australian almonds

In A Nutshell

The Official Newsletter of the Australian Almond Industry Winter 2020

2020 Australian Almond Conference

POSTPONED

IN THIS ISSUE

DO YOUR CUSTOMERS VALUE CLEAN AND GREEN, QUALITY PRODUCE?

Haifa supplies Australia's highest quality, fully water soluble fertilisers. Haifa Multi-K GG, MKP and Multi-K Reci comprise 100% pure plant nutrients and extremely low sodium and chloride levels. Growers have confidence using these products for their high quality crop production programs because every bag comes with a batch number and corresponding certificate of analysis (COA). Have you checked your fertiliser for a COA?

HAIFA – QUALITY YOU CAN TRUST!

FERTILISER CHECKLIST

- WHERE IS IT FROM?
- DOES IT HAVE A BATCH NUMBER? (12345)
- DOES IT HAVE A CERTIFICATE OF ANALYSIS?

MUCH MORE THAN JUST A FERTILISER SUPPLIER...

UN Global Compact

Haifa Group is fully committed to the Global Compact on human rights, labour, environment and anti-corruption. We also are fulfilling the UN's Sustainable Development Goals to help end poverty, protect the planet and ensure prosperity for all.

Motti Levin, CEO

Waste and recycling

Haifa has been one of the leading organisations behind the Farm Waste Recovery industry stewardship program for large bulk bag collection. It has been actively promoting the program to ensure the industry is seen in a positive light. Haifa has been driving the outcomes for larger growers and smaller growers, so they understand what their responsibilities are.

Stephen Richards, Farm Waste Recovery

Haifa

(03) 9583 4691 australia@haifa-group.com www.haifa-group.com

Winter 2020

In A Nutshell

The Official Newsletter of the Australian Almond Industry

Published by: **Almond Board of Australia Inc**

ABN 31 709 079 099
1801 Bookpurnong Road , PO Box 1507, LOXTON SA 5333
+61 8 8584 7053 admin@australianalmonds.com.au
www.australianalmonds.com.au

The Almond Board of Australia is the peak industry body representing the interest of almond growers, processors and marketers in Australia. In a Nutshell is published by the ABA to bring news to all industry contacts and members.

Advertising & Editorial Content
The Almond Board of Australia (ABA) acknowledges contributions made by private enterprise through placement of advertisements in this publication. Any advertising and/or editorial content supplied to this publication does not necessarily reflect the views of the ABA and unless otherwise specified, no products and/or services are endorsed by this organisation.

Funding
This publication has been funded by Hort Innovation, using the almond research and development levy and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.

Some articles within this publication refer to projects managed by Hort Innovation with funding from the grower R&D levy and matched by the Commonwealth Government.

Disclaimer
Hort Innovation Australia Limited (Hort Innovation) and the Almond Board of Australia (ABA) makes no representations and expressly disclaims all warranties (to the extent permitted by law) about the accuracy, completeness, or currency of information in the *In A Nutshell* publication. Reliance on any information provided by Hort Innovation or the ABA is entirely at your own risk. Hort Innovation and the ABA are not responsible for, and will not be liable for, any loss, damage, claim, expense, cost (including legal costs) or other liability arising in any way, including from any Hort Innovation, ABA or other person's negligence or otherwise from your use or non-use of advice published in *In A Nutshell*, or from reliance on information contained in the material or that Hort Innovation provides to you by any other means.

Hort Innovation
Strategic levy investment

ALMOND FUND

australian almonds
ALMOND BOARD OF AUSTRALIA

CONTENTS

Cover image: Almonds in blossom, Julie Hill

Biosecurity signs available

The ABA has printed 400 biosecurity signs for distribution to almond growers to assist the implementation of COVID-19 and other biosecurity plans for orchards. The signs request visitors to contact the grower before entering the property. Almondco have joined the initiative to distribute the signs to their grower members whilst other growers can arrange delivery by contacting Ben Wiblin, ABA Industry Development Officer on 0432 697 144 or by pick-up from the ABA office at the Loxton Research Centre. For other useful information in managing COVID-19 in your business see the ABA website.

From the *Executive...*

Peter Hayes | Chairperson

Ross Skinner | CEO

The Australian almond crop in 2020 has been harvested with the preharvest estimate of 106,000 tonnes holding up. The harvest has had some disruption from rain but fortunately most of the Nonpareil crop was in storage before this occurred. The pollinator varieties stand up to rain events very well and so the overall quality of this year's crop is very good from a colour perspective though the volume in smaller sizes is higher than last year.

The record predicted US crop, combined with the economic uncertainty and lockdowns caused by COVID-19, has resulted in a significant fall to global pricing. The large jump in Californian production has been expected as is the resulting need to stimulate demand with lower prices. The low Australian dollar is providing some relief.

The focus on family wellbeing is beneficial to foods such as almonds that are known to have wide ranging health benefits. The promotion of the health benefits from cardiac, diabetes, and weight management perspectives and as the ideal fitness snack after exercise, given almonds' protein rich nature, has better placed our industry to meet the challenging times ahead.

With the good rains over the catchment area for Murray water storages and the wetter weather prediction for winter, the availability of water for the 2020/21 crop should see some cost relief for this key production input. The ACCC interim report on the water market may also see measures strengthened to prevent market manipulation leading to higher prices for leased water. The improved weather in terms of rain has also benefited floral resources for beekeepers who have endured a tough period with drought and bushfires that have destroyed hives and sites on public lands for some apiarists. The ABA is working with the honeybee industry to obtain access to new sites from government. With significant increases in both the price of honey and hives for pollination services it is an opportune time for new entrants and an expansion of existing businesses in the bee industry. The ABA is able to link beekeepers wanting to undertake pollination services with almond producers for the bloom period in August.

With the uncertainty regarding future COVID-19 restrictions, the Australian Almond Conference, that was to be held this year in October in Adelaide, will now be held in 2021.

It will also be an unfortunate consequence of the pandemic if the blossom festivals, that have become a part of the social calendar in the producing regions, do not proceed. The sight of the flowering orchards is enough to raise peoples' spirits, hopefully even during this period of upheaval.

australian almonds
ALMOND BOARD OF AUSTRALIA

ABA MEMBERSHIP: JOIN TODAY

The ABA is the peak representative body for the Australian almond industry and as such addresses many issues that impact on all participants in the industry including growers, processors and marketers and those who supply inputs. These impacts can be positives such as free trade agreements or promotion to stimulate demand and hence prices or they can involve minimising negative situations such as food safety issues, market access problems, chemical registrations etc.

The ABA develops and drives the implementation of the Australian industry's strategic plan which is done to benefit all producers and other industry participants. The strategies involve building domestic and export markets, the key to strong grower returns and addressing a wide range of risks from the availability of production inputs to government policies that impact on costs and yields. These matters effect on the bottom lines of almond enterprises.

The ABA's whole of industry strategies have been successful and have worked to ensure the large increases in production have been cleared.

The ABA operates a number of activities that support industry and generate revenue to fund its operations and keep membership fees at a low and affordable cost. Being an ABA member provides crucial support for your industry body that we need and appreciate. A strong membership base provides added force in our representation of industry to government and in the wider community.

Join the ABA today, in the knowledge you are assisting the industry and yourself to move forward as Australia's most valuable horticultural industry.

Join the ABA by visiting our website, phoning
08 8584 7053
or email admin@australianalmonds.com.au

OMC

ORCHARD MACHINERY CORPORATION

TREE SHAKERS AND HARVESTING EQUIPMENT

OMC Hedgehog Model 301 1 Hedger

200HP (149kW) 4,5L Cummins Stage V turbo diesel engine

- Load Sense hydraulic system
- 4-wheel-drive and 4-wheel-steering
- Traction control
- Heated and Air-Conditioned Cabin
- LED lights
- On-board air compressor
- Air Ride Seat
- Tilt steering wheel
- Backup Camera
- Hydrostatic transmission
- Powder coat finish
- 378 liter fuel tank

Shockwave® Sprint
SIDE-MOUNT TREE SHAKER
with Tree Seeker Phase 2
shaker automation system

TREE SEEKER
PAT. # 6,658,834 7,757,471 9,485,912

Aftershock®

CC-350
DUAL CHAIN CONVEYOR CART

AR-400
SIDE-DUMP SHUTTLE

SD-36
SIDE-DUMP ELEVATOR

Strong on Parts and Service
Since 1961
www.ShakerMaker.com

AUSTRALIA
Cowanna Almond Harvesting
Mildura, Victoria
Tel: 03 5025 3700
Mobile: 0418 990 391
Email: neale@cowanna.com.au

HEADQUARTERS
2700 Colusa Highway
Yuba City, CA 95993 USA
Tel: +1 530 673 2822
Fax: +1 530 673 0296
Email: sales@shakermaker.com

Follow us on Facebook & Instagram
@OMCshakermaker

Australian Almond Conference postponed until 2021

DUE to COVID-19 circumstances, a decision has been made to postpone the 2020 Australian Almond Conference until 18-20 October 2021.

The difficult decision was made by the Almond Board of Australia's Conference Committee late last week and was strongly influenced by the desire to preserve the value of the Conference which has been built on each year.

Uncertain timeframes for the easing of restrictions on numbers able to attend events, international and interstate travel restrictions and social distancing requirements were all considered when making the decision.

The COVID-19 pandemic has already seen events for many industries cancelled or postponed. Whilst a modified 2020 Almond Conference was considered, the Conference Committee did not believe it would do justice to this signature industry event .
The 2020 Australian Almond Conference was scheduled to be held from 7-9 October 2020 at the Adelaide Convention Centre. The venue will remain the same for the 2021 Conference.

The ABA will hold its AGM on the 8th October in Loxton, and /or by video conference should COVID restrictions still be in place, and will continue to keep industry informed of any further changes to planned industry events.

Replanting considerations

Deidre Jaensch |

Industry Development Manager

Many of the Australian almond plantings expanding along the lengths of the Murray River are now approaching 20 years in age. While many things improve with age, almond orchards tend to have a limited productive lifespan. How long this is will differ for every orchard. At some stage, the decision to replant will be faced by every almond grower. I caught up with Neale Bennett, Brendan Sidhu and Andrew Lacey about their experience with redevelopment and share some of their thoughts about deciding to replant an orchard.

When do I need to replant?

While the prices are strong, and yields are good, there may seem little point in thinking about replanting. However, early planning may help avoid hasty decisions and improve the chance of getting it right. Three key signs that you may need to start thinking about replanting are:

- Declining yields – being able to measure how much you are harvesting from each area will indicate when yields start to decline. Tree age may be one of many reasons why crop tonnage gradually tapers off. Crack-outs need to be considered to work out yield performance.
- What the crop looks like – as trees get older and have larger canopies, there is more wood to manage within the lower parts of the tree. As parts start to die out it tends to get more difficult. At some point it may be too resource intensive to achieve the same consistently high quality product.
- Profit margins – are continually fluctuating in response to resource inputs to manage seasonal conditions and market prices. At some point declining yields means higher returns are required to offset the increase in management costs due to aging trees.

A cost:benefit comparison of replanting a 15 year old orchard versus a 30 year old orchard illustrated that there may be greater gains in replanting earlier rather than waiting too long.

What variety to choose?

There is no simple or clear answer to this question. The Australian industry has been established on mixed plantings of Nonpareil, alternating with pollinators such as Carmel and Price. While Nonpareil is accepted by the world industry, and has a strong and reliable market, it is not the easiest crop to grow. Growers are looking for an alternative with new varieties accounting for 1,709 hectares or 12.5 percent of the 13,702 hectares planted from 2016 to 2019. Desired characteristics include: a look and taste like Nonpareil, sealed shell reducing pest and disease susceptibility and self-pollinated.

For those who have been in the industry for a while, many new almond varieties have come and gone. Some have been removed as they haven't turned out as originally hoped. In Australia, there are now more options with overseas varieties licensed to local nurseries and the commercialisation of locally bred varieties through the University of Adelaide. Although new varieties are thoroughly tested and screened for pest and disease resistance, they are yet to prove themselves across the diverse range of Australian soils and growing conditions. Andrew Lacey has been involved with the Australian almond breeding program for a long time and when discussing the newly bred varieties he is confident that the improved characteristics will provide good options to suit each growers' preferences.

More information on the Australian Almond breeding evaluation program can be found on the **ABA website**.

When thinking about which variety to plant a good place to start is to talk to your handler (processor/ marketer) to find out what is happening with market trends and plans for new or expanding markets. Marketers need to forward plan on what will be

coming in and what needs to be sold so it's important to align with these strategies. Asking questions about each variety now will let you know if they will accept your crop later rather than assuming all things grown will have a home.

And then there's the rootstock

Earlier plantings were based on Nemaguard as the industry standard. Picking the perfect rootstock to maximise varietal performance is a decision that should be based on soil water holding capacity, presence or absence of limestone and nematodes, and planting densities. It is less about what everyone else is planting. Neale Bennett from his earlier experience growing grapevines cautions growers that good soils and a strong rootstock can end up with a disaster.

"Hybrid rootstocks are designed to cope with marginal soils but when they are grown in heavier soils the trees can be enormous."

"Growers need to be careful to match the rootstock with their soil-type", said Neale. "We need to work within the limitations and maximise what we've got."

Overseas research has shown that Nemaguard is an inefficient user of water. Its shallow rootzone has less resilience against heat waves. New hybrid rootstocks seem to cope better with Australia's heat and may provide a better option.

Rootstock trials at Lindsay Point are beginning to show differences in canopy efficiencies (kernel yield per canopy area) and suggest that management regimes (developed for Nemaguard) may need adjustment to realise the performance benefits of various variety/ rootstock combinations.

Use high health material

Most growers realise the importance of planting high health, virus tested material to give their trees the best start. Brendan Sidhu wouldn't recommend anything but ABA accredited budwood. Clean trees have stronger growth and can establish quickly.

"It's silly that some people are willing to skimp on the price of a tree they may have for 25 years or more. The money saved in the short-term, may end up costing more with delayed tree establishment."

"Paying for accredited material is a small investment for a long-term gain." Brendan hopes that new players do not have to learn the hard way by using sub-standard planting material for a cheaper price.

With change comes opportunity!

When replanting an existing orchard, there is a rare opportunity to make changes. It is an ideal time to apply what has been learnt over the last 20 years and address some of the shortcomings of initial plantings that were designed based on the best knowledge at the time.

Rethinking irrigation system design

Early almond developments aligned irrigation system design with soil characteristics and water holding capacity. Since this time there have been further advances in irrigation technologies and system designs that can help maximise water deliverability as well as reduce system drainage. It is recommended that growers discuss their plans with irrigation designers as this may help identify technologies to meet your goals.

Land preparation

There is not much time between the last harvest for old trees and planting new trees so you need to be well prepared if you want to improve the soil. Andrew generally removes trees in May and replants by July the same year and finds it helps to "get rid of as many roots as possible and deep rip if you can."

Brendan suggests "adding as much as you can afford of good composted and pathogen free organic material will help improve the soil structure and soil health."

Monitoring almond yield variability *from the sky*

A view of the orchard captured from the skies above.

Almond producers are aiming at improving productivity with efficient use of nutrient and water resources. Assessing plant water and nutrient status can provide precise diagnosis and guidance to balance plant production against economic and environmental effects for sustainable agriculture.

The University of Melbourne's airborne facility.

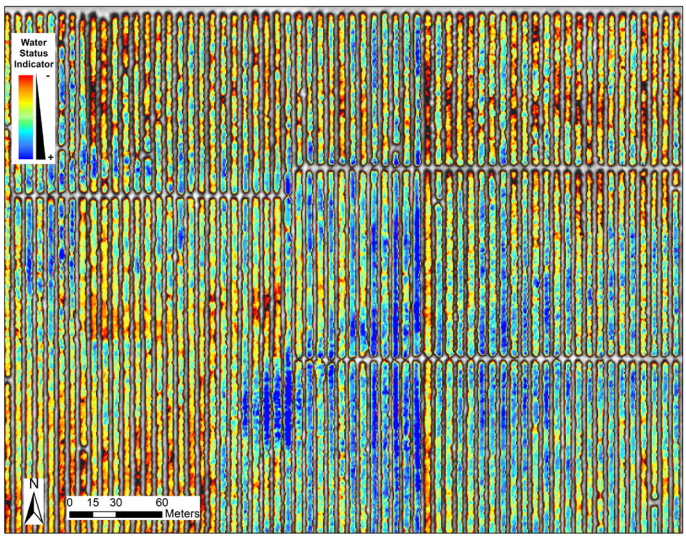
Recently, the development of sensor technology and remote sensing methods has made significant progress towards monitoring plant deficiencies at leaf, canopy and landscape levels to inform irrigation and fertiliser management decisions efficiently.

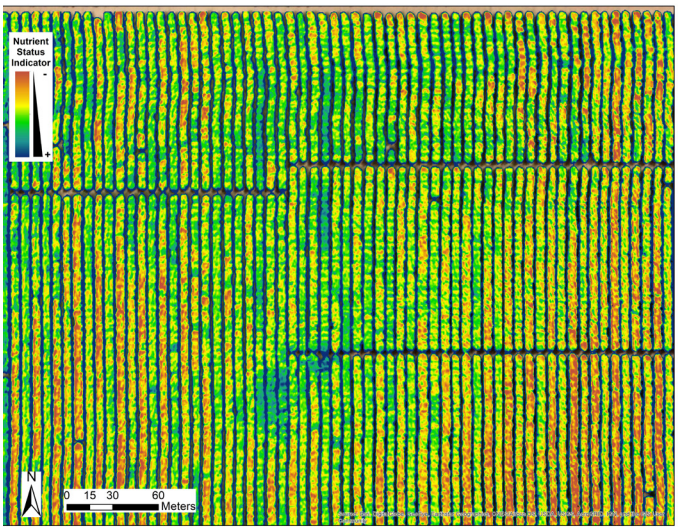
Currently, aerial hyperspectral and thermal imaging and modelling techniques are being developed to monitor almond stress and its effect on yield by the University of Melbourne's **HyperSens Remote Sensing Laboratory** led by Professor Pablo Zarco-Tejada.

In February this year, an airborne campaign was successfully carried out over a 1000+ ha almond orchard in the Mallee region led by the research fellow Dr Tomas Poblete. Two hyperspectral imagers covering hundreds to thousands of spectral bands and a thermal imager were installed on the light manned aircraft collecting the data at a spatial resolution of around 50 cm to allow for definition of individual tree crowns. A thermal mosaic map was then processed within the same day to inform of the current water status at canopy-level over the orchard. Other stress factors potentially affecting final yield were then identified, such as nutrient status variability present across the orchard.

Concurrent to the flight, the research team led by research fellow Dr Lola Suarez and PhD student Anne Wang were working on the ground, collecting data using a series of handheld instruments, including leaf pigments, nutrient level and performance indicators. Combining the airborne imagery with the ground measurements allow quantifying stress levels for individual trees across the orchard. The resulting maps derived from the hyperspectral images demonstrate leaf pigment and nitrogen variability, as well as water stress variability derived from thermal imagery.

The innovative modelling method that the research team is developing is robust and transferable; it quantifies the plant biophysical and biochemical parameters for every tree later related to yield. This can help growers to better understand the variability in yield and make the corresponding decisions to avoid yield loss across the orchard. It also allows the grower to make cost-





Above left: Shows nutrient stress availability, Above right: Shows water stress variability.

Below: Field measurements by the research team from HyperSens Remote Sensing laboratory.

benefit analysis of variable water and nutrients applications correcting for the effects of soil types, and actual needs of trees, given varying ages, dimensions and vigor. This method will help farm uniformity in terms of yield and nuts quality.

"We know it is challenging to identify and quantify tree-level stress in orchards with the complexity of tree crowns in such extensive areas. However, it is interesting to link the response of stress to the spectral plant traits for individual trees. It is our pleasure to contribute in adopting new technologies that inform water and nutrient management to help reduce the environmental impact of the sector by decreasing the use of resources and the contamination of soil and water", Anne says.

THE UNIVERSITY OF MELBOURNE

This research is part of a network of projects under the umbrella of the Mallee Regional Innovation Centre (MRIC). The Centre has offices in Mildura and is a joint venture between the University of Melbourne, La Trobe University and SuniTAFE and has the four focal areas of water, horticulture, energy and the environment. Anne is the Centre's inaugural recipient of the McPherson Family and Invergowrie Foundation Women in STEM PhD scholarship.

Maximise your yield potential with Stoller Solutions.

Stoller

25 YEARS

50 YEARS

stoller.com.au

- It's important to prepare your almond trees with the correct nutrients for flowering and pollination.
- A strong, even bud burst is crucial for flowering and ultimately, a good harvest.
- Stoller's Bio-HOLD will promote early fruit and nut sizing, improve retention and increase marketable yield.

Bio-HOLD

- A liquid fertiliser formulated with macro and micronutrients.
- Reduces ethylene in the flowering and early setting stage.
- Supports carbohydrate movement to developing fruit.
- Increases strength of late flowers.
- Increases fruit and nut size.

Stoller will help your almond trees reach their full potential. Ask us how today.

Contact Stoller on FREECALL 1800 337 845 or info@stoller.com.au

Pollination 2020 season update

Robert Wheatley |

Almond Board of Australia Pollination Committee Chairperson

Drought conditions in southern Australia and bushfire damage to beehives and native floral resources made it a challenging start to the pollination season. Australian beekeepers have been busy over autumn to get hives back up to condition. With 'better than average' rains this should provide a reasonable supply of natural resource that will hopefully mean a good quality standard of hives.

To address losses from fire and drought more beekeepers are reducing the reliance on mother nature and providing hives with supplementary feeding. This increases the opportunity for beekeepers to expand operations and maintenance of hive nutrition to improve hive strength.

More bee friendly cover crops are being planted in and around orchards taking advantage of wetter conditions to encourage bees to forage longer providing a good nectar source, increasing better results of pollination and keeping the bees happy. Early results from forage trials are promising and may encourage more growers to go down this path. In California this has also translated into a reduced pollination price with the production of almond honey during pollination. For the first time last season, Beechworth Honey produced a limited edition of **Almond Honey.**

There is positive feedback all-round from apiarists and State Government biosecurity officers about the proactive efforts in implementing the Bee Biosecurity Code of Practice (the Code). The Code is a step in the right direction to help protect beehives from diseases especially when multiple beekeepers service an orchard.

It will also help almond growers with the delivery of healthy hives to orchards.

The ABA pollination committee is developing the Australian Honeybee Best Management Practice (BMP) guidelines providing simple and practical steps for almond growers to work with beekeepers to nurture bee health during pollination. The committee is aiming for release

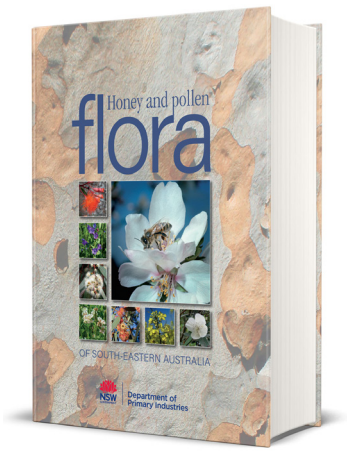
Talking points for growers and beekeepers

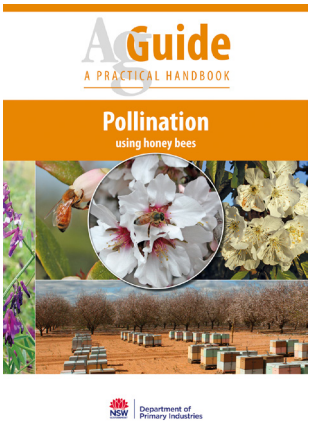
- The number of frames per hive and stocking rates per hectare
- Where the hives will be located in the orchard (sheltered and warm)
- Accessibility of colonies to beekeeper and potential site hazards
- Forecasted dates for gradual introduction of hives into the orchard (Recommendation of incremental increases in hive density beginning at 5 percent blossom)
- Proposed dates for hive inspection including temperature and time of day, number of hives to be inspected and of a third-party auditor will be involved
- Any proposed spray application plans and provision of spray diary records
- Supply and maintenance of a clean water source especially for sandy soils and warm weather
- When to notify the beekeeper of signs of dead bees
- Removal and replacement of dead or weak hives
- Dates for gradual removal of hives from the orchard
- Payment terms, including the deposit, progress payment and final payment
- Evidence of appropriate insurances including public liability insurance for all parties
- Bee Biosecurity annual Certificate of Compliance.

Resources

The following documents produced by NSW Department of Primary Industries are a good source of information for growers interested in learning more about pollination and flora for bees (check links for pricing):

- **Honey and pollen flora of south-eastern Australia**
- **Pollination using honey bees Ag Guide**





of the publication prior to the 2020 pollination season, the BMP guidelines will promote:

- hive standards, agreements and auditing for hive health
- phased moving hives in and out of orchards to match floral resources
- avoiding disease risks through the National Bee Biosecurity Program
- minimise chemical use during pollination to protect bees.

The ABA is establishing a pollination directory on their website in response to growers wanting to connect with beekeepers as well as an increased demand for independent auditors' contacts to inspect for hive health and contractual agreements. The ABA are inviting interested beekeepers and auditors to **contact the ABA** for inclusion in the directory.

Further research has been done by the University of Adelaide on the effect of various fungicides on hive health. We encourage growers to be vigilant when spraying orchards. Consulting beekeepers about your spray plans for the season ahead is a dialogue that needs to be started sooner rather than later. We have provided some talking points for growers to discuss with their beekeeper / broker.

Growers who regularly talk with their beekeeper develop a strong relationship so that the beekeeper is more likely to return every year.

By the end of May, contractual terms between growers and beekeepers should be agreed. It is important to remember that these agreements are likely to change every year due to climatically driven events.

General observation from a grower's perspective has been that there is an improvement in beehive health after hives leave almond orchards, also a sentiment recently conveyed by Peter McDonald from Australian Honey Bee Industry Council (AHBIC).

"Our family business has been providing professional almond pollination services for approximately 35 years. In all that time we have never had a bad experience for our honey bees from almonds.

"The bees have always come away from the pollination period of August in better health and condition that when they went there.

"We believe this is because of a couple of reasons, the almond pollen is high in nutrition and there is a large quantity of pollen on offer.

"We have also been pleased to witness directly the continued development of the almond industry and the constant drive to implement best practice in all facets of producing a crop. This includes items important to healthy hives such chemical usage regimes, provision of additional floral sources and water.

"The pollination period of August, the last month of winter, is critical in expanding beehives to provide healthy young bees that can take the hive forward through its natural expansion period of spring. An early start sets up the hive and the beekeeper for the opportunity to capitalise on future floral events.

"We see no downside to us undertaking almond pollination and it will continue to be a regular and important part of our beekeeping calendar."

OrganiBOR®

Reliable, safe boron, all year round

One application for up to two seasons of safe, plant available boron

The Importance of Boron

- Root growth
- Nutrient uptake
- Structural strength
- Disease resistance
- Flowering fertility
- OrganiBOR is certified for organics

Omnia has a range of products designed to help you increase plant growth and crop yield including:

K-humate®

Increase fertiliser efficiency with K-humate, the world's most concentrated humate product. 100% Australian made. Recognised as the international industry standard.

Rhizovator™

Rhizovator™ promotes biological diversity, soil health and nutrient availability. Improving biological diversity makes the soil environment more resistant to diseases. Reducing disease and improving nutrient uptake means plants have more energy for growth.

Mega-Kel-P™

Mega-Kel-P allows you to manipulate crop growth to your advantage by scientifically managing plant physiology, improving yields and quality with better nutrition and fruit set. Apply Mega-Kel-P as a foliar spray to new foliage for vital root growth.

Kieran Christian
0429 897 074
kieran.christian@omnia.net.au

Johan Prinsloo
0488 911 981
Johan.prinsloo@omnia.net.au

omnia NUTRIOLOGY*
*the science of growing

www.omnia.net.au

Supply and demand: the current global context

Joseph Ebbage |

Marketing Manager

The recent release of the USDA-NASS Subjective Estimate of the 2020 Californian almond crop at three billion pounds highlights the significant growth of global almond production. The Almond Board of California has been communicating this growth trajectory for some time. The estimated 2020 Californina crop is 18 percent higher than the previous year.

While there will be some immediate challenges within the global market to consume this increased volume of almonds, there are numerous global demand drivers that point to a positive road ahead.

Why consume almonds?

Almonds are enjoyable to eat, highly versatile for use in a wide range of food products from savoury to sweet, convenient to carry as a portable snack and overall, very healthy. More than twenty years of published research highlight the role of almonds in helping to lower LDL cholesterol and reducing the risk of cardiovascular disease. A significant body of recent research is connecting almond consumption with lowering the risks associated with Type 2 diabetes.

Almonds are well positioned to appeal to the growing middle class populations around the world led by India and China. According to research by the European Commission, India and China are expected to represent 59 percent of the entire global middle-class consumption by 2030. The Brookings Institute suggest that by then, the annual value of the middle-class markets in India and China with be $12.3 trillion and $14.1 trillion, making them comparable to the US middle-class market of $16 trillion. The INC 2019-20 Statistical Yearbook indicates that the average almond consumption per capita in the USA is 1.07 kgs/ year and Australia is 1.09 kgs/ year. By comparison, India's average almond consumption is 0.09 kgs/ year and China is 0.03 kgs/ year. The potential for increased almond demand in each of these markets is significant.

Plant based diets

Almonds are part of the global trend towards increasing the proportion of plant food in our regular diets. The term 'flexitarian' describes this desire to cut down on animal-based foods and increase plant-based alternatives. According to research by Mintel, there are multiple factors driving the growth of plant based eating. These include concern for the environment, health and wellness, ethics and animal welfare, and diversity in protein sourcing.

So, where do almonds fit in the bigger picture?

When looking at the growth of almond production, it is important to also view the size of some of the markets that are relevant to the evolving nature of almond consumption. The 2019-20 INC Yearbook indicates that global almond production is valued at $US7.09 billion and comprises 1.137 million tonnes. As the almond non-dairy segment grows, it is worth noting that the global cheese market is valued at $US60 billion. The global cow milk market is estimated to comprise 522 million tonnes. As a healthy snack, almonds can look at the global potato chip category which was estimated to be valued at $US27 billion in 2017.

The Innova New Product database highlights the leadership of the global almond industry in new products launched with nuts as an ingredient. There were 10,673 new products launched in markets around the world in the twelve months to April 2020 that featured almonds as an ingredient. This compares to 6,857 products with hazelnuts and 3885 products with cashews as ingredients.

Global new products: MAT April 2020

Almonds	**10,673**
Hazelnuts	**6,857**
Cashews	**3,885**
Walnuts	**1,858**
Pistachios	**1,233**
Macadamias	**530**
Peanuts	**7,073**

Hort Innovation Strategic levy investment | ALMOND FUND

This project has been funded by Hort Innovation using the almond research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

Meet the New Sales Team!

Orchard-Rite® frost fans offer the ultimate in orchard frost protection.

In addition, the fans provide the added benefit of drying and cooling when needed.

Orchard-Rite® frost fans offer multiple optional accessories, including the **ORCell™** remote monitoring and control system.

Whether you're harvesting almonds, walnuts or pecans, Orchard-Rite® makes a tree shaker to fit your needs.

Orchard-Rite® shakers include **HydraShake™** allowing you to control the aggressiveness.

Orchard-Rite®

SUNRISE AG
MILDURA - SWAN HILL - OUYEN

Factory Authorized Distributor of Orchard-Rite Frost Fans & Tree Shakers

Frost Fan Sales - Andrew Jolley (AJ)
Mobile: 0428 839 182
Email: ajolley@sunriseag.com.au

Tree Shaker Sales - Ray Pickering
Mobile: 0427 283 220
Email: rpickering@sunriseag.com.au

Parts and Service:
Sunrise Ag, Mildura 03 5023 0284
393 Benetook Ave, Mildura, VIC, 3500
workshopmildura@sunriseag.com.au

www.sunriseag.com.au

First of its kind: Leading dieticians participate in almond tour

Lou Martin |
Marketing Officer

On March 10- 11 the Almond Board of Australia (ABA) hosted a group of six leading dietitians in the Riverland, South Australia. This group were taken on an industry tour covering all facets of almond production. The purpose of this tour was to provide an insight into the sustainable practices used across the industry.

The group visited several different Riverland almond orchards and processors. With a full itinerary planned for the two days, the highlights from the first day were a visit to Phyche Bend to explain the start of the Mildura Irrigation Colony, Tony Spiers' orchard at Lindsay Point to discuss the new varieties to increase yield, Select Harvests' Amaroo Orchards to explain the Phytech tree sensor scheduling, Almondco Australia's hulling and shelling facility and the last stop was at CMV Farms looking at their off-grid energy program and native vegetation work.

The second day consisted of a visit to the Almond Centre of Excellence Experimental Orchard (ACE) at Loxton North, where Mark Skewes from the South Australian Research and Development Institute (SARDI) provided an insight into the R&D to further improve yields and water efficiency and then to the Loxton pumping station where Gavin McMahon from the Central Irrigation Trust (CIT) provided an in-depth description about irrigation and environmental water allocations. The last stop was a visit to Almondco Australia's processing facility.

During the two days, ABA staff provided a summary of the ABA's Water Policy and its alignment with the Murray Darling Basin Plan. The group left with a greater understanding of Australian almond production practices and what methods are used to improve greater sustainability on our orchards.

A huge thank you is given to everyone who was involved and contributed to such a successful trip. The dietitians were very impressed with the amount of knowledge and experience each of the presenters had in almond production and irrigation. Due to the success of this trip, we will be organising another dietitians' tour during the blossom season in August.

Fitness & Sports Nutrition Program Ambassador: Simone Austin

We are proud to announce that Simone Austin has been appointed as our Fitness and Sports Nutrition Program Ambassador. Simone participated in our first Dietitians' Orchard Tour in March and since then has been working with the ABA providing articles, blog posts and social media content to contribute to our health education program. Simone is a highly accredited practising dietitian with a specialty in fitness and sport. She was the first sports dietitian appointed to work with the Australian Cricket Team until they moved their training centre to Brisbane. Simone has been the long-term sports nutritionist for the Hawthorn Football Club and is currently the President of Sports Dietitians Australia. Simone will make a significant contribution to the development of the Australian Almonds nutrition program and we are thrilled to have her on board.

Hull rot resistance in new breeding lines shows promise

Dr Jacky Edwards |

Agriculture Victoria

Hull rot is an emerging issue in almond production regions round the world. Hull rot is caused by the fungus *Rhizopus stolonifer*, which colonises the almond hull at hull split and causes it to rot, accompanied by shoot and twig dieback. Clusters of leaves will wilt and die remaining attached to the spur, and the twig will die back towards the branch. These are called 'strikes' (Figure 1). At least one infected fruit is associated with each strike. Multiple strikes may combine to kill larger branches. Wet weather at hull split and harvest favour disease.

In a recent almond grower census, 90 percent of respondents indicated that hull rot is present in their orchard, and 75 percent of participants reported that hull rot is having a medium to high impact on yield. Additionally, affected nuts are difficult to shake from the tree and spur dieback negatively impacts tree growth and yield in following years.

To improve our understanding of hull rot, the Hort Innovation project, (AL16005) *An Integrated Disease Management Program for the Australian Almond Industry*, led by Agriculture Victoria, is investigating potential management strategies. Californian reports indicate considerable almond varietal differences in susceptibility to hull rot.

Over the last two seasons (2019 and 2020) project staff from Agriculture Victoria (Figure 2) had the opportunity to assess a block of new breeding lines from the Hort Innovation funded (AL12015) *Almond Breeding Program* led by Dr Michelle Wirthensohn, University of Adelaide. The 2013 planting consists of 21 new lines as well as Nonpareil, the main commercial variety in Australia, and the pollinator, Carmel. In March of both seasons, we measured hull rot disease severity (i.e. the number of hull rot strikes per tree) for 19 lines and compared them with the commercial varieties. Nonpareil is one of the most susceptible, whereas Carmel is more resistant.

In general, the 2019 season was dry with only 2.6 mm of rain in January when hulls are most susceptible to infection, while in 2020 there was 11.4 mm of rain in January. There was also significant rain in early March 2020 (15.5 mm total) which favoured increased disease expression. While seasonal variation was evident, the trend of susceptibility compared to Nonpareil and Carmel remained similar (Figure 3). Nonpareil was always the most susceptible, and in 2020 recorded an average 300 strikes/tree. Line 33 also scored consistently high. At the other end of the spectrum, Carmel scored low each year and lines 18, 23, 25, 26, 35 and 36 were also consistently low.

In both seasons, all lines except 33 were significantly less affected than Nonpareil and most were comparable to the more resistant variety, Carmel (Figure 3). Based on these results, the new breeding lines generally have less hull rot even in a wet season. We will assess more advanced plantings (2006 and 2010) of the breeding lines in coming seasons.

This project has been funded by Hort Innovation, using the Hort Innovation Almond Industry research and development levy, co-investment from Agriculture Victoria and Primary Industries Research South Australia and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

Figure 1: Hull rot strike with infected nut and spur dieback.

Figure 2: Project team members marking out the trees in winter 2018.

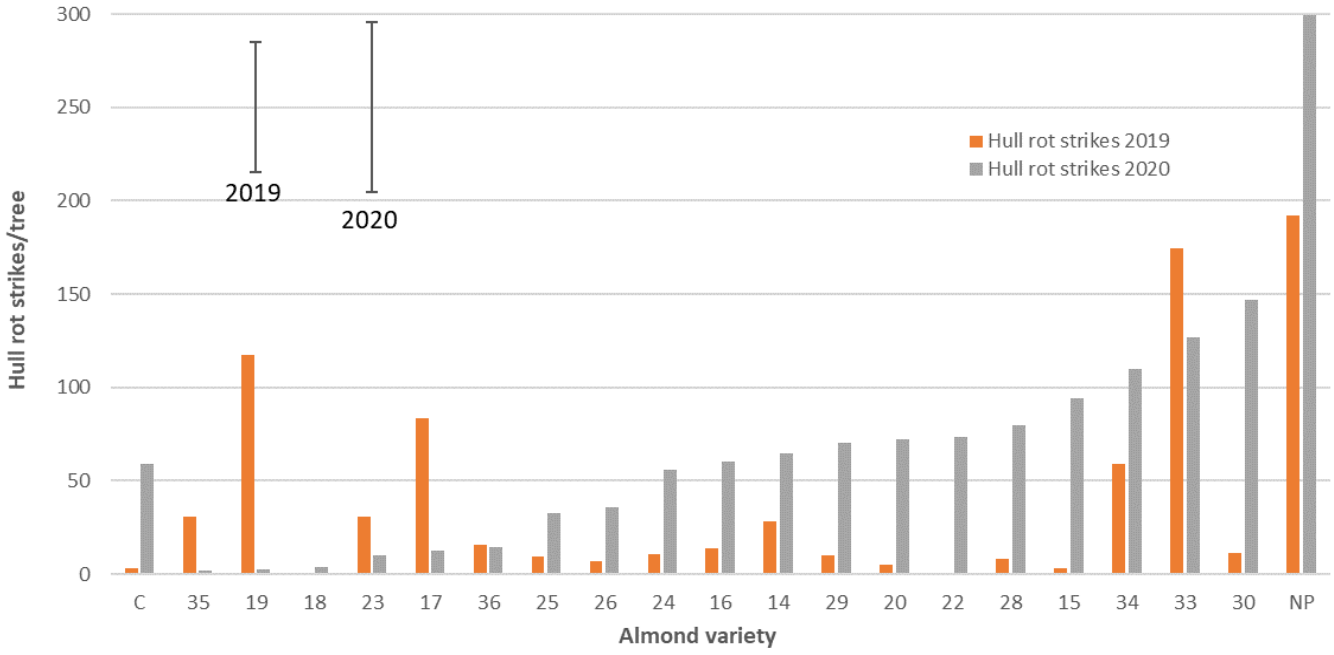


Figure 3. Hull rot disease severity at harvest in 19 new breeding lines plus Nonpareil (NP) and Carmel (C), for two seasons, 2019 and 2020. Bars indicate the least significant difference for each of the seasons.

Hort Innovation
Strategic levy investment
ALMOND FUND

This project has been funded by Hort Innovation using the almond research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

WE'VE GOT YOU COVERED

HYDROCOP WG

500g/kg Copper Hydroxide

- Control of Leaf curl and Shothole
- Dry-Flowable granule for ease of mixing and minimal dust
- Superior weathering and sticking properties
- Available in 10kg bags

NASAA INPUT FOR ORGANIC PRODUCTION Cert. No. 6358M

BORDEAUX WG

Protectant Fungicide/Bactericide 200g/kg COPPER (Cu) present as Tri-basic copper sulphate

- Control of Leaf curl and Shothole
- Dry-Flowable granule for ease of mixing and minimal dust
- Superior weathering and sticking properties
- Available in 15kg bags

NASAA INPUT FOR ORGANIC PRODUCTION Cert. No. 6358M

australia grochem

grochem.com | for all enquiries 1800 777 068

WATERBIRD®- TRUSTED BY GROWERS FOR **OVER 40 YEARS**

MANUFACTURED IN SOUTH AUSTRALIA. MEETING THE NEEDS OF GROWERS IN OVER 50 COUNTRIES.

Waterbird® Mini Sprinklers, available in Classic, PC, PC Olive and Trellis models:

- Aerofoil shaped frame for superior water distribution pattern
- Anti-dust and insect proof spinner
- Colour coded flow rates for easy identification
- Two stage deflector spinner for irrigating young trees
- Snap Fit bearing for easy in-field maintenance
- UV stabilised components for long field life
- Available with pre-installed tube and stake
- Assembled with red stake for easy identification *(PC Olive only)*

CALL FOR A QUOTE TO CHANGE TO A *PC SYSTEM* TODAY!

A sprinkler for every application:

ORCHARD | NURSERY | OVERHEAD FROST PROTECTOR | VINEYARDS | UNDER TREE IRRIGATION | VEGETABLES AND ROW CROPS

WATERBIRD® PC

Next Level Of Uniformity. Increase Your Yield.

- Patented Pressure Compensating diaphragm for uniform flow on undulating terrain
- Precise distribution of water and nutrients for increased yield
- Promotes even crop growth over long run lengths and varying elevations

1300 130 898
toro.com.au

/toroaus /toroaus /toroaus YouTube /toroaustralia

TORO

Almond IPM project making *good progress* two years in

Dr Paul Cunningham, David Madge and the IPM team |

Agriculture Victoria

Hort Innovation's almond IPM (Integrated Pest Management) research project commenced in 2018, aiming to establish a comprehensive R&D program to assist the industry in developing tools and practices for management of insect pests, in particular almond's two arch-enemies, carpophilus beetle and carob moth. The five-year project is led by Agriculture Victoria, partnering with NSW DPI and SARDI. Two years in and there's been some exciting progress, which *In a Nutshell* will be covering over the next two issues. This month's issue covers research that has been focusing on improved orchard hygiene and biocontrol.

Orchard hygiene

Orchard hygiene is an essential foundation for any IPM program targeting carpophilus beetle and carob moth in almonds. High levels of crop residue and mummy nuts can support large populations of both pests within orchards, and techniques such as mass-trapping, mating disruption, biological control and even pesticides are unlikely to be successful in keeping these pests below economically damaging levels if good hygiene is not practised.

Pest population distribution throughout the orchard

Understanding the within-orchard distribution of the two almond pests is important for the development of sampling methods that accurately reflect pest populations, improved orchard hygiene (nut removal and destruction), and more targeted application of control measures such as insecticidal sprays. The Agriculture Victoria team have been conducting detailed studies across two growing seasons, looking at both spatial distribution of pests across the orchard, and vertical distribution of insect populations from the ground up into the canopy. Results are showing that the two pests are quite different.

Beetles are clustered, moths are not. The results of detailed surveys across the winter season and harvest in an orchard in the Robinvale district have shown that carpophilus beetle populations tend to cluster within the orchards, whereas carob moth populations do not show such clustering (see Figure 1, next page). This may well be due to the aggregation behaviour of the beetles, which signal to each other through release of an aggregation pheromone (more on that next issue, when we report on attract and kill mass trapping). Analyses of the spatial distribution of these pests are being used to clarify relationships between mummy nuts and pest populations in winter and crop damage at harvest. This will help to guide more strategic use of orchard hygiene, such as targeting mummy

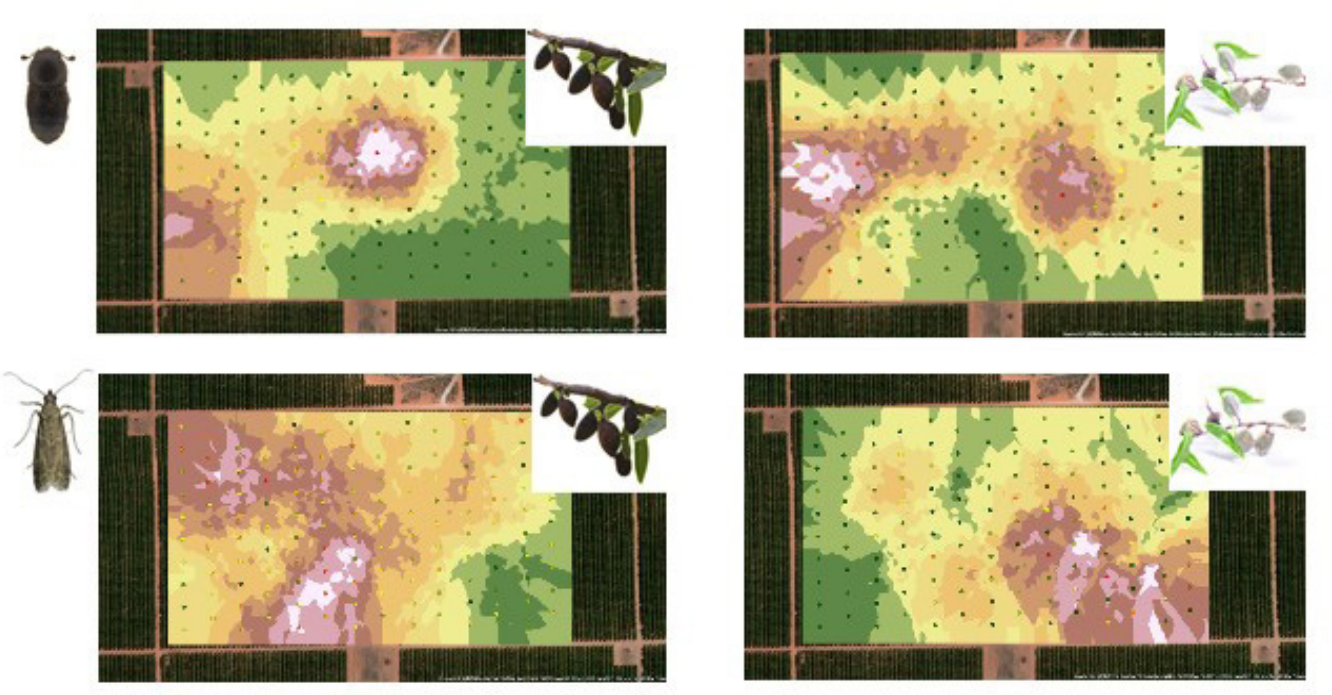


Figure 1: Heat maps modelling the distribution of carpophilus (top row) and carob moth (bottom row) in a 20Ha almond block for mummy nuts (winter) and new nuts (harvest). The warmer colours indicate increased insect numbers in samples taken from 133 trees. Carpophilus populations show a clustered distribution with some correlation between seasons in mummy infestations and new nuts. Carob moth distribution is not clustered.

nut hotspots. These analyses are also being used to determine the most cost-effective sampling patterns for detecting infestation hotspots and average infestation levels across blocks.

Moths are up high, beetles are down below. Population distribution at the level of the tree is also very different between these two insects. A study conducted in the Riverland and Robinvale districts showed that carob moth damage at harvest time is observed predominantly in nuts higher up in the canopy, whereas damage by carpophilus is seen much more in nuts in the lower canopy. These skewed distributions have implications for sampling and treatment of the two pests. Samples collected by walking around the trees and picking nuts that are within reach, will give underestimates for carob moth and overestimates for carpophilus beetle. The easiest way to get an accurate picture of average infestation or damage levels within trees is to sample nuts from the ground after the trees have been shaken as those samples will represent the whole tree. When it comes to spray application to protect the new crop from carob moth, it has proven difficult to achieve good spray coverage in the tops of trees, but that is clearly where most damage occurs. Extra effort needs to be directed towards achieving good spray delivery where it will have most benefit – in the top half of tree canopies.

Factsheets on monitoring for carpophilus beetle and carob moth are being updated with this recent season's findings (and will soon be available through the ABA).

In mummy nuts in winter and spring, the vast majority of carpophilus beetles can be found in nuts that are on the ground. This strongly reinforces the need to control carpophilus through improved removal or destruction of mummy nuts after shaking. By contrast, carob moth tends to be evenly distributed in mummies high and low in the tree, while also infesting mummy nuts on the ground.

Working closely with industry on several large-scale trials this season, the project team are comparing in-situ mummy nut destruction using the 'Seed Terminator' (see picture) against pick-up and off-site disposal of mummy nuts. The study has entailed sampling 2000 new nuts per block across 14 blocks at harvest, and results will be presented to growers and industry later this year.

Will burial of nuts kill insect pests?

In a research trial burying infested nuts to depths up to 90 cm, the project team found large numbers of carpophilus beetle were still surviving and emerging at the 90 cm depth, with a peak emergence in spring indicating that burial could even provide beetles with a protective breeding and overwintering site. Carob moth, on the other hand, appeared unable to survive when nuts were buried below 30 cm. The team are currently monitoring a deep burial plot (1.8m depth) established by industry, to see if any beetles emerge.

Biocontrol for sustainability

The potential for developing a biocontrol strategy for almonds has been investigated through a field trapping study looking for the presence of natural enemies (predators and parasites) of carpophilus and carob moth. This preliminary study identified a number of predatory and parasitic insects within orchards that could be helping to naturally control pest populations. The field study was

Nuts were sampled from different heights in the canopy just before harvest to determine the within-tree distribution of damage by carpophilus beetle and carob moth.

Inset left: The 'Seed Terminator' in action. The device is attached to the rear of a standard harvester and pulverises the mummy nuts before scattering the residue back on the orchard floor.

accompanied by a desktop review of biocontrol options. A factsheet providing a visual guide to predatory and parasitic insects observed in Australian almond orchards is in development.

Next generation biopesticides

Insect-killing fungi, known as entomopathogenic fungi or EPF, are currently the focus of international research as potential "biopesticide" options to be incorporated into environmentally sustainable management of a wide range of pests. The Agriculture Victoria team have been screening a number of Australian strains of the EPF, *Beauveria bassiana* (including a commercially available strain), for its toxicity to adult and larval stages of carpophilus. Results of lab trials have been very encouraging, with over 70 percent mortality of larvae in bioassays using one particular EPF strain. Adult beetle mortality is much lower, but this in itself might be beneficial in helping the spread of the fungal disease. The work is continuing in the form of a PhD commencing this year, and will include field trials in orchards, stockpiles, and nut burial trials.

More to come in the next edition of *In A Nutshell* including attract and kill methods and post-harvest research.

Management inputs and *spur behaviour*

Zelmari Coetzee, Cathy Taylor and Michael Treeby |

Agriculture Victoria

The Australian almond industry is interested in season-to-season crop size variability, and improving productivity. This prompted an investigation by Agriculture Victoria into the influence of key management inputs on the potential size of an almond crop, and the size of the final crop harvested. The trial was conducted on a commercial orchard at Lindsay Point in north west Victoria.

The difference between potential crop size and the actual crop size can be quite large and not always predictable, hence the interest in investigating why there are differences from one season to the next and how management inputs affect these differences. This may allow almond producers to steadily improve productivity and produce more-or-less consistent yields.

The final almond crop size is measured as tonnes of kernels per hectare and is simply the product of the number of kernels and the average kernel weight. The potential number of kernels is determined by the number of flowers but the final yield by the total number of flowers that are successfully pollinated and that set and retain fruit. So, to increase productivity spur fertility, pollination, fruit set, retention and spur longevity need to be improved.

Observations of Nonpareil and Carmel spur fertility and vitality were conducted for five seasons from 2015 to 2019. Spurs are the main fruit bearing structures on almond trees; spur fertility and longevity are obviously critical factors. In general there are thousands of spurs per tree and counting them is impossible. Therefore a sub-set of tagged spurs were followed to determine overall spur behaviour. Spur numbers per tree were inferred from the number of kernels harvested per tree, and

Vegetative and flowering spurs. Nonpareil spurs that bore a nut in one season are more than likely to be vegetative the next season or die following harvest.

the average number of nuts/spur and the proportion of vegetative versus reproductive spurs using the sub-set of tagged spurs.

Nonpareil spurs were highly fruitful, but Nonpareil spurs that carried fruit through to harvest were unlikely to survive through to the next season, and if they did, they almost certainly weren't fruitful. On the other hand, although Carmel spurs were less fruitful, the rate of spur mortality was low irrespective of the fruit load, and survival into the next season was far more likely. The rate of spur death and spur appearance must be more-or-less in balance or higher to maintain yields. Knowing how to encourage new spurs to appear would be a great help in the development and improvement of current and future production systems.

Spur productivity and turnover were also strongly influenced by spur location on the tree and the amount of light that reached these parts. Spurs high in the canopy were more fruitful than spurs lower in the canopy. The rate of spur mortality was also lower in the upper locations of trees relative to spurs located lower down. These relationships were stronger for Carmel than Nonpareil trees, which potentially explains why Nonpareil is prone to lower limb dieback.

The effects on spur behaviour of two critical and costly inputs, namely water and nitrogen, were investigated over four seasons from 2016 to 2019 as part of the project. The importance of water and nitrogen in almond production has been demonstrated by work in California (Muhammad et al., 2015) and trials at Lake Powell (Sommer and Monks, 2014) showing that 30 percent and 46 percent sustained reductions of water and nitrogen supply, respectively, did not debilitate trees. Reducing the volume of irrigation water applied to the trees at Lindsay Point from the industry standard of around 14 to 10 ML/ha/season, and the standard nitrogen supply from 300 to 160 kg/ha/season did not result in significant yield reductions in either Nonpareil or Carmel over the course of the experiment. Less water was also needed to produce a kilogram of kernels so water use efficiency was higher.

Look for the project's final report (AL14005 - Identifying factors that influence spur productivity in almonds) on Hort Innovation's website.

Acknowledgements

CMV's Lindsay Point site for allowing the establishment of the trial and the modification of the site's irrigation system as well as their patience, flexibility and assistance. The ABA's Josh Fielke and Ben Wiblin (previously Brett Rosenzweig) for providing access to the ABA's nut processing and weighing equipment. This project was possible because of the co-investments of the State Government of Victoria, levy payers and the Commonwealth Government and was managed by Hort Innovation.

Cathy Taylor busy with spur assessments in winter to determine spur fertility (number of floral buds) and vitality (which spurs survived) of the tagged spurs.

Tagged dormant spur. More than 1,000 spurs were tagged and their behaviour followed over multiple seasons if possible. Finding tagged spurs when the trees were in full leaf was challenging!

Spur manipulation and behaviour

Michael Treeby, Zelmari Coetzee and Cathy Taylor |

Agriculture Victoria

Australian almond producers understand the importance of spur reproductive behaviour and tree health. To that end, we recently completed a 4-year study on the impact that water and nitrogen fertilizer management has on spur population dynamics, reproductive behaviour and longevity (Coetzee et al., 2020). Amongst other things, the project showed that Nonpareil spurs that produced fruit were unlikely to survive past that season and if they did were unlikely to be fertile. In other words, a Nonpareil fruit-bearing spur was highly unlikely to bear fruit in consecutive seasons. This pattern suggests that Nonpareil fruit exhaust any localized carbohydrate (i.e. spurs are semi-autonomous) and a leafless spur bearing a fruit dies shortly afterward. It is known that spur leaf area in one season is positively correlated both to the likelihood of spur survival into the next season and the likelihood of return flowering (Lampinen et al. 2011).

We wanted to test the veracity of that relationship by manipulating spur leaf area as well as fruit load and assessing what the impact was on spur survival and return flowering the following season. We used Nonpareil trees because this variety is the mainstay of the Australian industry and because Nonpareil spurs, though highly productive, do not live long. This implies that fruit production places too great a demand on the spurs' ability to grow and mature a fruit at the expense of flower initiation and spur survival. This infers that spur leaf area is important.

What we did

In October 2018, on a commercial orchard near Merbein in north west Victoria, we tagged:

- 256 spurs with fruit and
- 28 spurs without fruit.

The tagged spurs were distributed evenly around 16 trees of uniform appearance across two rows.
A month later we:

- removed the fruit on 128 of the 256 fruiting spurs and
- counted the leaves on all tagged spurs and removed every second leaf on half the tagged spurs.

The experimental design is summarised diagrammatically in Figure 1 (below).

In July 2019, we observed each tagged spur and recorded whether:

- it was dead
- all the spurs around it were dead
- it was barren or bore one or more flower buds.

The distinction between a single tagged spur being dead and all the spurs around the spur being dead was made because the latter is not necessarily indicative of a spur dying due to some internal factor but rather is more indicative of limb failure or disease.

What we observed

Fertile spurs had an average of six leaves per spur and non-fruiting spurs an average of seven leaves per spur, but spurs could have up to 15 leaves. Before fruit removal there were, on average, 1.6 fruit per fruiting spur.

When we inspected the tagged spurs in July 2019, we noted that about 24 percent of spurs that were fertile at the start of the season were broken off or died together with the spurs in the vicinity compared to 12 percent of non-fruiting spurs. Interestingly, the removal of fruit from a spur didn't reduce the incidence of broken spurs or spurs succumbing to a general malaise affecting all spurs in the region. Note that these losses do not include spurs that died between the time that de-fruiting and de-leafing treatments were imposed in spring and reassessment in winter.

Amongst the remaining spurs, the strongest influence on whether a spur survived the season was whether it bore fruit or not (Figure 2). Roughly 95 percent of leafy spurs and de-fruited fruiting spurs survived, but only 85 percent of spurs that bore fruit through to the end of the season survived. Removing 50 percent of leaves had no impact on spur survival and removing 50 percent of the leaves on a de-fruited spur reduced spur survival only marginally. The removal of half the leaves on fruiting spurs reduced spur survival from around 85 percent to approximately 70 percent.

Of the spurs that survived it was seen that previously leafy spurs were far more likely to carry a flower bud the following season compared to spurs that either bore fruit through the previous season or had fruit removed in October the previous season (Figure 3). Across all the tagged spurs that survived, reducing the number of leaves on a spur reduced the likelihood of that spur being reproductive the following season compared to similar spurs that weren't subjected to 50 percent leaf removal. De-fruiting a spur improved the likelihood of that spur reproducing fruit the following season. The extent of the leaf removal influence was important for spurs that bore fruit through to maturity, but less so for de-fruited spurs and unimportant for leafy spurs (Figure 2).

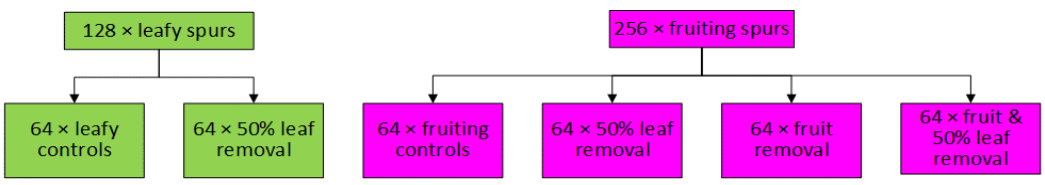


Figure 1: Summary of experimental design to test the relationship between spur leaf area and presence of fruit on spur survival and return bloom.

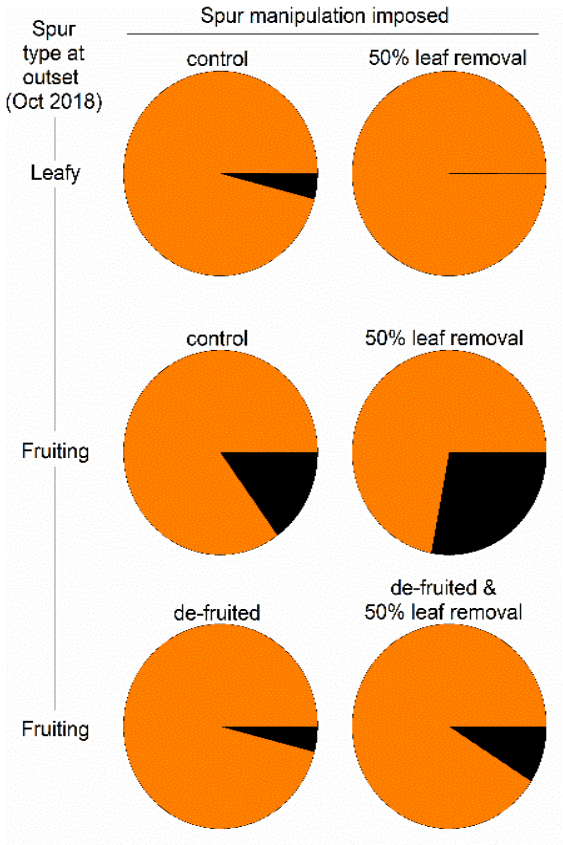


Figure 2: Influence of spur type and spur manipulation on Nonpareil spur survival observed the following winter.

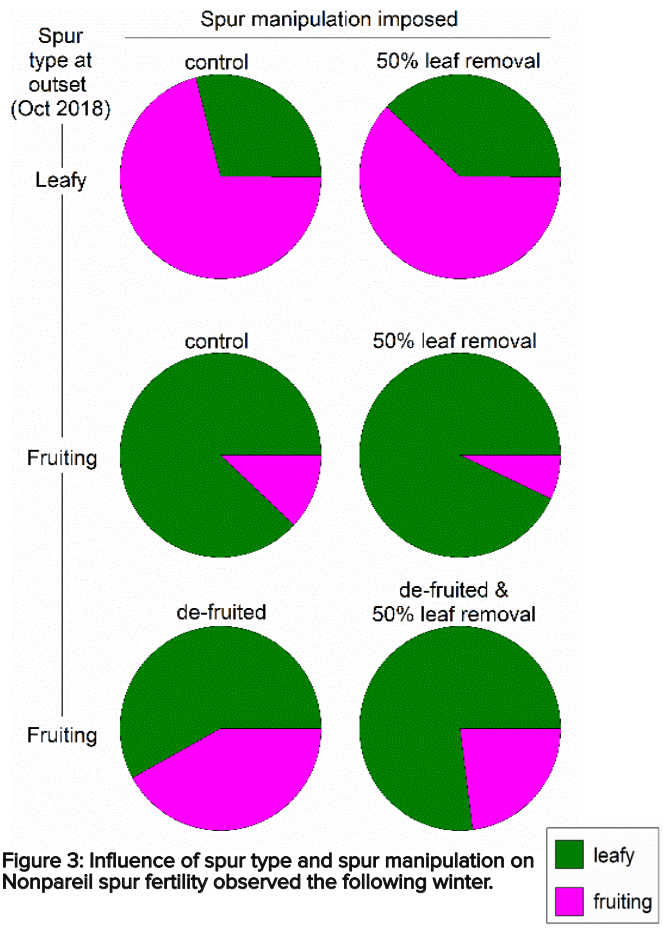


Figure 3: Influence of spur type and spur manipulation on Nonpareil spur fertility observed the following winter.

Conclusion

This experiment highlights the enormous strain on resources Nonpareil spurs experience trying to grow and mature fruit. Under the conditions of the experiment, the strongest determinant of whether a spur is fruitful, in a given season, was whether it bore fruit the previous season or not. Spur leaf area — which we manipulated by removing every second leaf on half of the spurs we tagged — is an indicator of a spur's photosynthetic capacity. In other words, the number of leaves a spur has is indicative of the amount of carbohydrate that a spur can produce to grow and mature fruit and provide for the spur's needs as well. By observing the effect of reducing the leaf number on fruiting spurs, the fruit's energy needs are clearly higher than a leafy spur's energy needs. On the other hand, removing half the leaves on leafy spurs did not diminish the proportion of those spurs that were fruitful the following season, suggesting that the developing buds' needs are easily met in the absence of fruit.

Thus, we'd question whether the relationship between leaf area and subsequent survival and fertility is as universal as suggested elsewhere. Obviously though there are some critical relationships between carbohydrate partitioning by the spur and the events leading up to floral bud initiation and the development of that bud. These relationships are clearly of some importance; understanding them better may be the basis of more appropriate management techniques and targets for genetic improvement.

The observation that reducing the photosynthetic capacity of fruiting spurs greatly reduced the likelihood of there being floral buds being present on those spurs the next season, highlights the importance of leaf function in spur longevity and fruitfulness. By this we mean that whatever leaves are present need to be fully functional to provide for the spur's needs which we'd suggest are quite modest compared to fruit.

Literature cited

Coetzee, Z., Taylor, C. and Treeby, M. (2020). Identifying factors that influence spur productivity in almonds. Final report to Horticulture Innovation Australia. 104 pages.

Lampinen, B. D., Tombesi, S., Metcalf, S. G., DeJong, T. M. (2011). Spur behaviour in almond trees: relationships between previous year spur leaf area, fruit bearing and mortality. Tree Physiology 31 (7), 700-706.

Acknowledgments

Neale Bennett is thanked for allowing this experiment to be conducted on his orchard, and Karen Connolly is thanked for providing editorial input. The financial support of the Victorian Government via the Agriculture Infrastructure and Jobs Fund is acknowledged.

Hort Innovation news

Matt Brand |
CEO, Hort Innovation |

In these unusual and changing times under the pressures of the global COVID-19 situation, Hort Innovation wants to update you on how our work as Australian horticulture's research and development corporation has been continuing for you and the sector.

Things may be a little different in both circumstance and approach, but levies are still working hard across R&D, marketing and trade, our staff continue to be available for you and, most importantly, we're in this together.

We have a full update on what we've been doing to see the horticulture community through at www.horticulture.com.au/covid-response, but in a nutshell...

We're closely managing our R&D investments for risks

Hort Innovation funds hundreds of projects to increase productivity and profitability for horticulture growers. We've been working closely with all of our delivery partners to identify and manage those investments that have or may be disrupted by COVID-19 impacts, such as border restrictions, access to support services, or social distancing requirements.

Our marketing programs are changing with the situation

We're constantly reviewing consumer behaviour and market trends under COVID-19, and shifting the focus of our industry-specific marketing programs to suit.

International trade remains a focus

We're still working with industries and the government in reviewing current and future market access and improvement opportunities, under COVID-19 and beyond. We're also tracking practical impacts and consumer sentiment in export markets, and adjusting international marketing and engagement activities under our Taste Australia banner as needed.

We're continuing to work with the government and other relevant bodies, providing connections, information and insights to assist in important conversations

As an example, Hort Innovation is proud to have provided data to support the government's decision-making around temporary changes to visa arrangements and airfreight assistance measures, to the benefit of the horticulture sector.

We're planning for the future

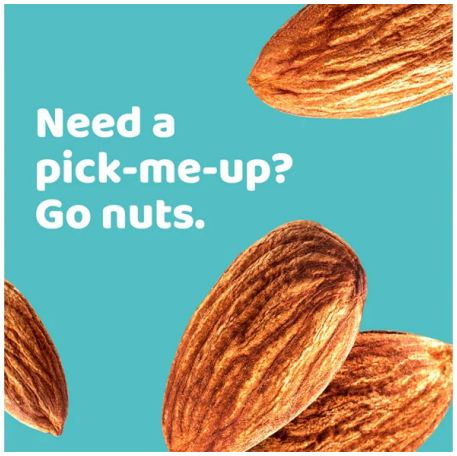
We're taking into account a range of possible scenarios for the 37 horticulture industries we look after, and ensuring we can prioritise the right investments for you through 2020/21 and into the future.

We're trying new things

Hort Innovation has developed the whole-of-horticulture The Good Mood Food campaign, which is about delivering an immediate and enduring behaviour change message to motivate more people to eat fruit, vegetables and nuts. The campaign is being funded through risk management reserves that the Hort Innovation Board has released in response to the challenging times being faced by the horticulture sector following drought, bushfires, COVID-19 and what lies next. More information is being shared on this initiative as it develops.

Please make sure you visit www.horticulture.com.au/covid-response for the full picture, and don't hesitate to reach out using the contact details there if you'd like more information about who we are and what we're doing for you.

Visit Hort Innovation's COVID response page



The Good Mood Food campaign for Aussie horticulture

Hort Innovation's new marketing initiative is supporting Australian horticulture in an exciting new way.

In the mood for some good news? Hort Innovation has developed The Good Mood Food initiative to support the horticulture sector through the effects of recent times, which are being felt in consumer spending and purchasing behaviour. The bold new marketing campaign is motivating more people to consume more hort produce more often, with the message that when you eat better, you feel better. Visit the Hort Innovation website to watch the video with CEO Matt Brand and get the full scoop on the campaign.

Hort Innovation Insights

New webinar series launched!

The Hort Innovation Insights webinar series is connecting you with the people closest to the research and investments you want to know more about.

Each short webinar session features subject matter experts, project delivery partners and Hort Innovation staff discussing key topics, opportunities and challenges for horticulture growers.

Grab a cuppa and attend a live session to ask questions and discover essential insights and tools to implement in your business today. Webinar recordings will also be available after each event if you can't join us live.

New International Trade Hub on Hort Innovation website

Hort Innovation has developed an International Trade Hub on our website to deliver essential information and insights to the Australian horticulture sector as we progress through and beyond the global COVID-19 situation. It is available on our website at www.horticulture.com.au/growers/trade-hub/.

This resource has been designed to capture the vast amount of information that is in circulation and make it available in one simple locations, including info on:

- Top-level insights: economic and political impacts, plus general consumer sentiment
- Business tools and support for exporters
- Country-specific updates.

We're also working to develop consumer insight reports specific to fresh fruit, vegetables and nuts, to provide more details data and information.

Gumming: the causes and different types

Josh Fielke |
Industry Development Officer

As the season went on this year, I had several enquiries about growers seeing gumming and have observed these symptoms myself. Gumming is a common response from a tree when something is wrong, and I believe all growers will come across it in their orchards at some point. In growth, this symptom can be displayed on either the tree trunk, branches or fruit. In a previous issue of In a Nutshell (Summer 2020) Agriculture Victoria spoke about the industry disease survey, where the two common pathogens causing gumming, bacterial spot and anthracnose, were not as prevalent as the industry thought. So, what are the alternative causes of gumming, and how do we tell if pathogens are involved?

This article provides a suggested approach to investigate gumming symptoms to help identify the possible cause. It also offers a case study where the investigations have provided a solution to on-farm management.

In general terms, gumming symptoms can be classified into two groups, clear and coloured (amber or murky). In most cases, a clear gum is of less concern as it is less likely there are pathogens involved. However, it may be possible that a gum can go from clear to amber suggesting multiple causes, post-gumming infection or if it is only faintly coloured it could be a result of drying. Defining the timeline of events can help to determine the possible cause of the gumming. The flowchart (Figure 1) may assist in determining the cause of gumming on fruit.

Through this article we will discuss how nutritional inputs can cause gumming, utilising a case study that was witnessed this season. This information has been guided by resources from California written by David Doll, Roger Duncan, Patrick Brown and Phoebe Gordon.

Learnings from a case study

This year at the Almond Centre of Excellence (ACE) Experimental Orchard there were fruit-gumming symptoms observed on some of the new varieties in their second and third leaf. On closer observation, we saw symptoms of clear gumming in specific varieties and in orchard areas that were lower in topography and across multiple valves/watering units. There were some situations where the kernels had also formed into a gum as displayed in Figure 2. Using these observations, and following Figure 1, it was determined that it was likely a nutritional deficiency as there were no signs of insect damage and insects would not cause symptoms such as in Figure 2. To confirm, a post-harvest laboratory analysis of hulls was conducted which showed all but one sample of the variety displaying symptoms having a boron concentration of less than 80 parts per million (in most literature 80-160ppm is adequate[3], although Doll mentions yield is not negatively affected between 100-160ppm). Post-harvest hull samples are the best way to determine your boron levels as almonds accumulate boron in the hulls. Leaf samples are not a good indicator of boron levels as they do not consistently detect deficiencies or toxicities[4].

To remedy the low boron level, boron product (fertiliser) was applied in accordance with the recommendations found in the footnotes and will be reapplied post flowering. In application it is also important to consider leaching[5].

Note: Boron is mobile in almonds and applications can affect the following season's crop. Before application, it is important to test your soil and water to ensure the levels are low and toxicity is not induced.[6]

Very minimal amounts of boron are needed to remedy deficiencies. Reference 4 provides application rates for soil and foliar applications to address major and minor boron deficiencies[7] . Boron sprays can interfere with bee pollination as well as damage flowers if sprayed when flowers are open[3].

Boron in different varieties

As knowledge is developing it is becoming more evident that different varieties perform differently and can require different amounts of water and nutrition. Similarly, as the industry is trailing new varieties under different soil types, the growing requirements are likely to be further refined. In the situation we observed at the ACE farm this year, the trait of early crop production was a common factor associated with gumming symptoms. So, let's hypothesise why this might be. Traditionally Nonpareil produces a commercial size crop in its fourth leaf, however with some new varieties it is not uncommon for a

Figure 1: Identifying an issue through gumming on fruit.

There are no studies to confirm but it may be possible that a pathogen can enter the clear gum and cause an infection making the gum darker.

CLEAR GUM

CLEAR GUM
There are four scenarios for clear gum. It is either physiological, an insect, nutritional or physical. Have a closer look at the symptom[1].

PHYSIOLOGICAL
A slit may arise as a physiological disorder, resulting from rapid fruit growth. Upon cutting open you will see no sign of kernel damage.

INSECT
If you see a pinhole, it is likely an insect has pierced the fruit. Cut a slither under the gum and see if a darkened circle is present to confirm.

NUTRITIONAL
A nutritional deficiency of Boron can be like that of a pinhole. As it develops, a browning embryo can be observed.

PHYSICAL
Physical damage can also cause gumming. Check for rub marks and dents with surrounding twigs to note possible source.

PICKING THE DIFFERENCE
If unsure, look further in to the orchard and try to find trends. Specifically, in different soil types, topography, valves, varieties and location on trees.

I FOUND A TREND!
If you have found a trend, it is likely there is a nutritional deficiency. Boron is the common element that causes this. To confirm, do a hull sample test post-harvest. In season, leaf sample tests are not representative of boron levels.

SYMPTOMS ARE RANDOM OR ISOLATED
Random or isolated incidences lead to a belief of insect damage. Monitor the symptoms to see any further development.

COLOURED/ CLOUDY GUM

COLOURED/ CLOUDY GUM
Amber or cloudy/ murky gumming is common when a disease pathogen has entered the fruit. Less commonly, a nutritional toxicity may also cause this effect.

PATHOGEN
When a pathogen attacks the fruit it is likely to be either anthracnose (fungus) or bacterial spot (bacteria).
For observational differences view link[2]. When observing, look for trends to determine how widespread the disease is and what treatment is required.

NUTRITIONAL
It is uncommon but nutritional toxicities can cause a dark gum formation. Toxicities will be generally be displayed in the leaf. For confirmation check your nutrition levels through leaf and hull analysis lab tests.

Figure 2: Observations made January 17, 2020. A strong indicator of boron deficiency.

significant crop in their third and even second leaf! In this case, Boron is needed for reproductive and vegetative growth as well as pollen formation and fruit set. Throughout the season boron accumulates in the hulls, therefore with the higher crop level and more crop, more boron is needed in the earlier years[8]. Therefore, if we continue to apply nutrients as if they were a Nonpareil tree, it could lead to deficiencies. A source of boron is through irrigation water however the boron levels and root mass or volume may not be significant enough to satisfy the tree's boron requirements if the tree is cropping in its second or third leaf.

David Doll (the Almond Doctor) describes how much boron the tree uses in relation to hull boron content per tonne of kernel[9] (Figure 3).

Interestingly, Roger Duncan reported to the Almond Board of California that most peach-almond hybrids accumulate significantly less hull boron than other rootstocks (Note: This was in a high boron environment). If you have these rootstocks (e.g. Brights Hybrid, Garnem, Conerstone, GF677 etc.) in combination with a new variety, this would be something that needs to be considered and managed over time in your orchard[10].

To conclude, boron is an important element in growing almonds and while application levels required are small, as demonstrated it is highly critical that optimal levels are being reached and maintained. Continued sampling should take place and I would recommend doing so to help guide decisions. This article highlighted the effect of early production on young trees, but growers should also pay attention to orchard areas that are older and yield highly. These areas should be tested to ensure the levels of boron are adequate to maintain productivity yet have not exceeded applications which could negatively affect your yield in the following season.

Other causes of gumming

Observations of boron deficiency discussed in this article are just one of the many possibilities for why gum is caused as outlined in Figure 1. As we further develop the industry's integrated disease management program, more information will be provided to assist growers in identifying when gum is caused by a pathogen/disease or other issues within the orchard.

References

[1]The Almond Doctor: Almonds exuding clear gum

[2]The Almond Doctor: Bacterial spot vs anthracnose vs plant bug

[3]Post-harvest boron applications can increase almond yields

[4]The Almond Doctor: Hull sampling for boron

[5]Almond post-harvest nutrition

[6]University of California, Sacramento Valley Orchard Source: Boron deficiency

[7]The Almond Doctor: Post-harvest boron applications can increase almond yields

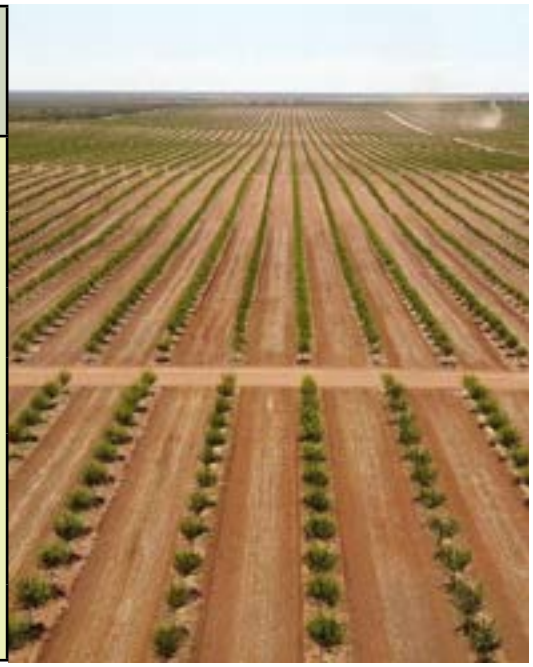
[8]Californian Almond Conference 2019: Research Update (Nutrient Management) .pdf

[9]The Almond Doctor: Q&A for boron in almond orchards

[10]Field evaluation of almond rootstocks

Figure 3: How much boron the tree uses in relation to hull boron content per tonne of kernel (David Doll, the Almond Doctor).

Hull boron content (PPM)	Converted to kgs of boron removed per 1000/ kernel kgs
75	0.15
100	0.2
125	0.25
150	0.3
200	0.4
300*	0.6
500*	1



*These levels are considered toxic within almond.

JUNE

SUN	MON	TUES	WED	THU	FRI	SAT
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27

*June

JULY

SUN	MON	TUES	WED	THU	FRI	SAT
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

*July

6 ABA Adelaide Regional Meeting

7 ABA Riverland Regional Meeting
ABA Sunraysia Regional Meeting

8 ABA Riverina Regional Meeting

16 ABA Processing Committee Meeting, Loxton

17 ABA Pollination Meeting, Mildura

AUGUST

SUN	MON	TUES	WED	THU	FRI	SAT
30	31					1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

*August

5-7 China Tree Nut Conference (TBC)

6 ABA Plant Improvement Committee Meeting, Waite Campus

19 ABA Almond Centre Committee Meeting, Loxton

26 ABA Production Committee Meeting, Mildura
ABA Market Development Committee Meeting, Mildura

27 ABA Board Meeting, Mildura

NOTE: Dates and meeting formats may change with COVID-19 restrictions in place.

Chickpeas with steamed eggplant and almonds

15 mins preparation
25 mins cooking
Serves 2 - 4

INGREDIENTS

- 200 gm chickpeas, soaked overnight in cold water, drained (1 cup)
- 1 eggplant, cut into 2cm cubes
- 1 cup (firmly packed) coriander, coarsely chopped
- 1 cup (firmly packed) mint leaves, coarsely chopped
- 80 gm roasted natural almonds (½ cup)
- 2 tsp finely chopped preserved lemon zest
- 40 gm fresh coconut, coarsely grated
- 280 gm plain yoghurt (1 cup)

Spiced dressing

- 50 ml olive oil
- 1 tsp ground spice blend, such as a chermoula spice blend
- 1 tbsp lemon juice
- 1 tsp harissa

METHOD

1. Cook chickpeas in a saucepan of unsalted boiling water until tender (20-25 minutes). Drain.
2. Meanwhile, steam eggplant until tender (15-20 minutes). Add to chickpeas.
3. For spiced dressing, heat oil in a small saucepan over low heat, add spice blend and stir until fragrant. Transfer to a bowl to cool, then add lemon juice and harissa, and season to taste.
4. Add herbs, almonds and preserved lemon to chickpeas, then add dressing and toss to combine. Serve topped with grated coconut and a dollop of yoghurt.

Recipe and image source:
Gourmet Traveller