

SUMMER
2020

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Nº4

Talking Avocados

NEW LOOK FOR
YOUR MAGAZINE

FIRE RECOVERY
TIPS

AVOCADO EXPORT
ROUND-UP

Talking Avocados

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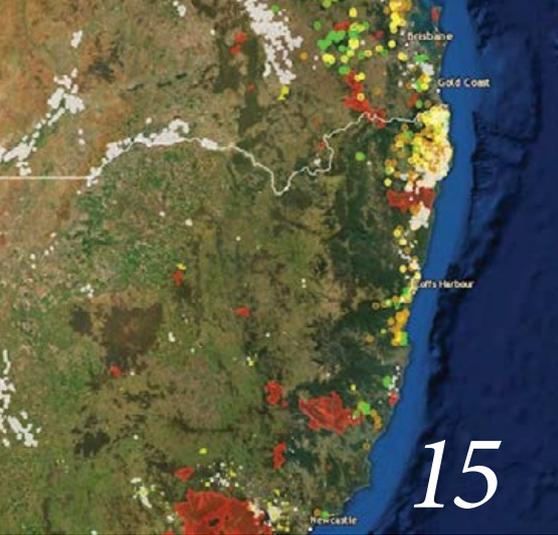
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COVER IMAGE: Dr Ken Pegg in the orchard during the Tamborine/Northern Rivers Regional Forum. More on page 28.

CHAIRMAN'S PERSPECTIVE

Jim Kochi, Avocados Australia Limited



Welcome to the New Year and a new look for *Talking Avocados*! The last 12 months have seen a smorgasbord of challenges and opportunities for the Australian avocado industry: increased domestic consumption, the steady upward climb of production, frost, hail, droughts, fires and now floods.

However, I want to focus on the much bigger picture: our responsibilities in the Australian market and our growing export markets.

Our first responsibility is to help our consumers quickly and easily identify what is an Australian avocado. Given the impending imports from Chile, existing imports from New Zealand and interest from various other international players, we can't give consumers a moment's hesitation when they're ready to put an avocado in their shopping bag.

Whether it's our domestic or export consumers, we have to identify our fruit as Australian and the easiest way to do that is the Kangaroo Label. Let's be honest, without a label, one avocado looks very much like another. It's the label that helps our consumers quickly identify a piece of Australian fruit.

Our consumers don't have time to try and decipher whether it's Australian or not, and it's our responsibility to make the path clear. Once their eye hits that

green kangaroo label, they won't look further because it's so easily identified by colour and pattern.

I have used the Avocados Australia Kangaroo Label from day one because I believe it is the best label to show Australian grown, and to identify the grower/packer.



An example of the new databar, incorporating the Kangaroo Label branding.

Now your industry body, Avocados Australia, has done what it can to protect our industry from imports and other competitive forces, but in that moment of hesitation at the fruit display the consumer may want to make the choice: buy Australian grown avocado or imported avocado. The choice the consumer makes is now up to how YOU have labelled your avocado.

And guess what our second responsibility is? It shouldn't be a surprise to anyone because I bang on about this regularly. Yep, quality.

As growers, we have to provide the best

quality fruit to consumers.

If we do that, we will protect our market as best we can and successfully expand into new markets, by keeping the confidence and loyalty of our consumers.

We now face the prospect of Chilean fruit in the domestic market (more on page 16), which means our Australian avocados are going to need to be at 100% quality.

We need to have customers who want to buy Australian fruit, and who want to buy Australian fruit no matter what other options are on their retailer shelves here at home or at a fruit market in Malaysia, Singapore, Japan or even, in future, India and China.

One important strategy is to implement a more aggressive export development program, and this is something Avocados Australia is pursuing.

Easy identification of Australian fruit and quality are the two things that are going to protect our industry from imports, and assist us when we are exporting.

These things matter now in 2020, and they're going to matter even more in a decade. Now is not the time to sit back and think "we're doing a good enough job". Now is the time to ask what more we can be doing.

New Year. New resolutions. Let's go.

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www.avocado.org.au/our-programs/anvas/

CEO'S REPORT

John Tyas, Avocados Australia Limited



2020 is shaping up to be another very busy year for Avocados Australia. One of the changes is the new look for your industry magazine, *Talking Avocados*. We will focus on bringing you the latest news and in-depth research and development content each quarter, but with a fresh, exciting new design. In addition to the core program of work around communications, industry data management, regional forums and export development, we have some new initiatives in the pipeline. These are focussed very much around building increased demand for Australian avocados.

New Avocado Market Development Manager

While the industry currently enjoys very strong demand in the Australian market, Australia's avocado production is forecast to increase dramatically in the coming years and our data analysis shows that demand will need to grow at a much faster rate than it has done in the past.

Avocados Australia has proactively created a new position to help grow the domestic market. The Market Development Manager position will focus on avocado quality, supply dynamics and promotions.

Hayleigh Dawson has been appointed to this new position and will start work with Avocados Australia in March. Since graduating in 2016 with degrees in applied science and agribusiness, Hayleigh has been working in fresh produce supply chain management roles including direct experience with the avocado category. I'm really looking forward to having Hayleigh on the team and I'm confident she will make a great contribution to the various market development initiatives underway.

The aim of this position is to support and leverage key industry activities to drive domestic market demand growth

with maximum impact.

The priority areas for development are:

- **Quality** – Improve the quality of avocados available to Australian consumers at retail point of sale. Working with Hort Innovation, major retail chains, key industry stakeholders, researchers and consultants the role will develop and drive a coordinated program to achieve high quality avocados at retail level.
- **Supply dynamics** – The role will help to leverage maximum value from the industry's highly regarded crop forecasting and dispatch monitoring system (*Infocado*). Hayleigh will work with Avocados Australia's Data Analyst to ensure the value chain is well informed about the supply dynamics of Australian avocados across regions, seasons and varieties to facilitate optimal retailer category planning.
- **Promotion** – Hayleigh will work closely with the Hort Innovation Avocado Marketing Manager and key accounts, to seek to optimise the performance of the avocado levy-funded marketing and promotion program. This will include building relationships with the major retailers to seek opportunities to leverage the industry and retailer investments to drive growth in the avocado category.

Export planning

Late last year, I engaged a market access and trade specialist, Jenny Van de Meeberg to help refine our market access strategy. Following consultation with industry and government over the past two months, we have identified a number of new activities to help drive our market access and trade development into key markets.

Importantly, the Australian Government has agreed to progress our market access application for India this year, which is a market with great

potential for Australian avocados.

While no-one can make the access process faster, there are new initiatives we have commenced to ensure our market access goals are reached. You can read more about Avocados Australia's current export activities from page 17.

Second season in Japan

We have now concluded our second round of registering packhouses and growers for export to Japan, working with the Australian Government Department of Agriculture, Water and Environment. In 2019, 27 growers with 178 blocks and five packhouses in Western Australia were successfully accredited for export to Japan. Australia was granted market access of Hass Avocado to Japan based on conditional non-host status for areas free of Queensland fruit fly in May 2018.

It is great to see the Western Australian growers and exporters have strongly supported this new market access. The commitment to utilise the new protocol and develop the market is very important, and will strengthen the case for our future market access requests to the Australian Government.

Hort Connections

For the second year, Avocados Australia has signed up as an industry partner for the Hort Connections conference. This year, we are taking this a step further and we will host an avocado-specific event on the afternoon of Monday, 15 June.

This event will focus on the supply chain aspects of the avocado industry, with updates on the latest research, news and innovations. Keep an eye out for more details in the fortnightly *Guacamole*. You can read more about Hort Connections on page 32.

Sustainability survey

I know it seems as if we are being surveyed almost constantly in horticulture, but I encourage growers to take this survey from Hort Innovation. As the national research and development corporation for horticulture, Hort Innovation is developing a Horticulture Sustainability Framework.

This short, 10-minute survey will help them understand and respond to the issues that are most important to growers: horticulture.com.au/sustainability.

If you have any further queries, please contact Ingrid Roth, Horticulture Sustainability project lead, on 0428 195 485 or ingridroth@roth.net.au.

Avocados Australia AGM

Our AGM was held in Casuarina on 13 November 2019, in conjunction with the Tamborine/Northern Rivers Regional Forum. Ian Tolson (Central

NSW), Eric Carney (CQ), Dudley Mitchell (WA) and Jim Kochi (NQ) were all re-elected. The 2020 annual general meeting is likely to be held in Central Queensland in October, and we encourage everyone to attend.

Do you know a new grower?

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

As we all know, new growers have joined the industry in every region in the last few years. It is important that new growers stay well informed about industry matters and we are very keen to engage with them.

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.



At the end of last year, we surveyed our Best Practice Resource users about their experiences using the resource. Katia Plouznikoff (pictured with Avocados Australia CEO John Tyas) was one of the many people who provided feedback, and she was also the winner of the \$100 gift voucher. We'll provide a full analysis of your feedback in the next edition of *Talking Avocados*.



Market access expert Jenny Van de Meeberg with Avocados Australia CEO John Tyas.

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AROUND AUSTRALIA



TRISTATE

By Kym Thiel

Harvest in the Tristate wound up in mid to late January, with the bushfire chaos creating a minor windfall for those lucky enough to have some fruit. This has helped offset the damage caused by severe sunburn

and the extreme temperatures we experienced in mid to late December, where 48°C were not uncommon.

Coupled with northerly winds, burn to trees was evident no matter what the management practices of growers.

Looking forward, there are many challenges facing us in 2020, not the least being water, including both pricing and availability. (There have been forecasts that better conditions might be on their way; we can only hope.)

Although it's still early, the 2020/21 crop appears to be very light in this district with the dreaded biennial bearing now seemingly entrenched in the Tristate. Flowering was patchy, temperatures were not ideal and frosts over winter appear to be the major factors that have impacted on this crop. WE hope that with the trees carrying less fruit through summer, they will be in a better position to carry as much as possible without dropping as much as when we have a heavy set.

From an industry point of view, it's heartening to see the volumes supplied between October and December, and that pricing was still maintained at a viable level. Coupled with the export potential out of the Tristate, I am still optimistic the industry has a viable and bright future.



CENTRAL NEW SOUTH WALES

By Ian Tolson

Welcome to a New Year, new decade and of course new challenges.

The drought conditions of 2019 were extremely challenging. Irrigation schedules had to be revised to accommodate the dwindling water supply; unfortunately for some growers they had to cease irrigating. With no rain forecasted thoughts then turned to how and if the trees would sustain the heavy crop load under such conditions. These tinder dry conditions compounded by many years of

accumulated fuel load lead to prolonged horrific bush fires. The impact of which lead to loss of human and wildlife, bushland, property and damage to orchards ranging from wiped out to minor. Thunderstorms were more of a hinderance than a help as the lightning strikes ignited more fires and produced little or no rain.

Mid-January produced some very useful rain across the regions, amounts varied greatly but everyone welcomed what was on offer. Of course, much more follow up rain is needed, but orchards may now avoid what could have been a large fruit drop.

One of the greatest future challenges will be 'activists'; some growing regions are experiencing groups whose members take photos of properties and post online, questioning the farming practices and insinuating growers are acting illegally. Trespassing has been reported and growers are banding together by watching their neighbours' property and advising of any unwelcome visitors.

Growers are a resilient group, no matter what challenges whether new or old are thrown their way they rise to the occasion, working probably 300+ hours a month to supply quality, safe produce to those who are convinced we are ruining the planet.



SUNSHINE COAST

By Robert Price

As I sit writing this report it seems the interminable dry and heat is sapping the focus of all else other than managing the trees, water supply and nutrient availability. While the coastal highlands have had some rain (281mm) those on the other side of the hill have had 171mm from 1 July to 30 December 2019. Compounding the lack of rain was high temperatures averaging 32°C over the six months.

So, what have been the observations of the effect on the trees? In conversation with local growers, the trees are stressed. The new season started off with a good flowering and fruit set, but then the heat started to beat down, sapping the moisture out of the leaves and tree which saw a dropping of (mostly the upper leaves in constant sunlight) exposing young fruit to the UVs. Mostly they handled the change in their environment, although without a sunscreen they will suffer sunburn. As the season moved along and there where hotter and drier days,

there were reports that fruit drop was occurring, and younger leaves were burning on the edges.

To date the general consensus in the area is that fruit in the coming season will be smaller and more skin damaged than in previous years while quantities are yet to be estimated.

Our next Avocado Regional Forum in this area will focus on soil health and nutrition, and managing avocados in dry conditions. You can find the full details online at avocado.org.au for the event scheduled for 26 February at the Bellthorpe Community Hall.



TAMBORINE AND NORTHERN RIVERS

By Tom Silver

As I write this report (early February) we are on the cusp of a very large rain event. Forecasters are predicting the possibility of up to 500mm for the whole event. Let's hope we get some! The forecast is in stark contrast to the last 12 months. Growers in the Northern New South Wales/Tambourine district, like many of the other avocado growing areas have been exposed to the drought

conditions that so much of Australian agriculture has suffered under over the past three years. On the Alstonville plateau there was zero significant rain fall between the start of July 2019 until we received 40mm on the last day of November 2019. There was no follow-up rain until Christmas Eve when we received another 40mm. Storms and rain have been slightly more consistent for January but still only just.

The dry has been incredibly tough on some growers who have had to take severe pruning action to save trees, and simply write off a significant crop they were carrying. Other growers already struggling with zero water have had to contend with bushfires pushing into their orchards from surrounding native forest.

Though crop estimates are still down on last year, more fruit is showing and hopefully the continued rain and healthy leaf flush I'm seeing will push fruit sizes along. Insect and disease pressure appear low.

Growers in our region were recently invited to a field day on native bee pollination run by Richmond Landcare Inc. The 5 March event was a chance to hear more about some of the Hort Innovation-funded pollination work.

My thoughts are with those growers who have struggled over the past 12 months, my hope is that 2020 can only get better!




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WESTERN AUSTRALIA

By Brad Rodgers

What a difference a year can make. Fruit set in the early spring/summer of 2019/20 has been very mixed. Orchards closer to the coast seemed to fare better with fruit set than the south-western inland growing areas.

It's also these coastal areas that are hanging a little better after four to six days of 40°C plus temperatures in a row which caused fruit drop in varying amounts across the region.

Inland orchards in some cases have had no fruit set at all, and those that did experienced a lot of fruit drop, will show an obvious impact as we approach the 2020/2021 harvest. Why you might ask? I will leave that to far more learned colleagues to write and hypothesise about!

There will be a knock-on effect with varying results not just here but in Queensland, Victoria and New South Wales, based on the current fire situation; it's going to be a real mixed bag.

Here in Western Australia, there have been some fires, and one of the impacts has been interruptions to road transport, including a 12-day closure of the Eyre Highway in January. This is the main connector to our eastern markets (the only sealed road between us and South Australia) but fortunately our rail infrastructure was spared, and it seems most were able to divert from road to rail during the disruption.

A lot of people in New South Wales and Victoria were going through catastrophic events as I wrote this. We feel fortunate at this stage to be spared so far and extend our sympathies to all the people caught up in that horrific situation.

I would also like to flag two upcoming events in Western Australia: our Avocado Regional Forum in Pemberton on 12 March and this year's AvoSkills workshop. The fact the AvoSkills event is over-subscribed is a good indication of the interest in our industry. Keep an eye out for future events elsewhere in the country.

If you are new to the avocado industry, the AvoSkills workshops are an excellent opportunity to improve your knowledge and skills. This event will be held in Pemberton on 10-11 March, and will cover the "A" to the "O" of growing avocados in Australia. The extension project team (AV17005) have designed a workshop that is practical and hands-on, providing information on the essentials of growing good quality fruit, and tailored toward new growers, re-sellers, farm supervisors and farm managers.

As always, feel free to contact me with any questions or issues, and I'll do my best to assist you.



SOUTH QUEENSLAND

By Daryl Boardman

Happy New Year!

Once again, I report it is still dry and doesn't seem to want to rain. This will have a big impact on fruit size in South Queensland orchards, but time will tell. If we get good rain this may assist in sizing but if we have to keep relying on irrigation, most likely fruit size will be down, which will also reduce yields out of the region.

Some areas have had bad fires prior to Christmas but it hasn't caused any damage to orchards in South Queensland as yet. However, summer has a long way to go and there's still potential for more fires.

Due to the dry, it will be important to update your yield forecasts, to make sure industry has the best knowledge of the

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upcoming crop. This will be particularly important, as I read of the impact of adverse weather in other regions as well.

In South Queensland, our next Avocado Regional Forum will focus on managing avocados in dry times, soil nutrition and related topics. This event will be held at the Blackbutt Hall on 11 February and I encourage everyone to attend. There will also be an Avocado Regional Forum at Bellthorpe in the Sunshine Coast region on 26 February, with similar topics.

Let's hope it rains before then and we all have to wear our gumboots on the day!



CENTRAL QUEENSLAND

By *Eric Carney*

Happy New Year! This is a difficult sentiment to follow considering the challenges facing our region (and country). At the time of writing this

in mid-January, the country is still battling fires, and the Central Queensland district is in severe drought with the lowest recorded rainfall at Bundaberg airport in the history of keeping records and water security from Paradise Dam is sketchy to say the least.

2019 rainfall records at Bundaberg airport show a dismal 320mm for the 2019 calendar year, which is one-third of the median rainfall of 960mm. With such little rainfall, adequate irrigation, monitoring and application is ever more critical. Despite the challenges, crop for the region in general is looking similar in volume to last year. Fruit quality is looking great; this is heavily influenced by the fact we have had less than 80mm since 1 July.

I strongly encourage growers from the area to become educated and involved in the Paradise Dam situation. Bundaberg Fruit and Vegetable Growers (BFVG) has gathered concerned irrigators and formed a sub-committee to urgently review the situation and to ensure that grower concerns and needs are being met. If you are not a member of BFVG, I encourage you to join, be informed and attend grower meetings.

By doing so, the region will be able to demonstrate the massive negative economic impact reducing the capacity of the dam will have. There is precious little time before potential irrevocable actions are taken to reduce the height of the dam wall and growers need to understand these potentially long lasting ramifications. Even as this is written, legislative changes were occurring to allow for the lowering of the dam wall.



NORTH QUEENSLAND

By *Jim Kochi*

At this time of year most of the comments that come to me from growers are about the weather and what the next crop will look like. I know this sounds a bit "cliché", but we are that weird group that always looks

to the sky for two reasons. Firstly, to see what the weather will bring us, and the second reason is to ask "why me". It seems like the weather is always not what we ordered at any particular time.

So how have the last three months been in North Queensland? It started off as a longer, colder winter that caused two frost events in September, which is very unusual and late. As this was in the middle of the later flowering period for both Shepard and Hass the end result was a lower fruit set. Long explanation, so the short result is a lower than expected crop in total.

Added to the frost event, we have had a hot dry spring in all areas and while we have the luxury of Tinaroo Dam and good aquifers for irrigation, that source of water never has the same benefit to the trees as a dollop of good rain. As I write this report in late January, we still have not had a good rain event. This prolonged dry will result in adding to the lower crop forecast through the fruit size downsizing thus causing less trays, more bulks and a dose of sunburn/sun bleach.

The season will begin with Shepards as early as February with a first pick, followed closely by Maluma and then a second pick of Shepard in late February/March, and then the Hass starts.

The positive here is that the dry conditions mean that fruit quality should be good regarding fruit fungal diseases.

My original estimates were to a crop of about 30% of last year but my new estimates are a bit more positive at 50%, or around two million trays. Individual growers and even individual blocks vary widely depending on the flow and duration of the cold air flows.

The North Queensland growers understand the consequences of severe weather events and the damage and stress that causes, so our hearts and compassion goes out to any grower who has suffered distress to your families or damage to orchards, and assets during these past few months.

I hear thunder in the distance, so anything can happen in the near future!



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NEWS

— General News —

Welcome to the new look Talking Avocados!

We've given your favourite avocado magazine a refresh, keeping all the great content but making it easier to find.

At the bottom of each page, we've added a handy reference guide to let you quickly and easily find news (blue) or the ever-popular R&D section (green).

Talking Avocados has been a mainstay of the industry's communication suite since the very first edition was published by the Australian Avocado Growers' Federation, back in March 1990.

It won't be a surprise that the hot topics of 1990 remain important today: managing quality, the latest research, orchard management and improving shelf-life, just as a sample.

This revamped *Talking Avocados* maintains the same goals as that very first edition, to keep industry up to date with research and technology, and the latest news at home and overseas.

The evolution of your industry magazine



Talking Avocados, Edition 1, 1990

Talking Avocados, Winter 2010

Fire preparation and recovery

Simon Newett, Queensland Department of Agriculture and Fisheries

Australia's fire season started hard and early, and it has impacted on rural communities, and farms of all descriptions, including avocado orchards.

In the Best Practice Resource (avocado.org.au/bpr) you can find information and resources on irrigation, mulching and nutrition. To provide some advice on how to prepare for and recover from fires, we turn to our colleagues in California, who have faced their own fire crises in recent years.

We thank Dr Ben Faber, University of California Cooperative Extension Farm Advisor for sharing his work, and allowing us to slightly alter his advice to fit Australian conditions for both recovery from and preparation for fires. We have linked to his original works throughout.

After fires

Growers need to be patient and observant to bring the trees back into production, Dr Faber explained in a November 2019 article (bit.ly/TA304wait).

Although injury to foliage and young growth is visible within a few days of the fire, the full extent of the damage may not be known for several months or possibly the next growing season. In the case of severe injury, die-back may continue to occur for several months after the fire. New growth that occurs after the fire may suddenly collapse the following year if there are more adverse conditions.

The important rule to follow after a fire is to do nothing – don't prune, don't fertilise and maybe don't water. Or rather, water very carefully. Dry winds may have sucked the water out of the ground and may need to be replenished. The fire may have burned the irrigation lines and need to be replaced.

Waiting game

In the meantime, if the tree has been defoliated by the fire, it has lost its ability to transpire water. Watering a tree with no leaves will set up those conditions that are conducive to root rot. Until the tree begins to leaf out, watch soil moisture to decide how much water the trees are pulling out of the soil. The emitters should be capped or plugged on some leafless trees. Then as the tree puts on new growth, shallow, infrequent irrigations should start. This may mean replacing mini-sprinklers with drippers if only a portion of the orchard has been burned and the rest of the trees need their usual amounts and frequency of water.

The avocado has a tremendous ability to come back from fire and frost damage. However, the tree will tell you where it is coming back. It will start pushing growth where the tree is still healthy. It may take 3 to 6 months for this growth to occur.

Pruning

Delay pruning until the tree clearly shows where it is going to regrow. By waiting, you save the expense of having to return sometime later to remove more wood.

An activity the grower can perform is painting exposed limbs with white acrylic paint. The defoliated tree can be further damaged by sunburn after it has lost its protective cover of leaves. The upper surface of horizontal limbs and the north and west sides of exposed trunks are the most affected. The paint can delay the appearance of new growth, but it does not affect total growth. There is usually no value in applying paint to small limbs.

Avocado trees have a great ability to recover after fire damage (see the image with this article taken by Australian growers during the recent industry tour in California). Even trees killed below the bud union will frequently develop into good trees if they are rebudded and given good care. Trees which do not put out vigorous sprouts should be removed. However, you may end up with a very uneven orchard so the stumping or staghorned option described below may be a more practical option. Interplanting avocados would rarely be advisable because of their rapid recovery.

As Dr Faber notes (bit.ly/TA304ready), every fire is different, so experiences vary. It may take several months to be able to observe whether the bark is killed all the way to the cambium or not. Thus, he recommends against pruning until new growth appears to indicate where the wood is alive. According to a 2012 US research paper and article (bit.ly/TA304recov and bit.ly/TA304bender), an alternative method which is rather unique to the avocado industry, the burned trees can all be "stumped" – referred to in Australia as "staghorned" (cut back to the graft) immediately and allowed to re-grow.



Avocado trees written off for dead after the devastating 'Thomas' fire in California showing good recovery 20 months after the fire (in 2019). Image: Simon Newett, QDAF.

“Staghorning” is a normal practice in the industry when avocado trees have reached such heights that fruit is high off the ground and picking becomes difficult. In many of the groves that were burned in California, staghorning was probably needed anyway; therefore after a burn staghorning would be a reasonable alternative for many growers. If the goal is to reduce the size of all trees in the irrigation block to a manageable size, then staghorning the block immediately after the fire is the best solution. Under Californian conditions, trees will be out of production for two years and have about 50% production in the third year, and some re-grafting may have to be done, but fertilising and watering properly is manageable.

In Australia, “stumping” is called “staghorning” and you can read more about the practice in the BPR.

A third option could be to scaffold all trees in an irrigation block to two to three metres in height. This would get rid of a lot of deadwood immediately, and might allow the trees to come back in production faster than the staghorning the trees.

Before fires

In a 2019 article prepared by Dr Faber (bit.ly/TA304ready), based on the 2015 work of Sonia Rios, Henry Herrera and Gary Bender, he outlines some fire readiness options.

These preventive measures suggested for orchards in areas of high fire hazard are often counter to other measures which might reduce erosion or improve root disease control, so a balance should be strived for (Goodall 1965):

- remove all combustible material (including mulch) from around the trunks of the trees for a distance of up to one metre (two to three feet)
- prune off low-lying limbs, those that are low enough to trap leaf mulch below them
- remove from the orchard all broken limbs, deadwood and other combustible debris
- clear brush, trees and other heavy vegetation away from edge of orchard for a distance of at least 15 metres (50 feet). Keep in mind any local regulations regarding fire break widths
- do not pile brush or other combustible material in gullies, or around the edges of orchards
- apply sprinkler water for as long a period in advance of the fire as possible so as to have everything wet. Water during the fire would obviously be desirable but often is lacking because of lack of pressure, power or speed of the movement of the fire
- use steel pipe and risers for above-ground sprinkler systems.

Acknowledgement

Avocados Australia thanks Dr Ben Faber for generously sharing his work in this area. If you want to read this article online, visit avocado.org.au/public-articles/recovering-from-fire/.

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High-tech map shows orchards hit by bushfires

Amid devastating bushfire activity across Australia, scientists have released a map that shows avocado, mango, olive, banana, macadamia and citrus orchards that have been impacted, to help with response and recovery efforts.

Driven by a Hort Innovation investment, in collaboration with various universities, state and federal government agencies, private sector companies and industry, the Australian Bushfires Rapid Response Map outlines the location of targeted treecrop farms across Australia, overlaid with a map of burnt areas, which updates every ten minutes.

Scientist Craig Shephard, from the University of New England's Applied Agricultural Remote Sensing Centre (AARSC), said the new tool aimed to help authorities and industry bodies easily identify any crop damage and loss.

"While broad land cover maps are useful for making general assumptions and policy decisions regarding the impact of national disasters such as bushfire, it is industry specific maps that allow the impact and extent of the damage to be calculated," he said.

"This data can also be useful in instances such as claiming insurance and it can help growers if they are unable to get out to assess damage themselves."

The map reveals that avocado, mango, olive, banana, macadamia and citrus orchards have suffered minimal fire damage this season, with the bulk of farms unscathed.

Avocados Australia chief executive John Tyas said the Australian Bushfires Rapid Response Map had provided an easy, up-to-date and credible tool to help his industry body keep growers informed and respond as needed.

"This mapping has done exactly what it was meant to do: allow for assessment and response to a natural disaster," he said.

"Like everyone, we're hoping for some better conditions in the coming weeks and months and our thoughts are with everyone affected."

The web map works in any browser on any smart device and offers three different base maps (imagery, terrain or streets) and has a search function to find an address or place of interest.

This response map is a snapshot of work being delivered as part of a broader national avocado, mango, olive, macadamia, banana and citrus crop mapping project.

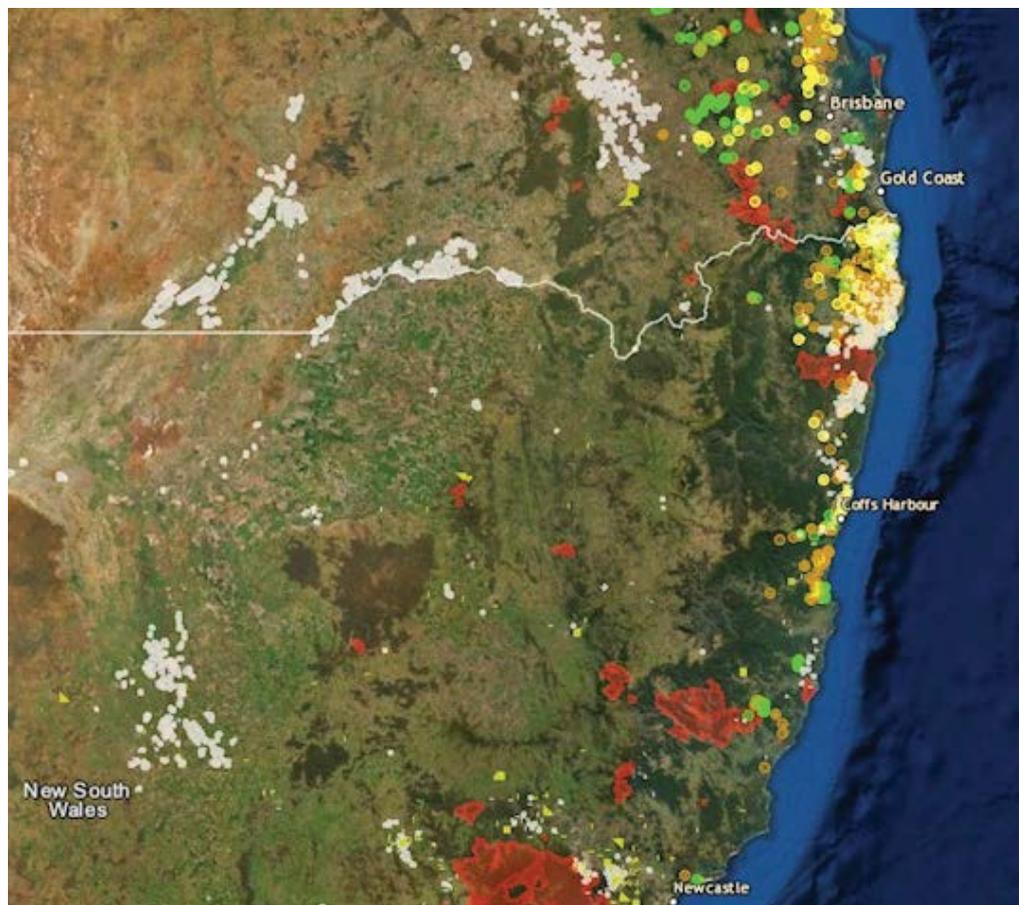
More information

You can see the Australian Bushfires Rapid Response Map online: bit.ly/AUfire2020.

For more details regarding the map, the overview is here: bit.ly/TA304map.

Acknowledgement

This initiative is supported by Hort Innovation, through funds from the Australian Government's Department of Agriculture Rural R&D for Profit program and coordinated by the University of New England, with bushfire extent from the EMSINA Group and Geoscience Australia.



Chile access closer

In a final report released in December, the Australian Government recommended that the importation of fresh avocados from Chile be permitted, provided they meet the biosecurity import conditions. All imports must come from commercial production areas of Chile.

However, the question is, will Australians want to eat avocados that have been shipped half-way around the world when Australia can supply plenty of home-grown avocados?

Avocados Australia CEO John Tyas said the Australian market was well supplied already from domestic production and summer imports from New Zealand.

“In time, we expect that New Zealand supplies will not be required either,” he said.

“With a population of just 25 million, Australia is a minnow compared to Chile’s existing export markets in Europe, the US, and China.”

Mr Tyas said it was important to keep in mind that this was the final report on an import risk analysis.

“The next step for Chile will be to establish workable quarantine protocols and there’s no timeframe on when that process will be completed, but it’s possible access could be achieved as early as 2021,” he said.

The recently completed risk analysis was focused on biosecurity risks, in line with Australia’s international obligations.

The Australian industry has identified three key steps to help mitigate the impact of possible imports from Chile:

- increase efficiencies to reduce costs
- develop strong alliances
- implement an export strategy.

“Avocados Australia has been proactive on behalf of industry with regard to helping direct levy-funded research toward quality improvements, efficiencies from the farm to the retail level, and increasing the Australian industry’s own export activities,” Mr Tyas said.

Australian domestic avocado consumption is the highest in the English-speaking world, at 3.8kg/person per year, and demand is strong. However, with domestic production at 85,546t in 2018/19 and on the way to more than 115,000t by 2025, there is limited space for another player in the market.

More information

You can read the Australian Government Department of Agriculture, Water and the Environment’s report here: bit.ly/TA304chile.

PERU/AUSTRALIA FTA

The free trade agreement between Australia and Peru entered into force on 11 February. However, this does not mean Peru will have access in the near future. The application from Peru for market access to Australia for avocados was only submitted in 2017, and is a multi-year process.

However, according to ComexPeru, the trade agreement represents a chance for the growth of existing markets and the development of new ones.

A release from ComexPeru, notes deputy head of mission of the Australian Embassy in Peru, James Yeoman’s belief that the products with the greatest potential to enter the Australian market are avocados, asparagus, table grapes, blueberries, tangerines, textiles, fish and shellfish, fishmeal, cuttlefish and preparations used for feeding animals.

ComexPeru is a private union that brings together the main companies involved in foreign trade.

“The trade agreement with Australia means new opportunities for Peruvians, who will be able to access a new range of high-quality goods and services, and one of the largest markets in the world to sell their products and services,” says ComexPeru.

“Fishing, agriculture and export textiles are expected to be the sectors most benefited by the agreement.”

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What are we doing about exports?

John Tyas, Avocados Australia

While the Australian industry has enjoyed strong market growth in the domestic market over many years, the development of export markets is paramount for the future sustainability of the industry.

Australia is a small player in the export scene, but this is changing, (Figure 1).

There is a lot of activity underway to support the industry in transitioning to a more export-oriented industry and this article provides an overview of some of the work underway. We need to develop new export markets and grow the ones that we currently have.

Export markets can be described as two types:

1. Protocol markets, which are markets that require specific protocols to manage quarantine risks, and
2. Non-protocol markets (often called open markets), which are markets that don't require quarantine risk management protocols.

Through consultation with key industry stakeholders and insights gained through market research, the industry has an export market development strategy. More recently, Avocados Australia commissioned work to develop a more detailed implementation plan for these two groups of markets.

A summary of our current status and our plans for the next few years is described below.

Protocol markets

Our greatest opportunities for longer term export growth in terms of volume sales are expected to come from markets which happen to be protocol markets.

It can take many years to negotiate workable protocols that are acceptable to both the exporting country and the importing country. These negotiations need to be underpinned by robust science to support the risk management procedures that need to be agreed.

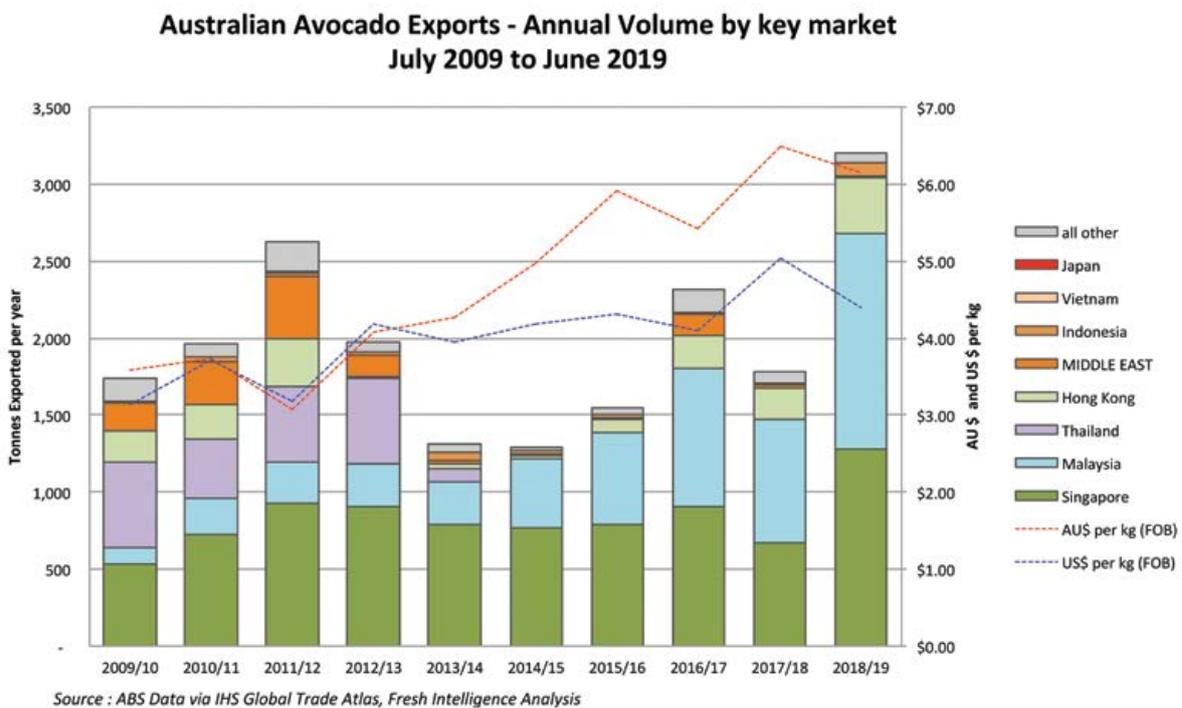


Figure 1. Australian avocado exports reached a record level in 2018/19 passing the previous record set in 2011/12. Singapore and Malaysia were the key markets. Average returns per kilogram are 72% higher in 2018/19 compared to 2009/10 aided by the exchange rate depreciation shown by the \$USD comparison.

The industry's current priorities for protocol markets are China, Japan, India, Thailand, New Zealand and South Korea. The rationale for targeting these markets over other potential markets is outlined in the Australian avocado export strategy 2019-21 (available in the BPR Library).

The greatest pests of quarantine concern in the markets of interest are fruit flies, in particular, Mediterranean fruit fly which only occurs in Western Australia and Queensland fruit fly which occurs in Queensland, New South Wales and Victoria. Our preferred market access protocol to manage the risks associated with these pests is what we call a conditional non-host protocol. What this means is that some varieties of avocados such as Hass, in their hard condition, are deemed to not be a host of fruit fly.

Mediterranean fruit fly is present in many other parts of the world. As a consequence, extensive research has been conducted by other avocado exporting countries to prove the conditional non-host status of Hass avocados. However, Australia is the only country in the world that has Queensland fruit fly. So, any research on this species can only be conducted by our Australian researchers. The avocado levy has been funding research (since 2016) to prove that Hass avocados are not a host of Queensland fruit fly in the hard condition. This research is due to be completed in 2021 and will underpin the Australian Government's market access negotiations in relation to Queensland fruit fly.

Research is also underway to support market access for the Shepard variety. Unfortunately, the fruit fly host status of Shepard is not sufficient to support a conditional non-host protocol. Therefore, researchers are experimenting with short cold disinfestation treatments as a potential protocol for Shepard. This research is expected to be completed this year and the results will determine what options we have for protocol negotiation into selected markets.

China

We are still some years away from the commencement of the market access negotiations for Australian avocados to China. The Australian and Chinese governments only work on one product from each country at a time. The current Australian priority that the Department of Agriculture, Water and the Environment (DAWE) is working on for access to China is apples followed by blueberries.

Avocados Australia is working to ensure avocados are the next Australian priority for negotiation and we need to demonstrate a strong business case for this. Each year we participate in government-influencing activities in Beijing. We need to continue to demonstrate our keen interest in this market so this work will continue. It is expected that the research in relation to Queensland fruit fly will be completed before the China negotiations commence, so that the negotiations will cover all regions of Australia.

Japan

Market access for Australian avocados to Japan was achieved in November 2018 for avocados grown in areas free of Queensland fruit fly. The Western Australian growers, packers and exporters have demonstrated strong support for this new market. For the current season, 27 growers (178 blocks) and five packhouses achieved export accreditation by DAWE to supply the Japanese market. Export data will be available in the next few months to indicate how much fruit was exported this season.

The next step is to grow this market with marketing and promotion activities and avocado marketing levy funds have been allocated for this. Hort Innovation is developing plans for this investment. One initiative is to provide funding for two exporters to attend FOOD EX Japan, a major trade show in March, to promote Australian avocados.

Market growth will be accelerated once we have market access for areas where Queensland fruit fly is present, enabling year-round supply of Australian avocados to Japan. Once the current host-testing research has been completed, Avocados Australia will request DAWE to seek an amendment to the current protocol to include areas where Queensland fruit fly is present. The timing of this will be determined by the Department, who need to consider our request against those of other products in the queue for access negotiations.

India

India is a fairly recently identified opportunity and we have been working to get avocados prioritised with DAWE. We are hopeful that action on our market access request will be initiated by the Department later this year.

A government delegation from India visited Australia recently and they were shown around our avocado industry in Western Australia. Based on my visit to India last year I believe there are great opportunities for Australian avocados in India. You can read more about the potential of the Indian market in my report in the BPR Library (under the Export heading).

Avocados Australia is seeking funding through the recently announced Australian Government grant programs, to undertake work in India that will support our plans to access the Indian market.

Thailand

Thailand was a non-protocol market until 2013 when the Thai government introduced a new cold disinfestation protocol for avocados. Since then, no avocados have been exported to Thailand as the protocol is commercially unworkable.

Avocados Australia has been working with DAWE for the past seven years to have the protocol revised to a conditional non-host protocol. This has included numerous meetings, in Australia and Thailand, including an industry delegation to Bangkok.

A draft protocol has been proposed but has not been agreed as it is still considered unworkable. Negotiations are continuing, but we have no clear timeframes for resolution.

New Zealand

There are a number of growers interested in exporting to New Zealand, during that country's low season. The New Zealand industry, which we all know has been an important supplier to Australia during the peak-demand Summer season, has also been focusing on growing its domestic market. There would appear to be some potential for Australian producers to help support that growth when New Zealand production is at its lowest, around April to July.

A market access protocol is in place for Hass avocado to New Zealand, however, there are some technical challenges with the protocol that we are working with DAWE to overcome.

South Korea

This is a market that has been identified as a priority with strong growth potential. New Zealand has developed a good market in South Korea as well as the USA and Mexico. At present, we don't have any activity underway for access to this market but plan to submit a business case this year.

Vietnam

This is another market that has been identified as a longer-term priority with strong growth potential. A business case will be submitted in the future.

Non-protocol markets

Almost all of our current exports are going to non-protocol markets, the main ones being Singapore, Malaysia and Hong Kong. These will continue to be important markets but are limited by their relatively small populations compared with the likes of India and China.

In these markets, the aim is to grow our market share and consolidate our existing customer base.

Increased marketing levy funds will be invested to support export promotion activities in Singapore, Malaysia and Hong Kong. Hort Innovation is working on these plans which should be rolled out later this year.

We will be focusing on our strengths (geographic proximity and speed to market, increasing capacity to supply, stringent food safety regulations, a highly regarded product and reliable supplier) to make the most of the opportunities available to us.

Key industry actions

Recent industry consultation has identified two key actions for industry in relation to exports. Firstly, work should be undertaken to more clearly define the unique value proposition of Australian avocados in export markets and to undertake more market and consumer research in our existing markets. While we think we know, it is becoming more important for us to have objective data on this.

I have developed a scoping paper for this research and have recommended Hort Innovation to commission R&D levy-funded projects to fill these gaps.

The second issue is the need to try and accelerate our market access into protocol markets. While this is dependent on government priorities, capacity and policies, there are some things that we can do, and Avocados Australia is working behind the scenes on this.

Acknowledgement

Avocados Australia continues to work on expanding the international market options for the Australian industry. Part of this work is the *Avocado export readiness and market access project* (AV17000). This project has been funded by Hort Innovation, using the avocado industry research and development levy and contributions from the Australian Government.



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Global avocado trade up 13%

Joy Tang, Export Coordinator

In 2018, 2.5 million tonnes of avocados worth AU\$8.1 billion equivalent were traded globally, according to UN Comtrade.

In the latest import market report prepared by Wayne Prowse of Fresh Intelligence Consulting at the end of 2019, he reports the global trade volume has increased on average by 13.3% per year over the past five years. The Food & Agriculture Organization of the United Nations reported (via FAOSTAT) global production of avocados as 5.9 million tonnes in 2017.

The United States is the largest single country importer of avocados, importing over one million tonnes in 2018. Europe is also a large importer by region with net imports to 414,000 tonnes.

Japan is the largest importer of avocados in Asia, which are mostly supplied from Mexico while China is recording the highest growth rate for imports of avocados followed by South Korea, driven by aggressive promotion activity from Mission Produce, Camposol and Dole according to the Produce Report.

United States

The United States is the world's largest importer of avocados. In 2018 the United States imported 1.038 million tonnes of avocados worth AU\$3.2 billion, which accounted for 94% of the country's total avocado consumption. The United States produced around 172,000 tonnes of avocados mostly in California.

Imports are sourced mostly from Mexico (86%) and also from Peru and Chile during periods of lower supply from Mexico, even though Mexico does supply avocados to the United States all year round. The import growth trend has been 9% per year over the past five years. Peru is the fastest growing supplier of avocados to the United States with a five-year growth trend of 27% per year. Colombia gained access in 2017 and is likely to be a larger player in coming years.

China

China has not been an importer of avocados until recently. In 2018 China imported 43,859 tonnes of avocados, which is up from under 100 tonnes since 2010. Consumption is negligible across the 1.4 billion population though is gaining awareness in more high-end areas where promotions are focused. FAOSTAT production records show over 112,000 tonnes of local production however other industry sources suggest this is not a reliable figure.

Imports are sourced mostly from Peru (38%) and Mexico (34%) and Chile (27%). New Zealand gained access in 2018. The import growth trend has been 81% per year over the past five years, from a low base. Mexico and Chile have been investing heavily in market development of avocados in China, and Peru is now following suit though as a lower price leader.

China imported 34% of its avocados from the Northern Hemisphere (mostly Mexico) and 66% from the Southern Hemisphere (mostly Peru) though supply patterns have shifted extensively.

According to The Packer, Mission Produce, the Californian founded and now major grower and packer in Mexico and Peru has promoted avocados, marketed under the Mr. Avocado brand, which have found a wide acceptance in China, and a new promotion in a high-tech supermarket is expanding brand awareness. Mr. Avocado is a joint venture between Mission Produce, Pagoda Fruit Stores and distributor Lantao International. The avocados are shipped from a ripening centre in Shanghai, which opened in April 2017.

In other activities Spanish based Camposol has also promoted avocados in China in a joint venture with Dole sourced from their Peruvian operations.

Hong Kong

Hong Kong is the third largest importer of avocados in Asia although heavily influenced by re-exports to China. In 2018 Hong Kong recorded imports of 24,290 tonnes of avocados, which accounted for 324% of their total consumption since Hong Kong re-exported some 70% or 17,000 tonnes to China. The net imports after recorded re exports were 7,142 tonnes.

Imports are sourced mostly from Chile (40%), Mexico (22%) and Peru (24%), however, much of this is re-exported. The import growth trend has been 55% per year over the past five years. The growth of the net imports (imports minus exports) has been 20% per year.

Hong Kong re-exported around 17,148 tonnes mostly to China in 2018 mostly Chilean and Mexican product. It is apparent that most consignments destined for China and unloaded at the Hong Kong port are recorded as a Hong Kong imports even if being immediately trans-shipped to Shenzhen market and beyond.

Hong Kong has a strong food service demand for avocados in addition to the growing retail trade.

South Korea

South Korea is a rapidly growing importer of avocados in Asia. In 2018 South Korea imported 11,560 tonnes of avocados, up 93% in a year, which accounted for all of the country's total consumption since there is no measured local production. Per capita consumption is low at 0.22kg per person per year.

Imports are sourced mostly from United States (70%) and Mexico (21%) and also New Zealand. The import growth trend has been almost 70% per year over the past five years. The United States is benefiting from the Free Trade Agreement (KORUS), which eliminated the 30% tariff in 2013.

South Korea imported 90% of its avocados from the Northern Hemisphere (mostly United States and Mexico) and 10% from the Southern Hemisphere (New Zealand). Peru gained access in October 2019 expects to start shipping in 2020 and Chile is also pursuing market access to South Korea.

According to New Zealand sources, promotion efforts by the New Zealand avocado sector, helped by tariff changes under the Free Trade Agreement (FTA), are paying off with a season of record returns in Korea however ensuring consistent supply remains a problem.

Singapore

Singapore is a regular importer of avocados where Australia is a significant supplier. In 2018 Singapore imported 5,070 tonnes of avocados, which accounted for 105% of the country's total consumption since Singapore re-exported some avocados to other Asian destinations and has no local production.

Avocados are sourced mostly from Mexico (34%) and Australia (23%) and also many other suppliers. The import growth trend has been 16% per year over the past five years. Mexico is the fastest growing supplier of avocados to

Singapore, growing 135% per year, which is driving growth and supplied 50% more than Australia's volume in 2018.

Singapore is Australia's second largest export market, after Malaysia, but there is a risk of trade being lost to Mexico, which is already placing high price pressure on Australian suppliers.

Singapore is Australia's second largest export market after Malaysia and is at risk of trade being lost to Mexico, which is already placing high price pressure on Australian suppliers.

Malaysia

Malaysia is Australia's largest export destination for avocados in Asia. In 2018 Malaysia imported 3,156 tonnes of avocados, which accounted for 100% of the country's total consumption although per capita consumption remains very small at 0.10 kg per person per year.

Imports are sourced mostly from Australia (42%) and Kenya (19%) and also many other suppliers. The import growth trend has been 35% per year over the past five years. Australia is the leading supplier though Kenya was rapidly increasing though eased slightly in 2018. Mexico has also entered the market and is likely to rise quickly if the pattern in neighbouring Singapore is to be followed.

Malaysia imported 52% of its avocados from the Northern Hemisphere (mostly United States, Kenya and Philippines) and 48% from the Southern Hemisphere (Australia).

Kuwait

Kuwait is a smaller importer of avocados in the Middle East, which has increased avocado imports at 17% per year over 5 years. In 2018 Kuwait imported 2,802 tonnes of avocados, which accounted for 100% of the country's total consumption. Kuwait has a very high GDP with strong capacity to purchase premium produce.

	2014	2015	2016	2017	2018	1 yr chg	5 yr trend	2018 share
	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes			
United States	729,142	867,364	859,606	900,198	1,038,111	15.3%	9.2%	41.5%
France	119,804	116,627	134,988	146,034	157,370	7.8%	7.1%	6.3%
United Kingdom	53,128	77,391	99,882	107,598	117,663	9.4%	22.0%	4.7%
Canada	61,087	-	77,872	79,871	94,208	18.0%	11.4%	3.8%
Germany	37,715	48,435	58,453	72,710	93,124	28.1%	25.4%	3.7%
Japan	57,600	57,588	73,915	60,635	74,096	22.2%	6.5%	3.0%
China	4,066	15,989	25,128	32,137	43,859	36.5%	81.2%	1.8%
Hong Kong	4,242	7,800	16,749	21,018	24,290	15.6%	54.7%	1.0%
Saudi Arabia	10,312	16,697	17,527	20,451	19,217	-6.0%	16.8%	0.8%
Korea, Republic of	1,097	1,515	2,915	5,979	11,560	93.3%	80.2%	0.5%
Singapore	2,815	2,991	4,210	4,159	5,070	21.9%	15.8%	0.2%
Malaysia	956	1,075	2,076	2,327	3,156	35.6%	34.8%	0.1%
Kuwait	1,601	1,791	2,084	2,341	2,680	14.5%	13.7%	0.1%
Qatar	193	258	277	526	804	52.9%	42.9%	0.0%
Thailand	434	532	601	599	763	27.4%	15.1%	0.0%
Other	451,894	477,221	580,411	638,312	826,749	29.5%	16.3%	33%
Global Exports	1,530,087	1,686,627	1,947,446	2,084,943	2,500,247	19.9%	13.1%	100%

Source: ITC Trademap; Fresh Intelligence analysis

Table 1. Major import markets of avocados 2014-2018

Imports are sourced from many suppliers including United States, Mexico and Kenya. Mexico is a fast growing supplier of avocados to Kuwait while United States is losing market share. Australia appears as an opportunistic supplier with 1.5% market share in 2017 and just two tonnes recorded in 2018. Kuwait imported 98% of its avocados from the Northern Hemisphere (mostly United States, and Mexico) and 2% from the Southern Hemisphere (South Africa).

India

Despite the size of the Indian population the imports of avocados by India is in its infancy and the country does not have any recorded avocado production (although it does produce avocados). New Zealand and Peru appear to be pioneering avocado trade into India. New Zealand gained access in 2013, Spain in 2015 and Peru in 2016. Trade has lifted to 256 tonnes in just over five years although this remains negligible in a market of the size of India.

The tariff on avocados by India is 30% for all suppliers.

India imported 36% of its avocados from the Northern Hemisphere (mostly Spain) and 64% from the Southern Hemisphere (Peru and New Zealand).

Qatar

Qatar is another small and fast growing importer of avocados in the Middle East. In 2018 Qatar imported 804 tonnes of avocados, which accounted for 100% of the country's total consumption.

Imports are sourced mostly from Kenya (43%) and Europe/Spain (41%) and also many other suppliers. The import growth trend has been almost 41% per year over the past five years. Europe is the fastest growing suppliers of avocados to Qatar. Records show that Australia has been supplying less than 1 tonne per month in 2019.

More information

You can read the full report (which includes a range of other import markets) via the BPR Library: avocado.org.au/bpr.

Acknowledgement

The *Avocado export readiness and market access project* (AV17000) and the *Avocado industry market data capture and analysis project* (AV16006), have been funded by Hort Innovation, using the avocado industry research and development levy and contributions from the Australian Government.

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Global producers and exporters

Joy Tang, Export Coordinator

The latest global market data analysis report provides some interesting insights into the global producers and market suppliers of avocado.

Prepared by Wayne Prowse of Fresh Intelligence Consulting, the report provides information on some of the largest avocado producing nations, as at November 2019.

In 2017, the Food & Agriculture Organisation (FAOSTAT) recorded 5.9 million tonnes of avocados produced globally with Mexico producing more than two million tonnes or 34% of the global production.

The Dominican Republic was the second largest producer (more than 637,000 tonnes) followed by Peru (more than 466,000 tonnes) and Indonesia (more than 363,000 tonnes).

Columbia, Brazil, Kenya, Venezuela, Chile and United States are also on the top 10 largest producer list. More than 40% of world avocado production is traded on the global market.

This is very different from the current situation in Australia, where just 3.73% of our production (3,195 tonnes) was exported in 2018/19.

Mexico

Being the world's largest producer, Mexico is also the largest exporter of avocados. Approximately 50% of its production is exported, mostly to the United States and accounts for 44% of the global exports. The average FOB (free on board) value of export was AU\$2.93 per kilogram in 2018.

Mexico exports avocados all year round although the main export season is from October to May. During 2017 there were periods of extraordinarily high price points during the low season influenced by very strong demand during a seasonal supply imbalance between Mexico, California and Peru. Trade in 2018 was more balanced though with higher price points in August/September low season.

	2013	2014	2015	2016	2017	5 year trend	2017 share	EXPORT Rank
	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	% CAGR	%	
Mexico	1,467,837	1,520,695	1,644,226	1,889,354	2,029,886	8%	34.3%	1
Dominican Republic	387,546	513,961	526,438	601,349	637,688	13%	10.8%	10
Peru	288,387	349,317	367,110	455,394	466,758	13%	7.9%	2
Indonesia	289,901	307,326	382,530	304,938	363,157	6%	6.1%	54
Colombia	294,997	288,739	309,852	294,389	314,275	2%	5.3%	11
Brazil	157,482	156,699	180,652	196,422	213,041	8%	3.6%	18
Kenya	177,799	218,692	136,420	176,045	194,279	2%	3.3%	7
Venezuela	112,670	121,576	128,601	130,290	133,922	4%	2.3%	51
Chile	165,000	160,000	148,459	140,558	133,636	-5%	2.3%	4
United States	166,106	179,124	207,750	124,860	132,730	-5%	2.2%	8
Guatemala	103,698	108,214	115,099	122,184	125,596	5%	2.1%	26
China	112,000	116,000	118,203	122,875	124,110	3%	2.1%	98
Israel	80,000	91,035	93,000	101,500	110,000	8%	1.9%	9
Haiti	88,253	97,078	98,808	93,017	97,520	3%	1.6%	93
Malawi	91,290	92,400	95,337	86,769	97,358	2%	1.6%	
Spain	69,400	77,401	86,636	91,509	92,936	8%	1.6%	5
Cameroon	73,700	66,964	68,864	70,140	71,235	-1%	1.2%	72
Congo DR	65,303	65,490	65,512	65,535	65,558	0%	1.1%	119
South Africa	83,718	107,176	86,189	89,440	62,840	-7%	1.1%	6
Ethiopia	18,206	53,698	59,331	64,982	57,120	33%	1.0%	66
Australia	52,982	43,969	49,397	67,600	56,501	2%	1.0%	28
Morocco	28,080	31,896	42,732	42,256	41,695	10%	0.7%	14
Côte d'Ivoire	33,945	34,303	35,391	36,349	37,307	2%	0.6%	31
Sri Lanka	11,370	15,620	18,000	19,000	30,606	28%	0.5%	58
Madagascar	25,900	26,065	26,319	26,395	26,560	1%	0.4%	
New Zealand	24,600	23,269	24,326	24,853	23,716	-1%	0.4%	15
all other	162,767	170,755	178,217	176,644	184,368	3%	3.1%	
Total	4,632,937	5,037,462	5,293,399	5,614,647	5,924,398	6%	100%	

Source : FAOSTAT; Fresh Intelligence analysis

Peru

Peru, the second largest exporter of avocados exported more than 359,000 tonnes, with an average FOB unit value of AU\$2.69/kg. Europe was the main destination accounting for 64% of all exports by volume followed by the United States with 23% share. Peru exports avocados from March to August. Peru gained access to Japan in 2014 and is complementing the Mexican supply to Japan from May to August, albeit at low volumes relative to Mexico. Peru has been supplying China since 2016.

Chile

In 2018, Chile is the third world largest exporter of avocados. Chile exported 132,525 tonnes of avocados with an average export FOB unit value of AU\$3.26/kg. This was 25% lower than in 2017. Europe remained the main destination accounting for 52% of all exports by volume followed by United States. Exports to China dropped 27% after strong growth reflecting strong competition from Mexico and Peru. Chile exports avocados mostly from September to February.

Spain

Spain is the largest avocado producer in Europe and exports mostly to other European countries. In 2017, Spain produced 93,000 tonnes of avocados according to FAOSTAT. In 2018, Spain exported 108,033 tonnes of avocados, including re exports, with an average export FOB unit value of AU\$4.30/kg. Almost all exports are to other European destinations or Morocco. Spain exports avocados all year round although the main export season is from November to April. The recorded exports were higher than production since Spain also imported 129,326 tonnes of avocados from outside of Europe, mostly Peru and Mexico and re-exported a significant volume, particularly between April and October. Spain has become known as an avocado hub in Europe and maintains a year-round supply to customers by importing to supplement local production.

Kenya

Kenya is now the largest producer and exporter of avocados in Africa and is building trade mostly to Europe and Middle East. In 2017 Kenya produced some 194,000 tonnes of avocados according to FAOSTAT. In 2018 Kenya exported 71,877 tonnes of avocados with a notably low average export FOB unit value of AU\$2.20/kg. Europe was the main destination region accounting for 69% of all exports by volume followed by Middle East/North African markets 29% and 2% to South East Asian markets. Kenya exports avocados mostly from February to September. Export growth of avocados from Kenya has been around 26% per year over the past five years.

United States

The United States is a net importer of avocados. In 2017 the United States produced some 132,730 tonnes of avocados according to FAOSTAT, mostly in California and imported more than one million tonnes mostly from Mexico and other Central American suppliers. Production has been increasing again after a period of decline in the past decade, influenced by the Californian drought (2013-2017).

In 2018 the United States recorded exports of 68,477 tonnes of avocados with an average export FOB unit value of AU\$3.51/kg. Canada was the main destination accounting for 77% of all exports by volume followed by South Korea. Exports to South Korea have increased 83% per year over five years following the introduction of the KORUS (Korea United States Free Trade Agreement). The avocado exports to Canada are not recorded by Canadian Customs as imports from United States, suggesting that these are re-exports of Mexican avocados to Canada via United States.

South Africa

South Africa was the largest exporter of avocados in Africa until exceeded by Kenya. In 2017 South Africa produced some 62,842 tonnes of avocados according to FAOSTAT, though industry sources estimated 2018 production was 110,000 tonnes in 2017 and 125,000 tonnes in 2018 following a breaking of the drought and new plantings coming into production. In 2018 South Africa exported 89,343 tonnes of avocados, lifting 105% year on year with an average export FOB unit value of AU\$1.75/kg. Europe was the main destination, accounting for 95% of all exports by volume. South Africa exports avocados from March to October and competes in Europe with avocados from Kenya and Peru during the same time frame.

Colombia

Colombia is the second largest producer of avocados in South America. In 2017 Colombia produced approximately 314,275 tonnes of avocados according to FAOSTAT. In 2018 Colombia exported 30,009 tonnes of avocados with an average recorded export FOB unit value of AU\$2.80/kg. Almost 97% of exports were destined to Europe and the balance to more than 20 other countries in small volumes. Colombia exports avocados all year round although the main export season is from October to March. Colombia is set to expand exports further since exports currently represent less than 10 % of the domestic production in Colombia.

New Zealand

New Zealand is not a large producer of avocados, but it is the supplier of Australia's only imported avocados. In 2017 New Zealand produced 23,716 tonnes of avocados according to FAOSTAT, however this was an "off" year and 2018/19 production was expected to be up to 40,000 tonnes.

In 2018 New Zealand exported 16,569 tonnes of avocados with an average export FOB unit value of AU\$5.77/kg. Australia was the main destination accounting for 80% of all exports by volume followed by South Korea and Thailand. As this measure covered part of two seasons a more indicative result is the 2018/19 exports that reached 19,897 tonnes or 36% more than 2017/18 exports of 14,533 tonnes. New Zealand exports avocados from September to February. New Zealand has significant biennial bearing and the 2018/19 season was an "on" season.

More information

You can read the full report via the BPR Library: avocado.org.au/bpr.

Acknowledgement

The *Avocado export readiness and market access project* (AV17000) and the *Avocado industry market data capture and analysis project* (AV16006), have been funded by Hort Innovation, using the avocado industry research and development levy and contributions from the Australian Government.

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New venue & dates for Asia Fruit

Asia Fruit Logistica has a new home for 2020: Singapore.

Organisers of the annual fresh produce trade show announced new dates and a new country for the annual Asiafruit Congress and Asia Fruit Logistica at the end of 2019, moving from Hong Kong to Singapore.

Asia Fruit Logistica will take place on 16-18 September at Singapore Expo, an exhibition centre near Singapore's Changi Airport, with Asiafruit Congress held on 15 September at the convention wing Max Atria.

Each year, the Australian Avocados brand is featured in the Hort Innovation Taste Australia pavilion as part of the Asia Fruit Logistica, showcasing Australian avocados to potential export markets.

Organiser Global Produce Events (GPE) has chosen Singapore as the location for the next edition of Asia Fruit Logistica because of the city-state's position as a key business and trading hub in Asia.

"On the background of ongoing instability in Hong Kong, we need to take care of the interests and concerns of exhibitors and trade visitors, who naturally expect clarity and predictability to make plans for 2020," Asia Fruit Logistica commercial director Will Wollbold said.

"Singapore is very well situated in South East Asia and creates further excellent business opportunities for our customers in the region," he said.

"With the 16-18 September 2020 slot, we have secured dates... that are very close to our traditional dates and which we believe will be more convenient for our many exhibitors and visitors from across Asia and the rest of the world."

Following the Singapore edition in 2020, GPE will review market conditions and evaluate the response to the Asia Fruit Logistica, before making their decision on the location for future editions.

Acknowledgement

The *Avocado export readiness and market access* project (AV17000) has been funded by Hort Innovation, using the avocado industry research and development levy and contributions from the Australian Government.



The interest in Australian avocados was evident to The Avolution's Antony Allen, who received support from AV17000 to attend the 2019 Asia Fruit Logistica and Asiafruit Congress in Hong Kong.

"One of the highlights from the Asiafruit Congress sessions was the presentations regarding online shopping and the growth rate being experienced in South East Asia for these activities," Mr Allen said.

"Certainly, for fresh produce the online sector is a massive change to traditional purchasing experience."

Mr Allen said presenters discussed the need for freshness and ensuring integrity within the supply chain to engage consumers with trust in the click and receive concept.

"The selection of product is critical to the success of the online business. Traditional online picking of items at a distribution centre can't be undertaken when fresh produce is involved – staff training is a key element in maintaining customer base."

Mr Allen said Australia's ability to link into these supply chains was largely based on critical mass and efficiency in getting the product right when the consumer wants it.

"Partnerships within country will be the only way for Australian suppliers to access this rapidly growing market trend," he said.

"At this stage, it is difficult to identify a market leader in this space as growth rates are incredibly inflated – coming off very low bases of zero adoption. Industry should maintain a close watch on market leaders and look to access in country supply links for these businesses."

Mr Allen said ripening and storage were two structural elements that posed a challenge for the avocado industry.

"Providing the consumer with a satisfying experience on a ready to eat avocado would take dedicated resources and time. Education at the ripening level would be essential."



The Avolution's Andrew McKillop, Dan Cork and Antony Allen at the 2019 event in Hong Kong.

What a difference a decade makes

Daniel Martins, Data Analyst

The Australian avocado industry has experienced significant growth in the past decade. In 2008/09, national production was 46,446 tonnes, and 33,179 tonnes of that was grown in Queensland.

By 2018/19, production reached 85,546 tonnes and we're expecting to be producing more than 115,000 tonnes by 2025.

Production has increased in nearly every growing region in the past 10 years. Queensland has grown from 33,179t in 2008/09 to 47,167t in the last financial year but the biggest increase has been seen in Western Australia, from 7,443t to 25,123t in the same period. And New South Wales production has increased from 5,456t to 12,202t.

The production in Victoria/Tasmania and South Australia has varied across the decade, however. Victoria/Tasmania started at 120t in 2008/09 before climbing to 1,947t in 2017/18, dropping to 225t in 2018/19.

In South Australia, the state's production was 248t in 2008/09, peaking at 1,931t in 2011/12 and then varying between 719-1429t per year since.

Farmgate value

Alongside production, the farmgate value of Australian avocados has also increased. The industry has grown from \$152 million in 2008/09, to \$444 million in the last financial year.

The farmgate value of the Queensland avocado industry in 2008/09 was \$109 million; fast forward a decade, and that has more than doubled to \$245 million.

There has been similar growth across all regions. Notably, Western Australia has grown from \$24 million to \$130 million, New South Wales from \$18 million to \$63 million, South Australia is now worth \$4 million at the farmgate and Victoria/Tasmania \$1 million.

Consumption also increasing

The industry has continuously backed itself when it comes to R&D and marketing of our fresh, Australian avocados. The industry's R&D levy is currently 2.9 cents/kilogram and our marketing levy is 4.5 cents/kilogram. The commitment to marketing has helped to increase domestic consumption from just a bit more than one kilogram per person per year back in 1997/98 to 3.8kg/person/year today.

That's a significant increase and is the highest consumption rate for an English-speaking country. Given some nations have rates as high as 5kg/person and even 6.5kg/person, we've definitely got room to grow.

The importance of data

The industry has done an excellent job of marketing avocados, growing domestic demand alongside production.

The industry has successfully been using marketing and promotion to capitalise on the great strengths of the avocado, building year-round supply, improving the reliability of quality and providing excellent data to assist with industry level and business level planning.

We are currently in the process of rebuilding our data collection systems, to make it easier for industry members to contribute, and enhance the accuracy and reliability of the data that underpins so many industry decisions.

Acknowledgement

The *Avocado industry market data capture and analysis* project (AVI6006), has been funded by Hort Innovation, using the avocado industry research and development levy and contributions from the Australian Government.

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Targeting industry growth through extension

Liz Singh, Industry Development Manager

The Avocado Regional Forums have delivered another two events in the Tamborine Northern Rivers and Central Queensland regions. The Regional Forums targeted important growing topics to assist growers improve management practices and fruit quality.

The Avocado Regional Forums are delivered as part of the Avocado industry development and extension (AV17005) project led by the Department of Agriculture and Fisheries (DAF) Queensland and co-delivered with Avocados Australia with collaboration from the Western Australian Department of Primary Industries and Regional Development (DPIRD). Simon Newett (DAF) and Bridie Carr (DAF) outlined the project objectives including the new AvoSkills workshops examining management strategies in detail for growing avocados, from canopy management to soil health.

Avocados Australia CEO John Tyas addressed both Avocado Regional Forums updating participants on the current position of the industry, the forecasted future and the activities that would be conducted on the industry's behalf to promote avocado consumption domestically and internationally.

Noel Ainsworth and Andy Mead from DAF described a new Avocado project (AV18000) examining the opportunities for improvements in the supply chain of avocados from the farm gate through to retailer DC.

Sixty-seven (67) grower and industry members participated in the Tamborine Northern Rivers event that was moved from Nimbin to Casuarina due to the bushfire emergency facing the region.

Dr Ken Pegg (DAF), an icon of the Australian Avocado industry presented his views on managing Phytophthora Root Rot during climate extremes. Dr Pegg described the impacts that a changing climate is having on growing avocados especially in relation to tree vitality, resilience and the ever-present challenge of Phytophthora. The management practices required to maintain and promote a healthy root system through adverse climatic conditions are multifaceted as described in the Pegg Wheel and are key to effective management of Phytophthora in all avocado orchards.

Simon Newett (DAF) talked about the trends and developments in nutrition, with nitrogen, calcium and boron requiring careful management for optimal production and fruit quality. Simon also delivered information on the

management of irrigation during dry times as avocado growing regions are declared drought affected.

The forum concluded with a field tour of Tropical Fruit World's avocado orchard. We would like to thank Tropical Fruit World for hosting the field walk at such late notice.

In Central Queensland, 101 grower and industry members had the chance to learn about irrigating avocados and new technology that could assist in making irrigation management decisions.

Shane Singh (AgriHort Solutions) spoke about managing water resources in the orchard including the tree water relations and the impact low water availability has on tree processes, yield, quality and profit. Shane presented information on the importance of managing water in relation to phenology and looking at fruit development on a cellular level to optimise water use efficiency and target fruit quality. Several examples of irrigation considerations were presented, and Shane demonstrated the use of app technology to forecast orchard water requirements.

Jamie Zapp (Netafim) illustrated the need for the 4 R's of irrigation – right amount, right place, right time and right rate. Jamie spoke about the cycle of water use in plants and the movement of water in soils. The use of technology to monitor plant water use in the form of sap flow, tensiometers and weather stations targeted knowing where your water is and ensuring it is not wasted.

Kathleen Murray representing Verterra explained that a 2.5 year project (RP209H – 'Delivering Tailored Solutions') aimed to help growers lose less fertilisers, pesticides and soil from the farm with the ultimate goal of improving the quality of runoff water reaching the Great Barrier Reef. The project is open to avocado growers in the Burnett, Mary and Burrum River catchments and for a \$300 investment, Verterra conducts an EM soil survey, takes soil cores to 1.2m, a full nutrient analysis and aerial imagery to provide growers with a targeted plan to improve on-farm efficiencies for production, quality and the environment. If you are interested in participating in this project, contact Kathleen on 0491 226 403.

One of the most important aims of the Avocado Regional Forums is to learn from other growers. Bruce Reynolds (Goodlife Orchards), Simon Grabbe (Simpson Farms) and Ivan Philpott shared their experiences with irrigation and

avocado production. Bruce spoke of the importance of soil moisture during flowering and the need to be able to read soil moisture probe data correctly. Simon agreed and was a strong advocate for getting out in the orchard to dig holes and make sure soil moisture probes are giving you the right data. Ivan hosted the field walk and told forum participants that he thought it was critical to see the orchard every day to fine tune irrigation and water use efficiency. All three spoke of the importance of irrigation in the production of good quality fruit.

What's coming up

Avocado Regional Forums will be held in the Sunshine Coast in February, followed by an event in Western Australia in March (please check the venue, as we have moved to Manjimup, due to demand!), Central New South Wales in April and Tristate in May. Check the fortnightly *Guacamole* newsletter and the events calendar at avocado.org.au for future dates. There will be a wrap up of South Queensland Sunshine Coast events in the next edition.

More information

If you would like more information on the project, contact Avocados Australia Industry Development Manager Liz Singh, 0499 854 111 or ldm@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.



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Declan McCauley (WA DPIRD), Noel Ainsworth (QDAF), Daniel Martins (Avocados Australia) and Andy Mead (QDAF) in the orchard during the Chiders Avocado Regional Forum in November 2019.



Kathleen Murray (left) in the orchard with fellow attendees at the Avocado Regional Forum in November.



In the orchard at Ivan and Robyn Philpot's during the Central Queensland Avocado Regional Forum.



Jason Crosby and Loh Ai Tee from Crescent Plateau Orchard at the Casuarina event on 13 November 2019.



Neighbours Ma'ayan Adar, Green Pigeon NSW, and Ashley Rorich, Green Pigeon Orchard at the Tamboorine/Northern Rivers Avocado Regional Forum on 13 November 2019.



Avocados Australia director Tom Silver and Bryce Latter, Alstonville, at their local Avocado Regional Forum on 13 November 2019.



Denise Whitney and Vicki Kuhnell from Mountain Top Magic Orchard, Nimbin, with Colin Rucker, Eco Growth. The Kuhnells were originally going to host the day's orchard walk, but a worsening fire situation caused the event to be relocated from Nimbin to Casuarina.



Louise Foyster, Pretty Gully Avocados, and Alison Tolson, Avorama, at the 13 November Avocado Regional Forum in Casuarina, NSW.

CQ tissue culture field day

A stakeholder information day on the latest research into avocado rootstock tissue culture will be held in Central Queensland on 25 March.

The Mitter team with the Queensland Alliance for Agriculture and Food Innovation at the University of Queensland, in partnership with the University of Southern Queensland and Central Queensland University, are inviting growers to a day that will include presentations and discussions on:

- progress with avocado rootstock tissue culture, including access to culture jars containing tissue cultured avocado so participants get a first-hand experience
- plant/tree performance results from commercially managed field trials
- the perceptions of tissue culture from industry, and

- economic and market feasibility of these rootstocks entering the market.

Morning tea and lunch will be provided. Additionally, there will be a tour of the first established field trial, hosted by Donovan Family Investments.

The day starts at 8.30am at the Isis Club in Childers. While the event is free, please RSVP to catering purposes:

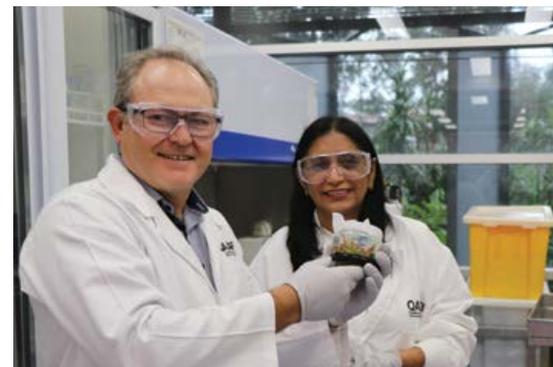
RSVP

This is a free event but please RSVP for catering purposes via bit.ly/2020CQ.

Acknowledgement

This research has been supported by the Advance Queensland through Industry Partnerships funding scheme at the Queensland Alliance for Agriculture and Food Innovation in collaboration

with the University of Southern Queensland, Central Queensland University, Anderson Horticulture Pty Ltd, Millwood Holdings T/A, Delroy Orchards Pty Ltd, Primary Growth Pty Ltd T/A, Jasper Farms, Donovan Family Investments, L&R Collins Pty Ltd and Mac Farms Pty Ltd.



Avocados Australia CEO John Tyas in the lab with Professor Neena Mitter discussing the tissue culture research.

An advertisement for Sidewinder Tree Injectors. The background is bright yellow. At the top, there is a white graphic of a tree trunk with a wavy line representing a path or injection point. Below this, the text "SIDEWINDER TREE INJECTORS" is written in large, bold, black letters. To the left of the main text, the phrase "Under New Management" is written in pink. Below the main text, there is a photograph of a red and black cordless tree injector tool. To the left of the tool, the contact information is listed in black text: "1/13 Josephine St Loganholme Q 4129", "0424 577 033", "sales@treeinjectors.com", and "www.treeinjectors.com". The website URL is also repeated in green text at the bottom of the ad.

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Hort Connections 2020: Brisbane

Delegate registrations are now open for Hort Connections 2020, with the early bird available until 19 March.

Widely regarded as the largest Australian horticulture event of the year, next year's event will take place at the Brisbane Convention Centre from 15-17 June, 2020.

The event will be run under the theme of “sustaining the future of fresh”, bringing together thousands of attendees from the local and international horticulture supply chain to discuss on-farm and supply chain practices, review consumer behaviour and consumption trends, and focus on the future of sustainable fresh food production.

Avocados Australia CEO John Tyas said the organisation was an industry partner for the 2020 event.

“This year, Avocados Australia will host a special session for our avocado supply chain on the afternoon of Monday, 15 June. More details to come!”

Hort Connections is a joint initiative between Ausveg and the Produce Marketing Association Australia-New Zealand (PMA A-NZ).

Organisers are expecting more than 3,500 delegates at the 2020 conference, which is supported by the Queensland Department of Agriculture and Fisheries, as a state sponsor of the event.

Hort Connections 2020 will incorporate networking opportunities, a trade show showcasing leading local and global businesses, and world-class speakers.

As part of the registration launch, Ausveg and PMA A-NZ announced businesswoman and best-selling author, Janine Allis, as the first confirmed speaker.

Ms Allis is the founder of Boost Juice, executive director of Retail Zoo and has appeared on Channel Ten's Shark Tank and Australian Survivor 2019.



Ausveg national marketing manager Nathan McIntyre said the organisations were proud to have Hort Connections become such a large conference.

“It is fantastic to see such strong support for the event from the Queensland Department of Agriculture and Fisheries now that the event returns to the Sunshine State, given that the horticulture industry is such a significant contributor to the state's economy,” Mr McIntyre said.

“This year's Hort Connections conference in Brisbane is being designed to deliver as much value as possible for growers and everyone else in the horticulture supply chain, from presenting world-leading research to offering a huge range of business opportunities on the trade show floor.

“We've already seen around a third of the trade show floor snapped up by exhibitors and we're more than seven months out from the event, so we're excited to offer what's turning into a massive business and networking space.

“Anyone thinking about attending Hort Connections 2020 should take advantage of the early bird rates on offer and register for what's shaping up to be an industry-leading event.”

The 2019 event attracted about 3,500 delegates from domestic and international horticulture, with visitors from more than 30 countries.

More information

<https://hortconnections.com.au/registration/>

New WA pollination project

Courtesy of FreshPlaza

A project underway in Western Australia is hoping to increase the fruit set and size of avocados, by better managing pollination techniques.

The South West Catchments Council (SWCC) is undertaking a three-year project with farmers to improve crop pollination; Transforming Pollinator Management Using eDNA to improve Productivity in Avocado Orchards in the SW of Western Australia. SWCC's Sustainable Agriculture & Climate Change Planning Program Manager Dr Mike Christensen says the initial findings indicate several potential benefits for growers.

“Early surveys show that natural pollinators are already visiting the trees, and we should be able to increase productivity or fruit set of avocados by up to 30-40% - which is quite massive,” Dr Christensen said.

“That’s a large increase in production, so I think farmers will be happy to see that. Another fascinating aspect of pollination is that it not only increases the amount of fruit, but also increases the size and quality. As it has set better, there is also less chance of fruit drop. While it’s not clearly understood, it appears that having multiple insects moving across a plant results in better cross-pollination, improving the quality.”

The idea for the project came from similar research being undertaken at Curtin University, who have successfully been working with Environmental DNA (eDNA) to identify insects, birds and other animals in mine site rehabilitation areas. Tests are undertaken by collecting dust from the air or plant, and analysing that for DNA.

Dr Christensen and his team then developed the project aimed at fruit crops, particularly avocados. The study will sample the DNA in avocado orchards during the flowering seasons over two years and seeing what insects visit the flowers. DNA from up to 40-50 species can be recovered from one flower.

“We know that insects visit avocado flowers, but not a lot is known about what insects do visit them and when,” Dr Christensen said.

“Once we know that, then the question is how do we increase the number of pollinators that visit them through various management techniques.

“So, we will sample the flowers and parallel to that the insects flying through the orchard, and matching the DNA, we can identify the insects.”

Dr Christensen said insects needed to be around for a longer period for effective avocado flowering, because of the A and B type varieties.

“So not all pollinators are as effective as others, this is why we need to understand what is visiting and when,” he said.

The avocado-specific project will be run alongside a National Landcare Program project that aims to develop guidelines for farmers to best manage their pollinators; what plants they can plant to attract insects by providing more food, shelter etc. It will focus on a range of pollinated crops including stone fruit, apples and canola.

“It will look at other ways they can manage their pollinators better to improve pollination services,” Dr Christensen said.

“Things like Integrated Pest Management (IPM) systems and the way in which you use pesticides and other sprays also play a role. The two projects in parallel will hopefully come up with some good clear guidelines for avocado growers and other primary producers. Having a good set of pollinators working those trees and crops really does improve production and the quality of the crops.”

Acknowledgement

The project is a collaboration between SWCC, Curtin University, Western Australia’s Department of Primary Industries and Regional Development (DPIRD) and involves input from a local Avocados Australia director. In December, it received more than \$500,000 in funding from the Federal Government.

More information

Mike Christensen, South West Catchments Council:
08 9724 2415 or swcc@swccnrm.org.au.

Looking for alternative pollinators

The bushfires that burnt across Australia posed a threat to Australian wildlife, including the bees crucial for successful pollination.

Early assessment has indicated that more than 10,000 honey bee hives have been destroyed across the Australian mainland and around 800 hives and 115 nucleus hives of the unique Ligurian subspecies of honey bee on Kangaroo Island.

The island is renowned for its floral diversity and distinctive tasting honey, being home to the only population of Ligurian bees in the world free of major diseases and biosecurity threats.

Hort Innovation Research and Development Manager for Pollination, Ashley Zamek, said the RDC was working with several research institutions across the country to assess the viability of alternative or complementary insect pollinators to ease the pressure on honey bees and their keepers.

“This research is now more important than ever considering the loss of such a significant number of hives during this catastrophic bush fire season,” she said.

Ms Zamek said promising preliminary findings had already been made in areas of alternative pollination where native stingless bees were successfully introduced into protected cropping environments.

She said researchers are also working to diversify landscapes to promote other supporting native insects such as wasps, beetles, birds and the like.

“And in a national first research project, we have partnered with the Department of Primary Industry and Regional Development in Western Australia to trial the use of flies for pollination,” she said.

Professor James Cook from Western Sydney University, who leads several pollination focused projects for Hort Innovation, said these projects are looking to understand what the natural pollinators are doing and how that can be strengthened to better support industry.

“Moving forward we’ll see an increasing recognition of the role of wild pollinators and pollinators other than honeybees,” he said.

“What our studies are showing at the moment is that insects such as native bees, wasps, flies and more are already playing quite a big role in pollination, but now we’re starting to get reliable data that demonstrates just what kind of contribution they are making.”

“If you put together all the pollination work we’re doing around the country, what we’re looking to do is to be able to provide information for resilient pollination services that don’t rely too much on any one situation or one species – leading to a better understanding of all the different options and how we can manage the landscape or the protected cropping environment so that we can harness these natural pollinators and get good pollination for crop production.”

You can read more about current pollination projects via horticulture.com.au.

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Soil mapping for productivity

Kathleen Murray, Verterra

Avocado growers at the Central Queensland Avocado Forum in Childers got a first-hand look at the soil mapping that is underway as part of a Reef Water Quality project aimed at improving nutrient and sediment management on avocado, macadamia and sweet potato farms in the Burnett Mary region.

The Burnett Mary Horticulture 1-on1 project delivers detailed soil mapping and soil analysis for an area of approximately 10ha. The results have shown farmers valuable insights into soil health, sub-soil limitations and opportunities to improve productivity and minimise sediment and nutrient loss.

The Electromagnetic (EM) survey is used to map soil type variation, identify management zones and soil sampling sites. Topsoil and sub-surface soil analyses are completed alongside the EM survey, both to correlate with EM map and to inform on soil health and nutrient management.

Verterra use a DUALEM-1HS meter to conduct the EM survey. The EM survey alone does not produce a soil map, it indicates where electro-magnetic inductance varies across the field. This variation may be the result of changes in salinity, clay content, soil moisture content, cation exchange capacity or organic matter. Ground truthing through soil coring is essential to establish a correlation between measured soil parameters and EM survey results.

Map 1 shows where the EM signal varies across the field to a depth of 15cm. Based on the analysis of the EM survey readings at multiple depths, five locations are selected for 1.2m soil cores across a range of field conditions and crop performance. The results from lab analysis are correlated with the EM survey results to produce maps like the one below.

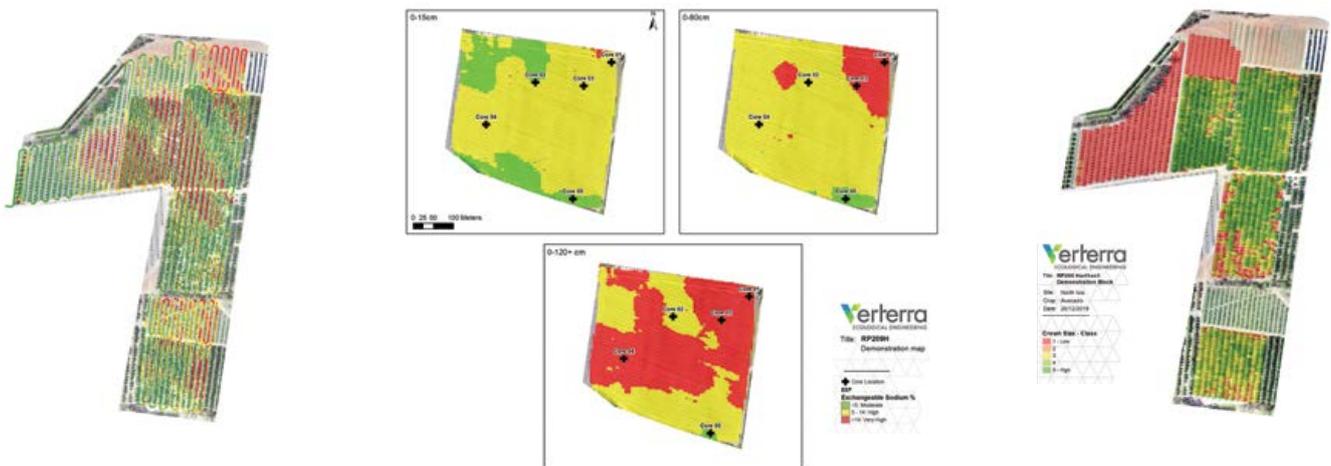
Map 2 illustrates areas with high sodium, increasing at depth. This is a useful tool to guide gypsum application and inform the grower on areas to monitor for increasing sodium levels in future.

While the EM survey and soil analysis captures what is happening in the soil, aerial imagery is used to complete the picture above ground. A digital elevation model, tree height, crown size and a range of plant health indices, such as NDVI, may then be used to identify issues in crop vitality, assist in yield estimation and nutrient or runoff management.

Together with your agronomists, we then evaluate the data, mapping and sampling results in relation to farm management practices. This may translate into a drainage plan, steps to address a sub-soil limitation, improve understanding of the relationship between soil variation and crop performance and how to manage it. The results are incorporated into a management plan and are accessible in a range of digital formats making the data easy to access for future planning and decision support.

The Burnett Mary Horticulture 1-on1 project will survey 30 sites this year, funded by the Queensland Reef Water Quality Program (through the Department of Environment and Science). Avocado, macadamia and sweet potato growers in the Burnett, Mary and Burrum sub-catchments are invited to participate in 2020.

For more information or to register your interest, please contact Kathleen Murray on 0491 226 403 or kathleen.murray@verterra.com.au.



Map 1. Electromagnetic Survey Reading 1-15cm – avocado demonstration block

Map 2. Exchangeable Sodium percentage shown at multiple depths

Map 3. Crown size map - avocado demonstration block

The latest in your BPR

A host of new resources have been added to the Best Practice Resource in the last few months, from highlights of the various regional forums, to extensive reports on the world's major avocado suppliers.

New export reports

Two new reports have been prepared by Wayne Prowse of Fresh Intelligence Consulting, the global market report into avocado import markets, and one into the current major avocado producers and market suppliers. You can find these reports in full in the Export section of the BPR Library, as well as summaries on pages 20 and 23 of this edition of *Talking Avocados*. We've also used the information from these reports to update the extensive Export section of the BPR.

Regional forum materials

Event proceedings have been added for all of the 2019 Avocado Regional Forums. This includes notes on the key messages, as well as copies of the various presentations. Check the Event Proceedings section of the BPR Library.

Disaster recovery information

Did you read the useful fire recovery article from Simon Newett on page 13? We have started to collate these timely articles in the BPR, for ease of future reference. The Growing section now includes a Disaster Management article, with links to both the fire recovery article, and our earlier frost recovery article.

Avo Alerts

Misplaced the monthly Avo Alerts email? Don't worry, growers can find the two latest editions of these useful orchard tasks checklists in the Australian Agronomy section of the BPR Library.

Check for related resources

At the top of many of our BPR articles, you may have noticed a drop-down tab for resources related to the topic of the article.

We've made these related resources easier to see, as this simple tab can often contain a range of useful, relevant further reading, from checklists to research reports.

WHS: year-round resources

At any time of the year, workplace health and safety should be a key consideration for members of the Australian avocado community.

The Best Practice Resource (avocado.org.au/bpr/) WHS module contains a range of avocado-specific resources, including guides, plans, registers and checklists to help you plan and implement a WHS program for your business.

There are also a range of links to external information sources in the BPR Library's WHS resources section, by state.

Registering for the BPR

Avocados Australia welcomes new applications for the Best Practice Resource from all businesses that are part of the Australian avocado industry. This includes, growers, packers, wholesalers, ripeners, transporters, retailers, exporters, researchers, consultants, input suppliers and other relevant stakeholders.

Information has been sourced from the latest research, development and industry investment, checked by industry experts and carefully structured to allow quick and easy access to information, including the ability to search the whole site, or just the BPR. Information and resources are updated as new content becomes available.

Can you apply for registration via avocado.org.au/bpr/.

New generation Kangaroo Labels

Avocados Australia manages the Kangaroo Label for use on Australian avocados.

Kangaroo Labels can be ordered through our registered Kangaroo Label suppliers listed below. Packhouses need to apply for a Packhouse Registration (PRN) with Avocados Australia before an order can be placed. Please arrange your databar directly with GS1 Australia.

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J-Tech Systems:	ph: 02 6049 5001
Label Press:	ph: 07 3271 2111
Mildura Printing Services	ph: 03 5022 1441
Warehouse Design and Packaging:	ph: 02 9905 0963
Orora Limited	ph: 0409 626 912

www.avocado.org.au or call **07 3846 6566**

Safety and labour update

Agriculture has retained its number one position, for the highest rate of serious workers' compensation claims.

SafeWork Australia released its report for the 2017/18 year in January this year, recording 3,560 serious claims for agriculture, forestry and fisheries. While there were more claims recorded in other industries, agriculture had the highest frequency of serious claims recorded at 8.6 per million hours worked, more than manufacturing (8.1), transport (7.7), construction (7.5) and health care and social assistance (7.2).

Within the broader agriculture category, the agriculture industry sub-division accounted for 77% of serious claims in 2017/18, with 8.3 serious claims per million hours worked and 16 serious claims per 1,000 employees.

The good news for agriculture, is that the number of claims has been decreasing since 2000/01, down by 32%

Overall, in 2017/18 the most common cause of injury for all industries was body stressing (36%), followed by falls, trips and slips (23%) and being hit by moving objects (16%). Body stressing is muscular stress while, for example, handling objects, lifting or other activities.

Victoria: new workplace manslaughter laws coming

There were six deaths on Victorian farms in 2019, making them once again the most dangerous workplaces in the state. Another five deaths occurred on construction sites.

WorkSafe Chief Executive Colin Radford said a failure to properly address major safety risks was a common reason for many of the horrific, but preventable incidents.

Nine of the state's fatalities in 2019 involved some form of moving machinery or heavy vehicles, which were the most dangerous hazards in Victorian workplaces.

"The risks associated with moving machinery such as tractors, headers, trucks, mobile cranes and scissor lifts are well known so there is simply no excuse for ignoring them," Mr Radford said.

"All employers must take time to properly assess workplace health and safety risks and plan how to eliminate or manage them, because failing to do so can be fatal."

Mr Radford said from July, new workplace manslaughter laws would come into force.

"So employers are on notice to take their health and safety obligations seriously or risk jail if your negligence causes a workers death."

Read more on the new laws: bit.ly/TA304vic.

Queensland – labour hire company fined

The third successful prosecution of an unlicensed labour hire provider has occurred in Queensland. Monstershield Pty Ltd has been convicted and fined \$60,000 in the Emerald Magistrates Court for operating without a labour hire licence, providing workers for grape picking.

In sentencing, the magistrate noted the overriding purpose of the labour hire licensing scheme was to protect vulnerable workers and the defendant had committed a serious offence which struck at the scheme's integrity. He considered Monstershield's failure to respond to requests for information and lack of co-operation with the investigation were calculated to draw out the application's assessment to continue operating for as long as possible.

Read more at bit.ly/TA304fine.

New South Wales – new first aid code

SafeWork NSW has adopted a revised model Code of Practice (COP) for first aid in the workplace, to update guidance on selecting first aid courses. The code commenced in NSW on 31 January 2020 and are available. Find the updated code here: bit.ly/TA304SA.

Tasmanian cherry exporter fined over death

Tasmanian cherry exporter Reid Fruits has been fined \$250,000 over the 2015 death of a worker at one of its Derwent Valley Orchards.

Retbe Chide Negga, 50, was crushed under the wheels of a tractor trailer at an orchard in Plenty while he was loading tubs of cherries onto the moving vehicle.

The Ethiopian-born father slipped off a side step that had been fitted to the trailer, suffering a crushed abdomen, pelvis and legs.

Cherry exporter Reid Fruits was later found guilty of failing to comply with its health and safety obligations.

In a sentencing hearing at the Hobart Magistrates Court in January 2020, Magistrate Reg Marron found the induction process for workers was "less than adequate" and a lack of safety guards around the side step and wheel meant the risk of injury or death was foreseeable.

More information

Preventing injury and keeping those people that work for you safe is important for your business. Specific resources have been developed for the avocado industry which will help you to manage Work Health and Safety (WHS) and meet your legal obligations: avocado.org.au/bpr.

International Year of Plant Health

Garnering support across Australia to protect plants from pests and diseases is the aim of the launch of the International Year of Plant Health at Parliament House, Canberra in February.

For the first time in history, the United Nations General Assembly has focused global attention on plant health by declaring 2020 the International Year of Plant Health (IYPH).

Executive Director and CEO of Plant Health Australia, the national coordinator for the government-industry partnership for plant biosecurity, Greg Fraser said the year presented a unique opportunity for innovative collaboration in plant health.

“Peak industry bodies, research and development corporations, botanic gardens, governments and the community will partner together and with the international plant health community to find new ways of combating emerging plant pest threats,” he said.

Australian plant industry research and development corporations are collaborating on addressing high priority plant health risks through the Plant Biosecurity Research Initiative.

“Our top plant pest threat, *Xylella fastidiosa*, is having catastrophic impacts overseas and threatens 350 commercial, ornamental and native plant species in Australia, so a coordinator is being jointly funded by Wine Australia and Hort Innovation, to ensure Australia is prepared for it,” said Mr Fraser.

The Director General of the UN’s Food and Agriculture Organization (FAO), Qu Dongyu, speaking at the launch via pre-recorded video message, said 2020 was a unique opportunity to increase global awareness of the important role of plant health for life on earth and to promote activities in favour of preserving and sustaining global plant genetic resources.

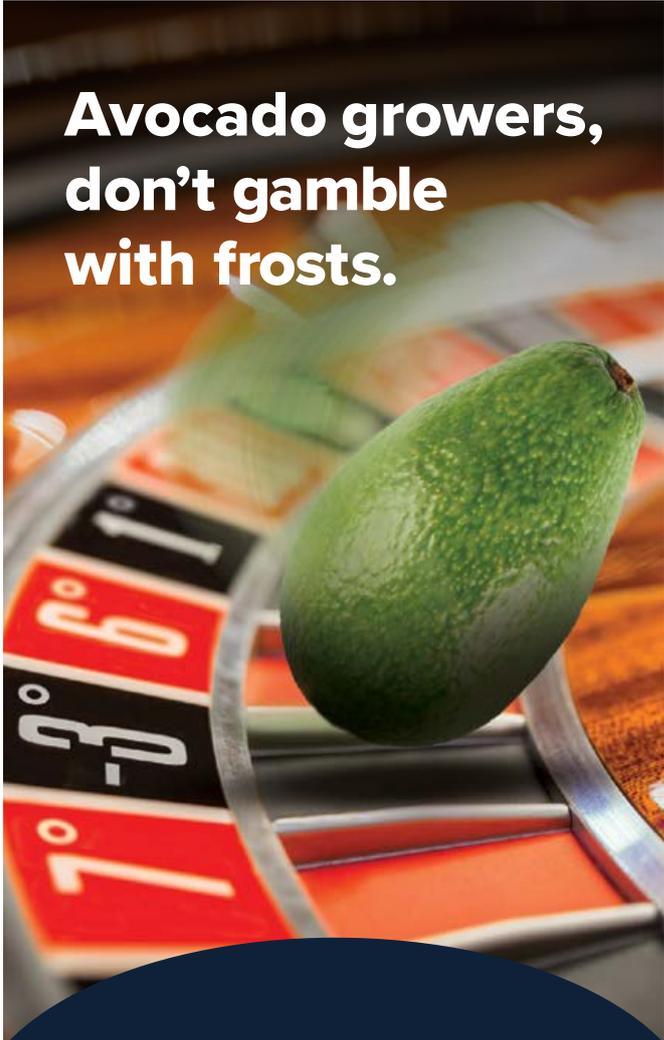
“Around the world plant pests and diseases leave millions of people without food and negatively affect agriculture, the primary source of income for rural poor communities. Protecting plants from pests and keeping them healthy, starts with prevention,” he said.

Government, industry and research leaders joined diplomats to Australia to mark the commencement of the year’s program of plant health events and activities being held around Australia.

To find about how you can help, events, stories and news about the year visit <https://planthealthyear.org.au>.

If you see something unusual, report it by phoning the Exotic Plant Pest Hotline 1800 084 881.

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MARKETING UPDATE

It's been a busy few months for Australian Avocados, connecting with both Aussies and overseas consumers. This activity is managed by Hort Innovation on behalf of the industry and is funded by the avocado marketing levy.

Reaching our ongoing goals

The goal of the Australian avocados marketing program is to increase domestic demand for Australian avocados by at least 20% by 2021 as outlined in the Strategic Investment Plan (SIP), and there a range of ongoing and exciting new activities to achieve this.

As noted last edition, part of the current planning by Australian Avocados targets occasional avocado buyers domestically, with the goal of transforming them into avocado lovers. The approach includes assessing the audience, driving home the versatility of avocados and giving all buyers a reason to love Australian avocados.

We're happy to report that, based on the avocado consumer brand tracker (Edentify, 2019), there is an increasing number of people who purchased avocados in the last two weeks from 61% in September-October 2018 to 70% in September-October 2019. Importantly, the likelihood of purchasing in the next two weeks is also high, having grown from 73% in May 2016 to 82% in September/October 2019.

Research by Edentify indicates the majority of people buy avocados with a specific preparation/occasion in mind, which means inspiring consumers with new ways to prepare and consume avocados will directly impact the conversion to purchase.

Among the noticeable changes, are results indicating purchasers are being driven more significantly by the fact avocados are "good for you". Price is also a growing purchase factor, while ripeness is the second essential criteria.

Japan

Marketing of Australian avocados continues in the global market.

As part of increased international marketing of Australian avocados, a special Hort Innovation Taste Australia campaign was held in Tokyo, Japan in December 2019. As part of the activity, up to 90 Japanese importers took part in a seminar on avocado seasonal availability, where they participated in product sampling sessions and received relevant Taste Australia marketing materials.



Guests sampling Premium Australian avocados at the Taste Australia Trade Seminar in Tokyo Japan.



Full house before the Taste Australia seminar in Japan during December 2019.

Australian Avocados' marketing manager Matthew Dwyer was in Japan for the event, taking the opportunity to talk about the next season and availability periods for Australian avocados.

Avotherapy: follow-up work

Back in Australia, the success of the Avotherapy event held in Sydney was followed up with ongoing public relations activities.

This included sharing avocado content within a range of digital and print publications, including within the October edition of That's Life magazine, which had a potential 751,000 readers.

The Avotherapy event in 2019 strategically aligned with the avocados "making everything better" message, and the brand's nutrition pillar, communicating health message to reinforce the benefits of avocados.

Encouraging the use of avos

As part of the ongoing public relations work, Australian Avocados continued promoting the use of avocados as part of the Christmas celebrations, before switching to a health focus for the New Year.

Similar to last year, educational content on the Shepard and Hass avocado varieties will be shared with consumers. This will educate consumers on the seasonality and availability, as well as the best uses for each variety.

Retail activity

An Australian Avocados booth featured at the Woolworths Customer First Trade Show at the Sydney International Convention (ICC) on 22 and 23 October 2019. The activity included providing two knowledgeable and experienced staff to engage with Woolworths' store managers, support staff and executives.

The objectives of the activation were to:

- connect with Woolworths' customer-facing and support staff to drive awareness and promote the sale of Australian Avocados, and
- drive in-store engagement to improve customers' in-store experiences.

Through the course of the two-day trade show, about 1,000 store managers and 250 support staff attended presentations on fresh food, with avocados being a feature. This was followed by visits to the booths of six fresh produce suppliers, including Australian avocados.

Features of the Australian Avocado booth included:

- stand attendees (growers, industry participants, Woolworths staff) communicated key messages
- product sampling to attract store managers and support staff to the booth, utilising a guacamole recipe aligned with Woolworths Fresh magazine



In the New Year, the Australian Avocados team are promoting the health benefits of avocados, including this example from Instagram.



Australian Avocados celebrated Christmas on Facebook with a popular image, helping consumers choose a ripe avocado.

- distribution of information sheets prepared by Woolworths on the avocado industry, avocado production and supply chain (“Avocados from the farm to you...”) and in-store requirements, for distribution to booth visitors
- the opportunity to complement the information with the results of the *Supply Chain Quality Improvement – Retailer Point of Purchase Improvements* project (AV15011) on retail best practice for avocados
- highlighting the results from trials in Woolworths for this project, which resulted in significant increases in sales and significant decreases in shrink, and which made a contribution to the development of a new avocado-specific merchandising unit, which is being rolled out to all stores across the nation
- promoting the new merchandising unit, which was installed on the booth, and gaining responses from store managers where the unit had already been installed
- the opportunity to communicate Woolworths’ summer activation plan for avocados to store managers, to further boost avocado purchase and reduce shrink.

Benefits of participation in the trade show included the opportunity to complement the key messages delivered to store managers during the presentations by Woolworths senior management on the importance of the avocado category, and store messages and tips to achieve the summer goals set for the category.

Broadcasting our message

In the first half of 2020, the Australian Avocados television commercial will be aired in key metro and regional areas from March to May. This will build awareness of the key messages

among the core segment audiences, including consumers who see avocados as a seasonal food or a treat for special occasions, and encouraging them to increase their planned purchasing. This will be complemented by radio activity and retail out of home (OOH) between February and April, as well as cinema advertising in January and April.

To encourage consumers to eat more avocado at home, there will be OOH activities, including street furniture in metro areas between February and April, as well as digital video and mobile content between now and May.

To maintain contact with those seeking avocado inspiration and recipes, Australian Avocados social media and online search activities will be ongoing.

Avocados online

Have you visited australianavocados.com.au lately? The entire website has had a refresh with a host of new content, including recipes and content for health professionals.

Acknowledgement

This activity is managed by Hort Innovation on behalf of the industry, and is funded by the avocado marketing levy.



The Australian Avocados booth at the Woolworths Customer First Trade Show.



Store managers at the Australian Avocados booth at Woolworths Sydney event in October 2019.

RESEARCH AND DEVELOPMENT

High-density avocado production in Australia

By Dudley Mitchell

The Australian avocado industry is approaching a tipping point where supply could outstrip domestic demand and in the absence of any significant export activity, producers could face declining profitability.

In addition, increasing land prices and decreasing availability to good quality water resources are forcing industry stakeholders to search for more productivity from existing assets.

This has been identified by the industry as one of four pillars of their Strategic Investment Plan (bit.ly/avostrat), with the outcome being a 10% increase in productivity per unit land area.

One of the ways that this could be realised is through intensification of production, which was the focus of my 2018 Nuffield Scholarship, supported by Woolworths.

High-density avocado production is in its infancy although interest to implement such systems is gaining momentum among top producers. Varietal selections of rootstocks and scions currently available do not suit intensive production systems meaning that physical and chemical manipulation of tree growth is necessary.

In order to utilise these tools effectively the underlying requirements for high production need to be understood. These include high light interception and good light distribution which in turn rely on orchard design, tree architecture and tree health. It is possible to integrate these requirements into an orchard management system that is based around a pruning model selected according to management intensity and the willingness to use Plant Growth Regulators (PGRs).

However, it must be emphasised that in order to maximise returns, all aspects of orchard management need to be optimised and it is recognised that agricultural systems are

complex and dynamic and that the systems adopted must be flexible enough to adapt to a changing environment, both physically and technologically.

The current situation

Australia lags behind other countries in regard to production, having an average of 219 trees/hectare compared with the Chilean industry average of between 800 and 1,000 trees/ha and some experimental plantings of up to 6,000 trees/ha. Intensification is not without its challenges and the purpose of the project was to investigate the current state of global high-density production and to assimilate that knowledge into a simple integrated model for implementation in Australia given the unique challenges that the local industry faces.

The six-year average yield for Australian avocado producers is 10.4t/ha, while the average global production ranges between 8-12 t/ha. High-density plantings have been suggested as a means of increasing yields since the early 1990s but it seems the lack of dwarfing rootstocks and low cost management tools has discouraged any change from conventional populations.

Making change happen

It was found that uptake was driven by factors other than productivity gains and without these strong drivers, change simply didn't happen.

For example, in Chile, higher density plantings and smaller trees are a result of having to plant on steep slopes to avoid freezes lower in the valleys. Smaller trees were seen as being beneficial and smaller trees meant more could be planted on a certain area which then gave rise to the interest in improving productivity through the use of practices that managed growth.

In Australia, the driver for smaller trees could be an increasing focus on safety, and the cost of utilising elevated

work platforms. In addition to this regulatory pressure, finite resources such as suitable land and water are forcing farmers to look at ways to increase their productivity per unit of resource. These factors, in combination with the forecasted supply and demand issues (Figure 1), make it imperative for farmers to look at ways of producing more efficiently.

In addition, implementation was complex and management intensive and current varieties and rootstocks were not well suited to high density production. However, tools do exist to mitigate these effects and, given the right scenario, could be used successfully to recoup establishment costs early and improve productivity.

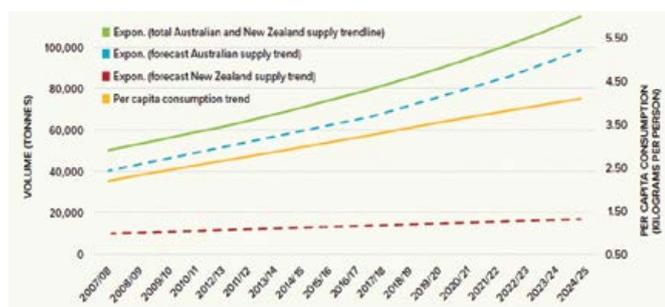


Figure 1. Supply vs Consumption Trends (Avocados Australia, 2017)

Further, research into new varieties and rootstocks have resulted in more horticulturally manageable cultivars that will, over time, replace the dominant Hass in high-density plantings.

While intensive production may not suit all regions and all management capabilities, it has the potential to increase productivity and could be used to counter the effects of lower returns in the face of over production.

The keys to high density plantings

The keys to successful high-density plantings are based on two systems, the interception and distribution of light (Palmer, 2004) and the tree itself:

- maximising light interception (60%) through
 - high density plantings
 - management of leaf area index (LAI) to between 2 and 3 – too high will result in excessive shading, too low will result in low interception
- maximising light distribution through
 - management of tree architecture and growth.

While there have been few avocado studies on this matter, there have been a number of studies that have shown a close positive relationship between total seasonal light interception and fruit yield (Lakso, 1994). Monteith (1977) demonstrated a fundamental correlation between crop dry matter production and seasonal accumulated light interception.

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- / Lift heights
5.40m | 6.40m | 8.00m

Tree architecture has been a major determining factor in the intensification of orchard crops. The ability to use dwarfing rootstocks and upright scions has helped the apple industry increase planting density. As between-row and within-row spacings decrease (and densities increase), light interception improves (Wunsche & Lakso, 2000; Palmer, 2004). Smaller, more upright trees enable this intensification.

Drawing on international experience

South Africa has a fairly long history of research into high-density production systems but little commercial uptake. Utilising Maluma, there is one semi-commercial trial with plantings at 800 trees/ha and 1250 trees/ha on both Tatura and vertical trellis systems (Figure 2).



Figure 2. Tatura (**top**) and vertical trellis (**bottom**) systems for Maluma avocado in semi-commercial South African trials.

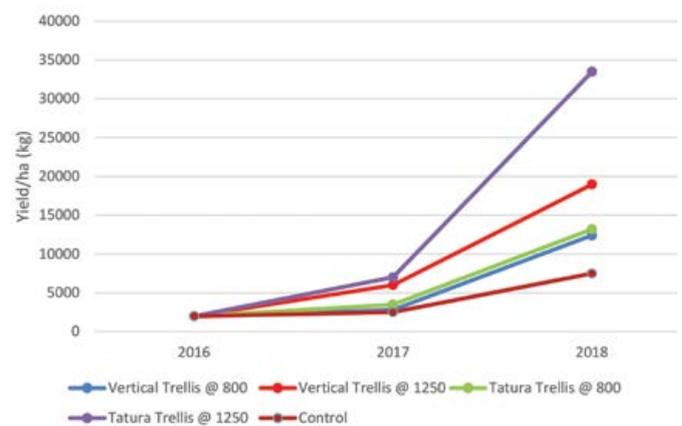


Figure 3. Results from the Allebeste Nursery trial in South Africa have been collected for two years and show highly significant yield advantages over the controls (Ernst, 2018).

In California, widespread adoption is low but there is potential for the germplasm collection held by the University of California Riverside to overcome one of the elements lacking for high-density production: the availability of dwarfing rootstock and scions suitable for such production.

Of particular interest for high-density production are the semi dwarfing rootstock P35 (still in trial phase) and the GEM scion variety. GEM is becoming a more popular variety in California due to commercial evidence for its precocity, high consistent yields and smaller stature.

The Chilean industry is unique in its use of hillslopes with steep inclines for the cultivation of avocados.

In Chile, the industry's use of hillslopes with steep inclines led to the intensification of plantings and the rise of ultra-high density production systems of up to 6,000 trees/ha (1.25m x 1.25m spacings).

The shallow soils and cool Mediterranean climatic conditions of these aspects are not conducive to excessive growth (Whiley, et al., 2013) while the steep slopes and inaccessibility to machinery dictate that trees are kept small for ease and safety of harvest.

While there are large areas planted to these ultra-high density systems, the majority of plantings range between 800 and 1,600 trees/ha which is still significantly higher than the majority of production systems globally.

This experience in high-density plantings is being used in New Zealand's North Island, where corporate interests have recruited Chilean expertise.

While the different climate poses challenges (the warm, maritime subtropical climate induces hard to control and vigorous extension), the yield outcomes have been impressive (Hermosilla, 2018).

Planning high-density

The foundation of a high-density system requires an analysis of bioclimatic regions, soils, trees (cultivars and rootstocks), and orchard design, before high-density systems are implemented. What works in one region, may not in another.

Once that analysis is carried out for local conditions, complexity is added by the need to promote early tree growth to help recoup establishment costs through early commercial yields, and to control tree vigour. This second challenge seems to be part science and part art, making management both complex and intense. The science involves the pruning system to be adopted and the application of PGRs. The art involves the decision of what to cut and when to cut, the balancing of current and future production and, the timing of PGR application.

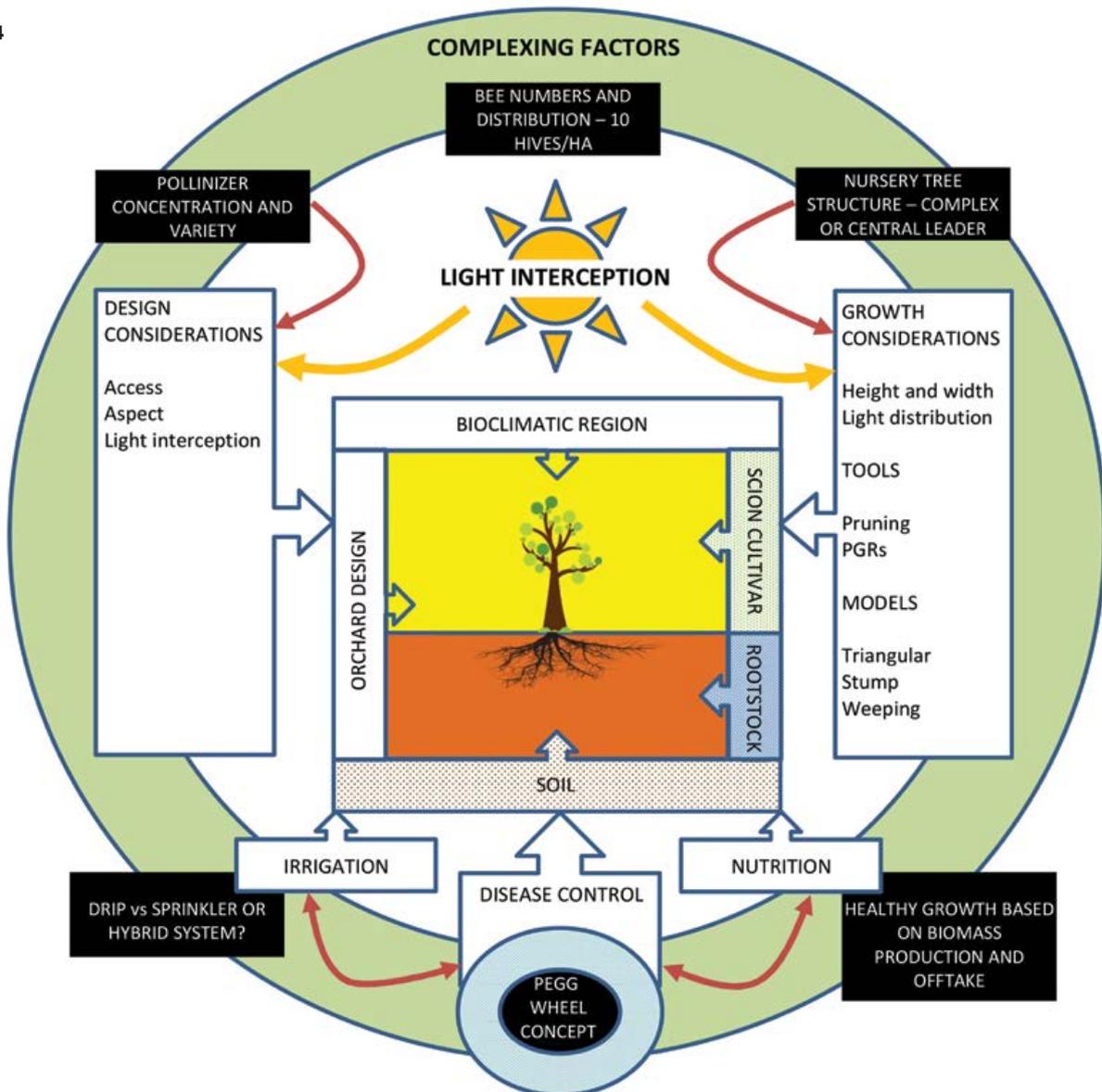
Liebig’s Law of the Minimum (Reilly & Fuglie, 1998) can be used to describe the success of an agricultural system as a function of the scarcest resource. This is an important consideration in implementing a high-density production system and Figure 4 tries to encapsulate all considerations in setting up and running a high-density project.

Recommendations

High density production systems in the avocado industry are a viable concept and can be used to improve productivity from a given set of resources. However, like any system, success lies in implementation and there are a number of recommendations that should be considered.

- Not every region is suitable. Highly invigorating environments such as those found in the tropics and warm subtropics will find it difficult to control growth without

Figure 4



intensive management and high use of Plant Growth Regulators (PGR).

- Ultra-high density (UHD) systems may not be suitable in Australia due to machinery access issues.
- Healthy trees are the key to success, so the management of *Phytophthora cinnamomi* is critical.
- Understanding the principles of light interception and light distribution is integral to proper implementation of pruning practices.
- Future avocado production will migrate toward more horticulturally friendly Hass-like varieties, but uptake may be slow and reliant on vigorous testing in sub-regions. Therefore, industry leadership should be looking to be involved in the global selection of new varieties for rootstocks and scions through the University of California's Avocado Variety Improvement Program (AVIP) and implementing widespread trials.
- Uptake of high density systems may be restricted to those operations that have the management capability, and for these businesses it cannot be over emphasised that the success of the system is dependent on the adoption of a 'whole of orchard' management view where high density is not a bolt-on module but an integrated growing philosophy.

More information

The full report is available at bit.ly/TA304Dudley.

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Managing high-density plantings

By Helen Hofman, Queensland Department of Agriculture and Fisheries

With the end of the first phase of the Small Tree High Productivity project, it is time to review what we have learnt from our experience in high density planting.

In our Planting Systems Trial, planted in Bundaberg in 2014, we compared Hass on two rootstocks (Ashdot and Velvick), in three different planting densities. These were a conventional or 'low' density planting at 9 x 5m (222 trees per hectare), a 'medium' density planting at 6 x 3m (556 trees per hectare), and a 'high' density planting at 4.5 x 2m (1,111 trees per hectare).

We also planted a rootstock trial in Bundaberg in 2016, in which there are nine rootstocks planted in a high density system (also 4.5 x 2m or 1,111 trees/ha). The rootstocks are:

181, Ashdot, Bounty, BW2, Dusa®, Latas®, Reed, Velvick and Zutano.

We reported in 2018 in the Winter edition of *Talking Avocados* (bit.ly/TApast) that the yields from our high and medium density plantings in the Planting Systems trial were disappointing compared to the conventional or low-density planting. This year's harvest (the fourth after planting) has been no different: the high-density planting yielded 11.3 tonnes per hectare and the medium-density planting yielded 16 tonnes/ha, compared to 19.6 tonnes/ha for the low-density spacing. These figures are the average of both rootstocks. Table 1 shows the details of yields per tree and per hectare for all densities and both rootstocks for all years of the trial.

Table 1. Planting Systems Trial, Bundaberg: mean yield per tree and per hectare by density and rootstock treatments 2015/16 to 2018/19

		Yield per tree (kg)				Yield per ha (tonnes)			
		2015/16	2016/17	2017/18	2018/19	2015/16	2016/17	2017/18	2018/19
Density	High	6.54	8.0 a	11.1 a	10.2 a	7.33 b	8.9	12.28	11.3 a
	Medium	3.19	14.7 a	24.1 b	28.9 b	1.85 a	8.2	13.38	16.0 b
	Low	7.43	29.5 b	60.2 c	87.7 c	1.71 a	6.6	13.37	19.6 b
Rootstock	Ashdot	5.93	20.2 b	37.3 b	46.3b	3.6	8.9	15.1 b	17.0b
	Velvick	5.51	14.6 a	26.2 a	38.2a	3.5	6.9	10.9 a	14.2a
Density x rootstock	High x Ashdot	6.5	8.7	12.8ab	11.8 a	7.2	9.7	14.2	13.1
	Med x Ashdot	3.3	16.1	27.2 c	28.8 b	1.8	9.0	15.1	16.0
	Low x Ashdot	8.0	35.9	72.0 e	98.2 d	1.8	9.0	16.0	21.8
	High x Velvick	6.6	7.3	9.3 a	8.6 a	7.3	8.2	10.3	9.5
	Med x Velvick	3.1	13.3	20.9bc	28.9 b	1.7	7.4	11.6	16.0
	Low x Velvick	6.9	23.2	48.4 d	77.2 c	1.5	5.2	10.8	17.1

Means within each vertical group that are followed by the same or no letter are not significantly different at the 95% confidence level.

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There appears to be several reasons why the high-density treatment has performed below expectations.

Structure and pruning

The first is structure and pruning. In the trial, we pruned and trained the high and medium density trees to a cone shape with a single central leader. The main reason for this is to maximise light distribution on the periphery and inside the canopy. This shape works well for many tree crops, and indeed, our measurement of light shows that all the densities had similar light levels on the periphery of the canopy and the high-density trees had the best light levels inside the canopy.

This can be seen in Figures 1 and 2 which show the average levels along the periphery of the canopy (Figure 1) and through the canopy (Figure 2) in our 2017 measurements. The figures show averages for six trees per density, measured three times on one day in winter, of photosynthetically active radiation (PAR). PAR is the light frequencies used by plants to photosynthesize, as a percentage of the 'total' PAR, or 'above canopy PAR'.

However, the pruning necessary to maintaining tree shape meant we were constantly battling against the natural structure of the tree, which naturally develops a small number of strong spreading limbs. Pruning often resulted in vigorous new vertical branches, particularly where we had created light-filled gaps in the canopy. In addition, when trees are closely planted, and pruned at the top to control height, multiple watershoots developed and formed dense 'shoulders' that retained very few fruit and shaded the rest of the tree.

It is difficult in our trial to demonstrate or accurately quantify the 'cost' of pruning on yield. Our data suggests that the trees we pruned most heavily had lower yields, but effects were variable, and relationships were weak (data not shown). It appears that effects may have been stronger in the year following pruning rather than in the year of pruning, but these effects are conflated by an additional pruning in that same second year.

As we reported in 2018, we found high levels of branch death, both from 'natural causes', mostly low light levels, and 'unnatural' causes, mostly damage from trunk-boring beetles. The high and medium density trees, because of their simpler structure, tended to be disproportionately affected by branch death, losing more fruit in the year of branch death and leaving gaps in the canopy. In addition, we tied the high-density trees to a single-plane trellis: this appears to have fostered rapid upward growth in the first few years, but with the adverse effect of poorer branching from the central leader or trunk lower in the canopy.

These structural issues meant poor branching and canopies in some medium and high-density trees. However, despite this, our estimates of the number of fruiting sites per hectare suggest that there was still a much higher number of fruiting sites and flowering terminals on a per hectare basis for the high and medium density plantings compared

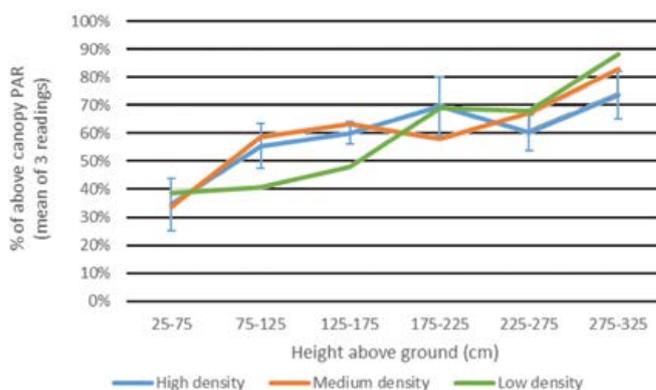


Figure 1. Light levels along the periphery of tree canopies measured in winter 2017. Lines show the average of 6 trees for each density. Error bars show 1 standard deviation for 'high density' treatment only. 'PAR': photosynthetically active radiation.

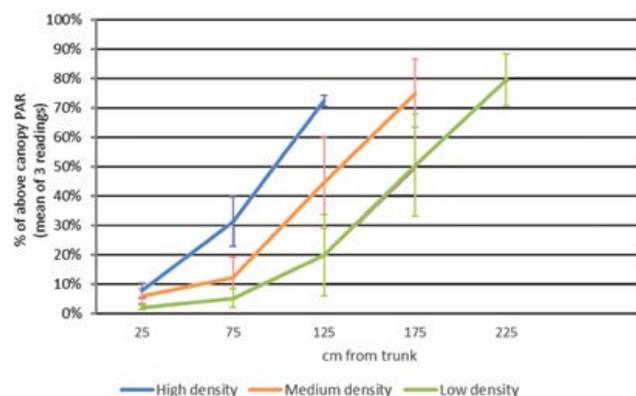


Figure 2. Light levels through tree canopies measured in winter 2017. Lines show the average of 6 trees for each density. Error bars show 1 standard deviation. 'PAR': photosynthetically active radiation.



Figure 3. An example of bare trunks in the high-density planting system

to the low-density plantings. Our calculation for 2018/19 of the number of fruiting sites suggests the high and medium densities had 1.6 and 1.3 million flowering terminals per hectare respectively compared to 0.8 for the low density. These numbers are based on the average number of terminals per branch cross sectional area (determined from samples), multiplied by the total branch cross sectional area (based on actual branch measurements), and then multiplied by the number of trees per hectare. So, if fruit set and summer fruit drop rates are the same in all densities, the high-density plantings should have yielded much more per hectare. However, our data shows that these rates were not the same for all densities.

Fruit set and retention

Fruit set and retention per flowering terminal has been lower in the high and medium densities than in the low densities in most years: this is the second reason for poorer yields from the higher density (Table 3). The reasons for this are not clear. It does not appear to be due to inadequate light (see Figures 1 and 2). Neither does it appear to be due to canopy inefficiencies. Our measurements suggest that the branches of all densities have similar number of leaves per cm² of branch cross sectional area (data not shown). As shown in Table 2, the higher density plantings have greater canopy volumes on a per hectare basis than the low-density plantings, although this calculation does not take into account gaps in the canopy.

Table 2. Mean canopy volume at time of harvest by density and rootstock treatments 2015/16 to 2018/19

		2015/16	2016/17	2017/18	2018/19
Density	High	15471 b	14746 b	16483 b	19746
	Medium	6450 a	13109 b	16554 b	18826
	Low	3434 a	9341 a	13630 a	15816
Rootstock	Ashdot	7618 a	11402 a	14437 a	17188
	Velvick	9286 b	13395 b	16675 b	19070

¹ Canopy volumes per hectare were calculated using planting space where canopies were interlocking. Means within each vertical group that are followed by the same or no letter are not significantly different at the 95% confidence level.

Table 3. Fruit set and retention per flowering terminal by density treatment 2015/16 to 2018/19

Density	Spring set fruit per flowering terminal				Summer retained fruit per flowering terminal			
	2015/16	2016/17	2017/18	2018/19	2015/16	2016/17	2017/18	2018/19
High	0.11	0.25	0.13 a	0.32	0.22	0.12	0.08 a	0.04 a
Medium	0.25	0.25	0.20 b	0.24	0.10	0.17	0.13 b	0.08 b
Low	0.23	0.32	0.26 c	0.36	0.21	0.17	0.16 c	0.13 c

Means within each vertical group that are followed by the same or no letter are not significantly different at the 95% confidence level.



Our data from the rootstock trial also supports the importance of fruit set and retention. In this trial we have striven to improve branch structure with some success so far (Table 4), although there may be more branch death as the trees in the rootstock trial age. However, the ‘fruit set’ factor appears to be in play here also: in spring 2019 we have so far had a disappointing level of fruit set averaging 0.14 fruit per flowering terminal on the Velvick rootstock and 0.24 on the Ashdot.

Our current hypotheses to explain lower fruit set and retention, which remain to be tested, are as follows. Of course, they are not mutually exclusive.

- (i) Pruning, depending on severity, means fruit set and retention suffer as resources are directed to vegetative renewal. This may affect fruit set in the year of pruning, particularly in spring, but also may affect the crop load in the year following pruning. Increased competition for light at the tops of densely planted trees may exacerbate growth at the top and further increase this fruit:shoot competition.
- (ii) The narrow canopy width of the trees in the higher densities may have some adverse effects in compressing bloom and fruit set periods, making them more vulnerable to adverse seasonal conditions. For example, warmer spring temperatures may advance vegetative growth relative to the timing of anthesis and fruit set. Narrow canopies may also reduce fruit protection.

- (iii) The higher densities may have inadequate rooting area to support both canopy and crop. In a high-density planting, the trees constantly compete at the tops to reach the light, requiring resources which might otherwise go to fruit set and retention. This is exacerbated by (i).

Rootstock effects

In the Planting Systems Trial we have compared growth and yield from Ashdot and Velvick. In every year, Ashdot has outperformed Velvick, regardless of density. Yield per hectare is higher, and yield efficiency (fruit per m³ of canopy) is also higher. Since planting, the height of the trees on Ashdot rootstocks has been from 86% (2016) to 92% (2019) of trees on Velvick rootstocks; and canopy volumes of trees on Ashdot rootstocks have been 82% (2016) to 86% (2019) of the trees on Velvick rootstocks (Table 2).

Our data suggests that the Ashdot performance is not simply due to less vegetative vigour but because of its flowering habits. The Ashdot rootstocks tended to have slightly more inflorescences (both terminal and axillary) per cm² of branch cross sectional area, but also had a higher proportion of axillary flowers (an indication of flowering intensity) and a higher proportion of determinate inflorescences (those without a vegetative shoot emerging from the tip) (Table 2). The larger proportion of determinate inflorescences contributes to better early fruit set as there is no competition at the individual shoot level between fruit and vegetative

Table 4. Mean number of second order branches by rootstock and height of trunk April 2019 (n=5 per rootstock)

Height of branching from trunk (0=ground)	Planting Systems Trial high density treatment			Rootstock trial		
	Ashdot	Velvick	Total	Ashdot	Velvick	Total
0-100 cm	1.4a	2.8b	2.1	5.0	3.8	4.4
100-200 cm	4.0	6.4	5.2	8.2	10.0	9.1
200-300 cm	6.2	5.0	5.6	14.0	15.4	14.7
300-400 cm	10.8	10.8	10.8	7.6	10.0	8.8
400-500 cm	16.8	12.4	14.6	na	na	na
Total	36.6	35.8	36.6	34.8	39.2	37

Means within each horizontal (rootstock) group that are followed by the same or no letter are not significantly different at the 95% confidence level. No confidence level can be calculated for comparisons between the two trials, as they are separate entities.

Table 5. Planting Systems Trial, Bundaberg: Flowering intensity and proportion of axillary and determinate inflorescences by density and rootstock treatment 2015/16-2017/18

	Inflorescences/cm ² BCSA			Proportion axillary			Proportion determinate		
	2015/16	2016/17	2017/18	2015/16	2016/17	2017/18	2015/16	2016/17	2017/18
Ashdot	5.82	7.35	7.68 b	63.9%	55.0% b	22.6% b	41.0% b	59.4% b	45.2%b
Velvick	4.69	6.53	5.41 a	56.6%	38.1% a	7.0% a	19.0% a	38.0% a	13.4%a

Note that inflorescences can be both determinate and axillary. ‘BCSA’ is branch cross sectional area. Means within each vertical group that are followed by the same or no letter are not significantly different at the 95% confidence level.

growth. Our studies show that determinate terminal inflorescences had higher rates of spring fruit set, and also higher rates of harvested fruit per terminal despite a higher fruit drop rate in summer. In addition, fewer vegetative spring shoots due to the lower number of indeterminate inflorescences may also contribute to the smaller tree canopy of the trees on Ashdot.

Some growers may have reservations about planting Ashdot from a tree health perspective. In our trial Ashdot has a lower ratio of rootstock to scion (cross-sectional area) than Velvick, suggesting less developed root systems. In 2019, for example, the average ratio for Ashdot was 0.929 but for Velvick was 1.048. We have not had any tree deaths to date in the trial, but our tree health ratings suggest the need for more assiduous management of Phytophthora root rot for Ashdot rootstocks. In these ratings, which are visual ratings of canopy density, colour and leaf loss, 0 is healthy and 10 equates to dramatic decline.

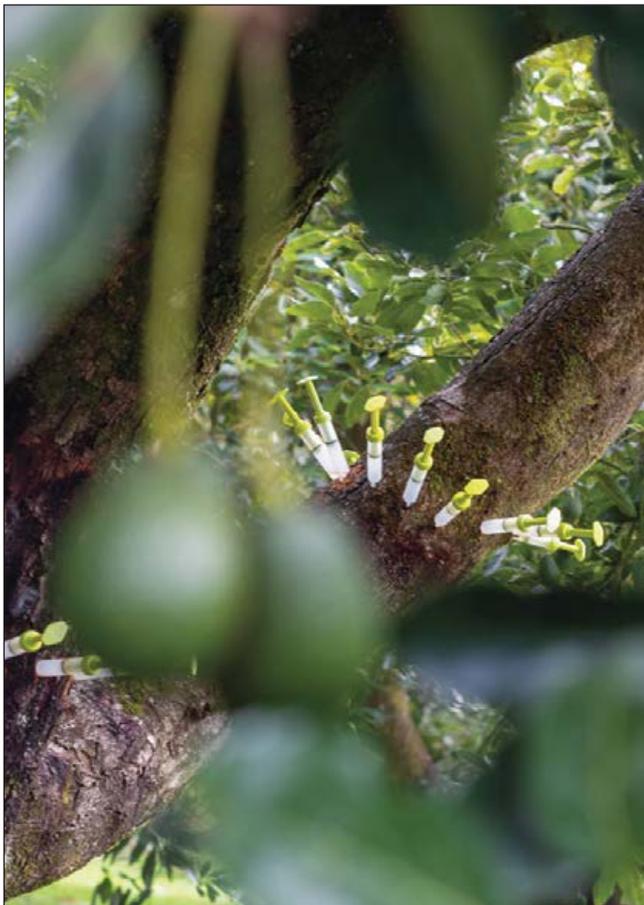
In 2017 Ashdot rated on average 0.7 compared to 0.2 for Velvick ($P=0.021$), and in 2018 Ashdot rated 2.7 compared to 1.4 for Velvick ($P<.001$). Note that these ratings are done in November when a heavy crop load can cause a large percentage of leaf drop which is recovered in the summer flush, which may mean the Ashdot ratings may be overstated as they had on average higher crop loads.



Figure 4. Determinate inflorescences (with no vegetative shoot from the tip)



Figure 5. Indeterminate inflorescences (with vegetative shoots emerging from the tip)



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Table 6. Avocado Rootstock Trial mean yields 2017/18 and 2018/19 and key parameters 2018/19

Treatment	Yield per tree (kg)		Yield per ha (tonnes)		Rootstock/ scion CSA	% of terminals determinate
	2017/18	2018/19	2017/18	2018/19	2018/19	2018/19
Grand mean	3.51	6.72	3.9	7.5	1.04	13%
Zutano¹	3.50	6.21 ab	3.9	6.9 ab	1.27 e	10% ab
BW2	3.15	8.23 b	3.5	9.1 b	1.10 cd	18% b
181	3.10	6.24 ab	3.4	6.9 ab	1.06 cd	9% ab
Ashdot	4.43	13.30 c	4.9	14.8 c	1.01 bc	30% c
Dusa	4.72	4.44 a	5.2	4.9 a	0.88 ab	11% ab
Latas	3.57	5.90 ab	4.0	6.6 ab	0.86 a	13% ab
Velvick	4.29	5.08 a	4.8	5.6 a	1.05 cd	9% ab
Reed	2.73	4.54 a	3.0	5.0 a	1.15 de	15% b
Bounty2						

¹ One replant was excluded from analysis in 2017/18 but due to rapid growth was included in 2018/19 analysis. ² Bounty results are not shown due to a lack of confidence that our data is representative of the rootstock. 'CSA' is cross sectional area. Means within each vertical group that are followed by the same or no letter are not significantly different at the 95% confidence level.

In 2018, a total of 10 of the 150 trees in our trial on Ashdot rootstocks (6.7%) rated ≥ 5 , our trigger for preventative or curative treatments for Phytophthora root rot. This compares to 1 of 150 trees on Velvick rootstocks, or 0.067% of trees. We leave it to growers to decide whether the yield gains from Ashdot justify the additional costs of root rot management.

In the high-density rootstock trial, planted in 2016, we now have two years of yield data. In both 2018 and 2019, yields from Ashdot were higher than all other rootstocks, although differences were only significant at the 95% confidence level in the second crop (Table 6). In this trial, unlike the Planting Systems Trial, we have not seen a difference between Ashdot and Velvick in the ratio of rootstock to scion cross sectional area. Nevertheless, we have seen the same pattern of higher proportion of determinate flowering in Ashdot than in Velvick which may be contributing to higher yield (Table 6).

Future research

What is the future then for our high-density planting research? We hope to pursue the following.

Different tree shapes. In the Planting Systems Trial the central leader shaping appears to have produced good light distribution but poor canopy structure in terms of weaker branches and increased branch death. Our efforts so far in the rootstock trial suggest it will be difficult to dramatically improve yield by improved structure and pruning techniques using the same shaping: spring fruit set in the trial this year (third crop) is a disappointing average of 0.14 fruit per flowering terminal across all rootstocks. Future high-density research should include trials of multi-leader structures, such as vase shapes or 'V' or 'Y' shapes, to help overcome these weaknesses. Systems which have the potential to stimulate constant regeneration of short fruiting branches, possibly



Figure 6. The high-density planting in March 2019 (with Technical Officer Carola Parfitt)

two-dimensional trellis systems, should also be tested. Two-dimensional trellis systems also maximise light distribution through the canopy and have a high canopy:root area ratio. Whether or not these benefits outweigh the adverse effects of frequent pruning, and yield justifies the extra costs required, remains to be seen.

Different cultivars. Cultivars other than Hass may be more suitable for high-density plantings. We have included Gem[®] and Maluma in the second phase of our rootstock trial, in a trellised a high-density planting. We are comparing two-dimensional and three-dimensional central leader shaping in this trial. In our experience to date, Gem has a dense and compact structure featuring many small branches. Maluma on the other hand has an open canopy, with a horizontal branching tendency. We will see in due course whether either of these habits contribute to improved yields in trellised systems.

Managing vigour and fruit:shoot competition. The potential for reducing fruit: shoot competition through changing pruning times from winter to later in the season and/or through changes to nutrition and Plant Growth Regulator (PGR) strategies needs to be explored. The use of soil drenches for avocado plantings less than 2.5m high of AuStar[®] (active ingredient paclobutrazol) is now permitted, and future research needs to include this management option, particularly in the absence of a viable dwarfing rootstock.

More information

Growers who would like to see the trials in Bundaberg and/or share experiences or ideas in high density plantings are most welcome! Please contact Helen Hofman (Helen.Hofman@daf.qld.gov.au).

Acknowledgement

The efforts of the project team at Bundaberg Research Facility, Jarrad Griffin, Carola Parfitt and Hanna Toegel, and of the farm staff, are gratefully acknowledged. We also thank the industry members of the Advisory Group for their help and advice in managing the trials.

The Small Tree - High Productivity Initiative is an initiative of the Queensland Government. Major partners include the Department of Agriculture and Fisheries (DAF), DAF's research alliance with the University of Queensland (Queensland Alliance for Agriculture and Food Innovation), and the NSW Department of Primary Industries.

A key element of this initiative has been co-funded by Hort Innovation, using the across horticulture levy, contributions from DAF and funding from the Australian Government, through the Hort Innovation project *Transforming tropical/subtropical tree crop productivity* (AI3004). We are especially grateful to Hort Innovation and the various associated industries and horticultural businesses for their support for this initiative.

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Remote sensing for the assessment of canopy decline in avocado

Surantha Salgadoe, Andrew Robson, David Lamb, Elizabeth Dann and Chad Simpson

The Australian avocado industry suffers millions of dollars of lost productivity each year as a result of Phytophthora Root Rot (PRR) (Australian Avocado Industry, 2016).

PRR disease is caused by the soil-born pathogen *Phytophthora cinnamomi* that reduces the ability of trees to take up water and nutrients, resulting in stress, canopy decline, loss of crop yield and quality and eventually tree death.

Currently, the presence of PRR is determined visually as canopy decline by grower observation at the individual tree level, where in some cases the severity of infection is quantified against the 'Ciba-Geigy' scaling system. This rating system uses photographic references to scale canopy density from 1 (healthy) to 10 (dead). Whilst this method is significantly more cost effective than tissue sampling, it is still labour and time consuming, subjective based on the visual assessor and struggles to detect the disease in its early stages (pre-symptomatic).

The University of New England's (UNE) Applied Agricultural Remote Sensing Centre (AARSC) has been investigating a range of ground and satellite based remote sensing technologies for their ability to more accurately and efficiently identify PRR induced symptoms, particularly in the early stages of infection. The technologies assessed included the standard red, green, blue (RGB) mobile phone camera, ground based thermal imagery (acquired with a mobile phone mounted FLIR camera and hand-held research grade FLIR camera), and Worldview-3 satellite imagery. The research was conducted within commercial orchards in Bundaberg, in the Central Queensland growing region (2017-2018).

Mobile phone images (RGB) method

Mobile phone images (RGB) were taken of 80 trees (cv. Hass) exhibiting different levels of canopy decline associated with PRR. Soil samples collected at each tree confirmed the presence of PRR, whilst the severity of canopy decline was rated by experienced agronomists using a modified Ciba-Geigy scale. The trees were also non-water limited at the time of sampling. Photos of the selected trees were acquired facing the shaded side and at an angle of 45° above the horizontal. All images were taken during daylight between 7am and 4pm.

The calculation of average canopy porosity (%) derived from the RGB images of each tree was found to be strongly related to Ciba-Geigy rating and as such presents a more subjective method for measuring canopy decline. This would allow

untrained staff to better classify trees across an orchard suffering canopy decline such as that associated with PRR. The additional recording of GPS coordinates with each photo would allow for the spatial and temporal spread of high-risk trees to be more efficiently mapped, monitored and therefore remediated.

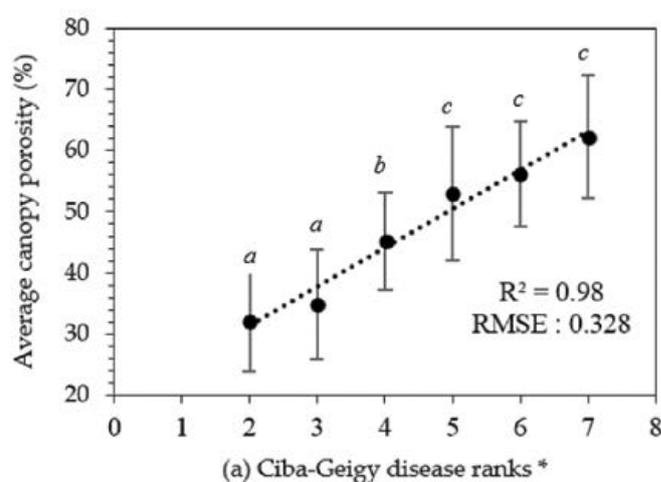
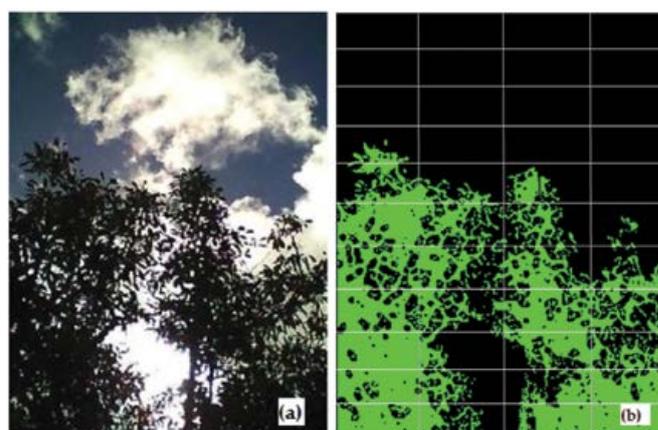


Figure 1. (a) RGB image acquired from mobile phone and (b) subdivision of image for calculating canopy porosity (c) Results of derived canopy porosity values against disease ranks (a) Ciba-Geigy. * Error bars indicate the standard deviation for each category. Averaged with similar letters are not significantly different from each other at $p < 0.05$.

On-ground canopy temperature method

Theoretically, it has been shown that plants suffering from water stress, or from diseases that reduce water uptake, will exhibit reduced stomatal conductance (I_g) calculated from the mean, minimum and maximum temperatures of the canopy, and therefore an inability to cool themselves when exposed to direct sunlight. This ultimately results in 'sick' trees having a hotter canopy on the sunlit side as opposed to shaded side. The temperature of sunlit and shaded sides of 80 tree canopies was measured with a mobile phone mounted FLIR camera and hand-held research grade FLIR camera (Figure 2). Plotting the resultant stomatal conductance differential (ΔI_g) against PRR-induced canopy decline produced a strong relationship (Figure 2), with the detection of early infection being achievable before canopy decline was visually apparent (~30% canopy porosity).

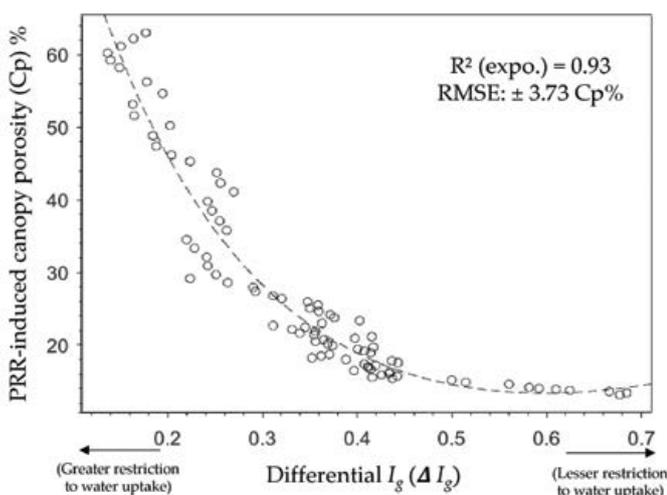
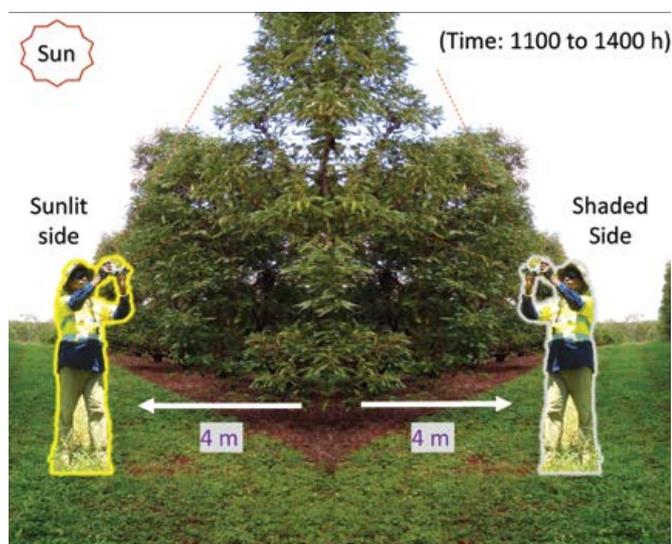


Figure 2. (top) Thermal images acquiring from shaded and sunlit side segments of the avocado canopy for assessing PRR-induced canopy decline. **(above)** Graph depicting PRR-induced canopy defoliation (porosity %) as a function of differential I_g (ΔI_g) values derived from the shaded and sunlit sides of avocado tree canopies.

Historically, thermal cameras have been used to measure water stress and disease in plants. However, the method was extremely slow as a 'wet' and 'dry' reference panel was required to be physically included in every photograph. The research undertaken within this project developed a mathematical method of image analysis that replaces the need for reference panels and as such creates the opportunity of collecting imagery at a greater rate from a vehicle or potentially with an airborne or UAV mounted sensor. Additionally, the low cost (~\$600) mobile phone mounted FLIR camera (Figure 3) was evaluated as it potentially presents as an affordable and practically adoptable option.

Satellite imagery method

Whilst both previous methods provided positive results, they still require every individual tree to be measured and as such remain labour intensive. In an attempt to increase the scalability of individual tree measures and therefore reduce the need for every tree to be assessed, very high resolution satellite imagery was also evaluated.

The canopy reflectance information for each of the 80 selected trees was measured from a Worldview-3 (WV-3) satellite image acquired on 3 April, 2017 (Figure 4). The simple ratio vegetation index (SRVI), a ratio of near infrared and red spectral bands, exhibited the strongest significant correlation to disease rankings (as well as the derived canopy porosity). Using this relationship, a classified map of tree health was derived, showing areas of decline such as that associated with PRR infection (Figure 4).

The derivation of the PRR risk map not only identifies the spatial variability of tree health across the orchard, but can be compared over time to identify where PRR symptomatic trees are historically located, the actual area of infection, how it changes seasonally and how remediated trees are responding. Additionally, the maps can be easily deployed to growers and field staff to better direct them to high-risk areas for more intensive on-ground diagnostics.



Figure 3. Mobile phone mounted FLIR camera

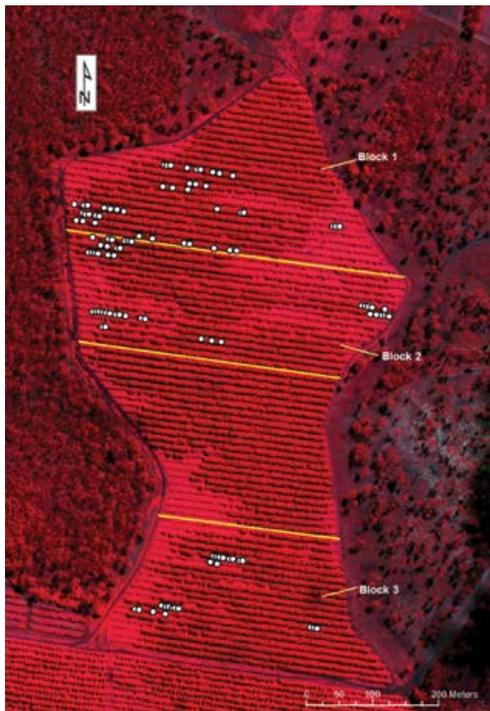
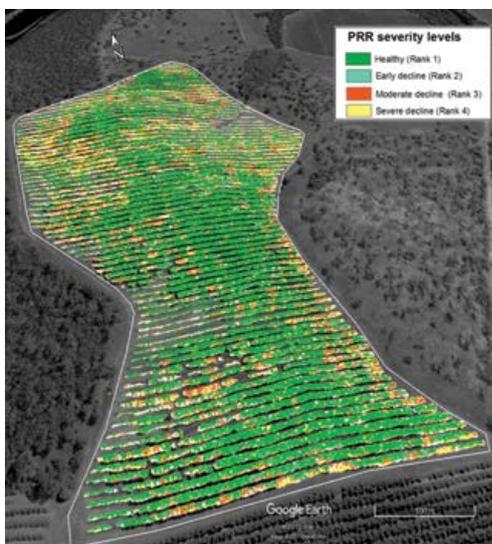
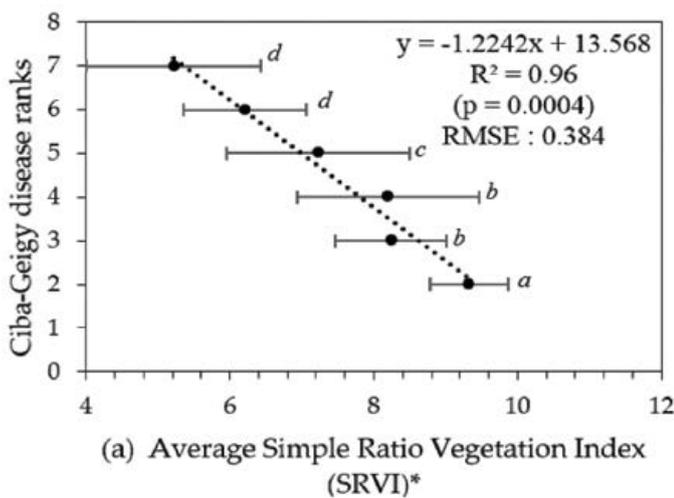


Figure 4. (top) Worldview-3 satellite, false colour image of the orchard with sample locations (acquired 3 April 2017). The location of selected trees is given as solid white circles. **(middle)** Ciba-Geigy disease rankings versus average simple ratio vegetation index (SRVI) values (respective trees grouped into their disease ranks). *Error bars indicate the standard deviation for each category. Means with similar letters are not significantly different from each other at $p > 0.05$. **(bottom)** classified PRR severity distribution map of the avocado orchard according to SRVI, super-imposed over an elevation layer in Google Earth.



Conclusion

The outcomes from this research identified a number of remote sensing technologies that have the potential for improving the efficiencies, accuracies and early detection of tree decline including that arising from PRR infection in avocado orchards. The full results for each method are provided in the reference section below. The project team is continuing to work with the avocado industry, Hort Innovation and commercial entities to further develop these outcomes as practical ‘tools’ to assist with future disease management strategies.

Acknowledgement

The authors gratefully acknowledge the Australian Government Rural R&D for Profit scheme and Hort Innovation for funding this research. The authors sincerely appreciate the support of Avocados Australia, Simpson Farms, and Dr Chris Searle.

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Get the app, improve the map!

By Craig Shephard, UNE Applied Agricultural Remote Sensing Centre

The Australian Tree Crop Rapid Response Map (published in 2017) is being updated at a larger scale (one hectare) and importantly will map the new avocado orchards.

The baseline map has been viewed more than 8,000 times and successfully applied in support of biosecurity preparedness, natural disaster recovery and industry metrics. In 2017, the production area covered totalled more than 13,000 hectares nationally.

The success of the baseline mapping was in the collaboration between growers and stakeholders, whose direct input and use of the Land Use Survey App provided the vital information to map the orchards accurately.

We are again seeking your input, by using the Land Use Survey App (www.qld.gov.au/landusesurvey), anyone can submit a land use observation (from any device, mobile or desktop - it runs in a browser), particularly for mapping new orchards. The observations submitted will help update a vital layer for the industry...“get the app and improve the map!”

The map is currently being used to provide an idea of the extent of the 2019/20 bushfire season, showing fire extent and the location of avocado, mango and macadamia orchards. Visit bit.ly/AUfire2020 to see the bushfire mapping, and read more about these efforts on page 13. The original Australian Tree Crop Rapid response map is available at bit.ly/AUtreecrop.

Potential applications

The potential applications for the map are not limited to post-natural disaster monitoring. Knowing the distribution and extent of orchards has the power to greatly inform decision-making at farm and industry level. Applications include increased biosecurity preparedness, where targeted field surveys and the implementation of exclusion zones can immediately be implemented following an incursion, saving both time and money.

For the industry, knowing the spatial distribution of orchards greatly assists with a better understanding of likely harvest timing and volumes whilst a more accurate measure of production area can assist with improved estimation of annual production volumes and subsequent business decisions.

Importantly the mapping adheres to national standards for commodity level land use mapping, supported by the Australian Collaborative Land Use and Management Program (ACLUMP).

ACLUMP promotes nationally consistent land use information. Privacy concerns are acknowledged and respected as the information sources used to compile land use include remotely sensed data (imagery), state and national ancillary datasets, field observation and expert opinion.

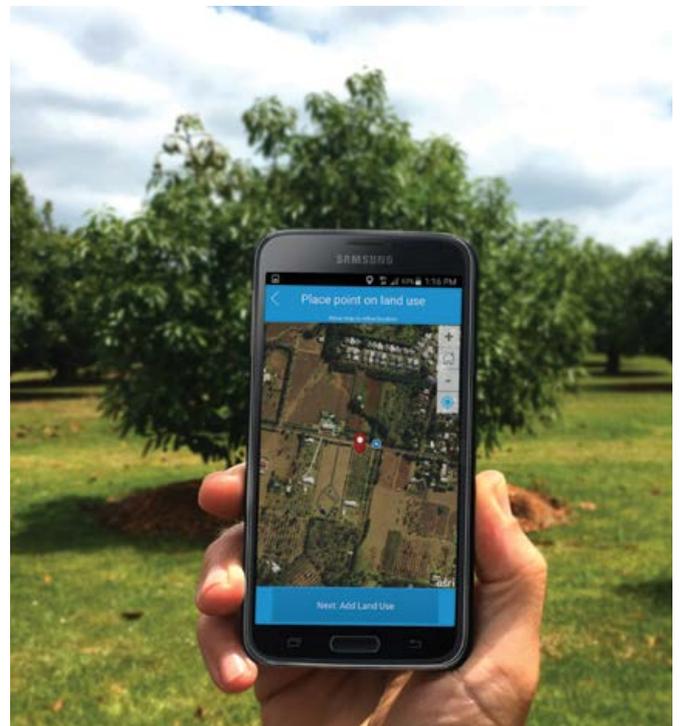
No personal or confidential information is collected as part of the land use mapping process nor contained within the land use datasets. The map simply presents a polygon feature that denotes the specific land use, no property information (block, variety, yield, etc) nor personal information (grower, enterprise, owner) is included.

More information

Contact Craig Shephard at cshepha2@une.edu.au or visit une.edu.au/aarsc.

Acknowledgement

The *Multi-scale monitoring tools for managing Australian tree crops initiative*, was supported by Hort Innovation under the Australian Government’s Rural R&D for Profit program.



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NIRS work progressing. How good is that?

By Jeremy Walsh and Kerry Walsh, Central Queensland University, Rockhampton

This article picks up on the report Old dogs and new tricks: new tools for dry matter in the Spring 2018 issue of this magazine (bit.ly/TApast), to discuss uptake of new technology for dry matter testing, and figures of merit used in reporting results. Work is continuing on assessing new technology, in avocado and other tree crops.

Technology uptake

NIRS (near infrared spectroscopy) technology is available in handheld and in-line (packline) formats.

For the Australian mango industry, it is the handheld format that has seen adoption. The Australian Mango Industry Association (AMIA) has set target specifications on mango fruit dry matter content (DMC), related to eating quality of ripe fruit. In mango fruit, DMC is an index of starch and sugar content. Starch converts to sugar during ripening, so DMC at harvest is related to sugar content at ripe, and thus to eating quality.

Larger producers have their own handheld NIR units, and AMIA officers offer an on-farm pre-harvest test as a service to growers (eg, see <https://mailchi.mp/mangoes/my-mango-31-december>). The handheld format has been adopted over the in-line format as this allows for testing of fruit on tree, with fruit able to be left on tree longer if fruit are not at specification.

The technology can be used to assess DMC of avocado fruit, as an index of oil content. The technique is not quite as precise for avocado as for mango, as expected given the thicker skin of the avocado fruit. However, there is a larger range in DMC in avocado than in mango fruit, and the technology may have a role in the avocado industry.

If you have watched the episode on the avocado industry in the series 'Rotten' on Netflix you will have an idea of the size of the Mexican industry. The Asociación de Productores y Empacadores Exportadores de Aguacate de México (APEAM) facilitates work to improve both the avocado export and internal markets, collaborating with the Mexican government agency Sagarpa and the USDA on phytosanitary, safety and certification measures, and undertaking research work to improve export. According to *FreshPlaza* (bit.ly/TA304mex) growers must provide APEAM with 30kg of fruit as a sample for quality assessment, which includes assessment of DMC. The method used for DMC assessment has been based on microwave drying. APEAM is now assessing the Felix F-751 handheld NIRS as an official dry matter measurement tool,

with focus on the Hass variety. The drivers for adoption are speed of assessment and less destructive sampling.

NIRS use on packlines has been used to maintain a DMC specification on a product line and to divide a population on DMC level, with higher DMC fruit tending to be more mature, and thus ripen faster.

Figures of merit

As the technology is also considered by the Australian industry it is timely to review some key terms and concepts relevant to describing its performance.

A prime advantage of the NIRS technology relative to an oven DMC determination is speed. This allows for an increase in the size lot sampling which results in better lot representation. To be technical, the uncertainty on how well a sample represents its population is decreased proportional to the square root of the number of samples taken.

Consider the following two graphs (Figure 1): in the top panel the "y" values are the "x" values with a random number added. In the bottom panel the "y" values with their random influence have been generated 16 times and then averaged. Obviously, the averaging has helped!

So how many samples should be taken, ie, how many fruit should be measured in an orchard to get a reliable estimate of that orchard? Well the answer is easy if all fruit had the same DMC – only one fruit would need to be sampled! But as variation in fruit DMC increases, the number of samples needed increases. There is a little formula to estimate the required number of samples, n , given the variation (standard deviation, SD) of fruit DMC, the acceptable error (e) and the desired probability level. For a 95% probability and an acceptable error of 1% DMC, the formula is:

$$n = \left(\frac{1.96 * SD}{e} \right)^2 = 25$$

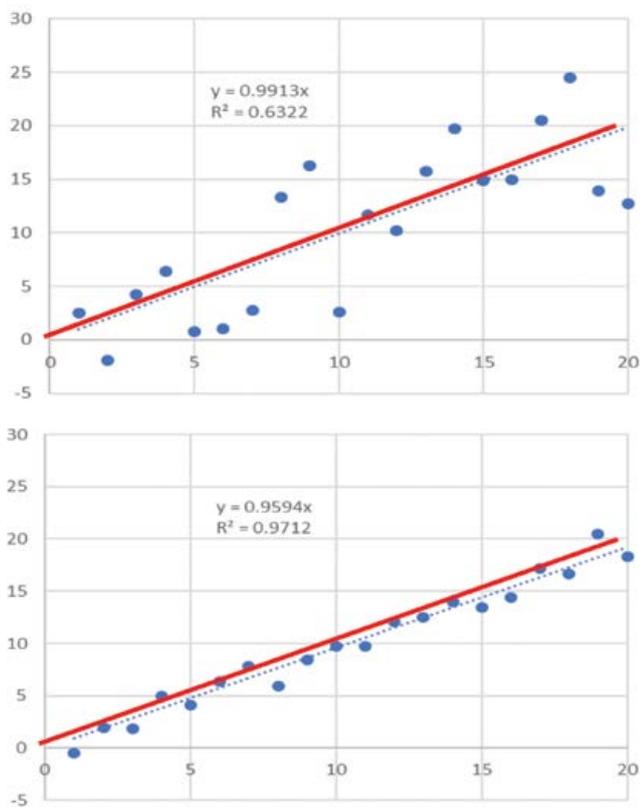


Figure 1. The value of averaging. Bottom panel has average of 16 values per sample. The red line is the ideal - a 1:1 fitted line. RMSE (root mean square of errors) for the top and bottom panels is 3.9 and 0.99, respectively.

Now a typical orchard has a SD of DMC between fruit of 2.5%, for which case the required number of samples is 25 ($n = 25$). Odds are few Australian producers assess 25 fruit per orchard! But assessment of 25 fruit is easily possible with NIRS technology.

The performance of a NIRS unit is assessed in comparison to the reference method, be that by microwave or forced air oven drying. Such a comparison can be shown as a scatter plot of NIR assessed versus reference method assessed DMC. For example, the Spring 2018 article carried the following plot of NIR estimated DMC versus oven-based estimation of DMC (Figure 2). The rest of this article will explain some of the terms used in describing such a plot.

Measurement performance can be described in terms of accuracy and precision. Accuracy is how close the measurement is to the actual value while precision is how repeatable the measurement is. A group of measurements can be precise (all around the same value) but not accurate, ie, a way off from the true value, or they can be accurate but not precise. If they are neither accurate nor precise they are of little value!

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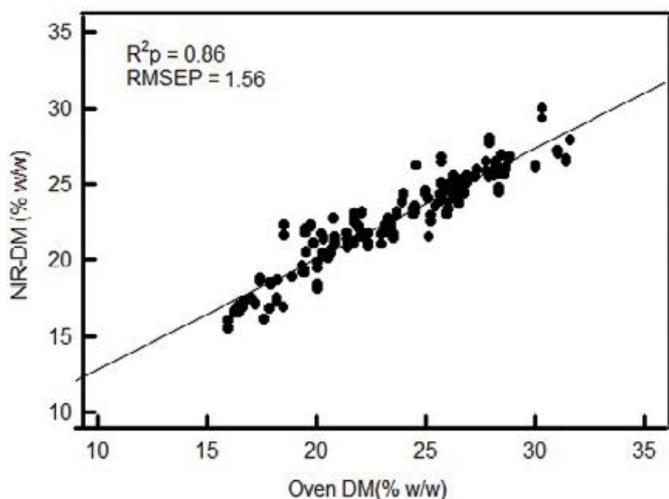


Figure 2. Example of predicted (NIR-DMC) values for a group of fruit using a F750 instrument, compared to oven DMC values for these fruit.

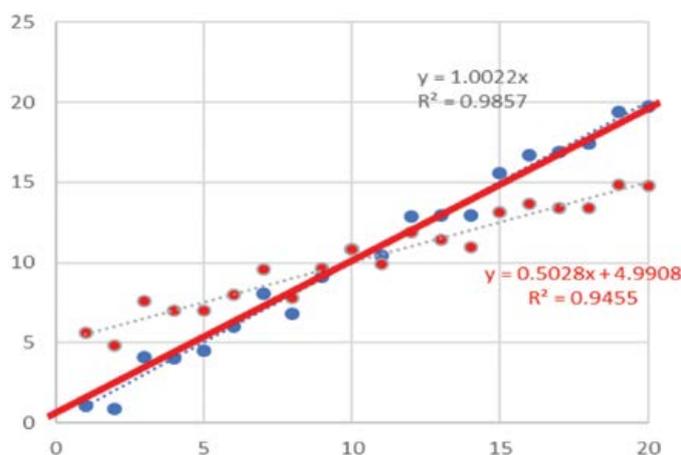
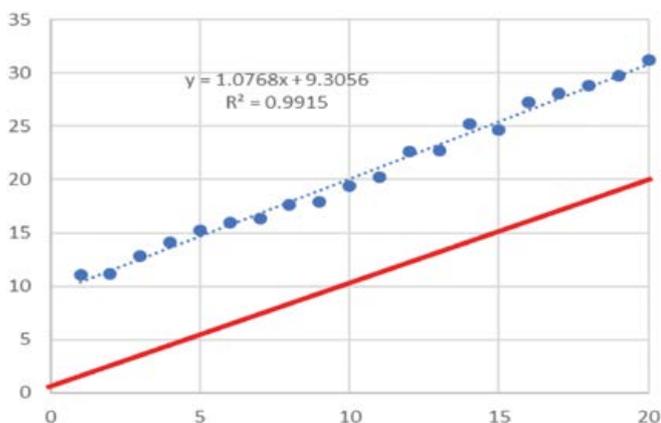


Figure 3. (top): the effect of a ‘bias’ – all values are shifted. **(Bottom):** the effect of slope – low values are over-estimated and high values are under-estimated (red dots). The red line is a 1:1 fitted line.

The closeness of the points to a line is described by the R^2 (‘correlation coefficient of determination’) statistic. This value can range from 0 to 1, with the closer this value is to 1, the tighter the relationship. For example, in Figure 1 the top plot has a low R^2 while the bottom plot has a R^2 close to 1. You can see which is better!

However, R^2 alone can be misleading. R^2 gives a measure of precision but not accuracy. Consider Figure 3 (top) – the R^2 is good, but all values are high. This error can be described as a ‘bias’ – the difference between the average of all samples for the NIRS and reference methods. Bias is an indicator of accuracy.

Another error results in over-predictions of low values and under-estimates of high values. This error is seen in the ‘slope’ value. In the example of Figure 3 (bottom), R^2 is good, and bias is 0, but the slope is low, ie, there is less range in the predicted values than the reference samples.

Another statistic commonly quoted in RMSE, or ‘root mean square of errors’, ie, the square root of the average of the squares of the difference between predicted and reference measurements. It is expressed in the units of the attribute being assessed – ie, DMC in our example. In Figure 1, RMSE is decreased from 3.9 to 0.99 by averaging of 16 samples. A lower RMSE is better than a higher one.

So, we have the terms R^2 , slope, bias and RMSE, all useful in describing performance of a NIRS measurement. On the positive side, if you know the bias and slope, you can correct for it, ie, adjust predicted values. If you have poor precision (low R^2), you can take more samples (average) to improve your result. If you want a single number to indicate how close NIR predicted values are to reference (oven) measurements, RMSE is useful. Typical RMSE reported on predictions of DMC of new populations of avocado fruit is around 1.5 % (Subedi and Walsh, 2019; bit.ly/TA304walsh).

Acknowledgement

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Snapshots – International Avocado Research Update

This series of research snapshots is compiled from abstracts of published scientific papers accessed through CAB Direct as well as Google Scholar searches. Dates provided reflect the date research was published.

PESTS & DISEASES

Novel approaches and methods for quantifying *Phytophthora cinnamomi* in avocado tree roots

South Africa (2019): *Phytophthora cinnamomi* is a devastating root rot pathogen of avocado. Robust and sensitive root quantification methods are required for determining seasonal *P. cinnamomi* root colonisation patterns and evaluating management strategies. This study investigated four *P. cinnamomi* root quantification methods using a newly developed *P. cinnamomi*-avocado-seedling bioassay system and a *P. cinnamomi*-specific probe-based qPCR assay. *P. cinnamomi* quantification through plating of roots (root plating) or lemon leaf disks obtained from root baitings (root-baiting-plating) onto semi-selective media were the best methods. Root plating consistently yielded significant differences in *P. cinnamomi* quantities obtained from seedling roots inoculated with five zoospore concentrations, whereas root-baiting-plating did so less often. The two methods were comparable in yielding root quantities that were significantly correlated with the inoculated zoospore concentrations, rarely yielding false negatives and having the lowest variability between replicates of the same treatment. qPCR quantification from roots was also an effective method; however, treatment replicates were highly variable and false negatives occurred more frequently. The least effective quantification method was qPCR quantification from lemon leaf disks obtained from root baitings. Find the full text online: bit.ly/TA304pr.

An evaluation of scent-discriminating canines for rapid response to agricultural diseases

United States (2018): Laurel wilt disease, incited by *Raffaelea lauricola*, has resulted in the death of more than 300 million laurel trees (Lauraceae) in the United States. One such tree is the commercially important avocado, the second largest tree crop in Florida other than citrus (*Citrus* sp.). This disease affects the industry in South Florida and two larger avocado industries in Mexico and California have taken notice. Trees succumb soon after infection, and once external symptoms are evident, the disease is very difficult to control and contain as the pathogen can spread to adjacent trees via root grafting. Presently, there is no viable, cost-effective method of early diagnosis and treatment. This study was undertaken to evaluate the use of scent-discriminating dogs for the detection

of laurel wilt-affected wood from avocado trees. Three dogs, one Belgian Malinois and two Dutch Shepherds, were trained and studied for this ability. In addition, prevailing weather conditions were recorded and evaluated to determine their effect on canine performance. The results of this evaluation indicated that canines can detect laurel wilt-affected wood and the laurel wilt pathogen and may be useful in the detection of laurel wilt-diseased trees in commercial groves. The full article can be found online: bit.ly/TA304wilt.

POST-HARVEST

Effect of post-harvest thermal treatments on reducing external chilling injury in Fuerte

Egypt (2017): This experiment was carried out during 2013 and 2014 seasons on Fuerte fruit to study the effect of post-harvest treatments with hot air at 38°C for (15, 30, 45 minutes) or dipping fruits in hot water at 46°C for 30 minutes. All treated fruits were stored at 4±1°C and 90% relative humidity (RH) to maintain fruit quality. Chilling injury percentage, weight loss, texture, soluble solids content (SSC), titratable acidity percentage, activity of polyphenol oxidase, peroxidase, oleic acid, linoleic acid and linolenic acid content were determined. Fruit treated with hot air at 38°C for 15 or 30 minutes before cold storage best maintained fruit quality and storability without significant difference between them. Read the full paper online: bit.ly/TA304chill.

Effect of conventional and alternative products on post-harvest disease control in avocados

Brazil (2018): Post-harvest diseases constitute a serious problem for avocado commercialisation. This study aimed to evaluate the effect of conventional and alternative products in controlling diseases affecting Hass avocados in the field and in the post-harvest by carrying out physicochemical characterisation of fruits subjected to post-harvest treatments. In the field, besides the management adopted by the farmer, seven products were sprayed three times during fruiting for evaluation. Postharvest products were diluted in water or in oxidized polyethylene wax and shellac. Water treatments with potassium phosphite, Soil-Set®, chlorine dioxide, thyme essential oil, sodium bicarbonate, lemon grass essential oil and thiabendazole reduced the incidence of diseased fruits, and anthracnose, the main disease, was controlled with sodium bicarbonate, lemon grass essential oil and thiabendazole.

Greater soluble solids content was found for control (water), chlorine dioxide, acibenzolar-S-methyl and thiabendazole. For the products that reduced anthracnose, there was no correlation between the disease and the physicochemical parameters, evidencing that the disease control is not associated with delayed ripening. For wax treatments, diseases were not controlled, and the fruits presented lower titratable acidity with thyme essential oil, sodium bicarbonate, control (wax), acibenzolar-S-methyl and lemon grass essential oil. Control and thyme essential oil were highlighted for maintaining the green coloration of the fruit skin for the shortest period. Under field conditions, azoxystrobin, thiabendazole, difenoconazole+azoxystrobin and acibenzolar-S-methyl+azoxystrobin reduced the occurrence of diseased fruits, while anthracnose control was only obtained with azoxystrobin. Find the full paper online: bit.ly/TA304post.

Nanomaterials as alternative control means against post-harvest diseases in fruit crops

Brazil (2019): Synthetic fungicides are the first choice worldwide to control post-harvest diseases of fruit and vegetables. However, several problems and constraints related to their use have forced scientists to develop alternatives control means to prevent post-harvest diseases. Physical and biological means, resistance inducers, and GRAS

(generally recognised as safe) compounds are the most important alternatives used during the last 20 years. Recently, nanomaterial treatments have demonstrated promising results and they are being investigated to reduce the utilisation of synthetic fungicides to control post-harvest rot in fruit and vegetables. The collective information in this review article covers a wide range of nanomaterials used to control post-harvest decays related to a range of fruit crops, including avocado. Find the full text at: mdpi.com/2079-4991/9/12/1752.

Bioactive compounds and antioxidant activity from harvest to edible ripeness of avocado throughout the harvest seasons

Peru (2019): The influence of regular air cold storage (7°C and 85 ± 5% RH) followed by ripening at shelf-life conditions (19-21°C and 65 ± 5% RH), on bioactive compounds of Hass avocados were investigated in this study. Results showed that the content of mannoheptulose and perseitol decreased significantly already during cold storage and ripening period. The fatty acid profile and contents of tocopherols (α- and β-tocopherol) and phytosterols (β-sitosterol, stigmasterol, campesterol) remained unchanged from day 0 to edible ripeness. Total phenolics, hydrophilic and lipophilic antioxidant capacity remained unchanged during cold storage and increased during the ripening period. At edible ripeness, significant amounts of phenolic acids,



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p-coumaric and caffeic and their derivatives were synthesised. Results demonstrated that regular air cold storage for up to 37 days followed by ripening at shelf-life conditions enhances the phenolic compounds and mainly the hydrophilic antioxidant capacity without affecting the remaining bioactive compounds in Hass avocado. Read the full text here:

<https://onlinelibrary.wiley.com/doi/abs/10.1111/ijfs.14474>.

VALUE ADDING

Converting industrial organic waste from the cold-pressed avocado oil production line into a potential food preservative

New Zealand (2019): The production of commercial cold pressed avocado oil (CPAO) generates large quantity of organic wastes such as pomace, seeds, peels and wastewater. During the early harvest season, for every 1000kg of avocado fruits processed, roughly 80kg of oil is produced and wastewater accounted for the highest proportion (500kg). Therefore, it is important to find an alternative application for this wastewater rather than its direct disposal into landfills. Proximate analysis, total phenolic content (TPC) and antioxidant assays were conducted on the avocado wastes. Avocado wastewater (AWW) was spray dried into powder at different temperatures from 110°C to 160°C, which simultaneously increased the TPC and antioxidant capacities of the AWW powder. The powder was further applied as a preservative in pork sausages and was found to be effective in preventing lipid oxidation. The full paper can be purchased here: bit.ly/TA304oil.

NUTRITION

Hass avocado inclusion in a weight-loss diet supported weight loss and altered gut microbiota: a 12-week randomized, parallel-controlled trial

United States (2019): Avocados contain fibre, lutein, and vitamin E, and they are a rich source of MUFAs (oleic acid). The effect of including an avocado daily as part of a hypocaloric weight-loss diet on weight loss is not known. The aim of this study was to determine the effect of daily avocado consumption as part of a hypocaloric diet on weight loss, body composition, satiety, biomarkers of inflammation, and intestinal microbiota composition. In this randomised, parallel-controlled, open-label, two-arm intervention study, 51 healthy overweight/obese women and men were assigned to a hypocaloric diet with one Hass avocado daily or a hypocaloric diet without daily avocado for 12 weeks. Serum markers and intestinal microbiota were analysed at baseline and week 12. Both groups experienced significant weight loss, decrease in BMI (in kg/m²), total body fat, and visceral adipose tissue, respectively. Researchers observed a significant decrease in serum glucose over time in the control group compared with the avocado group. There was no change between the groups in serum triglyceride, but a significant decrease from baseline

to week 12 was observed in the avocado group. Serum hepatic growth factor (HGF) and relative proportion of bacterial phyla (Firmicutes and Bacteroidetes), family (Bacteroidaceae and Erysipelotrichaceae), and genus (*Bacteroides*, *Clostridium*, *Methanosphaera*, and *Candidatus Soleiferrea*) were significantly altered in the avocado group compared with the control group. A trend to decrease in serum inflammatory factors and C-reactive protein was observed in the avocado group compared with the control. Daily Hass avocado consumption as part of a hypocaloric diet supported weight loss, a decrease in serum HGF, and an increase in the abundance of bacteria involved in plant polysaccharide fermentation. Find the full paper online: bit.ly/TA304gut.

Use of avo agent in cancer treatment, through improved bioavailability

US (2020): Avocatin B, a lipid-derived from avocado, is identified as a novel anti-cancer agent capable of inducing apoptosis of leukemia and leukemic stem cells. Although this bioactive compound has demonstrated anti-leukemic activity in vitro, there is concern about its poor bioavailability. In this study, we exploited the surface-active properties of avocatin B to design self-emulsifying drug delivery systems (SEDDS) that are potentially suitable for human oral consumption. The formulations were prepared without external energy and using only one surfactant. In vitro cytotoxicity testing of avocatin B-SEDDS in acute myeloid leukemia cell lines indicate significant increases in potency and bioactivity compared to dimethyl sulfoxide-based delivery. A pilot pharmacokinetic evaluation of avocatin B-SEDDS in C57BL/6J mice revealed appreciable accumulation in whole blood and biodistribution in key target tissues. We anticipate that data obtained from this study will provide the framework for the development of avocatin B as therapeutic agents in the clinical setting. Read more: <https://atrium.lib.uoguelph.ca/xmlui/handle/10214/17717>.

SOCIAL LICENCE

Life cycle environmental impacts of fruits consumption in the UK

United Kingdom (2019): Fruits are indispensable for a balanced and healthy diet. However, their environmental impacts remain largely unknown. Using a life cycle approach, this work estimates for the first time the impacts of fruits consumed in the UK. What makes the UK a particularly interesting case is that only 7% of fruits are produced domestically, with the rest imported, largely (70%) from outside of Europe. In total, 21 types of fruit and 46 fresh and processed products produced in the UK and abroad are considered to estimate the impacts at both the product and the national levels. The findings at the product level suggest that melons have the lowest and mangoes and avocados the highest impacts as a significant portion of the last two are air-freighted. Processing leads to high impacts of fruit juices, dried and frozen products. Storage has a considerable contribution to the impacts of fruits stored over a long

period, such as apples. Packaging used for canned fruits and juices is also a significant contributor to the impacts. Taking the annual consumption into account, the whole UK fruit sector generates 7.9 Mt CO₂ eq. and consumes 94 PJ of primary energy. This is equivalent to 4% of the annual GHG emissions and 9% of energy demand of the whole UK food sector. Moreover, fruits require 0.35Mha of agricultural land and 315Mm³ eq. of water per year. Oranges, bananas and apples are responsible for more than half of the impacts at the national level as they account for 64% of the total fruit consumption in the UK. It is expected that the results of this study will be of interest to different supply chain actors, including farmers, food processors and consumers, aiding them in reducing the environmental impacts of fruits. This paper can be found online: bit.ly/TA304soc.

Canadian consumers' benefit and risk perceptions of genetically modified food

Canada (2019): This thesis investigates the role of information, emotion, and risk attitudes in Canadian consumers' risk and benefit perception of a hypothetical GM product – a GM avocado with delayed browning. To do so an e-survey was distributed to Canadian consumers. Additional product information was provided to consumers through experimental treatment blocks. Information treatments describing product benefits did not have an effect on consumer risk or benefit perception of the GM avocado,

but did have an effect on purchasing likelihood. Emotions – interest, anger, worry, pride, pessimism – were significant on perception or likelihood of purchasing the hypothetical GM avocado; risk attitudes were also significant. These results suggest that emotions play a more significant role in consumers' perception of GM products than product information. However, information communicating product benefits may play a role in how likely a person is to purchase new novel food products. Read more here: <https://atrium2.lib.uoguelph.ca/xmlui/handle/10214/17681>.

More information

If you would like more details on any of the snapshots, please contact Avocados Australia on 07 3846 6566.

Acknowledgement

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INDUSTRY PROFILE

New look, same goals for Summerland Farm

The Tamborine/Northern Rivers' Summerland House Farm, now known as Summerland Farm, is a social enterprise operated by Aruma, formerly House with No Steps.

As a business of Aruma, Summerland Farm has the sole purpose of helping people with a disability to live great lives providing supported employment opportunities for those who want and value work and may face barriers in open employment.

The farm is continually expanding business opportunities to create additional supported positions on site, currently employing more than 100 people with a disability across a range of horticulture and tourism businesses. Summerland Farm will increase its staffing levels this year.

Summerland Farm is set on 96 hectares (238 acres) on the north coast of New South Wales, in the Ballina/Byron hinterland. The farm now has 7,000 avocado trees with new plantings of 5,000 Hass complementing the existing Fuerte, Lamb Hass and Hass orchard. The location high on the Alstonville plateau provides a fertile farm environment and a beautiful attraction for visitors to explore.

The site is a horticultural and tourism business, hosting visitors, weddings and events venue in its fully licensed restaurant and function centre.

On the production side, each year Summerland Farm produces 120 tonnes of macadamias and 20,000 trays of avocados, as well as packing produce distribution to major markets and supermarkets and an extensive list of local retailers.

Summerland Farm recently received Australian government funding through the Building Better Regions Fund to employ an additional 35 full-time equivalent positions for people with a disability in 2020, through substantial expansion of the tourism and horticulture facilities on site.

“Our employees will tell you, employment with us is more than a job,” Summerland Farm horticultural manager Chris Smith said.

“It provides a chance to learn new skills, gain valuable workplace experience, and meet new people.”

Summerland Farm history

In 1956, Lionel Watts caught what he thought was the flu. In fact, he had actually contracted polio and eventually developed quadriplegia.

After leaving hospital two years later, he was turned away time and time again from job interviews due to his disability.

Lionel realised that if this was happening to him, it must be happening to others too, so he began a journey to make a difference and formed House with No Steps, now known as Aruma.

In the early 1970s, Lionel discovered an emerging opportunity in Australia: growing avocados.

After surveying land in New South Wales, he came across a property at Alstonville that he considered ideal for establishing an avocado farm.

In 1972, Summerland Farm was established, beginning with the first of what has grown to 2,000 avocado trees and providing employment for people with a disability.

The farm is now an award-winning North Coast tourism attraction, distribution hub, working farm and macadamia dehusking facility. With the new \$5.9 million expansion in 2020, the farm is planning for an increase in tourism visitation and horticulture business, but most importantly, continuing to employ more people with a disability well into the future.



Some of the 100 Summerland Farm staff planting 5,000 new avocado trees, all Hass, in 2019.

INTERNATIONAL NEWS

US to access Chinese avocado market

China's expanding economy, rising disposable incomes, and urbanisation are increasing interest and demand for imported horticultural products.

On 15 January, the US signed an economic and trade agreement with the People's Republic of China, a deal that includes developing access protocols for California's Hass avocado industry.

According to the USDA fact sheet on the deal, China's customs data indicates domestic demand for imported horticultural products increased from \$12.5 billion in 2013 to \$22.5 billion in 2018. China's imports of horticultural products from the United States totalled \$2.3 billion in 2018, third after the EU-28 and Thailand.

As part of the agreement, China has agreed to sign and implement a phytosanitary protocol to import Californian Hass, within three months of the agreement coming into force.

According to the USDA, China will purchase and import on average at least \$40 billion of US food, agricultural, and seafood products annually for a total of at least \$80 billion over the next two years.

In addition, both countries have affirmed that phytosanitary certificates are not required for the import of frozen fruits and vegetables.

The California Avocado Commission said it had lobbied to be included in the first phase of the agreement.

"While there are no guarantees, the inclusion of California Hass avocados in the agreement is a very positive sign that China market access may soon occur," Commission president Tom Bellamore said

"Hass avocado consumption in China has continued to show tremendous growth and may provide a valuable market option for California avocado growers in the future."

The Commission says it is already working with interested packers, as they prepare for the registration/certification of Californian packing facilities.

Meanwhile, Australia's Trade Minister is hoping China extends the favourable terms to other countries.

Speaking to Norman Swan on ABC's Radio National, Simon Birmingham said China's commitment to purchase \$200 billion of extra US imports during the next two years was "unconventional in trade policy terms".

"But if we have a look at China's economy, the growth in Chinese imports from around the world in 2018 was around about \$260 billion. So this two-year commitment of the US has achieved from China amounts to significantly less than half of what you would anticipate China's import growth volume to be over the next two years," Mr Birmingham said.

However, he said the Australian Government would monitor the deal closely, as they hoped some elements of the agreement would apply to all countries, not just the United States.

"I'm not asking for a special deal there for Australia but if you're going to streamline your approvals or your licensing standards, then as long as any nation can meet those approvals and licensing standards, their exporters ought to be able to participate under those terms," he told ABC Radio National.

"I have no doubt that many of my trade counterparts from around the world will be making the same point and I trust and hope that China will ensure that all of their partners are treated equitably in that sense rather than giving preferential terms to the United States."

Peru planning bumper export year

Peru is planning to exceed last year's 285,000 ton export total, including targeting new markets in South Korea and Thailand.

Association of Producers of Hass Avocado from Peru (ProHass) present Daniel Bustamante Canny told agraria.pe the 2020 campaign would exceed 2019 as young plantations increased in productivity.

"It is too early to say the percentage that shipments will grow, only at the end of January or beginning of February will we have the first production estimates. So far the climatic conditions have behaved adequately for avocado," he said in agraria.pe.

The country's new avocado areas are mainly in the Olmos and the Sierra and Bustamante says this will extend Peru's commercial window earlier in the season.

He told agrarian.pe that where significant commercial volumes of Hass were previously available from the end of April, that would now be brought forward to early April or even March.

As for the destinations, Bustamante said Peru aimed to diversify further each year, so that now Asia and Latin America were important markets but they had yet to reach the volumes directed to Europe and North America.

He said markets of South Korea and Thailand had recently opened, and work continued to gain access to other new markets.

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