transfer the Xylella bacteria, should it arrive in Australia.

Avocado industry biosecurity capacity building (AV16010)

Service Provider	The University of Queensland
Project Leader	Dr Andrew Geering
Start Date	06/11/2017
End Date	05/11/2021
Funding	Hort Innovation Avocado Fund

This investment began in late 2017 to bolster biosecurity for the avocado industry. It is tasked with developing new diagnostic protocols for high-risk biosecurity threats to the industry, such as avocado scab fungus *Sphaceloma perseae*, and maintaining existing diagnostic protocols for quarantinable pests and pathogens.

The project is also monitoring emerging biosecurity threats to allow rapid responses to any incursions that arise, and providing diagnostic support for other levy-funded avocado plant health projects.

As part of the work, the researchers are also specifically looking at the diversity of scolytid beetles and associated fungi affecting avocados in Australia.

In the last year, the project team has trialled Checkpoint, a pest and pathogen surveillance tool that was developed by the Plant Biosecurity Cooperative Research Centre, but found that it has various shortcomings and was therefore not adopted by the avocado industry.

An alternative surveillance app called AgKonect has been found to be more useful. This app can be customised by the user for different purposes and has excellent software support. As such, AgKonect has been adopted for use in the avocado sunblotch survey project.

Investigation into citrus blossom bugs in avocados (AV19000)

Service Provider	Queensland Department of Agriculture and Fisheries
Project Leader	Ian Newton
Start Date	1/10/2019
End Date	31/07/2023
Funding	Hort Innovation Avocado Fund

Field collections of citrus blossom bug (CBB) have been completed for the first flowering season (2020); CBB have been collected from Far North Queensland (Atherton tablelands), Central Queensland (Bundaberg and Childers) and South-East Queensland. Collections could not be made in NSW due to COVID-19 travel restrictions at the time of avocado flowering, and this could be an issue in 2021 as well.

Field collected CBB specimens have been used to begin describing this species of mirid using a combination of morphological and molecular techniques. Of the approximately 300 mirid specimens collected from avocado orchards, 183 have been confirmed as CBB and to belong to the genus *Austropeplus*.

An expert mirid taxonomist has been engaged to assist the PhD student Dalton Baker in developing a complete species description for CBB. More specimens need to be collected from a wider geographic range to complete the objective to the highest standard.

A preliminary field trial to evaluate the damage caused by CBB to avocado crops and its subsequent pest status was conducted on the Sunshine Coast close to the end of avocado flowering in 2020. The results of this field trial were inconclusive, but the data collected are useful and will inform further investigations.

By the end of the project, the team aim to have produced a number of reference materials to aid avocado growers in identifying and monitoring for the insect. Finally, the team will work towards developing effective methods for managing citrus blossom bug that can be adopted by the industry.

Growers interested in participating by helping monitor for citrus blossom bug, collecting samples (*bit.ly/312citrus*) or allowing the project team to visit their properties are encouraged to contact Dalton Baker by email at *dalton.baker@uqconnect.edu.au* for more information and a sample kit.

Review and extension of avocado arthropod pests and their management (AV19001)

Service Provider	IPM Technologies
Project Leader	Jessica Page
Start Date	19/9/2019
End Date	15/9/2021
Funding Type	Hort Innovation Avocado Fund

This project aims to develop an understanding of any pest management issues that the avocado industry is currently dealing with or may face in the future. The focus will be on the main pests of concern in each growing region and the management practices being used to control them.

During the early stages of this project, the team conducted an industry survey to assess current pest management practices, with this now complete and the results analysed.

The results show that a prominent issue facing industry is the reliance on broad-spectrum pesticides targeting Fruit Spotting Bug (FSB) in Queensland and NSW, where it is the main pest of concern.

The survey also revealed that growers and advisors need greater support for how best to make pesticide use decisions utilising monitoring, with improved pest and beneficial identification skills required along with education about pesticide impact on beneficial species and how overuse of some pesticides can make pest problems worse.

Pest management workshops are now being offered to growers and agronomists interested in learning more about managing invertebrate pests in avocados.

The workshops run for about two hours and include a presentation on pest management options followed by a discussion on the pros and cons of current practice.

The main emphasis of the workshops is developing a management strategy that deals with all pests of concern for those participating in the workshop. If you would like more information, please contact Jessica by at *jessica@ipmtechnologies.com.au* or phone 0408 308 809.

In addition, this project is also responsible for the spray workshops being held nationally in September and October. Check the *Guacamole* for dates.

Management of six-spotted mite in WA avocado orchards - Phase 2 (AV19002)

Service Provider	Department of Primary Industries and Regional Development (DPIRD), Western Australia
Project Leader	Alison Matthews
Start Date	21/11/2019
End Date	31/08/2022
Funding Type	Hort Innovation Avocado Fund

This investment is delivering effective options for the integrated pest management (IPM) of six-spotted mite in avocado orchards. Beginning in 2019, it follows previous levy-funded project *Pest status and management of six-spotted mite (Eotetranychus sexmaculatus) in WA avocado orchards* (AV15012), which sought to assist growers in monitoring mite populations and implementing appropriate management techniques, as well as investigating the role predatory mites could play during production.

In order to develop a comprehensive IPM plan for growers – which will be extended via demonstration sites, online materials and articles in the levy-funded *Talking Avocados* – the research team will be investigating:

- the use of mass-reared predatory mites as a form of six-spotted mite management
- the role of naturally occurring predatory mites
- the relationship between tree health, mite numbers and leaf fall
- chemical application recommendations based on resistance management, impact of chemicals on beneficial species, and the impact that timing and/or application methods have on the level of pest mite control.

The project's first spring in 2020 allowed for many of the targeted field trials and intensive monitoring activities to take place. You can read more about the monitoring in the Summer 2021 edition of *Talking Avocados*.

Initial results showed a high degree of variability in six-spotted mite (SSM) numbers at all orchard levels – from within trees to between trees, between blocks and between orchards – highlighting the need for growers to closely monitor their orchards.

The project team are working closely with other local and international researchers, including two pest management-related projects in the Hort Innovation Avocado Fund: AV19001 and AV19003.

Avocado data generation investments (ST17000, ST16006 and MT17012)

Service Provider	Peracto & Eurofins
Start Date	27/04/2018
End Date	30/11/2020
Funding Type	Hort Innovation Avocado Fund

COMPLETED PROJECT

The generation of pesticide residue, efficacy and crop safety data is required to support label registration and minor use permit applications made to the Australian Pesticides and Veterinary Medicines Authority (APVMA) which, when approved, provide access to safe and effective chemicals for the management of pests, weeds and diseases.

For the avocado industry, the multi-industry investment *Generation of data for pesticide applications in horticulture crops 2018* (ST17000) produced the data required to support a Bayer DC-163 label registration, for the control of Lepidoptera including avocado leafrollers and loopers, and flower-eating caterpillar.

Data generation for other applications relevant to the avocado industry was also supported by the multi-industry projects *Generation of residue data for permit applications 2017* (MT17012) and *Generation of residue, efficacy and crop safety data for pesticide applications in horticulture crops 2017* (ST16006).

Avocado industry minor use program (AV16002)

Service Provider	Hort Innovation
Project leader	Jodie Pedrana
Start Date	This is an ongoing project
Funding Type	Hort Innovation Avocado Fund

Through this project, levy funds and Australian Government contributions are used to submit renewals and applications for new minor use permits for the avocado industry, as required. These submissions are prepared and submitted to the Australian Pesticides and Veterinary Medicines Authority (APVMA).

Permits secured in 2020/21 have included PER89167 (Bifenazate, for tea red spider mite and the six-spotted mite), PER89870 (Spinosad, for fall armyworm). The project is also working toward renewing several permits due to expire in 2021, and generating data for new label registrations including efficacy and residue trials.

All current minor use permits for the industry are searchable at https://portal.apvma.gov.au/permits or via bit.ly/312minor.

Regulatory support & response co-ordination (MT20007)

Service Provider	AKC Services
Project Leader	Kevin Bodnaruk
Start Date	01/07/2021
End Date	30/06/2024
Funding Type	Hort Innovation strategic levy investment

This project provides the Australian horticulture industry with key information regarding domestic and international pesticide regulation. A component of this is the production of Ag Chemical Updates, which provide information on any developments in regulatory oversight of relevant chemicals. They are an opportunity for industry to consider and develop responses to issues arising from actions proposed that may impact on grower ability to access and use needed pesticides.

To assist strategy planning with respect to future pest management options, the project also develops regulatory risk assessments. These highlight potential threats to agrichemicals currently approved for the management of pests and diseases in various crops, as well as current initiatives aimed at addressing identified pest management deficiencies.

This program is a strategic levy investment using across-industry funds, including the Avocado Fund.

Regulatory support and coordination (pesticides) (MT17019)

Service Provider	AKC Services
Project Leader	Kevin Bodnaruk
Start Date	30/06/2018
End Date	30/06/2021
Funding Type	Hort Innovation strategic levy investment

COMPLETED PROJECT

Among other things, this project provided the Australian horticulture industry with key information regarding domestic and international pesticide regulation. A component of this was the production of Ag Chemical Updates, available at bit.ly/2TDsgyr. These updates provided information on any developments in regulatory oversight of relevant chemicals, and were an opportunity for industry to consider and develop responses to issues arising from actions proposed that might impact on grower ability to access and use needed pesticides.

To assist strategic planning with respect to future pest management options, the project also developed regulatory risk assessments. These highlighted potential threats to agrichemicals currently approved for the management of pests and diseases in various crops, as well as current initiatives aimed at addressing identified pest management deficiencies. The avocado assessment from October 2020 can be downloaded via this link: bit.ly/3x7NU3U (PDF file).

This program was a strategic levy investment using across-industry funds, including the Avocado Fund. The final report can also be found in the Avocados Australia BPR: avocado.org.au/bpr/.

Strategic agrichemical review process (SARP) – updates (MT19008)

Service Provider	AGK Services
Project Leader	Doug McCollum
Start Date	01/12/2019
End Date	27/07/2020
Funding	Hort Innovation Avocado Fund

COMPLETED PROJECT

This short investment facilitated a 2020 Strategic Agrichemical Review Process (SARP) for a number of industries, including avocado. The reports provide an updated view of current priorities and gaps regarding pest, disease and weed control.

Each industry's SARP report assists in directing ongoing efforts to ensure the availability of and access to effective chemical controls for the industries, to address those needs and gaps. This may relate to pursuing chemical registration with agrichemical companies, or minor use permits with the Australian Pesticides and Veterinary Medicines Authority (APVMA).

You can find the avocado industry SARP in the BPR Library, under the R&D Report heading.

Underpinning projects

National avocado industry communications program (AV18003)

Service Provider	Avocados Australia Limited
Project Leader	John Tyas
Start Date	17/12/2018
End Date	06/12/2021
Funding	Hort Innovation Avocado Fund

This investment ensures the Australian avocado industry remains up-to-date with the latest R&D, marketing, emerging information, trends and issues both in Australia and overseas. By providing a consistent flow of relevant information, it keeps growers and other industry stakeholders in a position to make informed business decisions and best-practices changes. A number of communication channels are produced and maintained by this project, including but not limited to the *Talking Avocados* magazine; *Guacamole* newsletter; the Avocados Australia website, including its Best Practice Resource (BPR); industry social media channels; video content; and media releases and other industry articles.

If you are a levy payer or member of the avocado supply chain in Australia, you can review the full range of Avocados Australia's communication products and how to subscribe here: *https://avocado.org.au/public-articles/connect/*.

Industry annual reports & industry advice and grower consultation

Service Provider	Hort Innovation
Project Leader	Georgia Sheil
Start Date	This is an ongoing project
Funding	Hort Innovation Avocado Fund

Hort Innovation has ongoing projects to fund the advisory mechanism under Hort Innovation. This includes the strategic investment advisory panel (SIAP) and attendance by growers at meetings to provide advice on strategic R&D investment and marketing investment through individual project committees, such as evaluation panels and other meetings.

In addition, Hort Innovation produces an Industry Annual Report, available at *www.horticulture.com.au/growers/avocado-fund/*.

Australian Horticulture Statistics Handbook 2018-19 to 2020-21 (HA18002)

Service Provider	Freshlogic
Project leader	Adam Briggs, Hort Innovation
Start Date	This is an ongoing project
Funding	Hort Innovation

This whole-of-horticulture investment is responsible for producing Hort Innovation's annual *Australian Horticulture Statistics Handbook*, which offers the most comprehensive and contemporary data available on all sectors of the Australian horticulture industry in one easy-to-use guide.

The Handbook features more than 470 pages of information drawn from several supply chain sources, including international trade statistics and industry peak bodies, the Handbook includes data on more than 70 horticultural products including fruit, nuts, vegetables, nursery, turf, and cut flowers.

The Handbook can be found at *horticulture.com.au*.

Upcoming projects

Hort Innovation has either recently called for proposals, or closed the application period, for a number of projects that may be of interest to avocados. We will provide updates on these projects in future editions of *Talking Avocados*.

Avocado Rootstock Regional Variety Trials: Phase 1 (AV20006)

The objectives of the services being sought are to: create new knowledge on the performance of elite rootstock material for Australian avocado growers; develop regional variety evaluation sites across major growing regions, including North Queensland, Central Queensland, South Queensland, Western Australia and Central New South Wales; and develop a data-package for growers containing rootstock performance information to aid decision-making. The call for applications for this project closed on 26 February 2021.

Innovations for the control of honey bee pests and diseases of commercial importance (PH20003)

The objectives of the services being sought are to: develop new control options and technologies to control pests and diseases of honey bees in Australia, and contribute to safeguarding pollination services. The call for applications for this project closed on 4 August 2021.

More information

For further details on specific projects, we encourage you to contact Hort Innovation Industry Strategic Partner on 0487 362 717 or *georgia.sheil@horticulture.com.au*, visit *horticulture.com.au* or check for final reports in the Best Practice Resource Library.

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Flies as pollinators of avocado

Dr David Cook, Department of Primary Industries and Regional Development

The national collaborative project *Managing flies for crop pollination* (PH16002) is now nearly half-way into its five-year duration. This project will identify flies useful as alternate pollinators to European honey bees, given the global decline in these bees and the constant threat of a pest and/or disease entering Australia, threatening their viability.

This project will determine what flies are the best pollinators, given that they regularly feed on flowers, have hairy bodies that catch and transfer pollen, are active at cool temperatures, can be easily mass-reared, and don't sting workers.

Trials at avocado orchards in Busselton have allowed us to test the pollination ability of two native flies, *Calliphora albifrontalis* (found in south-west Western Australia only) and *Calliphora dubia* (found across Australia) (Figure 1).

Pairs of avocado trees were covered with fine netting just as flowering started (Figure 2) and adult flies were released into the enclosures during the entire flowering period to measure their pollination ability.

Hass (Type "A") trees and a neighbouring Type "B" tree were covered with mesh to exclude all other insects from pollinating the avocados. Adult flies were released into the enclosures on the day that bees were put out in the orchard as per normal practice. After flowering ended (six weeks), the netting was removed and the number of fruitlets (≥ 5mm diameter) counted after two months and then total fruit number and size was measured at final harvest (Figure 3).

Hass trees in the open (bee-pollinated) alongside a Type B polliniser also had their fruitlets counted. Avocado trees that had insects excluded produced very few fruit (6/tree), which highlights the need for an insect pollinator. The first trial (2019 final harvest) showed that *C. albifrontalis* were able to pollinate avocados at around 30% of what bees and all other insects could. The trees enclosed with flies produced an average of 46 fruit, with as many as 107 fruit on one tree (Figure 3).

The results from the 2019-2020 trial were even more promising, with *C.dubia* being able to pollinate around two-thirds that expected from open pollinated trees. This matched up with observations of flies with avocado inflorescences, where *C. dubia* fed on flowers 3.5-4 times more often than *C. albifrontalis*.

We now plan to use *C. dubia* in a bigger trial under larger enclosures (21 trees) this flowering season (Figure 4) and compare it with a third fly, *Calliphora vicina* (Figure 1), which is found globally, is regularly seen feeding on avocado flowers and has a unique larval diapause that gives it a mass rearing advantage.

Based on these results, methodologies for mass rearing and releasing flies in an orchard environment will be the next phase of this project so that they can be available for commercial uptake.

More information

For more information, contact Dr David Cook, DPIRD, 0416 181 162 or david.cook3@dpird.wa.gov.au.

Acknowledgement

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Figure 1. Flies tested as pollinators of avocados in tree enclosure trials, *C. dubia* (L), *C.albifrontalis* (C) & *C. vicina* (R).

Figure 2. Overhead view of the enclosures in the avocado orchard and a close up of the avocado tree enclosure.

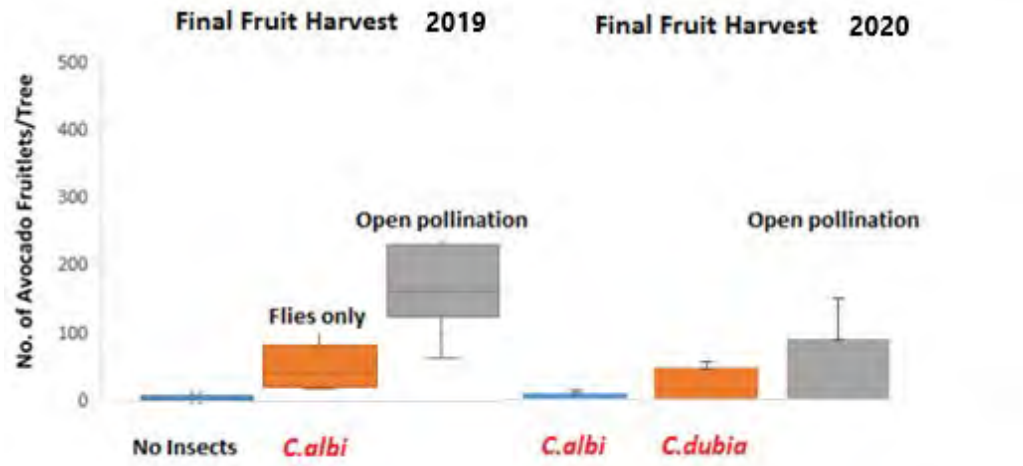

Figure 3. The number of avocado fruit at final harvest in 2019 (*C.albifrontalis*) and 2020 (*C.albifrontalis v C.dubia*) compared with Open pollinated trees (bees and all other insects on orchard).

Figure 4. Large enclosures will assess pollination by either *C. dubia*, *C. vicina* or just bees in avocado orchards at both Busselton and Pemberton (in Western Australia) and compared with trees in the open pollinated by bees and all other insects around.

Estimating carbohydrate levels in avocado

Everard Edwards, Anthony van Herwaarden, Ryan Lagerstrom, Amnon Haberman, Marc Goetz and Harley Smith

We recently completed a Hort Innovation funded project, AV19006, in which non-destructive methods to monitor tree carbohydrate status in avocado were reviewed.

Based on seasonal fluctuations in carbohydrate reserves, it was previously proposed that tree carbohydrate status is a major factor that influences flowering, fruit set and fruit retention and, therefore, is an important determinant for predicting and maximising yield1. The project began in June 2020 and was completed in May 2021. The first objective of the work was to perform a 'desktop' analysis to review non-destructive approaches that might be developed for estimating tree carbohydrate levels in avocado.

The desktop review identified near-infrared (NIR) reflectance spectroscopy as the technology with the most potential for in-field commercial application, but also considered the possibility of applying a modelling approach, requiring no in-field measurements, specifically photothermal quotient (PTQ). The subsequent objective of the project was to undertake a proof-of-concept trial of these two approaches, where they were evaluated in order to assess their effectiveness. Based on the results of this project future R&D directions are discussed.

Role of carbohydrates in growth, reproduction and yield

Non-structural carbohydrates (NSC), which include soluble sugars, as well as starch, are essential for the development of inflorescences, flowers, fruits, leaves, stems and roots[2]. In general, NSC can be used to generate energy for plant processes, incorporated into plant structure, e.g. lignin and cellulose in wood, or can be stored for future use[3]. In addition, soluble sugars including glucose, sucrose and trehalose-6-phosphate act as signalling molecules regulating key developmental processes including flowering, branching and shoot growth[4, 5].

All carbohydrates produced in a tree are derived from photosynthesis in the canopy and then transported throughout the tree for further use[2]. Although NSC can be stored in any living tissues, long-term storage typically occurs in the xylem parenchyma cells of the woody tissue, such as stems, branches, trunks and roots[6]. When growth and energy demands exceed the photosynthetic capacity of the tree, stored carbohydrates are mobilised to support growth. In avocado, fluctuations of stored starch in stems correlates with reproductive and vegetative growth patterns in the tree[7-9]. Therefore, the timing and degree of starch accumulation, as well as mobilisation, in woody tissues appears to be an indicator of tree carbohydrate status that plays a major role influencing reproductive growth and yield[1,6]. This hypothesis is supported by research from AV16005, which provides evidence that avocado tree carbohydrate status is a major factor that influences flowering, fruit set and fruit abscission (A. Haberman, M. Goetz and H. Smith, unpublished). Therefore, having the capability to effectively manage starch accumulation in winter, control starch mobilisation at flowering and direct sugars to flowers and fruits during the growing season is predicted to increase yields in avocado. In a step toward carbohydrate management and yield prediction, growers require a rapid, on-farm, non-destructive technology to estimate carbohydrate levels in trees. Ideally this technology should also be "on-the-go" in order to collect data at the orchard block scale.

Laboratory assessment

In avocado, NSC can be subdivided into two groups:

i) soluble carbohydrates, such as glucose, fructose, sucrose, mannoheptulose and perseitol, and
ii) simple, easily decomposed single chain polysaccharides, such as starch[10-11].

Soluble sugars are extracted by grinding plant tissues in water or ethanol. Total soluble carbohydrates can be directly estimated (eg using anthone[12-13]), or these metabolites can be individually separated via chromatography (eg high-performance liquid chromatography[14]), and quantified using various forms of spectrometry (eg mass spectrometry[15]). Alternatively, enzyme-based assays have allowed precise determination of individual carbohydrates from mixed samples[16]. To estimate polysaccharides levels, these chains are hydrolysed into their constituent monomers (eg soluble sugars) and subsequently measured as described above. In general, these methods are impractical for in-field use, require destructive sampling and are not possible to deploy at scale.

Practical and scalable alternatives are required for in-field use.

Identification of a non-destructive method

The overall objective for AV19006 was to recommend a pathway for the development of a method to rapidly assess avocado carbohydrate status at scale in the field. An *ideal* non-destructive non-contact method for assessing whole tree carbohydrate status would involve measuring these metabolites in every tree within an orchard with minimum user interaction from an aerial or ground vehicle moving

at constant speed (Figure 1). However, a *minimum viable* method would involve a rapid spot measurement using a handheld or vehicle mounted device that requires minimal staff training. Irrespective of the method used, it should provide a geolocated map of the spatial variation in the orchard in addition to summary data for each block.

Over the last two decades, spectroscopic techniques with the capability to measure chemical constituents of intact plant material that were previously developed for laboratory conditions are now practical, or potentially practical, for in-field use. Furthermore, advances in computing capacity have resulted in chemometrics[17], whether based on traditional statistical or newer machine learning algorithms, which can process spectroscopic data on a local machine or instrument.

Figure 1. Farm vehicle moving through orchard with on-the-go mounted sensors.

Most of these spectroscopic technologies can, at least theoretically, be adapted to a 'spot' sensor that can be held against living avocado tissue to collect data. Such a sensor is *active*, in that it provides the light, or energy, required to make the measurement. However, the simplest on-the-go sensor would be *passive*, using natural sunlight to provide the energy source. Normal digital video colour imaging is an example of this, and a passive sensor is the only realistic option for aerial observations. In contrast, an *active* on-the-go option that includes a light or energy source is the only way of using wavelengths for which the atmosphere is not transparent (eg much of the infra-red spectrum). A non-contact on-the-go sensor is ideal for in-field use as they provide more data with less labour than a spot measurement and have a greater field of view, enabling a large proportion of the avocado tree to be imaged. However, it is critical that the on-the-go sensor is able to image the appropriate tissue required to estimate tree carbohydrate status throughout the growing season, so that tissue must be visible from distance.

To identify a suitable non-destructive approach(es) for the estimation of NSC in avocado with the potential for commercial in-field application, a range of technologies for estimating chemical constituents of intact plant samples were reviewed. Further, these technologies were also considered for on-the-go measurements vs point-based measurement (listed in Table 1).

After reviewing these technologies, diffuse reflectance spectroscopy, specifically at near infrared (NIR) wavelengths, was identified as the most promising technology for a proof-of-concept practical trial[18].

Assessment of NIR Reflectance Spectroscopy

Developing an appropriate NIR reflectance spectroscopy sensor for determining non-structural carbohydrate levels in avocado, together with data analytics and in-field trials was well beyond a proof-of-concept, or the capacity of the AV19006 project. Therefore, with the time and resources available, it was determined that the most effective way to demonstrate the potential of this technology was a laboratory-based trial using field collected samples and a NIR hyperspectral imaging system which can be adapted

Table 1. Spectroscopic technologies considered for in-field NSC measurement in avocado.

Technology	Waveband	Passive/active sensor?	On-the-go potential?
X-Ray Fluorescence Spectroscopy	X-Ray	Active	Unlikely
Ramen Spectroscopy	Typically mid-infrared	Active	Unlikely
Attenuated Total Reflection – Fourier Transform Infrared Spectroscopy	Mid-infrared	Active	No
Diffuse Reflectance Spectroscopy	UV-VIS-NIR	Passive or active	Yes
Terahertz Spectroscopy	Far-infrared	Active	Possible
Nuclear Magnetic Resonance Spectroscopy	Radio	Active	No

for on-the-go in-field measurements[19] (Figure 2). This work will be reported on in more depth at a later date, but is briefly summarised here.

Fresh leaf and stem samples were collected from the field, including commercial orchards, brought back to the laboratory and scanned with an active NIR hyperspectral imaging system. Each NIR scan produced a 2D image of the leaf or stem, where each pixel consists of an entire reflectance spectrum (Figure 3). After imaging, the concentration of NSC were determined using standard wet-laboratory based methods. Chemometric calibration models were then developed for various carbohydrates or combinations of carbohydrates.

Results confirmed that NIR reflectance spectroscopy is able to accurately determine the carbohydrate status of avocado leaves (Figure 4) and, therefore, has the potential to be further developed to an in-field system suitable for widespread industry adoption.

Photothermal Quotient

Researchers and orchard managers already monitor weather variables like temperature, rainfall, and solar radiation (light) to help explain avocado yields and to make decisions in the orchard. For the modelling component of the project, we utilized a tool called photothermal quotient (PTQ), which can be used as a surrogate for photosynthesis in annual plants to estimate yield[20]. This is achieved by mathematically calculating the ratio of solar radiation and temperature to assess how much carbohydrate is available per unit of tree development.

An analysis of the climate statistics across Australia's avocado growing regions highlights the favourable PTQ in the months leading up to flowering. The researchers proposed that in avocado, favourable PTQ prior to flowering would be reflected in higher levels of carbohydrate reserves (eg tree carbohydrate status), which would be used to drive flowering, fruit set, early fruit development and growth of the spring flush. In contrast, low PTQ during summer and into autumn coincides with the period of greatest demand of assimilate for fruit development and growth of the summer and fall flushes. Post-flowering PTQ displayed less interannual variation than the pre-flowering PTQ, which supports the model that pre-flowering accumulation of carbohydrate reserves are important for determining yield[1]. However, the level of stored carbohydrate reserves appears to be equally as important as photosynthesis during fruit development.

Seasonal variation in PTQ appears to favour the development of inflorescences/flowers, as well as the vegetative spring flush, followed by a premature fruit drop event in response to a decline in carbohydrate supply associated with heat and low humidity events. In our investigation, growers from across avocado growing regions were invited to contribute commercial yield data to the study. When PTQ modelling was applied to historic yield data from commercial orchards,

Figure 2. Laboratory NIR reflectance set-up used for proof-of-concept (left) and the same instrument set up as a field device (right).

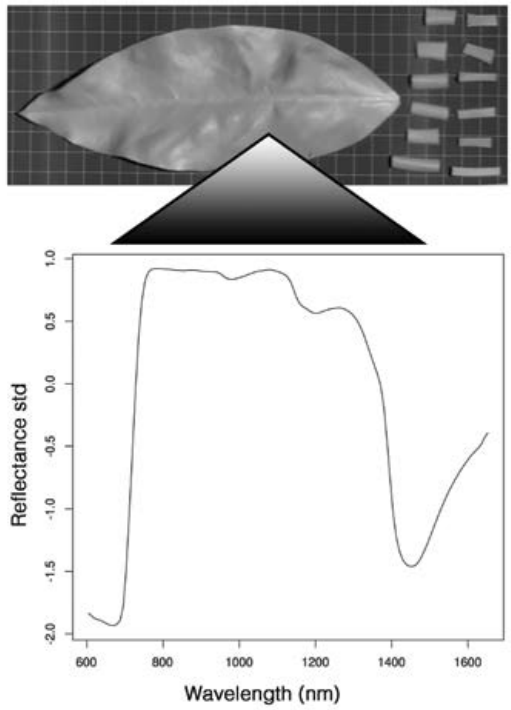

Figure 3. Image of an avocado leaf at a single NIR wavelength and a typical full NIR spectrum of a single leaf pixel.

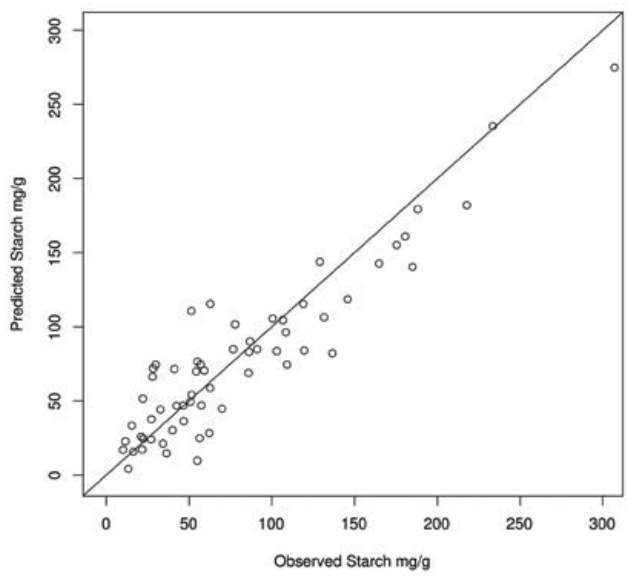

Figure 4. Example of test calibration success for starch using NIR reflectance spectroscopy.

there was little association of PTQ with yield even though annual yields were highly variable. There was no evidence of biennial bearing in any of the yield data, which suggests that infrequent weather extremes, such as low humidity, cold and/or heat stress, as well as biotic constraints, result in the interannual variation of yield in most regions.

Previous research studies indicate that a strong positive association between winter starch reserves in stems and trunks associates with yield[9]. Furthermore, research from AV16005 indicates stem starch reserves at bud burst and flowering determines the level of flowering and fruit set, respectively. To better understand the relationship between PTQ and stored starch reserves, results from Australian and California studies[7, 8], which measured starch over multiple seasons, were assessed using this modelling approach. When plotted against monthly mean PTQ, close agreement between starch reserves and PTQ were observed (Figure 5). This result indicates that PTQ is influencing in-season carbohydrate reserves in stems and branches close to the photosynthetic source. This finding suggests the potential for PTQ development for in-season assessment of carbohydrate status of avocado orchards.

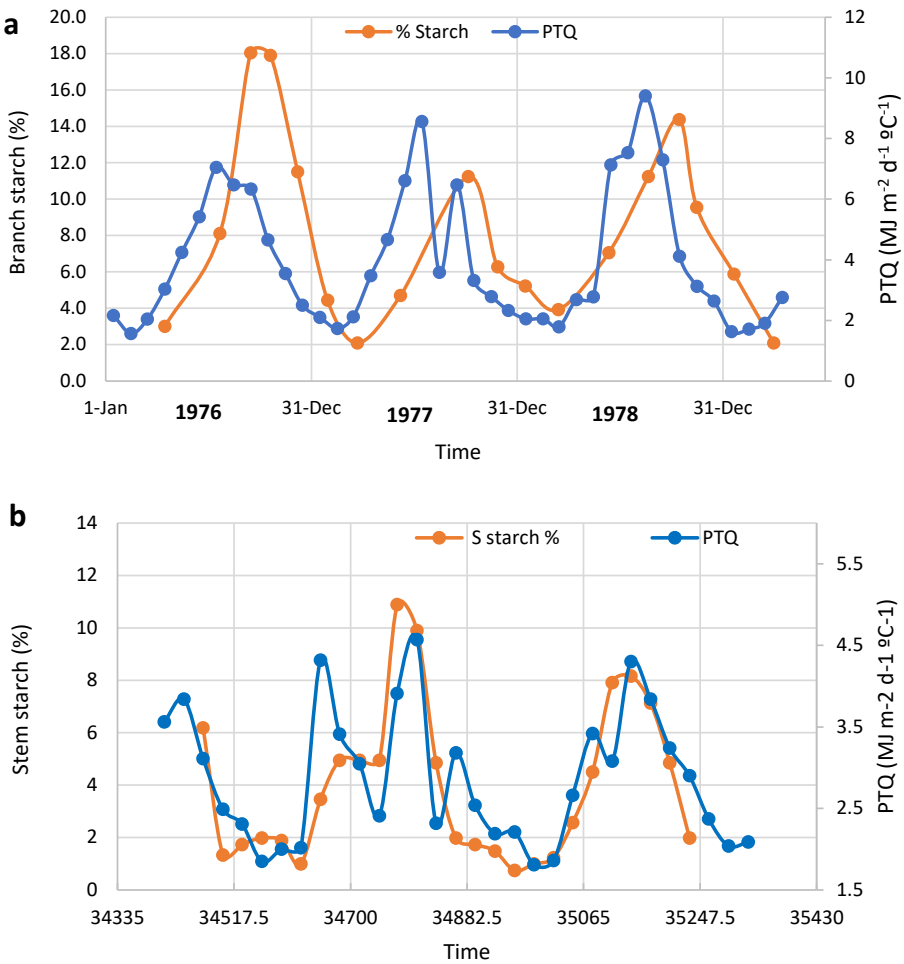

Figure 5. Non-structural carbohydrate storage (orange circles) and PTQ (blue circles) plotted against time for a) branch starch of avocado from Scholefield et al., (1985), b.) stem starch of avocado (from Liu et al., 1999) Note: PTQ was calculated from historic weather data downloaded from the internet.

Conclusion

NIR reflectance spectroscopy was identified as the technology with the greatest potential as a non-destructive approach to measure NSC in avocado and a successful proof-of-concept undertaken. This assessment used a laboratory-based system with controlled lighting conditions. Developing a commercially viable tool for growers would require several further steps. First, much larger datasets from a wider range of avocado orchards are required to improve the accuracy of the NSC measurement and demonstrate the broad applicability of the chemometrics. Second, the development of cost-effective field hardware is critical for transferring the laboratory-based NIR hyperspectral system to commercially viable in-field equipment. This step will also need to consider whether a passive or active sensor is required including an appropriate illumination system for the latter. Lastly, a commercialisation pathway must be developed for the field-proven system.

In parallel with this, additional R&D is required to address whether canopy NSC is an effective indicator of tree carbohydrate status and whether whole tree carbohydrate status is an effective indicator of the reproductive potential of a tree throughout the season, as trees exhibit branch and/or shoot autonomy, which isolates flowers and fruits from other parts of the tree[6].

Seasonal variation in PTQ appears to favour the development of inflorescence/flowers as well as the vegetative spring flush followed by immature fruit drop events to adjust yield potential, as temperatures warm. Due to the abiotic and biotic factors that impact yield in avocado, PTQ did not associate with yield. However, association between in-season starch reserves and PTQ indicates that this modelling approach may have practical applications as a surrogate for in-season tree carbohydrate status.

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Government. The authors thank the six growers for contributing historic yield data sets used for the PTQ analysis. Finally, the authors would like to thank the AV19006 Project Reference Group Committee (Simon Newett, Jacinta Foley, Simon Grabbe and Adrian Hunt) for input into this project, as well as researchers, commercial consultants and growers for their valuable discussions of orchard practices, crop responses and validation of ideas.

More information

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There is a place for NIR in avocados

Massimo Nettis and Terry Rudge, Rudge Produce Systems

NIR (near infrared) technology is very useful for measuring dry matter in Shepard avocados and you do not need to be a scientist to build a model.

According to Massimo Nettis of Rudge Produce Systems, you just need to read the instructions and be very careful about how you take measurements.

"A device such as a Felix F750 can take hundreds of non-destructive readings in the field in the time it takes to do one or two oven dry matter readings," Massimo said.

"This makes NIR a great tool for growers to predict harvest maturity and to understand the variability of fruit dry matter. It also allows growers to understand how weather conditions and growing practices affect fruit maturity."

There is widespread use of NIR to measure dry matter of mangoes, but the place for this technology in the avocado industry has been less obvious. This year, Rudge Produce Systems needed to take multiple dry matter measurements of avocados without destroying fruit. This was required as part of Hort Innovation project *Implementing best practice of avocado fruit management and handling practices from farm to ripening* (AV18000). This project is managed by the Queensland Department of Agriculture and Fisheries.

"We found the Felix F750 to be an ideal tool for this task but needed to develop a 'model' so the F750 had the smarts to estimate dry matter of avocados," Massimo said.

"A model is like a language and our devices were fluent only in mango. They could understand 'Hass speak' because our Sydney representative Nasser Abdi had already built a model, with help from Kerry Walsh's team at Central Queensland University.

"We needed to build a new model for Shepard, and we needed it urgently. I was given the task even though I had never heard of an F750," he said. Massimo's experience has useful lessons.

Lesson 1 – read the manual

On the Felix website there is a link to a YouTube about Felix's Modelbuilder software.

"The video was useful, but I did not understand the jargon. I had no idea what terms like 'training sets' and 'reference data' meant," Massimo said.

"I did not really understand the process until I read the 'Data Viewer & Model Builder User Manual'. I read the step by step the instructions in the User manual at least three times."

Massimo Nettis, Rudge Produce Systems, refining the use of NIR technology to measure dry matter in Shepard avocados.

Lesson 2 – collect reference data

"I must have checked at least 50 trays of Shepard to collect fruit with a wide enough range of maturity," Massimo said.

"I finished with a sample of 40 fruit ranging from 20-26% dry matter. I would have liked to include fruit with readings down to 18 and 19%.

"Next time I will start earlier and try to include some less-mature fruit."

Lesson 3 – Be precise

Massimo said he did this part "pretty well", marking the skin to ensure Felix readings were taken from exactly the same place as flesh plugs were to be taken.

"We used scales with readings to 0.001 grams and a very good dehydrator," he said.

Lesson 4 – use firm fruit for model building

Massimo said the fruit he used to build the model was at hard green stage.

"This was because I wanted to build the model as early as possible in the Shepard season," he said.

"It was easy to draw plugs of flesh for drying and I did not have the problem of flesh sticking to the side of the corer and knife.

"I plan to add data from ripe fruit to my model so I can be sure it works on eating ripe fruit. This will be a much dirtier process and I will need to be very careful in handling flesh samples."

Lesson 5 – Using the Modelbuilder tools to optimise the data

Massimo said he entered scan readings from the F750 and matched them up to the destructive Dry Matter readings.

"I pressed 'build' and it took only minutes to come up with a model. I then used the in-built tools to see how good it was," he said.

"To start with, my scan data did not correlate strongly with dry matter, but it improved considerably after I took out one or two outlying data points.

"The biggest weakness of my model was that it was based on only 40 fruit (80 readings). Next time I will take more readings and add them to the 80 that I already have."

Lesson 6 – Contact Felix support for any problem

"I copied the new model on to an SD card and inserted it into the F750, but our device could not detect the new file," Massimo said.

"I wasted a lot of time reviewing what I had done. Eventually I swallowed my pride and contacted Felix support, and it turned out that the SD card was corrupted.

"I followed the few easy steps that Felix suggested, and the model worked perfectly."

Lesson 7 – Test it in real life

Massimo said his Shepard avocado model worked.

"The Dry Matter values that it estimates are close to the actuals. I will continue to add additional data to the model to make it more reliable."

Massimo's recommendations

- The F750 can be used to take non-destructive measurements of dry matter in Shepard, and you do not need to be a scientist to build a model. You do need to read the instructions and be particularly careful about how you take measurements during the model building process.
- The F750 has a real place in helping avocado growers predict harvest maturity and understand the variability of fruit dry matter.
- A grower can take hundreds of NIR readings in the time it takes to do one or two oven dry matter readings. It is easy to see how it can be used to investigate how cultural practices influence fruit maturity.

More information

For further information contact Massimo Nettis on 0432 765 459 or *mnettis@rudge.com.au*.

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Industry views on tissue culture avocado plants

Talitha Best, Hannah Thorne and Jenna Axtens, Central Queensland University

Australian avocado growers believe they have the capacity to develop the necessary knowledge and skills to use tissue culture plants in future.

Tissue culture technology (TC) for avocado plant production is an innovation that aims to remedy many of the current issues of traditional propagation methods, namely the length of time needed to produce new seedlings for planting.

TC plants have not been widely used for avocado production. However, a collaborative project funded by Advance Queensland Innovation Program (AQIP), led by The University of Queensland (UQ) and involving researchers from Central Queensland University (CQUniversity) and University of Southern Queensland (USQ) has applied TC technology to the production of avocado plants. In particular, the UQ program of research has developed TC seedlings and cultivated a pathway from lab to field in order to provide access to avocado planting material for enhanced production efforts.

However, with the development of new technology comes the risk that uptake and acceptance within the industry will be low. Limited adoption leads to a waste of resources and missed opportunities for the industry to benefit from the innovation.

There are many reasons why new technology may or may not be adopted and there are extensive innovation and adoption models to support practice change within agriculture (Pathak et al., 2019). Within psychology, technology acceptance models (Venkatesh, 2000) and the theory of planned behaviour (Ajzen, 1991; 2002) inform the ways in which certain variables make adoption of new technology more or less likely. These variables include the perceptions that industry/organisational members hold about the new technology, their experience with similar technology, and their belief that they can develop the knowledge and skills needed to use the new technology (Folorunso et al., 2008).

CQUniversity explored this combination of psychological science and horticulture to understand the views and ideas held by the avocado industry about tissue culture trees.

In collaboration with UQ and USQ, we aimed to understand the Australian avocado industry's understanding of and attitudes toward tissue culture for avocados, the perceived barriers to adoption of tissue culture technology, and their perception of the knowledge and skills needed to use tissue culture. Across Australia, individuals in various roles within the avocado industry took part in an anonymous online survey about tissue culture for avocado production. The main findings were recently presented at the QAAFI Avocado Industry Update event at Hort Connections on 7 June. Information can be found in the Project Information Pack (PIP) on the QAAFI website (*qaafi.uq.edu.au/tissue-culture*).

The individuals who took part

There were 41 domestic avocado industry members from Queensland (68%), Western Australia (11%), New South Wales (11%) and South Australia (3%). The average age of the participants was 51 years, but we had a large spread of ages, with people aged from 22 to 80 years. Most (75%) of our sample was male.

Growers/farmers (41%), researchers/breeders (19%), agronomists (11%), consultants (11%), nursery/suppliers (8.3%), owners (2.8%), quality assurance (2.8%) and supply chain representatives (2.8%) took part. Within this group of individuals, the years of experience within avocado industry varied with 56% having 10 years or less of experience, 22% having 11-15 years, and 22% having more than 10 years of experience. Most participants (73%) currently worked on-farm with avocados.

Overall views about access to avocado plants

We first wanted to find out how the industry rated the current supply of avocado plants. We found that 72% of participants believed that the industry had limited access to the amount of avocado plants that they wanted. We also found that 56% and 53%, respectively, believed that the industry had limited access to the quality of plants that they wanted and types of cultivars they wanted. Participants were split over whether the cost of tree cultivars was a challenge for the industry, with just over half (56%) of participants saying that the current cost of tree cultivars was a challenge.

The knowledge and skills industry has around the use of tissue culture plants

Awareness of tissue culture for avocados was high in the industry, with 87% of participants indicating that they were aware of it. However, when asked whether they already had the skills and knowledge needed to work with tissue culture trees, less than half (40%) believed that they did. Undecided participants were the largest group (43%) and a further 17% disagreed that they had the knowledge and skills needed.

However, when participants asked if they could develop the necessary knowledge and skills to use tissue culture plants

if the right information were available, the majority (83%) agreed that they could. In addition, almost all participants – 93% – agreed that they enjoy learning about new technology and approaches in their work. These results suggest that overall industry sentiment and confidence to use and learn about tissue culture tress for production is high.

Barriers and facilitators to tissue culture adoption

We asked the industry members whether they thought that tissue culture plants would require more resource inputs to understand what things may be seen as barriers or facilitators to adoption of tissue culture technology.

Money was rated slightly higher than other resources needed, indicating a perception of tissue culture being costly, and staffing resources were rated slightly lower, indicating a perception of tissue culture requiring fewer staffing resources. Interestingly, findings from our USQ project partners indicate that the cost of tissue culture trees does not impact overall profitability for production. This is due to the net results of earlier access to trees on overall profitability, with a predicted 21% return on investment ratio. For more details on the financial modelling of tissue culture use, see the USQ report on the QAAFI website (*qaafi.uq.edu.au/tissue-culture*).

Discussion of findings

Overall, domestic avocado industry members reported that access to avocado plants is a significant limitation to production at present, both in terms of the amount and quality of trees. Cost of plants was also seen as a challenge. This indicates that there is a desire for an increase in the speed in which avocado plants can be supplied to farms, an increase in the quality and type of cultivars to which the industry has access, and a desire that costs to be reduced.

These results align with industry data that shows a surge in consumer demand for avocados in Australia but an inability of the domestic industry to keep up with that demand (Department of Agriculture, Water and the Environment, 2021). Further, the main barriers overcome by the TC technology developed by UQ are that more planting material is available, with greater opportunity for uniformity of plants, increased disease resistance and the removal of the seasonal availability of seedlings (for more info see the Project Information Pack (PIP) on the QAAFI website: *qaafi.uq.edu.au/tissue-culture*).

For example, unlike traditional propagation methods that have a reliance on the seasonal availability of seeds, tissue culture propagation offers year-round supply to support an increased number of plants available for planting and

production. Currently, Reed tissue culture plants are available commercially through Anderson Nurseries, but trials are progressing for other cultivars, and these are likely to become available in the future. In addition, research reports indicate that the price of tissue culture plants is unlikely to be significantly different from traditionally propagated plants.

Some other important information that the survey conducted by CQUniversity showed us was that avocado industry members, in general, were not confident in their knowledge about and skills to use tissue culture. However, most of the sample were confident that they could develop the skills needed to use tissue culture trees if they were provided with the right information. This indicates that appropriate extension resources need to be provided to the industry to support knowledge transfer. Critically, it needs to be effectively communicated that TC plants do not require care that is in any way different from traditionally propagated avocado plants. This should increase the confidence of the industry to explore and work with TC.

It is important to address concerns that were raised in survey responses about tissue culture, namely the perceived barrier to adoption being monetary. This finding echoes a general sentiment that the cost of trees is already a barrier for many industry members.

Australian famers, in general, operate in a volatile system as severe weather events such as droughts, fires and floods are common and negatively impact on production. In addition, farmers traditionally have taken on high levels of debt with which to finance growth.

Thus, this finding that cost is a concern is understandable and highlights a potential misconception about tissue culture technology. Economic modelling of tissue culture orchard growth has demonstrated that tissue culture planted orchards outperform traditionally grafted orchards with respect to decreased maximum negative cash exposure, decreased payback period, and increased cash flow annuity. Thus, this finding that cost is a sensitive area for domestic industry members presents an opportunity to "myth bust" when disseminating information to the industry.

The current project offers important insights about the Austrian avocado industry's perceptions and attitudes to tissue culture technology. It is important that the concerns of the industry are heard by researchers, policy makers, education, and extension officers in order to support awareness and use of Australian-based innovation with tissue culture technology.

The benefits of tissue culture need to be communicated in a way that is tailored to the current experiences of industry members, highlighting that tissue culture has been developed with the aim of addressing the problems in the industry. The merging of psychology with horticultural studies has benefits in tailoring extension resources to meet the needs of industry and increase the uptake of beneficial technology.

More information

Please go to the QAAFI webpage for further information and supplier details: *qaafi.uq.edu.au/tissue-culture*.

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Global avocado production to triple by 2030

Avocado is expected to remain the fastest growing tropical fruit variety globally, according to the *OECD-FAO Agricultural Outlook 2021-2030*.

Production is accordingly projected to reach 12 million metric tons (Mt) by 2030 – more than three times its level in 2010.

"Ample global demand and lucrative export unit prices continue to be the main drivers of this growth, stimulating substantial investments in area expansion in both major and emerging production zones," the outlook report says.

"Avocado production has been so far concentrated in a small number of regions and countries, with the top ten producing countries currently accounting for almost 80% of global output, but new growing areas are emerging rapidly.

"Nevertheless, about 74% of avocado production is expected to remain in Latin America and the Caribbean, given the favourable growing conditions in this region. In response to rapidly growing global demand, avocado is expected to become the most traded major tropical fruit by 2030, reaching 3.9Mt of exports and overtaking both pineapples and mangoes in quantity terms."

The report said given the high average unit prices of avocado, the total value of global avocado exports would thus reach an estimated US$8.3 billion in constant 2014-16 value terms, placing avocado as one of the most valuable fruit commodities.

In no surprise, the world's largest producer and exporter, Mexico, is expected to grow by 5.2% pa over the next 10 years due to continued growth in demand in the United States, the key importer of avocados from Mexico.

"As such, and despite increasing competition from emerging exporters, Mexico is expected to further increase its share of global exports, to 63% in 2030," the report said.

The United States and the European Union, where consumer interest is fuelled by assumed health benefits, are expected to remain the main importers, with 40% and 31% of global imports in 2030, respectively.

"However, imports are also rapidly rising in many other countries such as in China and some countries in the Middle East, and, as measured by the Herfindahl-Hirschman Index of all importers, the concentration of imports is gradually decreasing," the report said.

Avocados and COVID-19

All of this is despite the impact of the ongoing global pandemic.

The report notes that on the demand side, reduced consumer incomes globally has resulted in a reduced demand for tropical fruits, including avocados.

"While precise figures are not currently available, away-from-home consumption of tropical fruits, especially avocados and pineapples, can account for a substantial share of total consumption in key import markets," the report said.

"Preliminary data suggest that global exports of avocado declined slightly in 2020, by 0.8% compared to 2019, at a total quantity of approximately 2.3Mt. The main factors hampering the overall potential of this previously buoyant market, which had seen fast and uninterrupted expansion for more than a decade, were the impact of COVID-19 on global supply chains as well as a poor harvest in Mexico, the largest supplier of avocados globally."

The report said Mexico experienced an estimated 8.1% fall in exports in 2020, to 1.3Mt but there were higher supplies from Peru, Colombia and Kenya because of both favourable weather conditions and production expansion investments.

"All three suppliers (Peru, Colombia and Kenya) were thus able to achieve double-digit growth in exports in 2020, and together accounted for about 25% of total global exports," the report said.

The report said provisional data indicated a contraction of 0.6% in global imports in 2020, to 2.1Mt. However, this preliminary estimate may be revised as more data become available.

Read the report here: *oecd.org/publications/oecd-fao-agricultural-outlook-19991142.htm*.

New Zealand horticulture exports resilient in the year of the COVID-19 pandemic

New Zealand horticulture exports weathered the effects of COVID-19 to reach new heights, climbing to a record-breaking $6.6 billion in the year ending 30 June 2020. This is an increase of NZ$450 million from the previous year, and more than 11% of New Zealand's merchandise exports.

Plant & Food Research and Horticulture New Zealand publish Fresh Facts annually to provide key statistics that cover the whole of New Zealand's horticulture industries. According to latest edition, the value of the total New Zealand horticulture industry exceeded NZ$10 billion for the first time in 2020.

Kiwifruit (NZ$2.5 billion), apples (NZ $876.6 million) and avocados (NZ $112.3 million) made up most of New Zealand's fresh fruit exports (fob) in the year to 30 June 2020. Total avocado export value for the period (fob) was NZ$122m, including avocado oil exports.

New Zealand horticultural produce was exported to 128 countries in 2020. The top five markets were Continental Europe, Japan, the USA, Australia and China. Exports to Asia were NZ $2.76 billion, 42% of total NZ horticulture exports. Of the NZ $836 million in exports to Australia, NZ $84 million was avocados. The value of avocado exports to Asia to June 2020 was NZ$28m.

"In a year affected by the COVID-19 pandemic, New Zealand's horticulture industry has demonstrated resilience and our produce is more in demand than ever," Plant & Food Research CEO David Hughes said.

"Our reputation for high quality and safe food, combined with excellent growing systems and novel products, is vital in maintaining New Zealand's share of the global marketplace."

Horticulture New Zealand Chief Executive Nadine Tunley said it was great that the horticulture industry has continued to grow despite COVID-19.

"Horticulture has the potential to lead New Zealand's economic recovery and play an important role in climate change mitigation. However, if horticulture is to reach its true potential, government policies around seasonal labour, highly productive land and freshwater, investment in research and development, and compliance must be supportive," Ms Tunley said.

"At the moment, there is a disconnect between what is being said about our industry's potential and central and local government decisions that affect growers on the ground."

To view the latest issue of Fresh Facts, as well as all previous issues, visit *freshfacts.co.nz*.

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