‘Figures man’ builds performance by numbers
Taking charge of industry’s future

PHILIP TURNBULL – APAL CEO

In an unprecedented turnout for the apple and pear industry, over 200 growers, researchers, agronomists and packinghouse managers, came together for APAL’s Industry Forum in June.

Among the crowd, we welcomed 17 representatives from our inaugural Young Members’ Network. Funded by APAL, the Network will provide leadership, networking and career opportunities for future leaders although I suspect there will be plenty of reverse-mentoring as knowledge, innovation and experience flows between generations of growers.

Leaders must drive decision making. As growing regions heat up, the importance of reverse-mentoring as knowledge, innovation and experience flows between generations of growers. In an unprecedented turnout for the apple and pear industry, over 200 growers, researchers, agronomists and packinghouse managers, came together for APAL’s Industry Forum in June.

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Planetary pushback
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Going beyond gut feel
Capturing real-time data will enhance the operation of individual orchards, but even more powerfully, can help tackle industry-wide issues, improve planning, biosecurity and traceability.

Most growers have the experience to know what to do and how to do it, but often lack the situational awareness that technology now provides. Vision systems, for example, can now capture critical information thatigger timely accurate decision making.

Start preparing yesterday
Market access to China has the potential to transform our industry but the time to prepare is now.

Instead of competing with other southern hemisphere producers, Australia’s strategy must be to send premium quality to China where branded fruits will command a premium price. To succeed, a continued focus on quality (MRIs, food safety, specifications etc.), and developing trusted relationships cannot be understated.

The mind shift necessary to export is significant but cross-industry collaboration will help us accelerate faster, a point perfectly reinforced in CSIRO’s earlier presentation: “The best way to anticipate change in your sector is to spend some time outside of it.”

Lifelong learning
And for those who witnessed Cameron Schwab’s raw and captivating presentation, I suspect we each took away something different, but equally powerful. For me, it was a reminder that “Leaders must drive their own learning.”

And that’s what the Forum was all about: Challenging the status quo, embracing and adopting new ideas, connecting and talking to our peers – finding out what’s worked, what hasn’t and taking charge of our industry’s future.

Thank you to all who attended in June, I hope to see you again at our first Future Business event and dedicated Technical Update later in October.

APAL Annual General Meeting
14 November 2019, 1.30–4.00pm

APAL invites its members to attend the Annual General Meeting on 14 November at the MCG in Melbourne at 1.30pm.

All registered members will receive notice of full details of the AGM in due course. Not sure if you are a member? Email eag@apal.org.au to confirm.

Young Members launch
A highlight of the APAL events at Hort Connections 2019 was the inaugural gathering of the newly-formed Young Members industry group.

Some 30 growers, marketers, researchers and industry services employees under the age of 35 met in Melbourne to forge networks and share experiences and ideas for building a profitable and sustainable future.

Industry Services and Export Manager Justin Smith said the informal gathering had been a great success, with many attendees going on to visit newly-made acquaintances and share knowledge.

APAL once again partnered with Taste Australia and key exporters to promote Australian apple and pears at Asia’s biggest fresh produce trade show Asia Fruit Logistica in Hong Kong on 4–9 September.

To building a full picture of data will be a commitment by all to contribute their own piece of the puzzle.

APAL Financial Planning and Analysis Manager Alvin Kee said the project was an evolution of the industry stock tracking system Infopome. APAL is investigating broadening the spectrum to include tree numbers, production forecasting, product grading through the cool stores, consumer data and variety data.

Industry will be kept informed as the project gets underway.

Future Orchards®
Spring orchard walks

The November orchard walks will explore labour efficiency with the implementation of robotics and mechanisation, quality assurance of fruit, and how to open up new markets.

Dates and Locations – November 2019

Northern Loop
Monday 4th – Stanthorpe, QLD
Tuesday 5th – Orange, NSW
Thursday 7th – Bathurst, NSW
Friday 8th – Shepparton, VIC

Southern Loop
Monday 18th – Pemberton, WA
Tuesday 19th – Adelaide Hills, SA
Thursday 21st – Southern VIC
Friday 22nd – Tamar Valley, TAS

Register now at www.apal.org.au

Data-powered decisions
A new APAL Industry Data project aims to drive better-informed orchard and packhouse decision-making through the development of a new live online database holding up-to-date information on everything from cool store stocks to tree numbers.

To building a full picture of data will be a commitment by all to contribute their own piece of the puzzle.

For more information about the group contact Industry Services and Export Manager Justin Smith on jsmith@apal.org.au.
Jason Shields from Plunkett Orchards needs little introduction to the Australian apple and pear – and now wider horticulture – industry since receiving the 2019 National Awards for Excellence Grower of the Year for both APAL and Hort Connections.

‘Figures man’ builds performance by numbers

By Richelle Zealley – APAL

Jason Shields demonstrated the benefits and use of REVO platforms during the Autumn Future Orchards® walk in the Goulburn Valley.

By Richelle Zealley – APAL

Jason oozes passion, drive and determination and one key element that sets him apart from many is his willingness to share knowledge and information. His strong business acumen shows he’s acutely aware of Plunkett Orchards’ core business, working towards improving their commercial performance and setting industry standards for best practice. The introduction of picking platforms alone has given the business access to a larger pool of potential employees while removing various hazards that come with the use of ladders and bags.

During a demonstration of the new picking platforms at the 2019 Autumn Future Orchards® walk, Jason shared the benefits and opportunities that come from using no bags, trailers, tractors or ladders. “There’s no one running down the rows in front of the machinery where they are actually working,” Jason said. “Our staff need less training — we can put a person on the platform and once they’re used to the movement, they pick the same amount of fruit at the start of the season as they do at the end.”

Removing bags provides relief for pickers’ backs and improves fruit quality, helping avoid bruising and stem punctures. “Our biggest problem with rejects would happen as the fruit was coming off the tree, now the only time one piece of fruit touches another is in the bin.”

The first platforms came from Frumaco in Italy and were purchased in 2015 after Plunkett Orchards owner Andrew Plunkett saw them in action at Fruit Logistica, Berlin. “Our first two platforms were ordered ‘as is’, but we needed to make some modifications once they arrived to accommodate our row spaces,” Jason said. “They were so effective and efficient in terms of picking, pruning and other orchard practices that Andrew ordered another two that same year.”

They now have seven platforms — the newest three from REVO in Italy — and this is the first season they’ve picked using just platforms. At approximately $130,000 per machine they are an investment that Jason has costed out at just $3 per bin. “We need seven per cent efficiency to make it work and the machines have done that — this technology has turned a person that would usually pick two bins into one that picks four,” Jason said.

Fact-based decision-making

Jason joined Plunketts 20 years ago in January as fourth-generation grower Andrew Plunkett returned to work in the business. “They’d just bought 200 acres down the road, Andrew was focused on the packing side of things — they really needed someone to grow their fruit,” Jason said.

The Plunkett Orchards team now numbers around 30. Noel Plunkett (Andrew’s Dad) still gets out in the business and oversees the packing shed activity. Andrew is guided by Jason on orchard management and decisions are made on fact and worth as opposed to sentimental value. “The old original trees planted by Andrew’s great grandfather became a bonfire, it was an...”
Most people base the cost of a bin on picking, thinning and pruning expenses, but don’t include everything else which could be an additional $50–$80 per bin.

– Jason Shields

“I keep a running total for every block from when it’s been planted up to now and if it’s past that, that’s great. But if it’s a trending negative for three years and we can’t see any improvement we review, because once you get to losing money what’s the point? You’re better off investing in something else that’s going to make you money.”

Plunkett has planted between 10–20ha annually for the past 10 years and Jason estimates they’ve pulled out about 10ha each year. “The actual total area hasn’t really changed,” Jason said.

Their focus has always been on fruit that grows well in the Goulburn Valley climate and the challenge is to find the next suitable variety for the area. “People often ask why we don’t diversify, as there’s a variety of fruit grown in our region, but we’re not plum or cherry growers, it’s important to focus on what you do well and that’s apples and pears for us,” Jason said.

Figures key to performance

Jason refers to himself as a ‘figures man’. Although he didn’t do well in school, and still doesn’t like to be involved in a learning environment, he thrives on understanding performance.

“As a triathlete and triathlon coach I understand that figures prove performance,” he said. “I need to show why something isn’t working and unfortunately, I find a lot of people don’t go that far. They just take the ‘in’ and the ‘out’ for the year, look at the number and as long as that’s positive, they’re happy. “If only they could get rid of their bad go per cent, then their profit margin becomes bigger.”

Implementing systems like Tie Up Farming and Asana has helped with oversight and enabled instantaneous communication with the orchard team. “Previously we were paper-based, everything would be written down in the orchard and partly entered by one of the managers who would then pass it onto me – I actually hate entering data so it was never a top priority,” Jason said.

“By the time I had the data I wanted we’d finished picking apples, so I knew what it cost but couldn’t do anything to change it. Now with live data I can look at the app each night and know how much that day has cost us.”

They started using the new systems about two years ago and while Jason admits it’s still a work in progress, they’re moving in the right direction. Data is now entered into iPads in the field which reduces touchpoints and gives back time.

“We’re at a point where we’ve got the production pretty good, we’ve got the picking, thinning and pruning around world standard, average pricing. Now I’m working on the ‘other’ cost – which is all the other stuff we do that costs nearly as much as production,” Jason said.

“Most people base the cost of a bin on picking, thinning and pruning expenses, but they don’t include everything else which could be an additional $50–$80 per bin. With this system we can split those jobs and assign tasks, I can give the tractor drivers direction and say this should be a half a day’s work here and half a day’s work there and they can do their job as complete.”

“I can also send a notification outlining what needs to be done that day – it’s made logistics and communication much easier.”

Prior to introducing the platforms several people would be spread across the orchards with separate top and bottom gangs. “We had different supervisors looking after the top and the bottom, there were groups of people everywhere,” Jason said.

“We now group them in teams of six on a platform with three platforms together, one supervisor oversees 8 people and instead of driving from farm to farm he spends the day with everyone physically within 15 metres.

“The biggest advantage of this is our gang costs went from $12–$14 per bin to $3–$5 per bin so we actually paid for the platforms in the supervision side of it regardless of the efficiencies.”

“Everything is set up on Asana and I can estimate the time it will take to complete an activity in a particular block. Say there’s three hectares of trees which would take 32 hours to prune, if there’s six people on each machine, a block should take two days and with three machines it would take 10 minutes to complete a row. As soon as they’ve done the first row they know whether they’re under or over the estimated time.”

Changing systems can be challenging for a variety of reasons – a new system is unknown, it may not talk to an existing one, and it takes time and effort in setting up and learning the new system. All barriers to adopting new technology.

“Because Tie Up Venture is a start-up some people ask me what happens if in five years’ time they go out of business? Well, it’s no different to what happens with other companies that cease trading. You still have that data and can always export it. If it’s not all in the same system it doesn’t really matter, you know where your starting point is,” Jason said.

“I’d say the biggest hesitation is most farmers enjoy being in the orchard, that’s why they need to look at employing someone to focus on their business management so they can do what they want to. Noel Plunkett is a perfect example of this – he doesn’t want to look at numbers to the point he doesn’t really see them, he trusts that we’re making a decision off a proven reason.”

“We also needed to convince a few workers we weren’t introducing these new systems to get them into trouble but it was a way to plan their workload and provide additional support if necessary.”

Letting nature take its course

Jason is seen as a leader in the industry for the whole-systems package he’s introduced. Aside from the platforms and software, he has been working with Angelica Cameron and Paul Horne from BPM Technologies to control pests and diseases for almost 10 years.

“I had a real ‘aha’ moment talking to Paul one day where I understood that the more we sprayed for pests and diseases, the bigger failure we had,” Jason said.

“We were using all the chemistry we were told in soft, which was opening us up to outbreaks. We were killing all the beneficials without knowing it, and not controlling those we were using the chemicals for, so were ending up with a much worse result.”

“It’s so important to consider your beneficials in the orchard before you apply chemicals. Paul said to me, ‘nothing’s 100 per cent guaranteed so, ’
if you rely on chemistry for control, you need to expect some percentage of failure. You’ll also have no backup because all your beneficials are gone due to taking a chemical-based approach.

“Instead of taking a reactive approach, we now analyse what the consequence might be if we were to spray – because sometimes the consequence is worse than the problem. We had an issue with mealy bug two years ago, bit the bullet and stopped spraying and now there’s no trace of it.”

Jason stresses they’re not trying to reduce their use of chemicals altogether, but are wanting to get to the minimum amount necessary. “We try and encourage everything else that will help us use less chemical. The orchard has always looked nice and clean, whereas this year we’ve let the weeds grow and kind of go out of control. This has an impact on soil health, encouraging a healthier tree that is better equipped to fight pest and disease.

“If the tree’s healthy it will use its own fighting defence mechanisms to control the issue. We’re at the point of 90 per cent natural control and only using chemistry for the other 10 per cent. I was super surprised with how fast it worked – just crazily fast.

“This was one of the worst mite pressure years we’ve had. In January everyone asked how we were controlling mite and I said we weren’t spraying anything – in a 48-hour period I had five people call me a liar. So, I double-checked with our guys who meticulously went out and ended up finding a small amount along one channel. The next day I saw Elizabeth Mace (GV Crop Protection) and she said your blocks are amazing, there’s not a mite in sight and she’d checked that same block where the trace had been found.

“We haven’t sprayed a secondary pest insecticide this year for mealy bug, scale, mite or woolly aphid – not one. And they’re all the expensive sprays.”

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- Apply between 8 and 16 mm fruitlet diameter
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**No ‘work’ in lifetime apple achievement**

**ALEX WISDOM – APAL**

Western Australian grower Harvey Giblett and longstanding APAL Managing Director Jon Durham may both have already given a lifetime of service to the apple and pear industry, but neither looks like stopping yet.

While both received the industry’s ultimate accolade for service – the Lifetime Achiever award – at the 2019 APAL Awards Breakfast in June in recognition of their formidable contributions, both are still growing fruit and still championing the industry.

“Harvey’s daughter Nicole sheds some light on the inspiration behind the effort.” Nicole said. “If something is worth doing, it’s worth doing well, and ‘Find a job you’re passionate about and you’ll never work a day in your life’.

“Harvey works his hobby. Instead of fishing or playing golf, he grows apples.” Jon Durham served as Managing Director of the Australian Apple Pear Growers Association (AAPGA, now APAL) from 1995 to 2013, during which time he guided the growth of Pink Lady® in its infancy to establish it as the world powerhouse brand it is today. He was also one of the most prominent voices behind the efforts to prevent New Zealand apples from being imported in the early 2010s, which in turn set the precedent for strong biosecurity in Australia. Today, he considers it one of the achievements he is “most proud of”.

“I feel very honoured to be listed among industry people I have a very high regard for,” he said. “You don’t do what you do for an award, it’s very humbling.”

Jon has chaired many organizations over the years, from the Bacchus Marsh Fruit Growers’ Association to the Orchards and Minimal/Abridged Terms and Conditions

Nufarm Pick Your Prize Promotion 2019

Minimal/Abridged Terms and Conditions

All entries will be eligible to win a Major prize of a $50k Top Cropper points package valued at $25,000 to be won weekly. Total prize is valued at $1,250,000. Nufarm Pick Your Prize Promotion 2019 is open to AU residents 18+ only who if chosen as a minor winner, are/become a Top Croppers member. Between 12.01am (AEST) on 1/8/19 & 11.59pm (AEST) 30/10/19, visit nufarm.com.au/pickyourprize & fill out entry form inc receipt upload. Max 5 entries per person and 1 entry per household. Total prize valued at $1,250,000.

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For more information, contact your local Nufarm Territory Manager.
nufarm.com.au/pickyourprize

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**Other award winners:**

- **Grower of the Year:** Jason Buddin, Panki Orchards, Vic (see page 6)
- **Rising Star:** John Yecman, Hahndorf, SA
- **Researcher of the Year:** Helen Green, University of New England (Star Fruits)
- **Exporter of the Year:** Bill O’Brien, Wattamullan, Vic
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**AAPL SPRING 2019 | 13**
India, Thailand and Taiwan are attracting Australian markets, there’s a risk of inadvertently contributing but without the same focus on developing new varieties has delivered significant productivity gains, widespread adoption of new techniques and apple varieties. Almost certainly the largest premium fruit market people, and a rapidly expanding middle class, it is a market. With a population of nearly 1.4 billion waiting for access to be granted to the Chinese consumer.

PHILIP TURNBULL – APAL CEO

One growth strategy is to reignite export. Programs like Future Orchards® and June 2019. At the APAL Industry Forum, a presentation delivered by

Understanding the Chinese apple market

PHILIP TURNBULL – APAL CEO

With market access to China inching closer for mainland Australian apples, APAL undertook market research to better understand the mindset of the Chinese consumer.

Much-publicised stories of soaring Australian citrus exports have tantalised mainland apple growers waiting for access to be granted to the Chinese market. With a population of nearly 1.4 billion people, and a rapidly expanding middle class, it is almost certainly the largest premium fruit market in the world, and one with a growing taste for new apple varieties.

Programs like Future Orchards® and widespread adoption of new techniques and varieties has delivered significant productivity gains, but without the same focus on developing new markets, there’s a risk of inadvertently contributing to flat and declining pricing.

One growth strategy is to reignite export. India, Thailand and Taiwan are attracting Australian growers’ attention, but the sheer scale of China makes it a prize too big to ignore.

If we are confident that inter-governmental negotiations will ultimately secure access to China, growers need to start preparing now. Building knowledge of the markets and relationships with the right retailers is important. If we wait until access is granted to start these tasks, it may be three or four years before a single apple is shipped.

Modern China’s emerging and powerful generation

To hit the ground running, APAL commissioned market research firm, Crowd DNA to establish insights into the mindset of Chinese consumer. In-focus are the relatively young (25 – 35 year-olds), upwardly-mobile, urban individuals, who are already regular buyers of imported fruit and in charge of purchasing their own fresh produce. This powerful generation of buyers was the first to be born into a Modern China. Like our own millennials, they have been raised as digital natives, where social media and word-of-mouth recommendations from their network have the greatest influence on their purchasing decisions.

With the economy tripling in size between 2000 and 2010, this generation grew up in one-child families, knowing only increasing prosperity. Empowered by rising disposable incomes, they expect more in terms of product quality and customer service and have an insatiable desire for anything new and unique.

Food as status

Instead of brand-name ‘bling’, the modern Chinese consumer is looking for a more cultured, sophisticated show of success. Travel and food are popular options with young Chinese prepared to travel far and wide to ‘discover’ something that no one else knows about, or if travel is not an option, then they are prepared to pay a premium to access the exotic from home. Bargain prices are no longer the driver of customer satisfaction and consumers are swayed by better quality and a sense of the new and unique.

Nowadays our children have tried almost everything. They’re only interested in food with new tastes and ways of consuming it. We live an abundant material life today.

Our parents’ generation would shop in the farmers markets because it’s cheaper, but the younger generation don’t share their values, there’s no such thing as ‘un-affordability’ – if we want something then we pay for it, flavour comes before price.”

Fruit is a popular category in China, and while consumption still lags behind global consumption on a per person basis, the accelerating standard of living suggests there is enormous potential for this to grow.

Traditionally, apples, bananas, grapes and melons have been Chinese staples, but exotic products such as custard apples, berries, avocados, stone fruits, and mangos, as well as mind-bending ‘novelty fruit’ – square watermelons, thumb-sized miniature watermelons and white strawberries, have all piqued Chinese consumer interest.

Kiwis, coconuts, stone fruit and berries have been standout performers, making the transition from exotic treat, to regularly-purchased item, evidenced by foreign growers, like berry producer Driscoll’s, setting up domestic production.

Crisp, red and most of all, juicy!

Like Aussie consumers, the Chinese regard apples as perfect for snacking, baking, or breakfast foods, but they are historically eaten peeled due to concerns over pesticide usage, making it more difficult to eat as an ‘on-the-go’ snack.

Today, most Chinese will wash their apples very thoroughly, often scrubbing them with a specialist fruit wash and avoiding cutting them until they’re just about to eat them, to avoid fresh browning, which they see as a lack of freshness.

Individuals had their own taste preferences, although there was a clear trend in the market research group towards symmetrical ‘Goldilocks’ apples – not too big, not too small, with even, block-colour redness, seen as indicating a level of sweetness and juiciness, a criteria by which Chinese consumers are particularly impressed, boding well for pears!

And what about the domestic apple market?

There is a strong heritage of apple growing in China and production volumes are enormous. But with large-scale apple growing introduced over 70 years ago, most commercial orchards are now ageing and the yield is sub-optimal.

Add to this China’s very low labour costs, and it’s likely that Aussie apples will struggle to compete as a commodity in this market, so the focus must be on a premium, branded export offering.

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- Broad spectrum in-field control of powdery mildew and black spot, as well as suppression of alternaria in pome fruit, plus shot hole, blossom blight and brown rot in stone fruit
- Short withholding period – 14-days in pome and 1-day in stone fruit
- Safe on most beneficial species and pollinators#

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A misalignment between consumption patterns, which favour the premium end of the market, and large volumes of domestically produced, commodity-grade fruits, may favour international suppliers, at least in the short term. Add to this China’s very low labour costs, and it’s likely that Aussie apples will struggle to compete as a commodity in this market, so the focus must be on a premium, branded export offering.

**Safety first**

Production techniques play an important role in perceived quality. A growing process that is highly controlled and technologically-advanced provided market research participants with much greater confidence in product superiority, taste and consistent quality. Low-tech, more natural approaches, were seen as indicating a regressive, low-quality product.

The Chinese preoccupation with food safety is the result of a number of high-profile food and product safety scandals which have led to a lack of trust in many Chinese-made produced products.

The success of companies like Blackmores, Bellamy’s Organic and Swisse demonstrate a strong and growing preference for ‘clean and safe’ foreign products, which are now as much about lifestyle and health, as they are luxury brands. In terms of fruit, the overseas provenance of imported produce is enough to signify higher standards of quality, although specific locations, i.e. Australia versus France or Japan, don’t drive additional quality associations.

**The take-aways**

- Affluent Chinese consumers are prepared to pay a premium price for quality and freshness, delivered by standardised, high-tech production methods.
- The new generation of Chinese consumer is seeking new, exotic taste experiences and assurances of quality.
- Chinese buyers are highly-engaged quality-and-experience seekers, and food is a highly visible way to show status.
- With China’s very low supply-chain costs, it’s likely that Aussie apples will struggle to compete as a commodity in this market, so the focus must be on a premium, branded export offering.
- New varieties/brands that have process discipline, novel, exotic brand appeal and ‘seal of quality’ to guarantee the flavour, freshness and quality, will command premium pricing.
- A new provenance story is appealing to the younger Chinese generation – and imported status denotes a level of food safety that isn’t necessarily present in domestic fruit.
- Apples are staple ‘anytime’ food and the perfect piece of fruit will be un-waxed, block red apple, which is not too big or small, crunchy and very juicy.

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New South Wales

Kevin Dodds & Jessica Fearney

State Roundup

Orange

This winter has brought little relief from the dry for growers in the Orange district. The lack of rainfall continues as we approach the 2019–2020 season. Dam levels across the district are at critical levels, whilst most bores have slowed down. One grower indicated to us that this drought is one of the worst he has ever seen: “I have been here for 32 years now and have never experienced a drought like this.”

Although the drought is impacting heavily on growers, there is still a passion for growing among the community, with a large turnout for the June Future Orchards® walk at Ian Pearce’s Stoneleigh Orchard. Delegates across the Orange, Bilpin and Sydney Basin region braved the cold to listen to very relevant presentations about climate change from Professor Stephanie Midgley (summary page 48) and Jonathan Brookes. Orange growers could relate to particular experiences of the South African apple growers who had to mitigate risk in low water situations during a drought they have recently been through. At the time of reading, winter pruning will be well underway, with a targeted approach to crop load to ensure the best possible matching of yield to water resources as the dry conditions continue.

Bilpin

Whilst the June rainfall totals for Bilpin, like the other districts, were below average, rain has been well-timed and most growers still have adequate water in storage. The mean monthly maximum and minimum temperatures for June have been approximately one degree above the long-term average. But, at the time of writing, growers were reporting some cooler nights, making a good contribution to their winter chilling requirements.

Batlow

In contrast to the Central West, Batlow in the South West Slopes has received reasonable rainfall throughout June. Farm dams in most locations and canyons have received some badly-needed inflows. The great attendance at the Orange Future Orchards event was replicated in Batlow, with nearly 30 delegates turning out to hear about climate change and to take the opportunity to visit the Montague Fresh orchards. Orchard manager Barry McLean showed us around and described the progression of planting densities and canopy management systems employed over the two decades that he has managed the orchard. Growers were particularly interested in the latest system featuring a metal V-trellis planted at approximately 10,000 trees per hectare, and trained as twin stems (to give 20,000 stems/ha). An attractive feature of this type of system is that once full canopy is achieved, the instructions to operational staff for pruning and thinning are much simpler, and require fewer decisions than the same operations in free standing or trestled central leader trees.

We thank Montague Fresh for agreeing to host the orchard walk at Batlow and for continuing to welcome other growers to visit their orchard. This sharing of knowledge is important for the advancement of the apple industry.

The Batlow orchard walk concluded with a BBQ lunch which was the perfect opportunity to celebrate and recognise the fantastic contribution Barry McLean has made at Batlow since he arrived from New Zealand in 1997. Barry is leaving Batlow to take up an orchard management role with Blue Moon Orchards at Mullaloo, Western Australia. His fruit growing skills and insights and his willingness to share ideas will be missed at Batlow and we wish him the very best in his new role.

Queensland

Justin Heaven

The past season has been one of the most challenging in recent memory for Queensland producers, with one of the driest years on record and summer temperatures compounding the issue of reduced water availability. Despite the challenging season just past, producers remain positive, with the quality of fruit produced better than expected, although yields vary across the region depending on the individual water situation, and some varieties handling the dry conditions better than others.

With uncertainty around when the region will receive drought-breaking rain, producers will be considering a range of measures to reduce the impact on yield of limited water availability. It will be prudent to have a plan in place to manage the challenging season ahead. This may include pruning heavier to reduce tree size, managing crop load, allocating available water resources for the critical stages of growth and removal of older varieties from production.

Although a slow start to the winter season, the Granite Belt has regularly dipped below zero over the past month with close to average day time temperatures allowing for an accumulation of the cold units for dormancy requirements. With good winter chill accumulation building and the region hopeful of some decent spring rain, the season could turn.

The Emu Swamp Dam project is a step closer to providing long term water security for the Granite Belt with the Federal Government providing a commitment to fund $47 million dollars towards the construction of the project, matching the significant contribution already committed by local irrigators.

The newly-formed Granite Belt Growers Association (GBGA) is providing the opportunity for local producers to participate in a study trip to the United Arab Emirates (UAE) to explore how to improve agricultural productivity and sustainability in marginal environments. The study trip will look to address the challenges faced by Australian producers impacted by reduced water availability, climate extremes and, in particular, above average temperatures.

The Granite Belt Growers Association has a strong representation from the local apple industry with Nathan Baranov, vice president and committee members Daniel Nicoliotti, Trent Vedelago and industry consultant Stephen Tancred providing guidance in developing the group in the first 12 months. The GBGA are now working towards developing a brand and website for the association and have the AGM coming up in September.

About the authors:
Kevin Dodds & Jessica Fearney

NSW Department of Primary Industries.

About the author:
Justin Heaven

Senior Industry Development Officer, Department of Agriculture and Fisheries, QLD.
Spring is the time of plans and projects.
Leo Tolstoy, Anna Karenina

Spring marks the commencement and preparation for the 2020 season. Before the orchard activity really ramps up, Pomewest has been on the road, engaging with over 60 growers at dinner meetings in late August at Donnybrook, Manjimup and Perth Hills. Participants were encouraged to contribute to discussion to promote consultancy, communication and networking for the WA pome industry. Each event gave us valuable insight into providing future services to our growers. In particular to gather an understanding of state industry goals for the upcoming 2020–2025 industry strategic plan.

Hort Connections 2019
Hort Connections 2019 and the APAL Industry Forum were held on 23–26 June in Melbourne.
We would like to thank APAL for a well-oiled and organised event this year. The concept of bringing growers and stakeholders together under the umbrella of ‘Hort Connections’ is valuable. This year WA was represented by around 15 growers and stakeholders. This was an excellent opportunity for us to network and take notes from experiences and landscapes from the other states, particularly with recent incidences of climatic traumas with drought and hail, and food safety issues. We understand that collaboration and national ‘whole of industry view’ embracing collective messaging is essential. The APAL booth and variety showcase was a great meeting spot for growers to catch-up throughout the event.

WA APAL award winners
Congratulations to John Hearman, Hearman Ag Orchard and Nursery, Rising Star award, Bec Whittaker, Ladycroft Orchard – Women in Horticulture award and of course Harvey Giblett – Newton Orchards – Lifetime Achiever award (see page 13). WA was well represented at the APAL Awards Breakfast this year. All the winners on the day were extremely worthy and it was great to see them recognised for their passion and dedication to the industry.

Other memorable points from the forum include:
- Farmers are currently professional gamblers. There is so much value in knowing more about your business by embracing benchmarking for the collection and analysis of data to measure efficiencies and minimise risk.
- Globally, factors impacting horticulture include the increasing demand for food; global warming is a reality, increased focus on health – the longing of the majority to stay forever young, and rapidly-changing technology advances.
- Ways of understanding the consumer better, utilising these mindsets, finding innovative stories to inspire and the realising the value of the safe, clean, green messages and promoting provenance.
- Export; demanding and recognising that better quality will equate to better prices. Finding purposeful markets and the ability to take learning from other sectors that have had success in the field.
- Acceptance of new global trends such as plant-based diets/anti-plastic packaging and being reactive and proactive to the opportunities they generate.

About the author:
Nardia Stacy
Executive Manager, Pomewest

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APAL Industry Forum
The program was well organised, the forum speakers were relevant, and focused on solutions to build the sector. We learnt that increasing demand by the delivery and maintenance of quality is the single most influential factor, along with finding innovative ways to invigorate excitement to the category. Diversity by securing market access and building global trading relationships for the future is critical for industry expansion. Gathering marketing and promotional learnings from other fresh food sectors and exporting regions is also key.

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**Tasmania**

**Michael Tarbath**  
Industry Development Officer, Fruit Growers Tasmania

Winter is here and is already off to a very cold start. Despite the chilly conditions, growers are making the most of the rain-free weather to get out and about. Fruit growers across the state have been busy with planting, pruning and preparing for the coming season.

Apple producers were out in numbers on 5 July 2019 for the APAL Future Orchards® winter walk in the Derwent Valley. Attendees took advantage of the event to find out the latest apple and pear research findings and get input from New Zealand AgFirst consultants Dean Rainham and Ross Wilson on climate management, orchard design and pruning for productivity. Grower attendance and involvement was high despite cold and foggy conditions.

Apple producers and packhouse registrars for protocol markets are preparing to renew their annual export accreditation. To support these growers, Fruit Growers Tasmania (FGT) hosted its 2019 southern export registration workshop on 1 August covering changes to market access options, grower and packhouse registration requirements for protocol markets, domestic and international MRL requirements, and changes to crop monitoring requirements. Guest presenters Carolyn Kelby (Dept. Home Affairs) and Hans van Pett (Tourism Tasmania), discussed recent changes to Australian air freight regulations, the known Consignor program, the Australian Trusted Trader Program, and Tasmanian air freight infrastructure and developments.

Young growers and ag professionals are being invited to get involved with a Tasmanian young grower program. Supported by FGT, the program aims to bring together enthusiastic people aged 20–35(ish) from across Tasmania’s fruit industries for fun social and personal development opportunities. People keen to become involved in the group are encouraged to contact Ian at the FGT office on 03 6169 2199.

**Victoria**

**Michael Chisera & Mel Floyd**  
Fruit Growers Victoria Ltd

Winter has been well below average in most districts across Victoria and more is needed in all regions. Northern Victorian growers rely on rainfall in the main catchment areas to increase storage levels in Lake Eildon.

Spring rainfall will determine the final allocation, but a reduced irrigation allocation is looking very likely at this stage. In Southern Victoria, localised rainfall is the key for runoff into irrigation dams on farm. All growers are hopeful of more rain in late winter and early spring. Some regions have reported good mid-winter runoff.

The marketing season for apples has been better than previous seasons and quality of fruit in general is very good. Apple crops are down on forecasts and again we really need to work on regulations, ensuring the actual pickouts of Victorian growers at harvest. Pears are again experiencing lower retailer pricing which makes it a challenge for growers aiming to make a living, or at least cover their costs across the industry.

Fruit Growers Victoria (FGV) had a large turnout at our Northern and Southern Season in Review forums in mid-July and received positive responses from growers. Some great guest speakers covered topics such as Water Risk Management, Swarmfarm Robotics, Practical IPM Management, Australia’s export growth opportunities and the Online IPM tools developed by Agriculture Victoria (AgVic).

FGVL was successful in obtaining funding under the Victorian Drought Assistance program through AgVic to run a free Orchard Block Profitability forum on 6 August in Shepparton. The forum covered topics around costs, profits and how growers could gain visibility and make informed choices on how to invest for growth. Funding covers follow-up one-on-one grower visits to assess block by block performance and implement a model to drive optimum orchard profitability.

In other news, FGV is now preparing for the upcoming season and has also been meeting with Victoria’s new Labour Hire Authority to discuss new Labour Hire Licensing and legal obligations under the new Act.

**South Australia**

**Susie Green**  
Fruit Growers Victoria Ltd

Winter has brought some much-needed rainfall to the South Australian growing regions. However, after the long, dry summer and autumn a lot more rain is needed to fully replenish the water reserves in preparation for the season ahead. Growers are well into pruning and there is some additional net being installed across the region. After a number of difficult years, there is strong demand for some form of assistance to help growers with covering their orchards.

The key drivers for a netting scheme are to enable growers to access capital that they wouldn’t otherwise be in a position to, as well as to be better-placed to net more of their orchard, sooner than would otherwise be possible.

After very successful promotional events earlier in the year with Picked in Pink Lady Weekend and Pomefest, planning is now underway for our other major state-based promotional activity, the Royal Adelaide Show. Our apple and pear stand moves to a more prominent location within the Goyder Pavilion this year, close to the main entry from the Atrium, and we are hopeful of good traffic flow and the opportunity for growers to once again showcase apples and pears to the public. We have also ramped up our social media presence this year, underpinning the Hailstorm Heroes messaging with stories directly from the growers.

Installation has commenced on a number of solar systems to reduce irrigation pumping costs across the industry. More than 20 growers will install systems on more than 80 irrigation pumps over the coming two years. This is part of two projects being managed by Apple & Pear Growers Association of SA, apple, pear and cherry growers, with funding support from the South Australian Government through the Regional Growth Fund and the Federal Government through the Building Better Regions Fund.

We have also commenced development of a new strategy to shape future directions for all of horticulture in the Adelaide Hills Region, and inform investment, growth potential and policy. This is a collaboration between the Horticulture Coalition of SA, Apple & Pear Growers Association of SA, Cherry Growers Association of SA, Strawberry Growers Association of SA, RDA Adelaide Hills, Fleurieu and KI and PIRSA with support from the Building Better Regions Fund.

We wish all growing regions a successful year for many.
Introducing Future Business

Richelle Zealley – APAL

APAL’s newest program Future Business will build on the success of Future Orchards® and provide an offering for people working ‘on’ the business as opposed to ‘in’ it.

Future Business is a program designed to provide the Australian apple and pear industry support through the provision of products and services that enable the commercial aspects of a business. The program was launched at the recent APAL Industry Forum by Manager, Future Business, Richelle Zealley who said the objective is to improve commercial performance of the industry to deliver greater profitability and best practice.

“The Future Orchards program has delivered a significant uplift in on-orchard practices and a general improvement in the industry’s technical competence,” Richelle said.

“There has never been the same effort or attention applied to the commercial or business side of the industry. Future Business aims to address this imbalance and help participants understand where their focus and effort should be applied.”

There are five key areas to guide the direction of the program and assist in strengthening a business’ structure. These are:

1. Business Management: ensuring businesses have a strong framework for success.
2. Pooled Resources: an opportunity to maximise advantage and minimise risk, in particular to explore areas for collaboration and potential cost savings.
3. Compliance and Care: maintaining standards and quality control.
4. Systems and Reporting: access to operational and financial data that is usable and accessible by decision makers.
5. Financial Management: looking at ratios, equity and debt – helping to share a business’ story to acquire more assets or even prepare for a sale.

“Future Business is a long-term, evolving program designed to grow with the industry,” Richelle said.

“I’m excited to launch with the Discretionary Mutual Fund (DMF) which is a financial vehicle for the management of hard to place risks. It’s important to note DMFs are not insurance but offer an alternate risk financing strategy and can replace traditional insurance.

“A DMF is established by companies or associations with a common business purpose and members contribute to the fund to create an aggregate, which is used to manage the primary layer of risk. The DMF still needs to purchase Excess of Loss (XOL) insurance to ensure protection in case of catastrophic loss and to cap members’ liability at the aggregate.

“The DMF is set up to benefit members and give back to the industry; it’s an interesting concept and with participation from everyone could be extremely beneficial to our industry.”

Future Orchards® has delivered a significant uplift in on-orchard practices... There has never been the same effort or attention applied to the commercial or business side of the industry.

Future Business Workshop

Understanding risk: what are your obligations?

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For more information contact Richelle Zealley at rzealley@apal.org.au or 0438364728

Dates and Locations – November 2019

Mon 4 Stanthorpe QLD
Wed 6 Orange NSW
Thu 7 Bathurst NSW
Fri 8 Shepparton VIC
Tue 12 Huon Valley TAS
Wed 13 Yarra Valley VIC
Tue 19 Adelaide Hills SA
Wed 20 Manjimup WA

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Traditional insurance vs. Discretionary Mutual Fund

An insurance policy promises an indemnity; in contrast a DMF risk product promises a claim for loss will be considered.

TRADITIONAL INSURANCE

To ensure coverage, this is paid annually. If a claim is made the premium will increase the following year.

DMF

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A DMF is a company limited by guarantee with a board of directors who are majority members: owned and run by members, for members.

DISCRETIONARY MUTUAL FUND (DMF)

A DMF is set up to benefit all members. It is a self-insurance structure that provides an opportunity to control and manage an industry’s collective risk, helping industry to directly profit from risk management improvements such as training, development, or even reduced premiums.

A DMF is not insurance, however, it offers ‘discretionary cover’ in the form of an insurance-like product.

Success of a DMF comes down to scale, the more members involved in sharing the risk, the more successful the outcomes will be. The geographical spread of the Australian apple and pear industry is favourable as it’s unlikely a severe weather event, for example, will hit each region at the same time.

A DMF is not insurance, however, it offers ‘discretionary cover’ in the form of an insurance-like product.

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“The DMF is set up to benefit members and give back to the industry; it’s an interesting concept and with participation from everyone could be extremely beneficial to our industry.”

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Research highlights opportunity to increase the ‘pear share’

Optimal retail price point for pears identified as between $3.99

New Australian Pears logo and ‘Dare to Pear’ campaign will position pears as ‘different’ and ‘bold’ to build sales

New Australian Pears website to launch in October.

Marketing Australian pears as a fresh, inspiring and bold ‘break free’ fruit choice may be the key to securing pears a greater share of the staple fruit and shopping baskets, according to new levy-funded consumer research.

To underpin a brand refresh for Australian Pears, Hort Innovation, using the Pear levy funds, carried out research with Sydney-based agency Fiftyfive5. This research found that while pears were often overlooked, the majority of buyers still counted them among their favourite fruits and were quite open to buying them.

Repositioning them as a ‘different’ and ‘inspirational’ choice to those who already buy lots of fruit, but less frequently pears, and tapping into their desire for fresh, healthy, sweet and in-season fruit, had the greatest potential to get pears back on shopping lists and into baskets.

Hort Innovation has developed a fresh, new logo for Australian Pears based on the research and will use it in the Australian Pears marketing campaign, consisting of outdoor media like shopping centre panels, digital media such as Facebook and Instagram, PR and in-store sampling. A new website will also be launched in October to align with the new look and feel of Australian Pears.

The market research was carried out through March and April and included in-store interviews in Marrickville and Parramatta in Sydney across the three major retailers, an online survey of over 1000 consumers and two 90-minute focus groups.

It corroborated findings from earlier research commissioned by APAL and carried out in 2017 by Melbourne-based The Source, which found that consumers viewed pears as conventional and old fashioned. While consumers did not reject pears for this reason, it meant they were simply not thought of.

Both pieces of research also indicated that while price was certainly considered by consumers, it was rarely a deterrent to purchase.

Crucially, a price sensitivity analysis conducted by Fiftyfive5 found the optimal price for pear consumers was $3.99, within a range of $2.99–4.00. Low prices were actually a deterrent.

At 99c a kilo, over 80 per cent of buyers think that they are so cheap they would doubt the quality,’ the report stated.

Buyer behaviour: why and when?

Fiftyfive5 built a detailed picture of awareness, purchase behaviour, attitudes and usage to identify the clearest opportunities for change and growth:

- 89 per cent of people are open to buying pears.
- 37 per cent of consumers interviewed had bought pears in the last three months, making them an occasional fruit (compared to 71 per cent for apples and 74 per cent for bananas).
- Pears were often an impulse-buy, if fruit looked appealing in store, reinforcing the importance of providing the best quality in store.
- 85 per cent of pear buyers bought them to snack.
- 67 per cent checked firmness and ripeness before purchasing.
- Of those who had not purchased pears in the last three months, one in four said it was because they did not have pears on their shopping list.
- Awareness of varieties is low; pear purchasers are most aware of the greener pears, usually available all year round, although few have tried more than one type.

With a lack of knowledge around ripeness still a key barrier to purchase, ensuring top quality fruit on shelves and using education on how to pick the perfect pear and judge the ripening window will continue to be essential to driving growth.

Promoting the range of uses for pears also offered a means of reducing the over-reliance on snacking as a reason to buy pears – 85 per cent of pear buyers do so to snack – and increasing the opportunities to buy pears.

Narrowing the market

Fiftyfive5 looked at the purchasing patterns, and characteristics of buyers and what they sought from pears to identify the groups with the most potential for growth and how to appeal to them.

Buying patterns of pear consumers were compared with those buying all fruit, showing a large number of consumers who bought fruit weekly or more often, rarely bought pears. Influencing these regular fruit buyers to pick up more pears by increasing awareness of pears’, consistent quality, and educating consumers on health benefits, ripening and versatility offered a clear growth opportunity.

Pear buyers were broken down into five groups roughly equal in representation. Of these, three were chosen as offering the most potential for growth:

- Health pursuers – conscious about health, choosing healthy snacks and buying based on health benefits;
- Seasonal hunters – who like to know where their fruit and vegetables are coming from, prefer to eat Australian-grown fruit and tend to buy whatever is in season; and
- Sweet-tooth foodies – who love baking and being creative with food. They have a bit of a sweet tooth, and often choose sweet over savoury snacks.

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These groups collectively account for 70 per cent of value of pear purchases and 68 per cent of the volume of pear purchases. Families make up the majority of all three groups. All three groups want healthy, tasty and easy to eat fruit, with some favouring juiciness, origin or sweetness over other factors.

**Positioning for growth**

Three possible new ideas for positioning and marketing Australian pears were tested on two groups comprising both regular and irregular pear buyers, consumers from all three target pear buying groups, and a mix of ages.

-Shake it up – appealing to the desire to be bold and different – was seen as the most compelling and credible, with the advantage of highlighting both the difference of pears from other staples, and also the different uses of pears. Focus group participants felt it was most likely to drive purchases, and that, if consumers were educated on the different types of pears available, it would further encourage purchase.

-Australian Pears marketing manager Olivia Grey said a new Australian Pears logo had been developed by Hort Innovation in consultation with pear growers, using insights from the research. “It is modern, vibrant and eye-catching, which will hopefully help to shift the perception that pears are an old-fashioned fruit,” she said. “Importantly, it communicates the different pear varieties available beyond the green pear.”

**Digital Media**

The digital campaign will make use of programmatic video technology, which allows a targeted placement of ads in areas most likely to resonate with the target groups, in the case of pear advertising, on nutrition, cooking, health and lifestyle sites. Six-second unskippable ads on YouTube will be used to drive awareness of pears in the target groups and on nutrition, cooking and health sites. Additionally, 15 and 30-second videos will be used to raise awareness and consideration of pears on lifestyle and cooking sites. Digital media is expected to deliver over 3.5 million views by consumers.

-Social media activity

Social media activity is a cost-efficient way to reach the masses, to ‘keep a finger on the pulse’ in terms of how people are using pears, answer any questions they have, and give people an opportunity to simply share their love of pears.

-With one in two Australians using Facebook and one in three Australians using Instagram on a daily basis, social media for Australian pears will leverage both platforms to keep pears top of mind. Compelling content will be promoted to educate consumers about pear varieties and ripening indicators, as well as promoting different ways to use pears. The objective of the sampling is to encourage purchase frequency.

-In-store demonstrations

Following great results from in-store demonstrations in 2017 and 2018, a further 400 sampling sessions will occur across August/September and October/November in Woolworths and Coles stores. The objective of the sampling is to drive awareness of pears in-store to keep them top-of-mind at the point of purchase and educate consumers about the versatility of pears to encourage purchase frequency.

-Website

Importantly, the Australian Pears website at australianpears.com.au will be refreshed and relaunched in October 2019, with the look and feel updated to align with the new creative. Refreshed content and updated recipes will help to engage consumers. The website will allow data tracking through google analytics that can be leveraged for media targeting.

-Industry marketing initiatives

Industry marketing initiatives are managed by Hort Innovation and are funded by the apple and pear marketing levies. Growers are welcome to contact Apple and Pear Marketing Manager Olivia Grey (olivia.grey@horticulture.com.au) or Ben Daley (ben.daley@horticulture.com.au) for any questions relating to the marketing program.

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**Agribusiness skills core to understanding growth**

**Jack Barcels**

Jack Barcels has spent the last two years honing his agribusiness skills on a levy-funded scholarship at Marcus Oldham College, Geelong, Victoria. He reflects on what he learnt and how it is helping him in his new working life as a Sales Manager at Sumitomo Chemical.

Marcus Oldham has changed my approach to the job of sales and salespeople. Before undertaking the Associate Degree in Agribusiness, I could walk onto an orchard knowing the basics behind growing to get the best crop. Now I am more able to look at the bigger picture, and see beyond the orchard to understand the market into which those apples will be sold; how they will be marketed; how to add value; how to manage the costs; and how to seize opportunities that may arise.

The broadening of support networks has also been amazing – my 100 classmates are spread across the Australian agriculture and horticulture industry pears. I am also still in contact with the incredible teaching staff, all of whom I can turn to for help and advice.

**Lessons learnt; value created**

The Associate Degree in Agribusiness gave me the opportunity to travel to China, Hong Kong and New Zealand. Going to China allowed me to see the market from a customer’s perspective and understand the cultural and customary differences associated with business meetings – an insight that has already proven fruitful in my new role at Sumitomo Chemical, a Japanese company.

Similarly, the tour of New Zealand showed how successful the industry can be when a focus on export is developed. Less than 15 per cent of New Zealand’s agricultural products are consumed domestically, however, they have created a booming industry with a key focus on creating the highest quality products they can.

Everything at Marcus Oldham is taught in a practical manner through farm visits, international tours and real-world, in-class examples. Tours were well-integrated with classroom-based skills in accounting, finance, marketing, production, human resources and leadership and I have already used many of the market analysis tools and techniques in my new role.

Being a Marcus Oldham graduate puts you in a great position to develop leadership within the agricultural sector. I’ve learnt that leadership doesn’t have to come from outgoing personalities, however, all good leaders have great people skills, make others in the team feel valued and therefore get the best out of everyone. Dealing with a range of individuals, with differing personalities, is a big part of my new role where my focus includes helping growers get the most value out of their crop. The skills I learnt in dealing and negotiating with individuals have been invaluable.

**Reflections on studying**

Applying for the apple and pear industry’s New Horizons Scholarship has been the greatest decision I’ve ever made. Without the financial help of the New Horizons Scholarship I would not have been able to afford an opportunity like this.

I would strongly encourage anyone who is interested in a career in the horticulture industry to participate in any skills and development opportunities offered to them. Knowledge is like air, it’s vital to life.
Beyond the cost-barrier: Netting delivers growth

JEANETTE SEVERS

As APAL campaigns for support for growers to address the high cost-barrier to netting to protect crops, those who have been able to net report benefits beyond risk management including improved yields and packouts and labour and water savings, improving long-term sustainability and decision-making.

About the author: Jeanette Sever is a freelance agricultural journalist.

Western Australian growers Michael and Kaye Fox and son Mat took the plunge and started netting their orchard in the state’s south west after being able to work out how much netting has improved packout around $0.75 million. Mat said while it would take years to repay the investment in monetary terms, it had begun returning in increased production in the first season.

"Netting is still a bit new to us; once we finish netting most of the trees this year, we’ll be able to work out how much netting has improved packout across the orchard," Mat said.

"In the summer, you don’t have to allocate a labour unit to scare birds away. And you pick the number of apples you expect to pick – outside the net, you need to leave about another 50 apples on the tree just for the birds."

Halitorms represent the most frequent and – on an annual aggregate basis – the highest losses for the insurance industry in Australia. Climate change is predicted to make extreme events more frequent and more severe. As growers across the country know to their cost, it does not take much damage to see the crop downgraded to processing. Hail can wipe out the majority of the value of the crop in a very short time. Insurance is either unobtainable or prohibitively expensive.

That leaves growers with the daunting challenge of raising the substantial $60,000+ha required to net. Netting also creates a new microclimate and set of management challenges.

The Foxes’ experience, shared by others, is that if the cost barrier and management challenges can be overcome, netting can provide a range of benefits that, in addition to reducing risk, may make the business more profitable and more sustainable long-term.

Yield and water efficiency

A Western Australian netting trial study (2013–16) carried out by Agriculture WA on the commercial orchard at Manjimup owned by Mauri and Ann Lyster, looked at netting and non-netting scenarios for producing marketable fruit. Sunburn was twice to four times more prevalent on apples from trees without netting and the percentage of marketable fruit in the packout was higher under nets. Fruit tended to be on average 10g heavier and more prolific when grown under black net, compared to white net; but the average size of the fruit hardly varied.

One reason given was the fruit stayed longer on the tree because it took longer for the blush to rise; a secondary reason was increased leaf cover on trees under net, which also lengthened ripening time.

Irrigation use was reduced by 60 per cent, first by installing drip infrastructure across the whole site in the 2015–16 year of the trial in response to increased vigour under nets, and then reduced again to 1.7ML/ha under the nets, compared to using 2ML/ha outside.

Changing the microclimate

Permanent structures that hold the net 4.5m–5m above the ground, change the orchard management requirements, not least because they automatically impose a limitation on 4m–4.5m on the height of trees and 3m on the available width between rows for machinery to pass.

One of the issues to manage under permanent nets is the changed microclimate. A well-understood and significant benefit of increased shade is reduced sunburn damage – sunburn typically occurs when fruit surface temperatures rise above 45°C.

However, changing the microclimate has knock-on effects on tree vigour, pollination and pest management, all of which require their own management.

Jason Shields, orchard manager at Plunkett Orchards, Ardmona, Victoria, is confident of the return on investment from netting, but actively manages for microclimate and sunburn.

The 150ha farm, 67:13 apples and pears, has 36ha of fruit netted. The oldest netting block is 12 years old. About 50 per cent is fixed netting and 50 per cent is retractable – the retractable net remains on the superstructure but is pulled up as soon as harvest is finished. The labour cost is offset by increased production.

“Sunburn damage to the Granny Smith apples has reduced by 30–40 per cent under the nets and with an improvement of 10–20 per cent on skin marks,” Jason said. “That’s a substantial increase in production.

“Trees under the net have more vigour and grow stronger, but the bud development is poorer.”

Managing pollination in a covered or enclosed area is one of the challenges of netting and a work still in progress by researchers. New funding for further research into pollination under nets was announced by Hort Innovation mid-year. Jason encourages pollination by introducing bees in hives.

Another 25ha of trees will be under net by the end of this year, with a forecast improved packout of 25 per cent.

Jason has calculated a 12 per cent better packout on Pink Lady apples, quantified at $7000/ha return on investment (ROI) per year post-netting, and a 25 per cent better packout ($10–$11,000/ha ROI) on the Granny Smith.

It increases production up to 75–80t across the whole orchard,” Jason said. “An increased 10t packout of the Pink Lady apples gives payback within the first year.”

An increased 10 tonne packout of the Pink Lady® apples gives payback within the first year.

Jason Shields

Jason has seen a drop in the need to spray for molluscs, but an increased need to be on the lookout for powdery mildew.

The orchard also uses at least 30 per cent less irrigation under net.

No free lunch for birds

Maximising packout of first and second-class apples saw South Australian grower Joe Ceravolo invest initially in drape netting 20 years ago, and more recently in permanent flat top netting, in five orchards across 150 ha in the Adelaide Hills, at a cost of $50–$60,000/ha.

Bird pressure was the biggest management issue, with sunburn secondary and moisture and heat stress tertiary concerns.

“Netting improves the quality of fruit we grow,” Joe said. “There are 40 per cent more Granny Smith apples in the first and second-class pick; sunburn is reduced from 20 per cent to three per cent under the grey net. That gives us an

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1 Munich RE, The science of hailstorms.
improvement of 18 per cent increase in production. Netting also helps to reduce our water use considerably. Joe said the main reason for netting had been to eliminate the food source early for birds. He anticipates flying foxes may also be in issue in the not-too-distant future.

“Once the birds come in and start eating, they keep banqueting,” he said. “This year we lost 100 per cent of a patch of Gala apples, three weeks before picking was to begin. In the second patch we lost 60 per cent of the Gala, even though we put up drape nets. Never underestimate a bird’s intelligence.”

“When you lose 50 bins of apples, how can you not warrant the netting?”

“For efficiency, we converted to permanent flat top fully-enclosed netting 12 years ago. Initially we used Netpro over existing plantings. It’s purely an economic decision to use different nettings.”

Increased packout a standout

While birds are also an issue for fellow South Australian grower Robert Green, hail-protection was the main driver for netting, with the promise of higher quality and packouts reinforcing the case. “Parrots and lorikeets are becoming a pest species for the crop,” Robert said. “The big driving factor for us is the increased potential for heatwaves and hail risk. We asked ourselves, what does business look like if we get a hail event?”

The fourth generation Lenswood orchardist, with wife Nicola and father Ross, has 40,000 trees in the Adelaide Hills, planted at a density of 3000/ha. Nets were installed at 4.5m high, supported by steel structures, at a cost of $55–$65,000/ha; designed to release hail loads to deposit safely between tree rows.

When it did hail, in 2017 and 2018, 80 per cent of the orchard was covered by nets. Research by Apple & Pear Growers Association of SA, found that in 2017, an average 19 per cent of fruit under hail nets was damaged, compared to 61 per cent in orchards without nets; in 2018 when hail was accompanied by high wind speeds, an average 30 per cent of netted fruit and trees were damaged, compared to 64 per cent of non-netted crops.

Although more expensive, the trellis-release style of netting showed lower likelihood of damaged fruit, and limited damage to trees when the end post structures were erected on a lean.

Robert sees the benefits as reduced storm-damage potential, decreased sunburn and bird damage and increased water savings under the net.

But it was the increased packout that really stood out, as well as the capacity for the workforce to work longer hours under the net, picking with increased UV protection.

“Within two years of netting, it was obvious we were getting increased first-class packout and a 20 per cent increase in productivity,” Robert said. “The recoup on expenditure is not there quickly. But I can sleep without worrying about storm damage.”

Robert sees value in a subsidy to net orchards, given the environmental benefits of such a move, but believes it should also apply to replacing worn or damaged nets to ensure protection can be maintained.

“It’s a view echoed by other orchardists. Hardings Orchard at Pakenham, Victoria, was an early adopter of netting, after losing the entire 490t crop to a hailstorm on Australia Day, 1998. The cantilevered poles with permanent netting attached, at a cost of $18,000/acre ($45,000/ha), was recouped from the increased production of first-class apples.

A subsequent hailstorm in March 2010 caused about $100,000 damage to the net and established trees in half the orchard.

Robert sees value in a subsidy to net orchards...but believes it should also apply to replacing worn or damaged nets...
The urbanisation of coastal towns, supported by clearing of native vegetation, has led to flying foxes looking to orchards for food sources.

In a comprehensive assessment for the 2017 Raymond Terrace Flying-Fox Camp Management Plan, grey-headed and black flying foxes were found throughout eastern Australia, generally within 200km of the coast, and in Tasmania and South Australia. The report cited research showing a nightly foraging radius is up to 50km from the flying fox camp and the animals will travel 500km over 48 hours to move camps – the species show marked fidelity to camps and food sources. Little red flying foxes are distributed across northern and eastern Australia; and show the same foraging and fidelity behaviour.

For a few years early this century, the NSW government introduced low-interest loans to encourage growers to net their orchards.

NSW apple and cherry growers Bernard and Fiona Hall use variously permanent and drape net over 93 per cent of their total 80 hectares of apple and cherry trees. A few years ago, they were able to access a limited amount of government funding to support their netting program.

“We began netting about 17 years ago because we were being bashed by hail, flying foxes and lorikeets every year,” Bernard said. “Thousands of lorikeets dine on the fruit where there’s no netting or the nets have no sides. But we can only afford to spend so much money on nets each year.”

Bernard suggested a program that subsidised netting for 10 years – at a minimum of 50 per cent but preferably up to 75 per cent – would be ideal. He said the nets needed replacing every few years because of environmental damage. “Whatever the subsidy is, you’re going to spend double to install netting for each year you can get it,” he said.

Flights foxes are considered keystone species in the Australian landscape. However, they have significant impact on orchards – even with netting. Predation can result in 5–100 per cent production losses.

“The nets need to go out earlier and for longer, because the season of flying fox predation has extended year-on-year.”

“In any given year, Bernard estimates losses to bird, bat and hail damage can run to 30 per cent of apple production.”

A Victorian orchardist – Graeme Jenkins, at Johnsonville – believes the cost of netting prevents new people from entering the industry.

“A bit of a negative impact on the business and its 36-strong workforce – permanent and casual employees – employed in the orchard and packing shed. Higher packouts are one of the benefits reported from netting.”

“A Victorian orchardist – Graeme Jenkins, at Johnsonville – believes the cost of netting prevents new people from entering the industry. His main purpose in netting trees is to exclude flying foxes, which predate his trees from the start of October to the end of May, not entirely effectively.

“The flying foxes have worked out how to get onto the ground and climb the trunk to inside the net. The wingspan of a flying fox is about four foot wide and when they smash down on the tree, to smell the fruit to find out if it’s ripe, they damage the tree and the net. We’re getting about five per cent wastage because although they can’t get at the fruit, they soil onto it through the net,” Graeme said.

“‘If the flying foxes arrive three weeks early, before you get the nets on, you’ve lost the fruit. That happened to the crop of Facia Bella pears in January three years ago, before we got the nets over them – they ate all the pears off 60 trees in one night.’”

Flying foxes are considered keystone species in the Australian landscape. However, they have significant impact on orchards – even with netting. Predation can result in 5–100 per cent production losses.

...the nets need to go out earlier and for longer, because the season of flying fox predation has extended year-on-year.

He needs to manage his nets to put them away and roll them out each year, because deep snowfalls tear the nets. This is a two-man job, costing at three days/hectare, twice a year.

Taking the nets off the trees for a period has the advantages of enabling natural insect biodiversity that benefits pollination. However, he has noticed the nets need to go out earlier and for longer, because the season of flying fox predation has extended year-on-year.

“Flying foxes used to come looking for fruit in late March. Now they are arriving in December and they stay until the last apples are picked,” Bernard said.

“Bird and bat damage has increased from two to five per cent; hail damage each year still stands about 25 per cent. In any given year, we stand to lose 50 per cent of the 1800 tonnes of apples we produce.”

Any greater production loss would have a negative impact on the business and its 36-strong workforce – permanent and casual employees – employed in the orchard and packing shed.

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Flying foxes are considered keystone species in the Australian landscape. However, they have significant impact on orchards – even with netting. Predation can result in 5–100 per cent production losses.
Hail lessons: Base decisions on data and don’t skimp on inputs

Susie Green

Widespread spring hailstorms in the last two growing seasons have put South Australian growers through some challenging times managing orchards to minimise the impact on production. The Apple & Pear Growers Association of SA (APGASA) has just completed a project to capture key learnings to inform future hail event preparedness and spoke to four growers about their responses and experiences.

1. Paul Mason, SR & SM Mason: Lenswood

The 2017 storm came through on a Sunday evening. The first thing we did as a family and a business was to meet Monday morning to discuss what we’d seen and have a closer look at the orchard. We based our decisions on whether or not it was too late to act. We knew we had to keep growing the crop as we normally would in terms of irrigation, fertiliser and plant disease management, but knew we had to keep growing the crop as we normally would in terms of irrigation, fertiliser and plant disease management. We continued to irrigate and fertilise as normal.

The first decision was to add a full rate of carbaryl in the tank with the fungicide cover spray due at that time. We followed that up with heavy applications of ethephon on all blocks that would not meet an ‘acceptable’ packout. We also wouldn’t consider all options for trying to repair/improve the crop look like at harvest and the hardest bit was making the decisions was less emotional than actually executing them. The hardest part was knowing that once it was sprayed the crop was doomed, even if it remained on the tree. We also knew that this decision would potentially have further effects in subsequent seasons in terms of return bloom and biennial bearing. In the end we only grew around one third of our normal crop. The ethephon applications significantly reduced the vegetative growth of the trees but also negatively impacted on the quality of the fruit that remained. We expected both of these responses. The pears responded very strongly to the ethephon application and almost completely died their crop. We then grew a very big crop in 2018. We are confident that we will have a decent crop next year looking at resting spurs, but time will tell. The decisions we made initially were based on the fact that our business was in a position where it could sustain a year of very low returns, as long as we cut costs. We also invested further in netting with assistance from our bank. The bigger difference with the 2018 event was that it occurred later in the season than the previous years event and the fruit was more advanced. We had no chemical thinners at our disposal, so we had no choice but to grow it all and focus on reducing labour as much as possible by sending crews through quickly. The scenarios were different to the year before, but we were probably a little bit more prepared and we had more orchard netting.

2. Ashley Green & Michael Booth, SE Green & Sons: Lenswood

After the 2017 hail, we firstly had to pick ourselves up off the ground as we were in shock. We then had a good look around to try to understand the extent and the level of impact on an individual block basis. We talked to others, some of whom were planning to spray the crop off, but our approach was to look for value. In the early days we stripped whole trees and sorted fruit into three categories. We felt that if the assessments indicated a minimum packout of 50 per cent we would continue to grow the crop for fresh market. With a juice return of $100/bin maximum, we were willing to invest in the crop within the additional return that we thought we could get from the fresh market. If we thought we could get $200/bin, we were willing to spend up to $100/bin to give ourselves a chance of an improved return. On the better blocks, we continued with our secondary chemical thinning program with the aim being to do minimal hand thinning. The worse blocks, we just aimed to strip-pick for juice. We considered all options for trying to repair/improve skin finish such as 6,BA and Cytolin applications and applied to a significant number of blocks. We based our decisions on whether or not we could add value to the crop. What would the crop look like after hand thinning? Would the investment in that labour add enough additional value to the end product? We always had the following season in mind and knew we had to keep growing the crop as we normally would in terms of irrigation, fertilizer and pest and disease management. We sat down constantly to review and discuss at the end of every day, usually over a beer. The decisions were fluid and we adjusted our actions as we went along in response to what we were seeing and any new information. We remained calm and tried to take emotion out of our decisions as much as possible.

3. Jody Schultz, Appelina Hills: Forest Range

Like everybody else we looked around on Monday morning and it looked pretty bad. There were a lot of unknowns about what the hail marks on the fruit would look like at harvest and the hardest bit was predicting what portion of fruit would be saleable. We looked at all blocks in the early days and found that most blocks were damaged significantly. Having our own direct markets, we couldn’t afford to sit out of the market for 12 months, so we had to decide whether we thought a reasonable portion of the fruit would be saleable. Because the damage was so widespread across our district, we felt that everyone would be in the same boat and hoped that the local market could sustain some damaged fruit. In the end we decided to make the best of what we had and grow the crop pretty much as normal. We decided to write-off the worst blocks (high level of damage to low return varieties) and thin them as hard as we could with chemical thinners. Other than in those blocks, we didn’t do any more secondary chemical thinning as we didn’t want to remove any undamaged fruit. Ideally, we wanted to selectively remove this hand by hand instead, even though we weren’t sure we’d be able to do that cost-effectively.

4. In the end we decided to make the best of what we had and grow the crop pretty much as normal. – Jody Schultz

The emotional toll was significant in terms of wanting to keep all permanent staff employed. Keeping those staff was of utmost important to us – even if we didn’t make a cent and took a hit financially. We have a good group of staff and the impact of having to rebuild the following year without them would’ve been significant. In 2018 the hail impact wasn’t as bad on our properties. However, we were under significant financial pressure with hail-damaged fruit still in the shed that was yet to be sold which carried a significant financial and emotional toll. In that sense, 2018 was actually much harder to deal with emotionally than 2017.
Our primary focus was on ensuring that we didn't compromise our crop in the following year. Therefore, we continued to manage the orchard as normal in terms of pest and disease management, nutrition, irrigation, pruning etc. Hand thinning was not much different to normal apart from taking more care not to remove undamaged fruit. This increased cost was offset by the money we didn't spend in blocks that we wrote off.

Ethephon was the most effective thinner for crop removal. It didn't remove the crop completely but reduced it significantly and made it easier to manage. The return bloom in those blocks was strong as expected, but we don't think that it was excessive. In hindsight, we probably wouldn't have tipped any blocks off.

Our decisions around certain varieties would've also been different. The red coloured varieties hid the hail damage better and we would've continued to grow all of them. The yellow/green varieties (eg. Granny Smith, Golden Delicious) fared much worse than we hoped.

The 2018 storm was much more variable. The better blocks were better and the most-affected blocks were worse than the year before. The financial impact has been much worse because it has compounded the impact of 2017, even though the damage was overall less.

In terms of the emotional toll, initially it was heavier because we'd just finished selling the 2017 crop and had put that behind us, ready to move on to a new season with new hope. However, once we were able to come to terms with it, knowing how the first year ended up and how we managed to get through gave us more confidence to carry on and sell the crop again.

Strong focus was placed on next year and not wanting any actions to negatively impact on the following crop. – Graham and Noel Mason

Graham Mason & Noel Mason, AG & HC Mason: Forest Range

We had never seen the extent of damage caused by the 2017 storm before, so trying to determine what the damage would look like at harvest was difficult. The decisions evolved over the first few days; we had to make some decisions early though as we had a massive crop and hadn't finished our secondary thinning program.

We tried to find a balance between having enough crop left to be able to selectively hand thin through and dropping as much badly damaged fruit as possible. A strong focus was placed on next year and not wanting any actions to negatively impact on the following crop.

We focussed our assessments on what impact we thought we could have with our hand thinning program to improve packouts. Our decisions were based primarily on ensuring we had the best return crop we could next year but making the best of what we could with this year’s crop. This strategy came at quite a risk though as we could’ve spent a lot more money on the crop than what it was worth.

The best decisions we made were maintaining the balance of the trees and keeping in mind return bloom. As a result, our return bloom was unaffected.

Second time round we knew exactly what we needed to do and just carried on growing our crop as normal, just the same as the year before. Emotionally it was probably a bit harder deal with though.

Impacts of netting type on hail

Comprehensive damage assessments were carried out across orchards following on from the hail storms. From this information, a review was undertaken on the impact of different types of netting on reducing hail damage. The two South Australian hailstorms both featured several cold fronts of predominantly very fine “rice hail”.

- All types of hail netting provided some benefit in reducing both the amount of hail damage.
- Hail netting also reduced the severity of hail damage, with less major damage of unsaleable fruit occurring under net.
- Quad netting (16 and 20 mm), which was typically installed on flat top trellis structures, was not as effective as rice hail netting installed on trellis release systems in reducing the amount of hail damage.
- Smaller hole sizes in netting reduce the amount of damage from fine “rice hail.” However, when selecting the appropriate netting type and trellis system, other factors such as structural loading and light interception, as well as cost and the resultant cost benefit also need to be taken into account.

Key Tips

- Don’t rush into it. It’s hard to know at the time what the outcome will be, so advice is to remain optimistic.
- Have a thorough look at the crop and the business before making any decisions. Don’t rush into it. It’s hard to know at the time what the outcome will be, so advice is to remain optimistic.
- Don’t react by cutting inputs. By keeping up our nutrition, water and pest and disease programs we gave the trees the best chance to carry a big crop through to market the following year.
- Every hailstorm is different. Back yourself in. Listen to others, collect as much information as you can but then make your decisions based on the facts at hand removing as much emotion as you can. Make the decision that’s best for your own business, not just because your neighbour is doing it.

As part of this Building Preparedness of the Fruit industry for extreme weather events, APGASA are also capturing key learnings from a broader industry perspective, which will be shared with other state organisations and APAL to ensure that industry bodies are well prepared to support industry in the event of a future disaster or emergency situation.

The following conclusions can be drawn for these two hail events.

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Irrigation water supply can often be less than crop water requirement during a drought. This inevitably leads to tree water stress and subsequent loss in fruit size and yield in apple orchards.

About the authors:
Ian Goodwin, Mark O’Connell and Lexie McClymont.
Agriculture Victoria
Department of Jobs, Precincts and Regions (DJPR)
Contact:
Ian Goodwin
Research Leader, Tatura
E: ian.goodwin@agriculture.vic.gov.au
T: 03 5833 5240

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Ian Goodwin, Mark O’Connell and Lexie McClymont.
Agriculture Victoria
Department of Jobs, Precincts and Regions (DJPR)
Contact:
Ian Goodwin
Research Leader, Tatura
E: ian.goodwin@agriculture.vic.gov.au
T: 03 5833 5240
Growers must weigh up choices between purchasing scarce water, if available, at high cost; removing the entire crop and ‘parking’ trees on minimum irrigation to keep alive; or using a combination of thinning and deficit irrigation to prioritise fruit size/quality over yield.

Understanding the relationship between water deficits, yield, fruit size, fruit quality and crop load is critical for water budgeting and growing fruit to market specifications in drought conditions. Given the current forecasts and season outlook, it is timely for growers to review the established international and Agriculture Victoria research on these relationships, and to take them into consideration when evaluating irrigation plans for next season.

**Fruit size**

Just like apple yield, fruit size increases with irrigation up to the point where irrigation (and rain) matches the transpiration from the trees and the evapotranspiration from the wetted understorey. Applying additional irrigation will not increase yield. The trees cannot transpire the additional water and may become waterlogged if drainage is inadequate.

The response of apple yield to water (irrigation and rain) is shown in Figure 1. In Figure 1, the response of yield to water shows a linear increase up to point A corresponding to the maximum transpiration from the trees and the evapotranspiration from the wetted understorey. The water inputs at point A represent the crop water requirement of the orchard. Yield has reached a biological upper limit at point A where increasing water inputs to point B has no effect on yield and the difference in water input between point A and point B is ineffective and lost from the orchard system as deep drainage and runoff.

**Fruit quality**

The response of fruit sweetness, cracking and sunburn damage was explored in Agriculture Victoria experiments on Cripps Pink and Royal Gala. The results from these experiments showed that fruit sweetness and the risk of fruit cracking in susceptible cultivars like Cripps Pink decreases with higher amounts of irrigation. Sunburn browning was not affected by irrigation amount.

Fruit sweetness is measured by the concentration of sugars in the fruit. As the water inputs to an apple orchard increases, the total amount of sugar in an individual fruit increases but this is diluted by the size of the fruit. Hence the concentration of sugar in an individual fruit and its sweetness decreases up to the point where irrigation and rainfall matches the transpiration from the trees and the evapotranspiration from the understore (Figure 3). The response of fruit sweetness to water inputs is much less pronounced than yield and fruit size.

There is an upper limit to how big fruit will grow...and applying additional irrigation will not grow bigger fruit.
**Fruit thinning strategies**

The combination of heavy thinning and water deficits is a strategy that can be employed during water restrictions. Market fruit size can be maintained, but yield will be substantially reduced. For example, a market fruit size (e.g., fruit weight at 80 per cent of maximum size) with 50 per cent less irrigation is possible if trees are thinned to 20–25 per cent of the standard crop load. Overseas data published in Food and Agriculture Organisation of the United Nations (FAO); Irrigation and drainage paper 66 (FAO 66) – Crop yield response to water www.fao.org/docrep/016/12800e/12800e00.htm was used to construct the response of fruit size and yield to a range of water deficits and crop load shown in Figure 4. The important points in this figure are:

- The relationship between fruit size and yield is determined by crop load.
- Yield increases with crop load up to the biological maximum in an orchard. Further increases in crop load have no impact on yield.
- Fruit size rapidly declines with increases in crop load when the maximum yield is reached.
- Fruit size and yield decrease with increasing water deficits irrespective of crop load.

The effects of water deficits on fruit size are much less with heavy thinning.

Thinning early in the season is recommended. Base the level of thinning on fruit set and the outlook for irrigation water allocations. Regularly review irrigation strategies for different cultivars where low allocations are expected. A further follow-up thinning may be needed, although the longer thinning is delayed, the smaller the fruit will be at harvest. There are two reasons for this. Firstly, cell division dominates fruit growth at the start of the season. Any restriction on cell division cannot be regained later in the season. Conditions must be favourable for cell division so any competition between fruits needs to be minimal. Secondly, dry weight accumulates in developing fruits but there is a limited total pool of dry weight to go around. Too many fruits means that the tree can only supply each fruit with a limited amount of dry weight. At the start of the season there is usually enough dry weight for all the fruit. However, as fruit grows its demand for dry weight increases rapidly. Thinning well before the demand by the fruit exceeds the supply available from the tree is critical to maximise final fruit size.

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**Water saving options for pears**

Horticulture production in a changing climate faces the prospect of continued severe water shortages at regular intervals. During the Millennium drought, options for minimising irrigation applications to pear orchards were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parking trees and post-harvest irrigation cut-off were investigated by Agriculture Victoria. Parki

**Option 1: Parking trees**

The aim of parking trees is to sacrifice the crop and apply the minimum amount of irrigation so that trees survive and return to full production the following year. Trees are managed to minimise the transpiring leaf area and avoid excessive water stress so that developing fruit buds are not desiccated.

The following are recommendations to park trees and minimise irrigation:

- Withhold irrigation until the root-zone (defined as containing 80 per cent of the roots) dries out to a minimum soil water tension of at least 400 kPa. This occurs at the start of November in the Goulburn Valley after average winter and spring rainfall.
- Use deficit irrigation by applying 30 per cent of orchard water use capability. This is conservative and based on RDI studies conducted at Tatura. Apply frequent irrigation with less water. In other words, cut irrigation run time back to 30 per cent of full irrigation but maintain irrigation interval similar to full irrigation.
- Remove fruit from the tree. De-fruited reduces competition from dry weight accumulation by the fruit and thus increases the amount of carbon available for the developing fruit buds for next season’s crop. Fruit also consume water for growth and lose water through their skin although the amount is small compared to foliage transpiration.
- Remove water shoots. Shoot growth will be strong at the start of the season if there is adequate soil moisture from winter and spring rainfall. Summer pruning to remove water shoots will reduce transpiration, increase fruit initiation and remove a sink for dry weight accumulation.
- De-branching (mid-season) is a radical approach to reduce transpiring leaf area and is generally not recommended. De-branching reduces tree size and water use, but part of the following season’s crop is removed. If branch removal is undertaken it should be done mid-season rather than in winter to avoid high re-growth in late spring and early summer which draws on stored resources and depletes the pool of dry weight for next season’s crop.
Option 2: Post-harvest cut-off

Post-harvest water application in Australian orchards is substantial. This creates an opportunity to cut-back on irrigation with limited impacts on the developing flower organs in the reproductive buds. A study on post-harvest deficit irrigation of pear (Pyrus communis Williams’ bon chrétien) in a commercial orchard in the Goulburn Valley showed not irrigating during the post-harvest period had no effect on subsequent yield or fruit quality (Table 1). Five irrigation treatments (0, 50, 100, 160 and 200 per cent of the grower’s normal irrigation volume) were applied during three seasons. Irrigation of the 100 per cent treatment ranged from 141 to 290 mm depending on rainfall. Measurements showed no difference in yield between treatments, with mean yields of 45.3, 56.6, and 61.5 t/ha in the three subsequent seasons.

Option 3: Regulated deficit irrigation

RDI is a well-known strategy that saves water and reduces excessive vegetative growth with no effect on fruit size. Less irrigation than optimum crop water requirement is applied during the period when shoot growth is rapid and fruit growth is slow. Given the reduction in vegetative growth from RDI, it is likely that radiation levels reaching the lower parts of the canopy will increase, which will improve colour of blush pear cultivars, soluble solids concentration and firmness of the fruit.

There are distinct growth stages in fruit trees and the success of RDI depends on varying the application of irrigation during each of these stages.

1. Fruit cell division

In most seasons in the Goulburn Valley, pears are not irrigated until reference crop evapotranspiration (ETc) exceeds rainfall by 1.25 mm. This allows the soil to dry out so that water stress can develop during the slow fruit growth period. However, in recent years there has been insufficient winter and early spring rain to wet up the root zone. Root zone soil moisture must be measured to avoid water stress. Moisture should be accounted for over the entire root zone i.e. to a depth of 600 to 800 mm. Soil should not be allowed to dry out beyond 60 kPa in clay loam soils.

2. Slow fruit growth

During this period, fruit growth is slow and shoot growth is rapid (Figure 1). Water stress will significantly reduce shoot growth. Irrigation should commence when the soil has dried out in the fibrous root zone to 400 kPa in a clay loam. The trees are irrigated with greatly reduced volumes of water compared to that which would normally be applied. Irrigation replacements of less than 30 per cent of crop water requirement are recommended.

3. Rapid fruit growth

This stage commences in early December for Williams’ bon chrétien and mid to late December for Packham’s Triumph. The fruit is growing rapidly and the tree now needs ample water to maintain this growth. Water stress must not occur during this final period of fruit growth. Irrigation replacements of 100 per cent of crop water requirement are recommended. Soil moisture in the middle of the wetted fibrous root zone should not exceed 60 kPa in sandy soil or 60 kPa in a clay loam. A long irrigation event, or several irrigations at short intervals, may be required to re-wet the root zone in December, particularly if rainfall has been limited during fall.

4. Post-harvest

Many orchardists in the Goulburn Valley have implemented post-harvest irrigation deficits similar to the RDI strategy described above.

Water savings and avoiding excessive stress

In addition to the strategies outlined in this article, conversion to drip irrigation offers an opportunity to reduce water consumption. Use of drip irrigation from planting does not adversely affect growth or yield of pear trees. Irrigation of a mature orchard converted to drip should be managed conservatively in the first season to allow trees to adjust to the new wetting pattern. Concerns regarding irrigation practices (deficit or otherwise) can be alleviated by equipping yourself with the knowledge to accurately calculate crop water requirement and auditing your irrigation system to ensure it is operating efficiently with a good distribution uniformity.

Experiments in the Goulburn Valley have shown that pear trees seldom reach high levels of stress due to soil waterholding capacity and summer rainfall patterns. In other environments, care needs to be taken to avoid excessive water stress. In Israel, severe water stress in pear appeared to slow flower organ development, leading to reduced flowering intensity and lower fruit set compared to a moderate level of water stress (Naor et al., 2006). Growers contemplating imposing a severe irrigation deficit should plan to monitor soil moisture or use a plant-based indicator of water status, such as stem water potential, and discuss these options with their agronomist or Agriculture Victoria staff.

Avoid mite stress

Monitoring of mite populations is particularly important during dry conditions, regardless of irrigation strategy. Pear trees with high mite populations are prone to flower in late summer and autumn if they become stressed and are then irrigated. Control of mite populations and avoidance of excessive water stress will minimise this risk.

A study...showed not irrigating during the post-harvest period had no effect on subsequent yield or fruit quality.

Table 1: Post-harvest irrigation (l mm) and yield (t/ha) in subsequent seasons. Trees were irrigated relative to grower practice (100 per cent treatment).

<table>
<thead>
<tr>
<th>Year</th>
<th>Post-harvest irrigation</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>0 145 290 470 600</td>
<td>47.7 45.6 38.8 54.1 40.2</td>
</tr>
<tr>
<td>2009</td>
<td>0 112 225 364 463</td>
<td>48.5 67.6 49.9 61.1 57.0</td>
</tr>
<tr>
<td>2010</td>
<td>0 70 141 227 289</td>
<td>58.6 60.1 57.2 70.0 61.6</td>
</tr>
</tbody>
</table>

Table 2: Relative costs, water savings and yield penalties of water saving options.

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion to drip</td>
<td>20 – 25</td>
</tr>
<tr>
<td>RDI</td>
<td>Low 35</td>
</tr>
<tr>
<td>Post-harvest cut-off</td>
<td>Low 35 – 35</td>
</tr>
<tr>
<td>Parking trees</td>
<td>Low 70 – 80</td>
</tr>
</tbody>
</table>

Acknowledgements

Financial support was provided by DEPT project 103.303 Managing disruption to water supply in perennial horticulture in a changing climate. Experiments were conducted at Boorowles Orchard and Mt V. McNab and Son and we thank the families for their involvement.

...equip yourself with the knowledge to accurately calculate crop water requirement...
Understanding the vulnerability and natural responses of trees to water and heat stress will better equip growers to manage future droughts and heatwaves, advises South African climate change and agricultural sustainability researcher and specialist Professor Stephanie Midgley, from Stellenbosch University.

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**Tree knowledge key to meeting climate challenge**

**ALISON BARBER – APAL**

We need to know how the tree responds to normal environmental fluctuations, to monitor closely and to recognise when it is under stress.*

Stephanie said apple trees had some resilience and response strategies to stress and could also acclimatise. Growers who understood these natural responses could better target the tools and resources at their disposal to achieve the best yield/profit outcome.

**Water stress sensitivity**

While apple trees generally use water efficiently and recover from moderate daytime internal water deficits, Stephanie said there were key periods in the growth cycle where adequate water was critical, such as early in the season (first 40–50 days after full bloom) during flowering, fruit set and cell division; flower bud initiation, and the final phase of fruit swell.

“Water stress affects flowering and cell division, leading to lower yield and fruit size,” she said. “The risk of stress early in the season is low, but you cannot catch up later if the stress is lifted.”

“Bud initiation in summer is very sensitive to water stress. Bud development in late winter/spring is less sensitive to lower moderate water stress, but severe stress can lead to incomplete flower development.”

“Fruit growth can recover from low to moderate water stress but is sensitive during the early and final growth phases.”

Water stress would first affect vegetative growth, leaves and shoots and then fruit growth, which could be used strategically to limit canopy growth in the period of rapid shoot growth, and to limit fruit expansion (in early summer).

**Managing water deficit**

Strategies for managing water deficits included reducing demand and losses, using water more effectively and choice of rootstocks.

**Reduce water demand and losses by**

- Changing the microclimate - reducing temperature and wind through the use of shade netting.
- Reduce evaporation from soil through mulching, cover crop management, drip irrigation or irrigation overnight;
- Reducing transpiration/leaf area by pruning unproductive wood, removing limbs or in extreme circumstances, cutting back to rootstock;
- Reducing the crop – fruit thinning (don’t remove all due to impact on following season flowering), thin for size and quality, parking selected orchards with minimum water and focussing on productive high-value orchards to ensure best financial outcome.

**Water use more effectively by**

- Precise monitoring and scheduling – using soil, tree and weather sensors and satellite imagery
- Water budgeting and accounting – knowing what water is available, planning precisely and removing old and unprofitable orchards
- Increase water productivity by focussing on yield and profit per unit of water input.
- Reduce losses in on-farm system by upgrading infrastructure and drainage.

**Rootstock selection**

- Trees on dwarfing rootstock use less water than those on more vigorous rootstocks and rootstocks differ in their water stress sensitivity, with some recovering better than others.

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**Heat stress/sunburn**

Higher temperatures and more hot days are also increasing the rate of sunburn, impacting on quality and packouts. Weather, cultivar, exposure in canopy and tree stress could all influence the risk of damage, with red cultivars less susceptible than Granny Smith or Fuji.

“Stephanie said browning would occur at fruit surface temperatures of 46–49°C and as fruit surface temperatures could be 15°C higher than air temperature, there was a risk of damage once air temperatures rose above 32–35°C.”

Ten minutes of fruit surface temperature above 52°C would lead to necrosis. Water stress has been shown to dramatically increase the risk of sunburn as it heightened the fruit surface temperature.

Fruit grown in the sun could acclimatise and be less susceptible to sunburn than fruit grown in the shade and then exposed to strong sunlight.

“We have to avoid the sudden exposure of shaded fruit at all costs,” Stephanie said. “Sudden exposure will lead to sunburning, and is not dependent on temperature. We need to get the leaf to fruit ratio right.”

**Heat stress sensitivity**

Higher temperatures will impact fruit set, maturity and season length, storability and dormancy.

As with water stress, Stephanie said a key risk period was in the first 40–50 days where high temperatures impacted net carbon uptake and led to high losses to respiration in young fruit.

“There is a significant effect on daytime carbon balance in small fruit at temperatures above 30°C,” she said. “This can limit fruit growth potential and final fruit size.”

Although high light was part of the requirement for red colour development, temperature fluctuations could lead to a variation in colour and temperatures above 30°C could cause bleaching.

**Managing heat stress**

Strategies for responding to increased light and temperature include overhead evaporative cooling, protective netting and cultivar selection, both the use of improved red/blush cultivars less sensitive to climatic fluctuations and the use of early or late cultivar to avoid mid-season heat stress.

She said fruit colour was quite responsive to changes in temperature and cooling treatments, such as overhead water could lower surface temperatures by around 10–15°C and stimulate red colour, particularly if applied in the two to three weeks prior to harvest, but this increased water use.

**Beyond the farm gate**

Stephanie said as climate change would impact beyond the farm gate, a collective public-private partnership approach would be needed to mitigate the social and economic impacts of climatic events on jobs, livelihoods and communities.

Included in this should be bringing climate change risk into all spheres of investment planning and establishing viable financial mechanisms to incentivise proactive disaster risk management and transition to resilience.

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*Acknowledgements: Stephanie Midgley visited Australia as part of the Future Orchards® project.*
Managing climatic risks

Climatic risk to pomefruit crops comes in many forms. The main ones are frost, hail, wind, flooding, drought and high temperatures. These are the obvious ones.

There are other, more subtle effects too which can be put down to weather and climate patterns. For instance, prolonged wet or cloudy periods at critical stages of development can impact on fruit colour and maturity behaviour. In colder climates, such as Tasmania, very cool weather over the harvest may suppress fruit colour development in later varieties. There are also the mild winter effects on dormancy and bud break which I covered recently in this column.

The one thing we know for sure is that every growing season will be different in regard to these risks. When dealing with risk, control what you can and proactively manage what you can’t.

### Hail

Australian fruit growers have had lots of experience with hail, so have developed effective ways to protect their crops from this hazard. Covering their orchards with hail netting is now widely adopted amongst Australian fruit growers.

As well as giving hail protection, netting orchards also brings numerous other benefits and contributes to managing other climatic risks such as wind and high temperatures. Water use in netted orchards is also lower due to less wind and lower evapotranspiration rates. Netting also deals well with the bird and flying fox predation problem. On the negative side, hail netting adds extra capital expenses to orchard development budgets and has significant maintenance costs.

In locations where winter snow is likely, hail nets have to be folded back until the snow risk has passed. Pollination and fruitset may also benefit through having hail nets open over the blossom period. In this situation, it is important to close hail nets quickly after blossom to give protection before fruitlets become vulnerable to hail injury. Incidentally, fruit crops have been lost from hail when closing of hail nets have been delayed.

### Pollination

It is more difficult to obtain satisfactory cross pollination under hail net. Pollinator layout needs to be more intensive, preferably in each row at 20 to 30m intervals because bees tend to travel along, rather than across rows. I also suspect that hail net design impacts on bee behaviour under hail nets. We have observed that bees may prefer to work under some types of hail net, rather than in unprotected orchards. These observations have been made where the hail nets cover single rows with a gap between each row net and the hives are located just outside of the netted area. We think the bee preference for working under hail nets is because there is less wind there and less shading where canopies are dense.

### Pest and disease

Woolly apple aphid (WAA) have been reported to be more numerous under hail nets than in orchard blocks outside of nets. This applies to mites also, so more pest monitoring may be required under nets.

On the other hand, where the net has significantly lowered fine mesh, pests such as codling moth may be less of a problem provided the pupae are not over wintering within the net.

Hummidity is higher in netted orchards, drying is slower. These conditions favour fungus diseases notably scab and possibly Alternaria and summer rots. On the positive side, there is less wind inside netted orchards, so this gives more spraying opportunities.

### Drought stress and high temperature injury

These are major climatic risks in Australia and forecast to increase with climate change. Netting orchards is an effective way to reduce this risk. Water requirements in netted orchards are significantly lower than in orchards outside of net. Sunburn injury risk is also significantly lower under net than in the open. These benefits are often sufficient to justify the cost of netting.

As water supply for irrigation is a major limitation in much of Australia, reducing the evaporative demand through irrigation water supply, then intensifying production on that area, rather than orcharding a larger area is the best long term option for managing drought stress. Around 70 per cent of orchard operating costs are fixed so your best way to lower unit production costs and maximise revenue is to increase yields and fruit quality.

### Tree vigour

The netted orchard environment is more favourable to tree growth so excess tree vigour can be a problem under hail nets. More growth increases shading and canopy density often leading to fruit quality issues.

There are reports of more bitter pit under net. This is probably a tree vigour effect because increased shoot growth pulls calcium which travels in the xylem away from the fruit into the growing shoot tips. Shading where canopies are dense can reduce fruitset as well as suppress fruit colour development towards harvest.

Chemical thinner response is more aggressive in netted orchards than thinning strategies need to be adjusted to avoid over thinning. Netted orchards may need more attention to vigour management than un-netted orchards. Reflective mulches are often necessary under net to maintain good lower canopy fruit colour.

### Water requirements in netted orchards

A major climatic risk to pomefruit crops is water stress in netted orchards. The most severe stress occurs during the growing season, when light is highest, temperature stress is greatest and demand for water is highest. Water requirements in netted orchards are significantly lower than in orchards outside of net. Sunburn injury risk is also significantly lower under net than in the open. These benefits are often sufficient to justify the cost of netting.

As water supply for irrigation is a major limitation in much of Australia, reducing the evaporative demand through irrigation water supply, then intensifying production on that area, rather than orcharding a larger area is the best long term option for managing drought stress. Around 70 per cent of orchard operating costs are fixed so your best way to lower unit production costs and maximise revenue is to increase yields and fruit quality.

### Management options

- **Hail net**: A full hail net system is essential, as water use in netted orchards is lower due to less wind and lower evapotranspiration rates. Netting also deals well with the bird and flying fox predation problem. On the negative side, hail netting adds extra capital expenses to orchard development budgets and has significant maintenance costs.
- **Pollination**: It is more difficult to obtain satisfactory cross pollination under hail net. Pollinator layout needs to be more intensive, preferably in each row at 20 to 30m intervals because bees tend to travel along, rather than across rows. I also suspect that hail net design impacts on bee behaviour under hail nets. We have observed that bees may prefer to work under some types of hail net, rather than in unprotected orchards. These observations have been made where the hail nets cover single rows with a gap between each row net and the hives are located just outside of the netted area. We think the bee preference for working under hail nets is because there is less wind there and less light chill to the bee, so they feel warmer.
- **Pest and disease**: Woolly apple aphid (WAA) have been reported to be more numerous under hail nets than in orchard blocks outside of nets. This applies to mites also, so more pest monitoring may be required under nets.
- **Drought stress and high temperature injury**: These are major climatic risks in Australia and forecast to increase with climate change. Netting orchards is an effective way to reduce this risk. Water requirements in netted orchards are significantly lower than in orchards outside of net. Sunburn injury risk is also significantly lower under net than in the open. These benefits are often sufficient to justify the cost of netting.

### Conclusion

Now you have dug up the ORCHARD DATA?

**Technology** - Drones, Sensors, Autonomous Vehicles, Smart Machines, Artificial Intelligence (AI) Internet of Things (IoT), Mobile Apps, Blockchain, QC, Internet of Things (IoT), Mobile Apps, Blockchain, QC, Accounting, From the Orchard, Packing Shed, Grading, Warehouse, Transport, Customer, Sales.

**What do you do with all the data from multiple sources?**

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Irrigation and nutrition management

Once your water supply is secure, it becomes possible to adopt very water efficient irrigation methods such as drip irrigation or partial root zone drying (PRD) techniques. These systems need a secure water supply because tree root systems become confined to their wetted soil area so the trees will quickly succumb to drought stress if the water supply is interrupted.

PRD is a recently introduced technique in which only half of the plant’s root system is irrigated at a time, then once the un-irrigated half has dried out, irrigation is switched across to that side. Relative to full irrigation this technique has potential. There are now some very good thinning programmes around the world focusing on developing cultivars suited to higher temperatures. In general, pears are more tolerant to higher temperatures than apples.

Mulching

Mulching along the row with straw or similar materials, together with an irrigation system – such as drip – supplying irrigation water under the mulch, will conserve soil moisture and minimise irrigation water use.

Mulching works by providing an insulating barrier over the soil which lowers soil temperatures and reduces evaporation from the soil surface. Studies on the effects of mulching have shown that over time soil water holding capacity will increase.

In areas where soil moisture holding capacity is less than the surrounding soils, mulching those areas will extend irrigation intervals required to maintain soil moisture and even up water requirement over the block, leading to more even tree growth and cropping.

Thinning and crop loading

Crop loads drive fruit size. Sunburn problems are also positively linked to increasing crop loads. Setting crop loads conservatively and as early as possible after flowering will capture the full crop potential. There are now some very good thinning tools available to achieve this objective.

Ideally fruit should be brought down to singles so that if it is necessary to drop crop load further later in the growing season once high temperatures have arrived, this second thinning can be achieved with minimal sunburn risk.

Apple trees are reasonably resilient when it comes to drought stress. If trees begin to come under drought stress, marketable fruit sizes can be maintained by dropping crop loads down to around 60 per cent of normal. This thinning should selectively remove those fruits at high risk of sunburn.

Where PRD has been compared with regulated deficit irrigation (RDI), early indications are that apple fruit size and yields may be more likely to be maintained under PRD than under RDI.

Pulsed irrigation, applying water through a drip irrigation system will give water savings and allow fertigation to be taken care of. Tree nutrition to maintain tree growth and foliage during hot weather maintains production and minimises fruit sunburn problems without the need for netting the crop. This may be a viable approach where the expense of netting cannot be fully justified for other risks such as hail. However, in the longer term summer temperatures in many Australian fruit growing locations are forecast to rise so more robust sunburn protection will be required.

Managing both irrigation and fertiliser inputs well is an essential part of making these water saving irrigation techniques successful. This requires regular crop monitoring for water stress and nutrition, then making the appropriate adjustments to irrigation and fertigation as required.

Drainage and rooting depth

High soil temperatures increase drought stress effects so if deeper rooting can be encouraged, trees will be more resilient towards heat stress. Deeper rooting will also increase rooting zone volumes which means more available water can be stored in the rooting zone.

Frost

Relative to many pome fruit growing areas around the world, spring frost injury is less frequent in Australia. Climate change may advance budbreak in some locations bringing flowering and fruitset into a period when frosts are more likely to occur. It is also possible that the weather will become more erratic, increasing the risk of out of season frosts occurring. The higher altitude inland areas such as Bathlow, Orange and Stanthorpe are prone to this type of frost event.

Frost events may give protection against marginal frost events but is certainly inadequate protection for damaging frost events where temperatures are going to drop well into the injury zone.

Occasional frosts, because of their erratic nature and relatively low long term impact on the orchard business, probably do not justify the capital expense required to install a frost protection system. As most orchards have irrigation, using sprinklers in particularly frost-prone parts of the orchards may be the most cost-effective way to manage frost, provided there is an adequate secure water supply available. Where frosts are a regular occurrence, frost fans are usually the most cost effective solution.

If frosts occur, proactively manage the injured crop to salvage its full potential.

Passive frost control measures such as blocking cold air entry into the orchard and making provision for cold air to drain away by opening up gaps in shelterbelts in valley floors, will lower frost severity. Keeping weeds down, and the orchard floor well-mown, during the frost season will also minimise frost effects.

Where under-tree sprinkling is used for frost protection, the sward should be left long to provide a large surface area for the sprinkled water to freeze on. Under-tree sprinkling will lift minimum temperatures by 1 to 1.5°C which is often sufficient to avoid crop loss.

Pit and blotch

Drought stress and high temperatures increase problems with calcium related disorders such as bitter pit and lenticel blotch and breakdown. This is because during periods of stress, moisture is withdrawn from the fruit to maintain leaf condition. This moisture travels in the xylem and with it calcium leaks from the fruit too. Photosynthates from the leaves travel to the fruit in the phloem, but calcium does not, so calcium which is withdrawn from fruit to support the leaves cannot readily move back into the fruit.

It is important that a robust calcium spray programme is maintained through the season to minimise bitter pit and blotch problems.

Cultivars and rootstocks

Looking into the longer term, changing varieties and rootstocks from the heat sensitive ones we rely on at present, such as Royal Gala and Fuji, towards cultivars developed for hot climates such as Cripps Pink, will improve the heat tolerance of the crop.

There are now a number of breeding programmes around the world focusing on developing cultivars suited to higher temperatures. In general, pears are more tolerant to higher temperatures than apples.

Some varieties may show cracking or grossly deformed, equal fruit. It has been shown this type of injury in Stanthorpe.

Figure 5: Do not abandon injured crops. They are often salvageable with appropriate crop husbandry.

Figure 6: The bunch of apples in Figure 5 after shriveling off the injured fruit. There is still enough clean fruit for a worthwhile crop.

Figure 7: Typical Red Delicious frost injury. Note the radial rings towards the calyx end of the fruit.

Figure 8: Some varieties may show cracking or grossly deformed, equal fruit. It has been shown this type of injury in Stanthorpe.

Figure 9: Keeping the orchard floor tightly mown and free of weeds will reduce frost severity.
Soil characterisation and water use in Australian apple orchards

MARCUS HARDIE AND NIGEL SWARTS

Despite the economic importance of the Australian apple industry, little is known about the condition, characteristics and properties of Australian apple growing soils.

This study, as part of the apple and pear levy funded PIPS II Nitrogen fertigation project (AP14023), aimed to determine the physical and chemical attributes of typical apple-growing soils in four regions.

Improved soil information is needed to support growers to better understand and manage their soil, nutrient and water resources, and to assist with the development of perennial tree crop decision support tools. This study measured and reported on the condition of 31 soils including; apple, pear, cherry, apricot, peach, nectarine, plum, and apricot. This data will underpin the decision-support tool SINATA…to provide growers with the ability to strategically manage their irrigation and nitrogen resources.

For each site we reported the drainable porosity, readily available water content and plant available water content for each soil layer, and the soil profile as a whole. For example, we describe the characteristics of a Yellow Dermosol in Victoria (Figure 3).

Water is held within the pores and voids of a soil in which the size of the pore or void determines what that water can be used for. Large macropores pores larger than about 30 um are visible to the eye, these pores are responsible for infiltration, drainage and oxygen supply, but do not tend to hold water long enough for plants to use. The amount of water held between 30um to 0.2 um pores or (between field capacity and wilting point) is the plant available water content (PAWC). The water held here is described as readily-available water, which supports plant growth and fruit development. However, water held between the readily-available water content and the permanent wilting point is less available to plants and mostly contributes to plant survival rather than growth (Figure 2).

Figure 2: Soil water bucket concept (http://www.intermountainfruit.org/orchard-irrigation/swc).

For each site we reported the drainable porosity, readily available water content and plant available water content for each soil layer, and the soil profile as a whole. For example, we describe the characteristics of a Yellow Dermosol in Victoria (Figure 3).

The saturated hydraulic conductivity at 500 mm/hr is excellent, and the drainable porosity at 7.9 per cent is good and close to the desired value of 10 per cent which is rarely obtained in these soils. These numbers, together with the soil chemistry, indicate the topsoil (A1 horizon) appears to be a bit compact with a bulk density of 1.37 g/cm³ however all other measures indicate it to be a very well-structured soil. The saturated hydraulic conductivity at 500 mm/hr is excellent, and the drainable porosity at 7.9 per cent is good and close to the desired value of 10 per cent which is rarely achievable in a clay loam. The structure of the B horizons on the other hand are dense and have low hydraulic conductivity, limited drainage capacity and are highly likely to become waterlogged in winter, as indicated by the pale-yellow colours and presence of mottling throughout the B horizons.

Figure 4 shows that the Yellow Dermosol holds a total of 324 mm soil moisture. However, of this total moisture the amount of water which is actually available to the trees (PAWC light green and yellow bars) is only 167 mm, the moisture used for rapid plant growth (readily available water – light green bar) is relatively small at only 51 mm, while 134 mm of moisture is too tightly held by the soil and is not available to the tree (orange bars).

Comparison between the three soil horizons (Figure 5) shows that most of the readily available soil moisture is in the topsoil A1 horizon and the second B (or B21) horizon, whilst around 22 mm of the water in the A1 horizon and around 89 mm of water in the B22 horizon was not available for tree use.

These numbers, together with the soil chemistry, indicate the topsoil (A1 horizon) appears to be a bit compact with a bulk density of 1.37 g/cm³ however all other measures indicate it to be a very well-structured soil. The saturated hydraulic conductivity at 500 mm/hr is excellent, and the drainable porosity at 7.9 per cent is good and close to the desired value of 10 per cent which is rarely achievable in a clay loam. The structure of the B horizons on the other hand are dense and have low hydraulic conductivity, limited drainage capacity and are highly likely to become waterlogged in winter, as indicated by the pale-yellow colours and presence of mottling throughout the B horizons.

So how can this information be used by growers?

By calibrating this data with soil moisture data, growers can know when, how much and for how long to irrigate to supply enough water to meet tree demand.

This data will underpin the decision-support tool SINATA, a major output of the fertigation project, which will incorporate tree size, age and crop load with modelled environmental and climate data to provide growers with the ability to strategically manage their irrigation and nitrogen resources.

The soil data will be available on the APAL website, in the SINATA decision-support tool or please contact Nigel Swarts at nigel.swarts@utas.edu.au for more information.
How to make pears blush

MADELINE PAVEY

The effect of light on new pear cultivars

Pears have been declining in popularity in recent years, but new blush varieties offer opportunities for an image makeover and a revival in fortunes. The physical appearance of a piece of fruit provides the all-important first impression on the consumer. When it comes to purchasing pears, one of the most critical physical attributes according to consumers, is colour. Understanding how colour is impacted by changing exposure to light is therefore key to making that all-important first impression one that spares no blushes.

Red colour in pears

Red colour in pear skin is attractive and a highly-marketable trait, with the pigments responsible for red colour in fruit (anthocyanins) also known to exhibit a wide range of health benefits. New blush pear cultivars developed through the Australian National Pear Breeding Program (ANBP) provide a chance to reinvigorate the pear market, both domestically and internationally—provided that there is adequate coverage and quality of red blush on the fruit at harvest. In order to maximise the economic viability of blush pears for the grower, Agriculture Victoria Research initiated a project through the Agriculture Infrastructure and Jobs Fund to better understand how and when pears develop red colour. While the underlying mechanisms of red colour development are well understood for apples, there is still a way to go with pears.

The role of light

Different pear cultivars are not uniform in their seasonal patterns of colour development and their colour responses to environmental stimuli. Light is either an absolute requirement for, or enhances the synthesis of, red pigments in fruit peel. However, high levels of solar radiation can induce the degradation of pigments due to high fruit surface temperatures. With 30 per cent of Australia’s pears currently grown in the high-light environment of the Goulburn Valley, Victoria, the response of new pear cultivars to solar radiation is of significant interest.

The quantity of light penetration in the tree canopy (and therefore the amount reaching the fruit) changes throughout the growing season. The growth of vegetative shoots results in shading and subsequent summer pruning leads to higher exposure. A preliminary experiment performed on the cultivar ANP-0534 demonstrated a highly dynamic response to the application of shade followed by sunlight exposure. Shading during the early and middle parts of fruit growth resulted in complete loss of red colour, with red colour restored within three weeks of re-exposure.

A subsequent experiment examining the effect of pear shading and re-exposure to sunlight was conducted during the 2018/19 season on the commercially-released cultivar ANP-0131 (marketed as Ricó®) in the Experimental Pear Orchard at Agriculture Victoria, Tatura.

Sample fruit was chosen on the west arm of an Open Tatura trellis between a height of 1.2 – 1.8 m. The treatments included a control (pears fully exposed for the duration of the experiment) and 10 shading treatments of varying length applied at different stages of fruit development. Pear shading was achieved using aluminium umbrellas above individual fruit (Figure 1). The timing of treatments was measured in days after full bloom (DAFB): 1. Control (fully exposed) 2. Permanently shaded (28 – 175 DAFB) 3. Medium shading (28 – 92 DAFB) 4. Long shading (28 – 133 DAFB) 5. Short shading periods (approx. 3 weeks each) (i) 28 – 49 DAFB (ii) 49 – 70 DAFB (iii) 70 – 92 DAFB (iv) 92 – 112 DAFB (v) 112 – 133 DAFB (vi) 133 – 156 DAFB (vii) 156 – 175 DAFB.

The dynamics of blush development

Shading of ANP-0131 resulted in the same basic responses as for ANP-0534. That is, fruit that were shaded responded with a decrease in a* (decrease in red colour) and an increase in hue angle (movement away from red colour). All shading treatments of ANP-0131 up until the final three weeks before commercial harvest date (154 DAFB) resulted in a total loss of red colour, indicated by a negative a* value and very high hue angle (Figures 1 and 2). Fruit that was shaded in the three weeks just prior to harvest (Treatment (v)), shaded 133 – 156 DAFB) maintained some red colour, with red colour restored when shade was removed, regardless of the fruit growth stage. By commercial harvest there were no significant differences in a* value between the control treatment and other short treatments that had had at least three weeks of re-exposure to sunlight (treatments 5 (i)–(v)). In comparison, the cultivar ANP-0534 did not achieve adequate red colour recovery when shaded in the period six to three weeks before harvest (equivalent to treatment 5 (v)) 122–133 DAFB).

ANP-0131 fruit that was shaded for longer periods of time (nine and fifteen weeks), and re-exposed for at least three weeks, was still able to recover red colour. Permanently-shaded fruit remained without red colour. Exposed ANP-0131 fruit that was left on the tree after commercial harvest continued to improve in blush. With this cultivar, pears can develop sufficiently late in the season, providing sun exposure is maintained prior to harvest.

Figure 1 (top): Effect of shading and exposure on a* value (redness in pear skin colour) in ANP-0131 (Ricó®) over the growing season.

Figure 2 (bottom): Effect of shading and exposure on hue angle in ANP-0131 (Ricó®) over the growing season.

Acknowledgement: This project is currently in its second year and is funded by the Victorian Government’s Agriculture, Infrastructure and Jobs Fund of the Department of Jobs, Precincts and Regions (DJIKR).

About the author: Madeleine Peavey
Department of Jobs, Precincts and Regions (DJIKR)

The experiment extended three weeks beyond the optimum time of commercial harvest to observe the effects when fruit is left on the tree. The colour of the red blush was assessed using a spectrophotometer to measure two objective colour parameters: a* value (indicates colour on a scale of green to red) and hue angle (indicates the colour location on a 2-dimensional, circular colour wheel). These measurements were taken approximately every three weeks on all the sample fruit. These parameters can be represented on the CIE Lab colour wheel (Figure 2). To put it in perspective, a higher positive a* value means “redder” colour and a lower hue angle indicates a location on the wheel closer to red (°).
Orchard implications
Light exposure and canopy penetration are constant considerations for orchardists with regards to timely fruit ripening and colouring. And rightly so, judging by the results of this experiment. Now, it’s about getting down to the specifics and figuring out the best balance of orchard design and management and choice of plant matter to bring out blush in a pear. There are many methods already in use to enhance light distribution in the canopy, such as:
- utilising 2D training systems such as the Open Tatura trellis
- optimising tree planting density and leader spacing
- north-south row orientation
- selection of dwarfing rootstocks
- avoiding oversupply of nitrogen
- the use of reflective mulch, and summer pruning and regular removal of water shoots.

Whether the implementation of all these methods is beneficial towards blush development is yet to be seen.

How much is too much?
White exposure to sunlight is essential to the development of the blush colour prized by consumers, a concern, due in part to the soaring levels of solar radiation in this part of the world, is that too much can lead to colour bleaching (Figure 3) and sun damage. Bleached colour appears to eventuate as a combined effect of high exposure to solar radiation and high ambient temperatures heating the fruit surface and leading to anthocyanin degradation. Another possible risk factor for sun damage is the sudden exposure to high levels of light of heavily shaded fruit that are lacking in protective pigments. Anthocyanins behave like a sunscreen on the fruit peel, protecting the surface from sun damage. It is suspected that sudden exposure of fruit to high levels of solar radiation (from adjacent fruit falling or pruning close to the fruit) may be one mechanism for the development of sun damage. One way to mitigate sun damage or bleaching would be through the use of shade netting to reduce and diffuse the sunlight entering the orchard. However, the alterations in the quantity and quality of light entering the orchard may be detrimental to blush development. A retractable netting system could be used advantageously in this instance by being opened closer to the harvest date if colour is lacking in the fruit and extreme heat or hail events are unlikely to occur. More research is needed into the optimum netting colour, material and weave density for blush pears.

Check out pages 30-33 of the Winter 2019 edition of Australian Fruitgrower to see how Chloropicrin can benefit your orchards!

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R&D Blush Pears

R&D Dormancy

Addressing low winter chill in apples
Camilla Humphries

How dormancy breaking sprays can be used to assist with orchard management during mild winters.

During milder winters, dormancy-breaking sprays are used to help with the metabolism of carbohydrates when adequate winter chill (< 600 Richardson Chill Units for apples) has not been met. Inadequate winter chill leads to delayed and prolonged uneven flowering. As green tip date is variable between regions from season to season and difficult to determine, timing of the dormancy breaking sprays were based on accumulated RCU calculated from 1 July.

The trial, which was conducted at Launching Place in the Yarra Valley, July 2018, is an extension of the work previously done in Queensland, Tasmania and Western Australia, to gain more of an understanding on winter chill accumulation in the southern Victorian apple growing region.

Previous work by Heidi Parkes, of Department of Agriculture and Fisheries (DAF), Queensland, Susie Murphy-White, of Pomewest, WA, and Sally Bound, of University of Tasmania (UTAS) has examined the effects of dormancy-breaking sprays: Waiken™, Dormex® and Erger® on green tip dates, flowering window and harvest timing in Gala apples. In these trials Dormex® showed the greatest advancement on flowering and harvest in Western Australia and Queensland when compared with other dormancy breaking products. However, the active constituent of Dormex® is hydrogen cyanimide, which has known risks for plant and human health, and therefore alternative products are needed and were tested in this trial.

The aim of this trial was to compact the flowering period of Sirofresh (marketed as Jazz™), and thereby bring forward the harvest date. The trial also investigated how these changes impacted on orchard management and fruit quality. Two commercially available dormancy breaker products were used, Erger® and Waiken®.

Results
The trial was able to effectively demonstrate the relationship between chill unit accumulation and relative green tip dates. The early Erger® application was the only treatment that had a significant effect.

Flowering impacts
The earlier Erger® spray advanced full bloom date, flowering starting five days early with full bloom six days earlier. Flowering was also more uniform throughout the tree, whilst the later Erger® spray applied delayed full bloom.

Dormancy-breaker product information

<table>
<thead>
<tr>
<th></th>
<th>Erger®</th>
<th>Waiken®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active constituent</td>
<td>250g/l decanal alkylate (fertilizer adjuvant)</td>
<td>388 g/l methyl esters of fatty acids</td>
</tr>
<tr>
<td>Product rate</td>
<td>5l/100l water (5% v/v)</td>
<td>4 l/100l water (4% v/v)</td>
</tr>
<tr>
<td>Application timing</td>
<td>35 days prior to green tip (754 Richardson chill units) and 40 days prior to green tip (926 Richardson chill units)</td>
<td>34 days prior to green tip (926 Richardson chill units)</td>
</tr>
</tbody>
</table>

About the author:
Camilla Humphries
APL Southern Victorian
Front Line Adviser
E: chumphries@eemur.com.au
M: 0419 107 245

Figure 1: Treatment list.

Figure 2: Photo taken 1 October. Erger® treated (top) at 80 per cent bloom and Control (bottom) at 40 per cent bloom.

Figure 3: Bleached colour in the cultivar ‘Blush’ (fertilizer adjuvant) X 5204.
What’s in a Queensland Fruit Fly trap?

Bronwyn Koll

A suite of tools is required for effective Queensland Fruit Fly (QFF) prevention and management in a fruit production system.

Whilst orchard hygiene, M.A.T. (attract and kill male lures) and regular protein bait sprays are important factors for QFF control, traps are one of the tools farmers/managers also opt for, but which trap?

**What role do the traps play in QFF management?**

Traps are mainly used as a tool to monitor QFF population trends or in the role of early detection. When used in a grid, QFF traps can be used to observe general pest pressure over a given area or from a certain direction. Traps can be used to help prove QFF absence. The number of QFF in the traps can be tracked over time and farm management actions can be reviewed or altered to reduce the QFF population. Traps are also useful in backyards as one of the management tools, particularly where the use of other control options may be limited.

**What type of trap do I need?**

How are they used?

Traps are often a small container or sticky panel, brightly coloured, and hung in a warm yet shady location like a tree at about 1.5m high. They are based on a fly attractant (lure), and a kill method. Traps provide the grower with the ability to count the catch at regular intervals. Attracants are usually based on the release of colours and visual cues.

Attracants include a para-pheromone option (males only), a food source (male and female) or some mimic ripe fruit (females). Each type of attractant has its advantages. Lures are attractive according to a fly’s gender, age, sexual maturity and reproductive stage. Three types of kill methods include the use of insecticide (synthetic or organic), a body of liquid (that the fly drowns in) or a sticky surface, to capture the pest.

Using a variety of traps is one way to capture knowledge about the whole fruit fly population at a given time or over the season.

**Traps do not replace the need for fruit inspections.** It is important to consider what other attractions are in or around the orchard at the time of observing the trap counts and making management decision. These “real” attractions could be distracting the flies from the surveillance traps. Ripe fruit in an orchard, naturally occurring para-pheromones and protein food sources on leaves in the bush are “the real thing” when it comes to fruit flies! All practices to reduce fruit fly impact need to be used in a collaborative way to achieve good area wide management. 

**Acknowledgements:** Bronwyn’s role is funded under the Victorian Government’s Managing Fruit Fly Regional Grants program.

<table>
<thead>
<tr>
<th>Trap Type</th>
<th>Action</th>
<th>Use</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male lures</td>
<td>Traps contain a para pheromone scent that attracts male QFF to a trap.</td>
<td>Monitoring QFF populations over a wide area. Early detection.</td>
<td>Best used in a “grid” (multiple male lure traps). Inspect regularly all year. Change lure every three months.</td>
</tr>
<tr>
<td>Feeding lures</td>
<td>Traps attract flies with odours of decomposing and fermenting proteins and ammonia compounds.</td>
<td>Some monitoring (as part of a complete program). Population reduction (Particularly pre and post fruit harvest)</td>
<td>Proteins are attractive to immature stages of the adult fly – those that require protein to reach sexual maturity. Adult flies will also feed on proteins. Can attract other fruit flies.</td>
</tr>
<tr>
<td>Exclusion lures (egg laying lure)</td>
<td>Traps attract females that are looking for ripe fruits to lay eggs (visual element and a fruit odour).</td>
<td>Some monitoring (as part of a complete program). Preventing fruit being damaged. Population reduction.</td>
<td>Best used preharvest. Can attract other fruit flies.</td>
</tr>
</tbody>
</table>

**Traps**

<table>
<thead>
<tr>
<th>Blk</th>
<th>Treatment</th>
<th>Application date</th>
<th>Green-tip date</th>
<th>Full bloom date</th>
<th>Harvest start date</th>
<th>Harvest finish date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Erger*</td>
<td>01/08/18</td>
<td>10/09/18</td>
<td>30/09/18</td>
<td>17/03/19</td>
<td>30/03/19</td>
</tr>
<tr>
<td>2</td>
<td>Control</td>
<td>10/09/18</td>
<td>06/10/18</td>
<td>21/03/19</td>
<td>08/04/19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Erger*</td>
<td>14/08/18</td>
<td>19/09/18</td>
<td>06/10/18</td>
<td>21/03/19</td>
<td>17/04/19</td>
</tr>
<tr>
<td></td>
<td>Waiken*</td>
<td>15/08/18</td>
<td>19/09/18</td>
<td>06/10/18</td>
<td>21/03/19</td>
<td>17/04/19</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>18/09/18</td>
<td>09/10/18</td>
<td>21/03/19</td>
<td>17/04/18</td>
<td></td>
</tr>
</tbody>
</table>

Acknowledgements

A special thank you to Heidi Parkes, Senior Horticulturalist from the Department of Agriculture and Fisheries, Queensland who assisted with providing the Richardson CH Unit Model adapted from QFF and for sharing her research findings to assist with the methodology and background information for the trial. Thank you to Carol and Sue Eger for agreeing to host the trial at their orchard and for the help from his workers who conducted the spray application and assisted with fruit monitoring. Thank you also to Valadou for providing the trial product Erger® and to Susan Murray (White Project Manager for Pomewest, Western Australia for her advice and guidance.

Finally thank you to Paul Sellick, Senior Fruit Fly Agronomist at E.E. Muir and Sons for his expertise in apple nutrition and for assisting with field data collection.

The earlier Erger® application was the only treatment that had a significant effect.

**Fruitlet size**

Fruitlet size was advanced and more even in the earlier Erger® treatment indicating a more advanced fruit set compared to the untreated control.

**Fruit quality**

Dormancy-breaking sprays’ effect on fruit quality remains unclear, however the high starch index measured for the earlier Erger® treatment indicating a more advanced and more compact fruit size was advanced and more even in size. Secondary thinning sprays were consequently more effective.

**Harvest date**

Harvest date was advanced and more compact. This allowed harvest to be completed within the ideal maturity window. This is likely to improve fruit quality and storability.

**Final comments**

The trial highlighted the importance of timing of dormancy-breaker sprays. Every season is different and will impact on bud burst and flowering dates. Growers are encouraged to monitor and record:

- (a) Localised chilling data. Use the Chill Calculator website to access and accurate local winter chill data. https://hort-science.shinyapps.io/ChillCalculator/
- (b) Green-tip (budburst) dates.

Collecting this data over time will provide more reliable guidance as to the need for dormancy-breaker sprays and then the best timing of application for optimal effect.

**Key findings**

Advantages for earlier Erger® applied 40 days before green tip date:
- Flowering was advanced and more compacted
- Fruit set was earlier and the fruitlets were more even in size. Secondary thinning sprays were consequently more effective.
- Harvest date was advanced and more compact. This allowed harvest to be completed within the ideal maturity window. This is likely to improve fruit quality and storability.

Erger® (Apal. Org. Au)
APAL.ORG.AU

International apple and pear research update

Compiled by Dr Gordon Brown

Seeds and Stratification

Syria: The optimal seed stratification requirement of apple trees varies between 60 and 90 days at 4°C depending on varieties being germinated.

Nitric oxide releases seeds from dormancy

Poland: Nitric oxide treatment of apple embryos stimulates their transition from dormancy to germination and this is associated with a reduction in abscisic acid (ABA) hormone levels.

Production

Pollination and fungicides

Turkey: Pollen germination of apples was found to be inhibited by the fungicides captan and azoxystrobin but not by myclobutanil.

Carbon fixation

China: In a Fuji apple orchard the rate of carbon fixation per tree over a day reduces from 10 to 3 moles with increased cloud cover (a mole of carbon equals 12g).

Weeds reduce apple yields

Turkey: Research has shown that apple yield in a high density orchard is adversely affected by increasing completion from weeds.

PGR effects on pear fruit quality

Bosnia-Hercegovina: GA3, with BA applied at full bloom on pears improved fruit size while GA4+7 with BA applied just after full bloom on ‘Rocha’ pears improves fruit size while Potassium uptake in apples under dry conditions.

Cold hardiness of apple rootstocks

Iran: M9 rootstocks are harder than MM106, M26 or B9 when exposed to soil temperatures of -5°C during winter.

Pollination allele associated with red flesh colour

Japan: An analysis of 15 red fleshed apple cultivars found that all expressed the S3 pollination allele which is closely linked to the red fleshed gene.

Pests and disease

Fungicide costs using disease resistant apples

Romania: The fungicide cost for 10 year old disease resistant varieties Arava, Golden Lasa, Goldrush, Enterprise, Inredit, Iris, Luca, Real, Rebra, Redix, Remar, Saturn, Voinicel was half that needed for conventional cultivars.

Biocontrol of Fireblight

Spain: Lactobacillus plantarum has been shown to colonize and survive on pear plants and when applied in combination with lactic acid provides multibarrier biocontrol of fireblight.

Protected cultivation of pears

China: Pear trees grown under rain shelters had reduced incidence of fungal diseases, delayed defoliation, reduced flowering but increased fruit set and yield.

Anti-insect nets reduce postharvest rots

Italy: The use of anti-insect nets also reduces the incidence of three postharvest rot fungi during storage.

Apple necrotic mosaic virus

Korea Republic: Apple necrotic mosaic virus has been detected in apple trees for the first time.

Organic production does not improve apple pollination

Sweden: Organic apple production enhances the presence of predators in the orchard which suppresses pest pressure but has little benefit on insect based fruit pollination.

Yeast control of fruit rot

China: The yeast Sporodolobus parareutus directly inhibits Penicillium expansion germination and stimulates apple fruit defence mechanism resulting in a reduction of blue mould fruit rot.

Research snippets are sourced from abstracts of published scientific papers collated in the CAB direct database. To get the abstract related to any snippet, contact Gordon Brown on gordon@scientifichorticulture.com.au or 03 8239 6411.

Virus infection of Korean pear trees

Korea republic: Apple stem grooving virus infection of pear trees in South Korea is extremely common and typically between 70 and 100% of orchard trees.

Organic control of black spot and powdery mildew

Romania: In organic apple production the combination of potassium bicarbonate + wettable sulphur significantly reduces black spot and powdery mildew compared to other organic treatments.

Postharvest

Sulphite film extends cut apple life

Argentina: The use of soy protein based films containing sulphites on fresh cut apples extends their shelf life.

Apple cider vinegar has medicinal properties

Bosnia-Hercegovina: Traditionally produced apple cider vinegar has been confirmed as having antibacterial activity making it a useful ingredient in natural medicines.

High banana prices good for apple and pear prices

China: In China, the prices of apples, pears and bananas have a positive influence on each other due to strong substitutability between them.

Attapulgite against patulin in juice.

China: Patulin contamination from blue mould infection of apple and pear fruit used to make juice can be eliminated by absorption of patulin onto attapulgite.

TSS is a poor indicator of apple sweetness

Italy: TSS is poorly related to consumer perception of sweetness which is positively affected by volatile esters and farnesene.

Wild red fleshed apples

China: The phenolic composition and antioxidant activity of a wild Chinese red-fleshed apple is extremely high and the health benefits, novelty and attractiveness is appealing to consumers.

Anti-bacterial coatings on fresh cut apples

Portugal: Alginate edible coatings with Eugenol applied to fresh cut apples reduces the survival of Listeria and Salmonella bacteria on the fruit.

Visit APAL’s website to find the original research papers. www.apal.org.au

Greg’s Quiz

Crossword

**Question 1**

True or False Statement

In times past, walnut and elm trees were tapped to produce a sugary syrup from their sap.

**Question 2**

Multiple Choice

What is the name of a leaf’s internal (ground) tissue?

A: Cambium
B: Cortex
C: Dermal
D: Mesophyll

**Question 3**

Multiple Choice

One of the oldest companies still in business in the USA, this 200-year old and family-owned fruit tree nursery merged with Miller Nurseries in 2013?

A: Applewood Nurseries
B: Van Well Nursery
C: C&O Nursery
D: Stark Bros

**Question 4**

Multiple Choice

Which of these old apple varieties is a red-fleshed type?

A: Nonniel Bastard
B: Dooked Improved
C: Bloody Poughman
D: Red Royal Lumberton

**Question 5**

Multiple Choice

Which country has the highest production of pears in Europe?

A: Italy
B: Spain
C: Portugal
D: Poland

Across

1. _______ trees are one option for maintaining trees during severe water shortages (7).
2. _______ varieties offer an opportunity for a pear image makeover (5).
3. _______ is important in the application of _______ breaker sprays (8).

Down

1. _______ and Grower of the Year, Jason Shields (7).
2. Use of this can reduce water stress and boost packout as well as protecting the crop (7).
3. _______ will undergo the development of the _______ tool (6).
4. _______ update session will be held on 14 October at the MCG (6).
Grower R&D Update

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Melbourne Cricket Ground (MCG)

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