

### SUMMER 2022 | VOLUME 50 | NUMBER 4 NEWS BULLETIN



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Hort Innovation Strategic levy investment



Front cover. Steve McLean is the 2022 recipient of the Norm Greber award, which recognises outstanding contribution to the macadamia industry. Steve is a long-time member of the industry and is widely recognised for his commitment to excellence and support for practical, science-based solutions on the farm.

### **Our Mission**

The Australian Macadamia Society Limited is established to promote all aspects of the macadamia nut industry; to encourage a free interchange of ideas and information amongst macadamia growers and marketers of macadamia nuts and by-products; and to foster and promote goodwill among members of the Society in furtherance of its objects.

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### **CEO's Report**



I have been fortunate in my first three months as CEO to have been able to meet with many in the industry. Thank you for your warm welcome and for your openness to engage and discuss your thoughts as to how the AMS can best support you as individuals and the rapidly growing macadamia industry. In the next few months, I look forward to consulting further, including with those who may not have attended industry events, by continuing to visit farms in the growing regions and meeting with processors and other stakeholders.

Whilst there are undoubtedly challenges ahead, I firmly believe the strong foundations built over the almost 50 years of commercial macadamia production, and the committed and collaborative nature of those involved, stand the industry in good stead for the future.

My first contact with the AMS and the macadamia industry was soon after I arrived in Australia in the mid-1990s. The industry presented as a shining example of proactive good management practice on farm and through the processing sector, in an era when there was often strong resistance to such concepts across many sectors horticulture.

Recently searching through storage boxes, I found copies of the Macadamia Industry Quality Handbook and the Australian Macadamia Industry Code of Sound Orchard Practices. Although both were dated 2001, half the individuals acknowledged in those publications are still very actively involved in the industry today, a very strong reflection of their commitment and stability of the industry itself.

One of the greatest appeals of the CEO role is its diversity, where I will be involved in engaging with the industry, government and broader stakeholders in areas as diverse as our biosecurity commitments, our levy structures, negotiations for market access, as well as continuing to support growers and industry apply best practice in the orchard and through the supply chain. It will also be important to focus on advocacy and representation at a federal, regional and local policy level, as a way of providing a strong voice for the macadamia industry, and in some instances contributing to an even stronger voice in collaboration with other horticultural and agricultural representative bodies.

We will also be looking to drive collaboration and leverage opportunities for industry and market development by facilitating stakeholder engagement across our own industry, the international macadamia industry and in association with other plant industries and primary production sectors both in Australia and overseas. Underlying all this will be delivering valued services to members in an environment of changing national, regional and business needs.

While the industry is facing many challenges, I believe that with every challenge comes opportunity and I am certain we can deliver.

At the recent AGM, two new directors - Robbie Commens and Daniel Howorth - joined Mark Napper, Andrew Leslie, Michael McMahon and Michael Russo on the AMS Board. Under Mark's guidance as the newly elected Chair, the Board remains committed to a strengthened AMS delivering for industry in all regions and across the supply chain.

The proposed changes to the AMS constitution to introduce the new membership structure were deferred from the 2022 AGM and are currently being reviewed ahead of member communication in early 2023 and a proposed EGM to be held in April 2023, where member endorsement will be sought.

In these challenging times, characterised by the lingering effects of a world pandemic, climate change, distant conflicts and, more recently, associated economic impacts internationally, the need for engagement and collaboration, to work smarter and to leverage every opportunity remains key to our success. The AMS Board and team remain strongly focussed and committed to supporting you in everything we do.

After the disruptions of 2022 and after almost 12 months of occupying temporary desks within the DPI offices, the NSW-based AMS team will be moving to our own dedicated space on the DPI site early in 2023.

AMS team members Angela Williams (MSO – Bundaberg) and Susan Vallis (Business & Finance Manager) have both left the AMS in recent months to take up new challenges. Their roles will be covered by the existing AMS team and resources in the short term, with longer-term plans to be announced in early 2023.

Finally, my thanks to the sponsors and exhibitors whose support helped make AusMac 2022 the great success that it was, and to all those who attended. Feedback from the event has been overwhelmingly positive with many participants saying that it was wonderful to be able to see the industry back together after four long years.

Clare Hamilton-Bate | CEO

### Australian kernel sales hold steady amid upturn in new products with macadamias



Jacqui Price Market Development Manager, AMS P: 02 6622 4933 E: jacqui.price@macadamias.org

### **Clobal supply**

The 2022 global crop is forecast to finish at 294,960 t @ 3.5% moisture, up from 241,420 t in 2021. All origins except Hawaii and Australia are reporting an increase in production compared to last year, with the largest increases coming from South Africa and China. The Macadamias South Africa (SAMAC) forecast for 2022 production is 68,520 t @ 3.5%, up from 53,320 t in 2021. China is forecasting a crop of 62,500 t @ 3.5% for 2022, however many reports suggest a result up to 20% below this.



Figure 1. Global macadamia crop volumes 2020-2022 (tonnes) Source: INC, AMS, SAMAC. All volumes are at 3.5% MC.



### **Clobal demand**

Overall global demand for macadamias continued to rise in the 12 months to September 2022. Global imports to the top 5 kernel markets were up 16% (24,349 t to 28,160 t). All markets experienced growth, except for the domestic market.

Global in-shell imports to China/ Hong Kong for the period MAT October 21 to September 22 were reported at 40,519 t (+3% on prior period). The two major importers of in-shell into China/Hong Kong remain South Africa and Australia. However Australian imports dropped back to 10,577 t (26% share of total nut-in-shell imports) and South Africa hit a high of 18,041 t (45% share).



#### **Figure 2.** Macadamia kernel imports to top 5 markets (tonnes) MAT October - September

Sources: USDA, Eurostat, Japan Customs, China Customs, Hong Kong Census & Statistics Department via IHS Markit Inc, AMHA

### Australian sales

Total Australian kernel sales were steady in the 12 months to September 2022. Domestic sales declined but remained the largest kernel market with 29% share of total kernel sales. Japan is the major export market for kernel and was up 12% compared to the prior MAT period. China continues to record strong growth in the kernel market, up 53%, overtaking kernel sales to the US market for the first time.

In-shell sales were down 14% in the 12 months to September 2022, after a record year in the same period last year.

|                                 | 2018   | 2019   | 2020  | 2021   | 2022   |
|---------------------------------|--------|--------|-------|--------|--------|
| Domestic                        | 3,941  | 3,635  | 3,283 | 3,486  | 3,284  |
| Japan                           | 2,025  | 2,326  | 1,963 | 2,114  | 2,372  |
| China                           | 414    | 512    | 664   | 837    | 1,281  |
| USA                             | 1,140  | 1,716  | 560   | 1,190  | 1,217  |
| Other Asia                      | 774    | 730    | 881   | 662    | 879    |
| Korea                           | 631    | 654    | 664   | 1,099  | 848    |
| Other Europe                    | 670    | 825    | 710   | 844    | 639    |
| Taiwan                          | 548    | 487    | 451   | 572    | 517    |
| Germany                         | 627    | 892    | 742   | 690    | 478    |
| Total kernel sales              | 10,769 | 11,778 | 9,918 | 11,493 | 11,515 |
| Total in-shell sales<br>(@3.5%) | 7,285  | 10,441 | 9,201 | 11,978 | 10,346 |

Table 1. Australian macadamia sales (tonnes) MAT (October-September)Source: AMHA. AMHA represents 95% production, sales are adjusted to represent non-AMHA members.



### **Global product innovation**

The pandemic caused a general slowdown in product development in recent years as organisations were impacted by plant shutdowns, R&D staff working remotely, supply chain challenges, and financial or other business uncertainties. The focus was on ensuring availability of existing, popular products, which impacted the mix of launch types. In the 12 months to September 2022, although total launches were up 6%, "true" new product launches were the lowest since 2017-18, with 42% of launches coming from extensions and improvements to existing product ranges and 26% from new packaging formats.

The snacking, chocolate confectionery, and bakery categories continued to represent the majority of new product development using macadamias as an ingredient at 46%, 15% and 14% respectively. Count

Product Item





Figure 4. New product launches using macadamias as an ingredient, by market Source: Mintel GNPD, October 2017-September 2022

### Leoni's orchard rounds

Leoni Kojetin Industry Development Manager, AMS M: 0433 007 925 E: leoni.kojetin@macadamias.org



The 2022 harvest season is one many want to forget, and while the final crop will be announced in December 2022, the forecast of 52 900 t (@10% MC) is clearly made up of varied results across the regions. A saving grace for many this season is higher kernel recovery, which looks set to surpass the high 2018 TKR with the national average expected to exceed 38.2%.

Flowering for the new crop is being described as heavy but impacted by weather, and there are reports of two distinct flowering periods comprising an earlier and a later nut set. La Niña has certainly made it a challenge to protect flowers and nutlets from flower blights and husk spot. We also face a season ahead that appears to be set for high pressure from pests that proliferate after rain including spotting bugs, macadamia but borer and other moths such as leaf miner. Monitoring will indicate the best time to apply any control strategies.

### **Disaster assistance and grants**

If you have been affected by the severe weather this year and haven't already applied for disaster assistance, most claim periods have been extended and there is still time. You may only be seeing some of the longerterm impacts of the severe weather now. In many cases recovery and resilience assistance is available, meaning you can apply for help to invest in making your farm less susceptible to disaster events.

Below is a list (not exhaustive) of primary producer assistance available, area eligibility, indicative grant amount and closing date, which could be sooner if allocation is exhausted. For more information for assistance in Queensland, head to www.qrida.qld.gov.au and in NSW, head to www.raa.nsw.gov.au.

### **Creater scrutiny on water quality**

Following the flood and severe weather events in NSW and South East Queensland, it has been clear how devastating the impact can be on the environment. One of the consequences of this is that there is greater scrutiny on the role of landholders to mitigate these impacts.

A significant blackwater and fish kill event took place in the Richmond River catchment in the Northern Rivers in March this year following record flooding. Blackwater occurs with the rapid breakdown of organic debris in waterways, causing consumption of dissolved oxygen, deoxygenating the water and death of aquatic life. The situation is made worse by the complication of floodgates and drains that are not in landholders' control.

The Richmond River catchment is home to almost one-third of all macadamia hectares and more than half of all macadamia enterprises in Australia. Water quality monitoring over several years has found that

| Assistance   | Disaster area   | Grant amount     | Closing date    |
|--|---|------------------|-----------------|
| South East Qld, ex-tropical<br>cyclone Seth (January 2022)   | Bundaberg, Fraser Coast, Gympie,<br>North Burnett, South Burnett  | Maximum \$50,000 | 3 February 2023 |
| South East Qld rainfall and<br>flooding (February to April<br>2022)  | Brisbane, Bundaberg, Fraser Coast,<br>Gold Coast, Gympie, Ipswich, Lockyer<br>Valley, Moreton Bay, Noosa, North Burnett,<br>Scenic Rim, South Burnett, Sunshine Coast,<br>Toowoomba       | Maximum \$75,000 | 10 March 2023   |
| South East Qld severe weather and flooding (May 2022)  | Gympie, Lockyer Valley, Scenic Rim  | Maximum \$75,000 | 6 January 2023  |
| NSW severe weather and<br>flooding (February 2022<br>onwards)  | Armidale, Ballina, Bellingen, Byron,<br>Clarence Valley, Coffs Harbour, Kempsey,<br>Kyogle, Lismore, Nambucca, Port<br>Macquarie-Hastings, Richmond Valley,<br>Tenterfield, Tweed         | Maximum \$75,000 | 30 June 2023    |
| NSW Severe weather and flooding (June 2022 onwards)  | Central Coast, Kempsey, Nambucca,<br>Port Macquarie-Hastings  | Maximum \$75,000 | January 2023    |
| NSW additional critical<br>producer grant if you have<br>exhausted the above severe<br>weather and flooding<br>(February 2022 onwards) | Ballina, Bellingen, Blue Mountains, Byron,<br>Central Coast, Clarence Valley, Coffs<br>Harbour, Kempsey, Kyogle, Lismore,<br>Nambucca, Port Macquarie-Hastings,<br>Richmond Valley, Tweed | Maximum \$75,000 | 30 June 2023    |



Days after flood peak (not to scale)

Figure 1. General water quality processes after flooding. (Johnson, S. et al 2003.). Source: Rous County Council Technical Note, Understanding Blackwater in the Richmond River Estuary.

the worst water quality occurs mid-catchment, where a large portion of land use is for macadamia and cattle properties. Most emergent events such as the blackwater and acidification occur in the lower catchment.

The NSW Government has been researching agricultural and land use practices through many programs including, most recently, the Clean Coastal Catchment Initiative delivered by NSW DPI. This initiative includes two macadamia research and demonstration sites. While the findings from this initiative will inform what is likely to be initial voluntary minimum practice standards, NSW will in all likelihood follow Queensland in legislating agricultural practices in certain catchment areas. Minimum practice standards are likely to include:

- greater riparian responsibility on the landholder
- actions to control erosion and sediment
- spray drift mitigation and more robust buffer zones
- nutrient budgeting and application maximums record keeping and compliance with a best
- management practice (BMP).

### **Reef regulations for horticulture**

While record keeping, minimum practice standards and nutrient budgets have been mandated for certain crops such as sugar cane, bananas and grazing in the Reef areas in Queensland, the rollout of these in horticulture has been pushed back to a new proposed start date of 1 December 2024.

There are current permit requirements for new or expanded horticultural cropping activities on 5 ha or more that don't meet the cropping history test. Cropping history applies when any activity has occurred in three out of the last 10 years (with at least one year being in the last five years), appliable to all types of crops.

Record keeping requirements also apply to all agricultural advisers, such as fertiliser retailers and agronomists. They need to keep records of any advice given to producers



Figure 2. Reef regulations apply to six reef catchment regions

or to people seeking advice on their behalf (such as contractors) about meeting minimum standards.

One of the ways to comply with these regulations is through Hort 360 Reef Certification. There has been good uptake of this compliance and evaluation program, which is delivered by Growcom. To date, 70 macadamia farms have completed the certification, representing over 5,700 ha.

Hort360 is designed to align with existing Freshcare auditing programs to minimise duplication and the regulatory burden. This means if you already take part in Freshcare, you are likely well on your way.

Visit website www.qld.gov.au/ReefRegulations where you can register to receive an information pack. You can also visit www.hort360.com.au or contact Growcom who have a dedicated staff member in the Burnett Mary region assisting growers with certification.

See you out in the orchard. Leoni

### Let's reward growers and continue to lead the world

I am writing this letter in the hope it will stimulate discussion and result in actions that advance our industry.

Australian macadamias need to be strongly differentiated as the best in the world. In large part, this requires an emphasis on quality, something that would commence through growers being fairly rewarded for the market value of their NIS.

Competition for NIS has resulted in most buyers paying the same price for commercial as premium grade and not applying a penalty when the levels of commercial and unsound are high. Usually, high levels of unsound and commercial grades result in premium kernel being of reduced quality and shelf life. There is no benefit to the grower in maximising whole kernels, which has a major effect on kernel prices. Too often, stale kernel is still encountered in the marketplace.

For many years in Australia, NIS buying policy has been a disincentive to the grower to raise quality. Quality is derived in the orchard and subsequent processing can only maintain what is supplied. While there have been overall advances at grower and processing level in producing higher quality kernel, our reputation for quality is being challenged by advances in South Africa that provide an incentive we can learn from.

Of course, Mother Nature has made maintaining quality difficult, but her impacts are something all growers and processors must live with and learn how to minimise. Long shelf life, uniformity and the wonderful aroma and zest of fresh macadamias must be our goal. Our strategic investment plan and current research program do not include any projects on understanding quality, its applied research or an ongoing quality improvement plan. We have largely forgotten the quality initiatives in the 1990s that resulted in Australia leading the world and which resulted in growers being rewarded or penalised based on the real value of what they produced.

With massive global expansion of NIS production, a softer kernel market and surplus of Style 4, there is the

opportunity next season and beyond to implement procedures that encourage and reward higher quality.

Defining quality and the required procedures to optimise it can be done. A new paradigm can and should be simple; the only obstacle is our will to change. There are many models for raising the bar, and these can be applied at either a whole-of-industry or at an individual level.

Examples of criteria to raise quality could include some or all of the following, which would be positively or negatively weighted to determine the value of a NIS consignment:

- accreditation to define farm procedures, crop handling and storage, etc
- frequency of harvest
- percentage of premium kernel based on a standard, say 33%
- percentage of commercial grade kernel which is priced to reflect its market value
- percentage of unsound kernel where low unsound is rewarded and high unsound is penalised
- percentage of whole kernels (as determined by laboratory assessment?)
- percentage of first grade kernel
- peroxide value, e-nose or indicator of shelf life
- uniformity of colour and appearance.

These criteria could lead to having both a standard NIS offer and a rewards offer and to an Australian premium roasting kernel grade.

**Note.** The discontinued determination of percentage of first grade kernel is a simple test that corresponds to complete maturity and relates to shelf life and flavour. It should be re-considered.

I'd be delighted to debate, expand or encourage this proposal with members.

Ian McConachie E: ianmccon@spiderweb.com.au

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### **Norm Greber Award**

### **Stephen McLean**



Stephen McLean, a deserving winner of the Norm Greber Award, has developed a reputation of commitment to excellence.

Winner of the 2022 Norm Greber Award, Stephen McLean, is a long-time member of the industry who has developed a well-deserved reputation of commitment to excellence and promoting practical solutions backed by research that growers can have confidence in.

Significantly, this reputation spans all sectors as a result of Steve's varied background which encompasses being a grower, consultant, liaison officer and a representative on industry research committees.

Steve said he has always been involved in and loved agriculture, having grown up on an apple, pear and dairy farm in Victoria. It was a visit to his father's newly purchased macadamia farm in the Northern Rivers in 1986 that awakened his interest in the nut.

Around this time, he met Alan Coates and discovered that they had a mutual interest in the importance of pest and disease management and in developing onfarm solutions that were practical and that integrated cultural, chemical and biological approaches. They worked together for about 10 years, completing early research with NSW DPI and BioResources on a pheromone trapping system for macadamia nut borer as well as evaluation and implementation of MacTrix.

Steve has maintained this commitment to integrated pest and disease management in all his roles since - as a grower and consultant and providing grower services in NSW for Suncoast Gold. He strongly believes in the importance of supporting research focused on "practical solutions for growers and good outcomes for industry".

It was this belief that motivated him to become involved with the macadamia research and development committee in 2009 until it was disbanded in 2016, and he was chair of the crop protection industry refence group, again disbanded in 2016. His commitment did not end there as he was also on the steering committee for IPDM and the SIAP until 2019.

Steve explains that pests and diseases are a part of the farm environment that growers can have at least some control over. In this context, he was motivated by ensuring that research focused on having practical outcomes that growers could be confident in and had a good return on investment for the industry. Since 2019, Steve has reduced his time at an industry level and has prioritised spending time with and supporting his wife Brooke and two young daughters, Opal and Matilda, as well as developing his own macadamia enterprises.

He said he was surprised when he was told he had won the award, and his first thought was: "Why me?"

Since then, he has had time to consider what it means and is extremely pleased and humbled that his efforts have been recognised in this way.

### **Awards of Excellence**

The AMS Awards of Excellence recognise significant achievement by growers and industry representatives. Award categories are Grower of the Year (small and large farm) and Young Achiever of the Year.

### **Crower of the Year (large farm)** Macadamia Farm Management (Banyula)



MFM director Scott Allcott says that close attention to management is important to ensure consistent, high production.

Macadamia Farm Management's orchard Banyula has taken out the large farm award for Grower of the Year, which recognises consistent high production over the last five years. Banyula, a 52 ha orchard whose trees range in age from 14 to 22 years, achieved an impressive 1.6 t/ha SKR for the last five seasons and 1.96 t/ha for the 2021 season.

According to MFM director Scott Allcott, ensuring that the trees produce at a consistently high level as those at Banyula have in the last few years requires close attention to management.

Scott explained that part of this is to do with timing of all operations, from irrigation, to pruning and applying organic matter. This has been important in achieving the orchard's average of 5 t/ha NIS each year, as have generally intensifying operations and maintaining a high level of inputs.

The nutrition program for the orchard helps to support its productivity, with fertilisers applied monthly, and compost, annually. Soil and leaf tests are done regularly, and fertiliser is applied where it is needed with variable rate spreaders. This makes for a soil that is as consistent as possible across the orchard. Scott says that they grow their soils which, in turn, grow the tree.

"We believe that we need a buffer in our soils to produce ongoing yields, and that there are at least two crops in the trees' resource bank at any one time," he said. For the last three years, a program of row removal has been undertaken which has increased spacings from  $6 \times 3.5$  m and  $7 \times 3.5$  m to  $12 \times 3.5$  m and  $14 \times 3.5$  m.

Row removal has given the high-density trees more access to light with reduced hedging. The structure of the tree relaxes and allows more sunlight to penetrate. The costs associated with row removal are recovered by the organic matter that they compost and add back into the orchard in the following year.

Ethephon is a key ingredient in resetting the orchard each year with the aim being to drop nut as early as possible within the constraints of the annual management program. This allows time for compost to be applied and husk and orchard prunings to be swept up under the irrigated root zone of the trees.

The orchard is irrigated, and in recent drier years, Scott has found that less water increases production. This is in part explained by the fact that by improving soil structure over the past nine years of compost applications, they have found that the tree and soil require less water.

Regular harvest allows for fewer reject nuts, which means less are removed at the sorting shed. According to Scott, consistent yields of any orchard are achieved through years of constant improvement across all aspects of macadamia farming.

"There is no silver bullet," he said.

### **Crower of the Year (small farm)** Henry and Jarrod Agostinelli



Henry (left) and Jarod Agostinelli, winners in the small farm category for Grower of the Year.

Winners in the small farm category for Grower of the Year are Henry and Jarod Agostinelli whose 14 ha orchard, located in Beerburrum in the Glass House Mountains growing region, achieved an impressive 1.89 t/ha SKR over five years and 0.49% RKR for the 2021 season.

The family has been growing macadamias for 18 years on their Beerburrum orchard, which consists of 1500 trees (246 and 741s) that are 24 years old, and 2000 MCT1 trees aged between two and four years. The older trees are planted on  $4 \times 8$  m spacings and the MCT1 trees on  $3.5 \times 8$  m.

Jarod is largely responsible for managing the orchard, with help from his parents, Henry and Teresa. The only outside assistance is with pruning, which is done once a year using a local contractor. These prunings go back into the orchard, along with husks after dehusking and compost.

Jarod's management philosophy is to keep things simple. His nutrient regime is based on broadcasting a general macadamia mix, completing a soil test annually to ensure things are tracking along satisfactorily and regularly monitoring the trees to ensure that they are healthy. In the future he said he would like to install an irrigation system to provide just that bit more certainty.

Jarod's approach is a successful one that is borne out in the orchard's production figures, which average between 32 and 35 t for the 1500 older trees. In future years these figures will increase with the contribution of the MCT1 trees as they mature.

Jarod uses a Flory sweeper harvester, usually completing four rounds over the harvest period, each between seven and ten days, starting in April-May and ending in late September with a clean-up. This year was out of the usual in that only three rounds were possible, mainly because of the prolonged wet weather.

One of the things that Jarod believes contributes to the orchard's success is the fact that it is surrounded by state forest and is relatively isolated, which protects it from significant pest and disease attacks. Being close to the coast also means that rainfall is usually higher and more reliable than in the hinterland, and its flat topography makes for relatively easier orchard operations.

While he believes he doesn't do anything special as far as orchard management is concerned, Jarod does say that for him it is important "to put the hours in and do the job properly". This is certainly proving a winning formula for him and the farm.

### Young Achiever of the Year Craham Wessling



Winner of the Young Achiever award, Graham Wessling, is an innovator who is constantly looking for ways to improve productivity and nut quality.

The winner of the Young Achiever Award for 2022 is Graham Wessling, who manages four orchards (two in Queensland and two in NSW) for CLMacs totalling 270 ha with trees aged from three to 30 years.

Despite his relative youth, Graham has a long background in the macadamia industry having started his first job with 2005 with Gray Plantations in Mackay. Since these beginnings he has also worked in macadamia enterprises in central Mexico and has maintained an occasional consultancy service to growers in Mexico and Brazil. This range of experience and seeing a variety of challenges in different growing areas has given him a unique perspective on managing macadamias and has encouraged him to think outside of the square when solving issues on farm.

As a result, Graham has developed a reputation as an innovator who is constantly looking to find more efficient ways of improving productivity and nut quality, including on the farms he manages that are in floodplain environments. Earlier this year he successfully used a mini skid loader adapted to harvest nuts from hard-to-reach and boggy areas on the Lennox Head farm he manages. He has also used helicopters to apply nutrients to wet areas that were inaccessible using ground-based machinery.

Graham's commitment doesn't end at the farm gate, rather he is always prepared to support research and other activities that benefit the industry. Recently he has been involved in a NSW DPI Clean Coastal Catchments project looking at the movement of nitrogen and phosphorus through the farm and ways of reducing losses.

"I enjoy being part of new research and support many trials being held on our farms," said Graham. "I do this for two reasons, the first being that I believe it's important to co-operate with research bodies so that we gain new information as often as possible. Secondly, being at the forefront of research and trials gives me pole position to act on any new information learned and implement it on the orchards I manage."

Graham, who said winning the award was a great honour, acknowledged the support of the companies he has worked for, which have encouraged him to investigate and be open-minded about finding solutions. He also thanked all his "great staff members who have helped me carry out my sometimes-crazy ideas with enthusiasm".

### **Regional award winners**

Finalists in the regional awards were shortlisted by the QDAF benchmarking team using yield and quality data collected from the 2021 season. The awards are separated into small and large farms. Regional winners are listed below.

### **Central Queensland**

### Best productivity

Large farms - Macadamia Farm Management (Banyula), 1.96 t/ha SKR Small farms - Anthony Sinnott, 2.35 t/ha SKR

### Best quality

Large farms - Macadamia Farm Management (Alloway -Wallace), 0.93% RKR Small farms - Anthony Sinnott, 0.97% RKR

### **Cympie Queensland**

### Best productivity

Large farms - Tim Salmon (Benworth Plantation), 2.42 t/ha SKR Small farms - Bruce Maguire (Twisted M), 1.63 t/ha SKR

### Best quality

Large farms - Sandra and Ollie Lindstrom (Lindols Macadamias), 0.89% RKR Small farms - Gary, Julie and Mitchell Davis (Kilfenora South), 0.79% RKR

### **Class House Mountains Queensland** Best productivity

Large farms - Michael Cooper (Mr Macadamia), 1.73 t/ha SKR Small farms - Bob Grice (Grice's Macadamia Farm), 2.92 t/ha SKR

### Best quality

Large farms - Michael Cooper (Mr Macadamia), 0.6% RKR Small farms - Joy and Daniel Greensill (Qld Farming), 0.37% RKR

### Northern Rivers NSW Best productivity

Large farms - Graham Wessling (LNL Australia Newrybar), 1.5 t/ha SKR Small farms - Amanda Keller (Foxtail Farm), 1.83 t/ha SKR

### Best quality

Large farms - Ian McLeod (Waila Macadamias), 1.13% RKR Small farms - Bruce and Elizabeth Green (Julene), 0.94% RKR

### Mid North Coast NSW

### **Best productivity**

Large farms - Dymocks, Arapala Macadamia Farm (Thurgoods), 1.52 t/ha SKR Small farms - Lynda and Glenn Barnes (Patagonia Macadamia Orchard), 1.4 t/ha SKR

### Best quality

Large farms - Victoria Thynne (Elanora), 1.32% RKR Small farms - Tim Zeck and Dru Marshall (Wirrimbi), 0.73% RKR



Winners in the regional awards categories I to r), Tim Salmon, Bruce Maguire, Michel Cooper and Bruce and Elizabeth Green.

### **Selection criteria**

Best productivity (saleable kernel t/ha) and best quality (lowest RKR and achieving or exceeding 2021 industry average productivity of 0.98 t/ha saleable kernel).

**Gympie, Glass House Mountains, Northern Rivers NSW and Mid North Coast NSW** Small farms = <30 ha | Large farms = >30 ha

**Bundaberg and Central Queensland** Small farms = <50 ha | Large farms = >50 ha

# provenance

n. [ *prov-uh-nuhns, -nahns* ] The place of origin or earliest known history of something.

Revered by local indigenous groups as a nutritious food source since ancient times, macadamia nuts caught the eye of European botanists in the early 1850's when seeds were selected and the first groves planted in the Gympie and Sunshine Coast Regions in South East Queensland. Now widely cultivated in subtropical environments of Australia and across the globe, up to 80% of commercially grown macadamia trees have genetics originating in the Gympie Region.

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### **Conference wrap**

A big thank you to all the delegates, sponsors, speakers and exhibitors who attended AusMac2022. More than 700 people descended on Royal Pines at the Gold Coast for the all-of-industry event, our largest AusMac to date! It was a jampacked 2½ days, with highlights including the golf day, cocktail reception, many informative plenary sessions and workshops with industry experts, women in macadamias luncheon, celebrity chef breakfast and rockabilly gala dinner.



Welcome cocktail reception by the pool



The women in macadamias luncheon, sponsored by Nutrien Ag Solutions, was a hit





The AusMac trade expo was a highlight



Assoc. Prof. Femi Akinsanmi facilitated the young researchers forum

Michaelle Herbert, Sean and Alice Cox, dressed up for the Stahmann Webster rockabilly dinner



At the women in macadamias luncheon are Suzanne Fleming, Sharon Dew, Leoni Kojetin, Jacqui Price, Clare Hamilton-Bate, Giaan Rooney, Dianne Vere and Tania Mcananey



AusMac was attended by more than 700 delegates



Celebrity chef breakfast MC Giaan Rooney with Serge Usatov (from sponsor BASF) and Colin Fassnidge



Colin Fassnidge delighted guests at the celebrity chef breakfast



Suncoast Gold's Julian Lancaster-Smith was best dressed at the golf day



Rockabilly gala dinner entertainers



The AMS board - L to R - Michael Russo, Michael McMahon, Daniel Howorth, Robbie Commens, Andrew Leslie and Chair Mark Napper



Bundaberg growers Michael McMahon and Michael Russo talk about best practice orchard establishment



More than 75 trade exhibitors showed their wares to delegates



SAMAC's Myles Osborn (L) and Lizel Pretorius (R) with Jillian Laing (WMO) and Michael Waring (INC)



The indoor trade expo was popular





Prof. Andrew Robson talks about the technology changing our orchards





Enjoying the welcome cocktail reception are Diane Cheal, Scott Fullerton, and Kylie and Ben Wild



Michael Green and Andrew Pearce at the Macadamias Direct expresso zone



Grower liaison Mark Whitten and grower Elle Revell talk about orchard renewal programs



Corematic were proud platinum sponsors of the event





Lindi Botha with Marquis Macadamias' Claudia Lordao and Charles Cormack at the cocktail reception sponsored by Marquis



Having fun at AusMac are Ron Dorey, Rod Sproule, Henri Bader, and Jutta and Belinda Dorey



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### Sustainability reporting - getting the credit you deserve

**Dr Theunis Smit**, Senior Agronomist and Sustainability Analyst, Carbon Friendly **M:** 0436 431 131 **E:** theunis@carbonfriendly.com.au

An article published in the winter 2022 edition of the *News Bulletin* highlighted that macadamias are now the most reef-certified crop in Queensland. This is no surprise seeing that macadamia growers are aware of the importance of maintaining a healthy and sustainable orchard environment for their trees.

One of the greatest driving forces to farming macadamias more sustainably stems from the understanding that yield, quality and therefore profitability increase with the implementation of practices that include composting, mulching and the maintenance of living ground cover. These regenerative agriculture practices have become synonymous with macadamia farming.

Of course, very few, if any, macadamia growers would have implemented these strategies solely to tick an environmental box. However, in the times of a more conscious consumer and a greater drive towards being a net zero producer, some growers are asking what they can do next. One option is to examine the part they can play in reducing greenhouse gas emissions through carbon farming.

### The carbon cycle and greenhouse emissions

Before we delve into the details it is critical that we examine the fundamentals of the carbon cycle. Put simply, carbon is either captured, or sequestered, by the environment or it is released, or emitted, from the environment (see Figure 1). Carbon is most commonly sequestered through photosynthesis and the breakdown of organic matter through soil microbiology, while the major losses, especially in orchards, occur through topsoil erosion and the respiration (production of carbon dioxide) by microbes, a by-product of organic matter breakdown. The basic carbon cycle remains the cornerstone of sustainability assessments. To determine whether a production system is carbon negative, neutral or positive we must establish whether carbon emissions are less than, equal to or more than the total carbon sequestered. So, if a macadamia orchard was managed in a completely natural manner (i.e., no addition of compost and/or any other inputs), the total carbon emissions would always be less than carbon sequestered, which means that such an orchard would be carbon negative.

Macadamia orchards are, however, not managed in a totally natural manner, and all our farming practices, including the use of electricity, fertiliser, diesel and chemicals, would contribute to carbon emissions. Determining how much each of these practices contribute to carbon emissions is where greenhouse gas assessment and sustainability reporting comes into play.

### Reducing carbon dioxide emissions on the farm

Let's consider the average macadamia farm that produces 3.5 t of NIS per hectare and applies some compost, synthetic fertiliser, insecticide and herbicide and uses some electricity and diesel. How many tonnes of carbon in the form of carbon dioxide does this farm contribute per hectare and per tonne or kilogram of NIS and how do we measure and report it?



Figure 1. Fundamentals of the carbon cycle with carbon capture/ sequestration indicated by green arrows and carbon release/ emissions indicated by red arrows (image source: https://www. globaldairyplatform. com/news-posts/ carbon-sequestrationguidelines/). The short answer is that it is not simple. While we have no reference framework for gauging how much one tonne of  $CO_2$  equivalent is, we have been able to calculate carbon emissions for an actual macadamia farm based on ISO methods for this example to give an idea of the amount of carbon a farm can emit (see Figure 2). In this real-world example, the farm emits 5.54 t/ha  $CO_2$  equivalent.

To give some perspective, one tonne of  $CO_2$  equivalent is equal to charging more than 125 000 smartphones or driving the average ute for about 6000 km. While it is nearly impossible to gauge or benchmark emissions without completing a greenhouse gas assessment, we can say that if the average macadamia grower were to reduce the use of synthetic fertiliser, insecticide, herbicide and diesel by 25%, the total carbon emissions would reduce by at least 1 t/ha  $CO_2$  equivalent (see Figure 2).

### The role of soil organic carbon

Emission reductions are a brilliant solution to reducing the carbon footprint of macadamias, however, some growers already have low emissions and cannot reduce them further. Fortunately, agriculture has the opportunity to sequester immense amounts of carbon through photosynthesis and the enhancement of soil microbiology.

The yardstick used to measure carbon sequestration in agriculture is soil organic carbon (SOC) as this is a direct indication of the amount of carbon that is stored in the soil. Seeing that we now know how much carbon macadamia production emits (Figure 2), how much carbon can a macadamia orchard sequester on a yearly basis? Let's consider the multiple increases in SOC and how much carbon sequestration this relates to (see table), as well as the impact that this could have on an orchard.

### Benefits of being a carbon negative producer

Hypothetically, if the macadamia orchard used in our example applied some compost and this increased the SOC by 0.1%, this would mean that about 7 t/ha of  $CO_2$  equivalents would have been sequestered in a single year. Considering that our emissions were 5.54 t/ha  $CO_2$  equivalent, our net emissions would have been -1.5 t/ha  $CO_2$  equivalent, which would imply we captured more carbon than what we released into the atmosphere. Our hypothetical farm would therefore be classified as a carbon negative producer and, if this farm had completed a greenhouse gas assessment through a certified assessor, they could also label their product as carbon negative.

It should be noted that an increase in SOC does not always have to come from applying compost. Using regenerative agriculture principles such as maintaining a living ground cover and reducing erosion also would ultimately improve SOC. These practices usually come at a cost to the farmer but seeing the potential of the agricultural industry to sequester carbon, the world and especially net emitters of carbon are willing to pay for the credits accumulated by a farm to offset their emissions.

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In Australia there are both government and voluntary carbon credit programs that allow growers to sell the credits that they generate from the farm, including a carbon farming project specifically for Australian orchards. The requirements and rules for the different programs vary, so anyone interested should research the options available carefully using the help of an expert in the area.

Regardless of the potential to generate income from carbon credits, macadamia growers could benefit significantly from doing a greenhouse gas assessment, benchmarking their carbon emissions and using their status as a carbon neutral or negative producer. This would support their claim as being sustainable food producer and a proponent of change driving the world towards net zero emissions.

#### Information

For more information about carbon farming, contact the author. You can also find out more about carbon farming in Queensland by going to Queensland government website (https://www.qld.gov.au/ environment/climate/climate-change/land-restoration-fund/carbonfarming) and in NSW by going to NSW government website (https:// www.dpi.nsw.gov.au/dpi/climate/Carbon-and-emissions/carbonopportunities/carbon-farming).

### New online tool to unlock carbon curiosity

A new online tool for landowners and primary producers to navigate the tricky landscape of carbon choices was launched in October by agricultural R&D agency AgriFutures Australia. The Carbon Opportunity Decision Support Tool, which was developed by the Australian Farm Institute (AFI), is a practical resource that guides users through questions relating to risk appetite and their business goals.

The tool explains which carbon opportunities may be available for a producer and encourages users to consider the potential benefits and costs of different carbon projects for their farming businesses.

Opportunities covered in the tool include participation in the Australian Government's Emission Reduction Fund or private carbon markets, access to sustainability linked loans and carbon neutral certification, as well as productivity gains.

"The key message of the tool is to know your options and make good choices. As an essential ingredient for agriculture, reinvesting carbon back into farming systems is a win-win. There are plenty of pathways for this, so it's important to work out which one best fits your business's goals, capabilities, strategic plans and risk appetite," explained AFI Executive Director, Richard Heath.

You can complete the online tool through the Agrifutures Australia website https://carbontool.farminstitute.org.au/



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### When weeds are the good guys

Dr Gavin Chirgwin, Bundaberg | E: chirg2001@yahoo.com.au

On many macadamia farms, weeds are commonly found in surrounding bushland as well as in the orchard, while the inter-row areas are a mixture of grasses and weeds. We all know that weeds can host a range of horticultural pests and diseases, while their vigorous growth can use valuable nutrients and water. Some weeds are also known to have allelopathic effects on crops, which can impact the growth of nearby plants. While this article could continue to describe the many negative attributes of weeds, it is possible to look at them in a different way and see that some weeds growing in orchards can have positive effects.

### A food source for pollinators

We have all heard of parasitoid wasps, which are known to target a number of important macadamia pests. Adult wasps require a nectar food source so they can parasitise the pest eggs. When macadamias are flowering, nectar is in abundance, but outside of flowering, other floral resources are required. This is critical, as wasps will be actively targeting pest eggs before and after the main macadamia flowering period. If the inter row is a mixture of manicured grasses or regularly slashed weeds or if a significant portion of the inter-row vegetation is removed during pre-flowering orchard operations, food for these amazing wasps is going to be very limited. It is not just parasitoid wasps that require a floral food source; many other beneficial insects require such a source. Floral food sources are also critical to the insects performing one of the most important services, pollination.

While our focus might turn to pollinators during flowering, many of them, particularly resident pollinators, need a year-round food supply. On many macadamia farms, a lot of floral food sources most likely come from weeds. With this being the case, it is critical that we better understand the role weeds play in providing floral food sources to pollinators and beneficial insects.



Wild radish hosts beneficial insects, particularly honey bees and native stingless bees.

### A home to insects

Weeds are not only floral food sources; they are home to many types of insects that help provide free biological control services to your farm. Sweep a net through some shepherd's purse and you will be surprised by the abundance of spiders and small wasps.

These weeds can also be important refuges for beneficial insect populations when applying pesticides. Resident and fleeing insects can re-enter trees when spraying is complete. I can hear some people saying that while this is true, weeds also harbour significant pests that can hide and re-enter the orchard after spraying. Yes, absolutely correct, which is why weed knowledge and management are critical.

Where certain weeds form a more stable population, such as a blackberry nightshade growing in clumps, they can be an important host for vegetable bugs (both green and potato vegetable bugs). Weed knowledge and management are critical for promoting beneficial insects and minimising negative impacts of some weeds.



Mixed weeds in the inter row. The weeds are mainly mallow and blackberry nightshade, which are known to host vegetable bugs.



Shepherd's purse is a host of beneficial insects.

### Soil improvers

Weeds can also contribute to improved soil health, soil structure, soil organic matter content and nutrients. Weeds commonly found on macadamia farms, such as burr medic, common vetch and creeping indigo are known to fix atmospheric nitrogen.

Many weeds have taproots that penetrate into the soil profile extracting water and nutrients, while also contributing to soil structure. Creeping indigo and dandelion taproots can reach 60 cm or more, while wild radish can have taproots 160 cm long. Nutrient cycling and organic matter accumulation from weed species with varied growth habits will benefit the inter-row area and macadamia trees.

### Long-term aim

The longer-term aim should be to regenerate bushland areas and remove environmental weeds, while orchard inter-row vegetation not only provides a cover to limit erosion, but actively improves soil health (organic matter, soil structure, compaction) and are centres of biodiversity. The macadamia industry has supported projects in this area, however, substantial knowledge gaps still exist. Weeds can have significant positive impacts for orchard soils and macadamia trees, but we need to better understand how to use these positives.



Weeds such as burr medic (top) and creeping indigo can fix nitrogen in the orchard.

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### Soil samplers and samples sought

Southern Cross University and the Environmental Analysis Laboratory (EAL) are inviting farmers across the country to participate in a Department of Agriculture, Fisheries and Forestry soil sampling program.

Farmers and land managers can receive \$275 plus GST per sample site (capped at \$10,000 plus GST per ABN), towards the cost of soil sampling and analysis, in return for being able to share their data on the Australian National Soil Information System (ANSIS). They can also receive assistance from Commonwealth-funded soil extension officers to interpret their soil test results.

ANSIS is part of the National Soil Strategy, which was released in May 2021 and sets out how Australia will value, manage and improve its soil for the next 20 years. ANSIS is being managed by CSIRO and will store soil data, track and report trends and changes in soil health, and be used to monitor the impact of land management practices and environmental shocks over time. The publicly available soil information platform will support decision makers to identify gaps and opportunities to manage and improve Australia's soil assets. Qualified agronomists across the country, and those with soil sampling experience, are also required to assist with delivering this national soil health baselining program. Projects under the Emissions Reduction Fund are eligible to participate.

### Information

For information go to SCU website https://www.scu.edu.au/pilot-soils-program/, email soiltest@scu.edu.au, or phone 02 6620 3489.



Farmers are invited to participate in a national soil sampling program with results being stored in the Australian National Soil Information System.

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### Canopy management strategies in older orchards: grower perspectives

Matt Weinert, Grower Liaison, Marquis Macadamias E: mweinert@marquis.com

Managing canopies in older orchards is one of the biggest issues facing macadamia growers in the Northern Rivers. To help growers address this issue, in late August, Marquis Macadamias and the AMS packed three buses of enthusiastic growers for a roaming field day in the area showcasing successful canopy management strategies in older orchards.

A key message of the day was that effective canopy management has significant benefits for the orchard. It not only improves tree health and ensures long-term productivity, but it also makes orchards more resilient to

### Trevor and Barbara Martin, Eureka

Trevor and Barbara Martin began implementing a canopy management strategy on their 28 ha orchard about eight years ago. Trevor said the orchard was dark and crowded and they knew that they had to do "something", so they contracted Grant Flemming to remove limbs. The focus was to open windows in the canopy, which they did by taking a branch on either side of the tree, preferably from the north-east or north-west side.

Trevor's main rule is that you can't sit and do nothing.

"If you're not taking out trees or rows, you're locked into limb removal. You always need to be taking something," he said.

Trevor prunes part of the orchard every year on a roughly five-year rotation, which means 1200 to 1500 trees each year.

"We're on our second rotation, and on some trees, we're only taking one branch. I feel you don't have to take out a lot and it's surprising the difference taking out only a medium-sized branch can make to the light environment inside the orchard," he said.

With his main pruning contractor Grant Flemming retiring, and because there are so few contractors, Trevor thinks they will probably have to move to using excavator shears rather than pole saws.

Grant demonstrated limb removal with a pole saw, emphasising the importance of appropriate personal protective equipment and operating it safely. He explained that the aim of limb removal was to let in light as this allows more growth in the heart of the tree and promotes the growth of orchard floor ground covers, both of which are critical for sustainable production.

"I assess each tree individually and the amount I take depends on the tree health, shape and the effect

climatic factors and makes pest and disease control easier.

"Importantly, an effective canopy management strategy is far from a 'one-size-fits-all' approach, rather it needs to consider and incorporate factors such as spacing, tree height, tree health, cultivar, topography and available capital," Mark Whitten, grower liaison officer for Marquis Macadamias and one of the field day organisers, said.

Mark explained that growers can feel confused and overwhelmed about which technique or strategy to use and where and how to apply it. That is where field days like this, where growers share ideas and experiences, are critical to help them decide on canopy management strategies and techniques.



Grant Flemming and Trevor Martin describing their limb selection process, the aim of which is to let light in and allow more growth in the heart of the tree.

I want to create," he said. "I aim to take limbs that are competing with other trees and that 'lock up' the canopy, while making sure I let enough light in for both the tree and orchard floor. I prefer a central leader structure, so I try not to remove the leader."

Trevor also uses a bespoke harvester and mulcher, which boasts a 2.5 m dual head with mid-size finger wheels, dual sweepers, an Admac de-husker, a Faustini 2.4 m mulcher with flail or Y blades, all driven by a Fent 110 hp closed-cab tractor with front linkage, front PTO and Vario transmission. They have used it for a season and are "really happy" with it as it has reduced their harvest rounds to between five and six days, and it does a great job of picking up nut.

"We have set the mulcher at the rear to around 45 mm off the ground and it shreds any leaves and sticks and cuts the grass down, while leaving any nut that the wheels didn't get. As a result, with one pass it's ready for the next harvest," he said.

### Henri Bader, Knockrow

Henri's orchard was planted about 17 years ago on a narrow 7 x 5 m spacing, with the plan of moving later to a 14 m row spacing. He explained that two key points underpin their canopy management strategy.

"First, we need to get light onto the orchard floor and, second, we need to have as little impact on production as possible," he said.

To achieve this Henri employs a strategy of progressive row removal. This involves choosing the row to be removed first and then removing limbs over two operations spaced over two to three years.

Mark Cole, the orchard operations manager, said on the "go-row" they take out a few decent lower branches on each tree, especially ones that are growing into the adjacent rows. They then leave the tree for a couple of years, after which they come back and do the same, a process he described as like "lolly popping" the trees.

After another couple of years, they take the row. By that stage (about six years) the "stay" rows have stabilised and grown into that space, a strategy that minimises the risk of tree damage from storms and limits the production drop that is often seen when rows are removed.

The operation uses two small 4.5 t excavators. The first has a cut-and-hold head, which cuts the limbs and allows them to be placed facing the same way along the row; the second excavator is fitted with a grab, which feeds the 18-inch Bandit chipper.

"It's a very efficient way to operate and very safe, as workplace health and safety is important for our company. No one is using pole saws in this part of the operation, and everyone is safe inside a machine," Mark said.

Graeme Fleming, the orchard's general manager, agreed that progressive row removal has been a successful strategy. This is especially compared with orchards where rows have been removed in one operation, which almost always results in a significant drop in production.

"Using this strategy, we've been able to maintain production at over four tonnes a hectare, improve the productive canopy of all trees, better prepare the trees for when the rows are removed and, importantly, reintroduce light and consequently grass cover onto the orchard floor," he said.

While some people might query the costs of two extra operations before row removal, Graeme said that the continued good production and improved stability of the trees when the rows are removed far outweigh the cost of the two limb removal operations. As well, there are added benefits from the wood chip generated from the limbs, which is a valuable resource, and a more open canopy, which harbours fewer pests and allows for better spray coverage resulting in reduced insect pressure.

This orchard is part of a combined operation which totals more than 80 ha of orchard area. According to Graeme, they will continue with the phased row removal across all orchards. As well, they will also be carrying out strategic limb removal on the remaining rows when required to maintain canopy height and light penetration as the trees fill in the gap left by the removed row.



Limb removal using an excavator with a cut-and-hold attachment on Henri Bader's orchard. Removed limbs are placed facing the same direction to aid feeding the chipper.



Feeding a chipper using an excavator with a grab attachment.

### **Summerland Farms, Alstonville**

Shaun Reynolds, farm manager for Summerland Farms, showed his approach to canopy management in three blocks at different stages in the pruning rotation.

The first was a block of "big, old 344s" that were on a 10 m spacing and were pruned in 2019. Shaun explained that they were too wide for row removal, so they went with limb removal focusing on removing big competing leaders and limbs growing into other trees. These were often big (about 250 mm) cuts, where they left a stump (about 500 mm) for regrowth.

One of the things he said they had learnt was that if you want to let the light in, don't make multiple small cuts, rather do it "brutally" in one part of the tree.

With the older Hawaiian cultivars like 344s, they return in three years and make between four and eight cuts a tree targeting much smaller branches.

"For the follow-up cuts, we have found that small cuts made often are the most effective, otherwise production is hit too hard from the vigorous regrowth. The initial big cuts reduced yield by about a quarter but since the pruning, this block has averaged 4.2 t/ha over the last five years, which we're very happy with," Shaun said.

The next block was similar, and the Summerland Farm pruning team were making the first major cut. With only half the block pruned, this provided a great contrast and allowed people to better assess the impact of the cuts.



Shaun Reynolds (back to camera) for Summerland Farms describes the canopy management process on the 344 block.



A lot of limbs were removed in the first major prune of the second block visited at Summerland Farms.

A few rows were yet to be chipped, which highlighted how much material the cuts generate.

The final block was 25-year-old A4s, which were being pruned for the third time in five years. Also emphasising the importance of safety, Shaun showed the range of equipment they use, including chainsaws, pole saws and a 12-inch Bandit chipper. He noted that the block had not been pruned until five years ago and, because the trees were getting tall, hollow in the centres and unproductive, they made major cuts. This allowed in a lot of light and opened the rows and the trees.

"Two years ago, we pruned again taking any major branches we missed in the first operation and some smaller branches. The initial cuts resulted in a lot of new growth within the trees and production from this block has really increased," he said.

According to Shaun, A cultivars regrow and return to production more quickly than Hawaiian cultivars.

"It may take three years to get production on new growth on a 344, while there is some regrowth which have nuts on A4s after 12 months," he said.

Shaun's pruning philosophy is to manage canopy and maintain production.

"We're achieving this, and I can see continued and consistent production for a long time to come using this strategy," he said.

### **Take-home messages**

Feedback on the day was overwhelmingly positive and demonstrates how much interest there is for information on effective canopy management. Most growers who responded to the field day survey indicated they will make changes to their canopy management strategies after attending the event.

While all sites were tackling canopy management in different ways, the overall themes became clear:

- Trees will continue to grow and doing nothing is not an option.
- Productive and sustainable orchards need light and air.
- Each orchard is different and requires its own canopy management solution.
- Different varieties require different pruning strategies.

### Information

For information on the day, feel free to contact Mark Whitten (0429 826 510) or Matt Weinert (0438 644 136) from the Marquis Macadamias grower liaison team.

### **First meeting of Macadamia Masterclass**

In September this year, the first meeting of the industry's Macadamia Masterclass was held to introduce the 16 participants to each other, outline the program for the next 12 months and gain an understanding of the key outcomes people were looking for.



The Macadamia Masterclass has kicked off with the 16 participants sharing their backgrounds and what they hope to get out of the 12-month program.

Like the industry itself, the participants represent a cross-section of ages, experience, growing area, orchard size and tree age. What they all have in common is a desire to learn from each other and from the technical presenters so they can improve orchard productivity and nut quality. Gavin Lerch, who is involved on the family orchard near Bundaberg as well as a grower liaison officer from Nutworks, summed up the feeling of group when he said, "What I have learnt in the industry is that we have a lot more to learn".

The masterclass is designed so that participants, who come from growing areas from the Clarence Valley north to Rockhampton, can apply the theory they learn from the many participating organisations to their own orchards. According to Leoni Kojetin, they will choose issues after each module that they want to delve into and learn more about.

"The aim is for them to develop a project that has practical, on-farm application and then work through solutions using their own research and the knowledge and skills of the technical presenters as well as the other participants, all of whom have skills in different areas," she explained. "This approach of learning from each other has the potential to be very effective and help participants quickly develop skills so they can improve orchard management and, ultimately, the bottom line."

The masterclass will be delivered through a combination of flexible online self-directed study, face-to-face workshops, in-field activities and farm visits and will focus on six key subject areas:

orchard floor

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nutrition and soils



- water management
- pests and diseases
- harvest and post-harvest management.

The extensive collaboration provided by partner organisations and private consultants to deliver this course is a first for the industry and we acknowledge their commitment to this inaugural masterclass.

| Participants      | Region          | Organisation                |
|-------------------|-----------------|-----------------------------|
| Jamie Dilges      | Rockhampton     | MacField Farms              |
| Mark Coles        | Northern Rivers | Knockrow<br>Macadamia       |
| Michael Rasmussen | Childers        | Peirson Trust               |
| Adrian Crush      | Childers        | Perison Trust               |
| Bryce Fleming     | Bundaberg       | SuBry Farms                 |
| Michael Bell      | Northern Rivers | CL Macs                     |
| Jessica McMahon   | Bundaberg       | Nutbush Farms               |
| Jamie Joyce       | Bundaberg       | Natara Produce              |
| Henry Curtin      | Clarence Valley | Boombera Park               |
| Kathy Hoare       | Bundaberg       | Avodon                      |
| John Delisser     | Bundaberg       | Carney Farms                |
| Justin Anderson   | Childers        | Anderson Family<br>Trust    |
| Gavin Lerch       | Bundaberg       | G&H Lerch Family<br>Trust   |
| Jennifer Hulme    | Bundaberg       | Hinkler Park<br>Plantations |
| Wade Edge         | Maryborough     | RFM                         |
| Toby McCall       | Rockhampton     | RFM                         |





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### world macadamia organisation

### One Year On

Globally, there has been an increase in the number of macadamia trees planted, with more planting planned for the future. As these trees start to produce nuts, the global macadamia supply is forecast to double between 2020 and 2025 and triple by 2030 – the annual crop will then be above 600,000 MT (nut in shell at 3.5% moisture).

Macadamias are grown across five continents and, unlike other tree nuts, no origin produces a dominant supply. this projected increase in supply will be met with equal demand.

Early recognition that it would require a collaborative effort to realise this demand-based opportunity saw the genesis of the World Macadamia Organisation (WMO).

The WMO is a demand generation agency incorporated as a not-for-profit in Singapore in September 2021. Its purpose is to promote

Between 2017 and 2022, almost all origins reported higher yields, with the highest rate of growth seen in Vietnam and China (see chart).

These statistics prompted the major macadamiaproducing countries to look ahead and take action to ensure



macadamias globally, help consumers connect with the benefits of including them in their diet, and stimulate growth in existing and untapped markets.

One year on, we think it essential to review what has happened and what is ahead.

### Membership

The WMO exists due to the financial support of members – the macadamia-growing countries of the world.

At the time of incorporation, the target was four member countries. We have achieved seven.

Conversations are ongoing with several countries considering membership in the coming year.

Each member country has representatives at the Member Council. We elect a Board from this group, along with an independent Chair.

Inaugural WMO members: South Africa, Australia, Kenya, Guatemala, Hawaii/ USA, Vietnam, Zimbabwe.

### Generating new demand

The WMO has identified four avenues to prioritise to generate new demand. Because building demand takes time and a consistent approach, we have created a four-year roadmap for each.

### China



Chinese consumers enjoy nut-in-shell macadamias as part of their Chinese New Year gift-giving practice. WMO saw an opportunity to increase sales by creating rituals centred on families opening macadamias together around other festivals.

In January 2022, the WMO launched

its "open together" campaign. The campaign's video has been viewed over three million times. Influencers have shared images of their families enjoying macadamia moments, with the top performing influencer gaining 8,000 likes and 2,700 shares from their followers.

The campaign generated a significant shift in consumer interest in nut-inshell macadamias. Encouraged by this, we will continue to pursue similar marketing activities next year. We will also look at opportunities for kernel consumption.

### Supporting activities

The WMO also undertakes activities which help support the industry. Some key highlights from the first year:



Reviewed 70 existing studies on the **health benefits** of macadamias and creating a new health and wellness narrative centred on the "good fats" in macadamias and their role in managing inflammation.



Launched the WMO Macadamia **Product Standard,** so customers have more certainty about what they are going to receive and to ensure consumers have a good eating experience.



Started collating quarterly **production data** from all macadamia producing countries, providing more detail on changes that are happening during the season.

### The WMO Team

### Jillian Laing CEO

Jillian is an international food marketer with experience in most continents, with a focus

on Asia. Jillian loves the links macadamias have back to the farm, their potential as a healthy wholefood, and the global nature of the role.

### jillian@worldmacadamia.com

#### **Tina Herbison** Marketing & Admin Executive



diverse creative and admin background and has a keen interest in design thinking. Committed to healthy and mindful living, Tina enjoys collaborating with WMO members and partners to promote macadamias as a mindful food choice.

### tina@worldmacadamia.com

### Love Macadamia<sup>™</sup> targeting Mindful Consumption

The Love Macadamia<sup>™</sup> campaign is about elevating macadamias from occasional food to something considered an integral part of a balanced and healthy diet and generating greater awareness of macadamias among those who favour wholefoods.



Love Macadamia<sup>™</sup> recently launched

on Facebook, Instagram and Pinterest. The website contains recipes, health information, and other macadamia-centric inspiration: www. lovemacadamia.org.

It is too early to draw any definitive results, but a particularly positive sign is that the percentage of people engaging with our content on Instagram is high at 20%. Over double the industry average. This work will continue to build in the next year and will involve key influencers and new content.

### Ingredients for manufacturers



Aligned to the messaging of "where healthy meets luxury in a natural way", the WMO identified three key segments where encouraging manufacturers to formulate products using macadamias makes perfect sense: bars, bites and breakfast. To support this initiative, we identified that offering macadamia in

more ingredient forms will be critical as the industry evolves.

We delivered a multi-country product standard and consumer awareness campaign as part of this strategy. In the next year, we will create product concepts to inspire and inform product developers, along with an ingredient-specific campaign and supporting sales tools.

### India

India is a significant market for nut consumption. However, macadamias are not well known. This year we gathered information on where the opportunities lie and how best to realise them.

We discovered the following key points:

- Given the premium price point, we need to target the highest socio-economic class (this is a large group)
- Dieticians influence what this group eat
- We need to target one city for the initial marketing activity
- Ecommerce is growing quickly

Over the next 12 months, we will launch a campaign to increase macadamia awareness and encourage our target market to try macadamia.

If you'd like to know more there are several ways you can do this:

- $\rightarrow$  Sign up for email updates on www.worldmacadamia.com
- ightarrow Check out our websites: www.worldmacadamia.com and www.lovemacadamia.org
- → Follow us on our social channels:



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Hort nnovation FUND

### From manual to autonomous

Leoni Kojetin, Industry Development Manager, AMS M: 0433 007 925 E: leoni.kojetin@macadamias.org

In the last decade, there have been big advances in developing and commercialising robots and autonomous vehicles for agriculture. We can see this particularly in broadacre cropping enterprises, which are using autonomous vehicles to plough paddocks, sow crops and apply chemicals. While much is still done in the field in the macadamia industry using human labour, with robotic technology becoming available, this is likely to change in the next few years.

It is against this background that Bundaberg Fruit and Vegetable Growers, Hinkler Ag Tech and the AMS organised an on-farm autonomous vehicle field day on a Macadamia Farm Management orchard near Bundaberg. Four suppliers of autonomous equipment showcased its potential for operations like mowing and slashing, spraying for pests, disease and weeds, seeding, and light tillage. In this article, Leoni Kojetin provides an overview of the vehicles on show and how they can be used.

Of the four applications demonstrated on the day, some were autonomous vehicles such as robots and drones that once set up could complete an orchard task using a predetermined route, while others were bolt-on controls that enabled the automation of existing orchard machinery such as tractors.

### **GOtrack GPS Auto Drive**

The GOtrack, demonstrated by the AME Group, which distributes tractor attachments and other applications in orchards, is a technology that can be retrofitted onto an existing orchard tractor and used to autonomously operate an attachment such as a slasher or sprayer. Importantly, it can be switched off so the tractor and implements can be operated manually.

It operates using LIDAR technology and has inbuilt safety features that enable it to assess an obstacle such as an animal and pause and relay information back to an operator or continue if the obstacle moves. It uses an app that shows real-time geolocation as well as attachment-operating parameters such as spray rate, speed or volume left in a tank. This information can be uploaded to orchard record keeping systems such as a spray diary. The system can also receive a signal from a weather monitoring device to trigger the tractor to stop operating if necessary.

The GOtrack is highly suited to less skilled orchard tasks, freeing up operators to focus on jobs requiring decision-making capabilities or more complex tasks. It can also be used as fatigue management tool.

The technology has been trialled at the Almond Centre of Excellence and by other industries such as viticulture and is commercially available now. It can be purchased on subscription rather than paying upfront, which lowers the threshold to trial the technology.

**Information.** For information contact Cam Clifford, cam.clifford@amegroup.com.au



A tractor fitted with a GOtrack GPS being used to autonomously apply chemistry.



The SwarmBot 5, an 85 hp robot weighing about 2.5 t, can be used for a range of orchard tasks such as mowing.

### SwarmBot 5

The SwarmBot 5, which operates orchard attachments and other ag tech, was put through its paces by SwarmFarm Robotics, an Australian company that develops autonomous robots for agriculture. The name of the company refers to the fact that a number of robots, a "swarm", can be used for a particular application and operated as a single unit.

SwarmFarm robots are designed to analyse and respond to their environment and conditions while constantly sensing and adjusting the orchard operation. They do this using LIDAR technology and 3D obstacle detection sensors with live cameras on board for monitoring field operations. SwarmFarm has an open developer system, which allows independent tools and attachments to be integrated onboard for autonomous operation. While the robot does not need connectivity to operate, it is preferred to monitor and respond to the operation taking place.

It can be purchased on a three-year operational lease which includes all maintenance other than oil changes.

Forty of these robots are being used in broadacre crops around Australia. The orchard robot that was demonstrated will be commercially available next year.

**Information.** For information contact Andrew Bate, andrew@swarmfarm.com

### XAG PIOO drone

The XAG P100 was demonstrated by OzTech Drones, a Queensland-based company specialising in drones and ground robots. It is operated by a pilot, either a contractor or farm staff who has been trained and certified to fly it.

Advantages of drones are that they are highly suited to hard-to-access orchards and aerial operation eliminates compaction, orchard floor erosion and the spread of soil-based diseases. They are quieter than tractorbased, traditional spray technology, are much easier to transport between farms and can be operated as a swarm with a single operator controlling them at a base.

The XAG P100, which can be used to spread orchard inputs such as chemistry, seeds and fertiliser, has a payload of 40 L of liquid and 60 L of solids and can covers between 5 and 10 ha/hour, depending on application rate. The drone is programmed to operate within predetermined weather parameters and can communicate to fulfill orchard record keeping systems such as a spray diary. It is commercially available now can be either bought outright or operated through a contract service. The drone has been used on a number of macadamia orchards around Bundaberg and in other regions.

**Information.** For information contact Jamin Fleming, jamin@oztechdrones.com.au

![](_page_35_Picture_16.jpeg)

OzTech Drones' XAGP100 has already proven its application in macadamia orchards, where it has been used to apply chemistry and other inputs.


The Robotti, powered by two 72 hp Kubota diesel engines, is an autonomous robot that operates orchard implements.

### Robotti

AgroIntelli's Robotti, distributed by Corematic Engineering and Formatt Machinery, is an autonomous robot that operates orchard implements through the three-point hitch in the centre of the robot. The unit shown at the field day (150D model) was powered by two 72 hp Kubota diesel engines (a new improved LR model has a single 75 hp engine and a longer range fuel tank). An advantage of Kubota is that its engines are familiar to a lot of growers and parts readily available.

Robotti uses real-time GPS technology to operate based on an optimised, predefined route. LIDAR sensors keep the robot safe in the orchard and a geofence keeps it from going outside of a defined area. Some of the applications it had been designed for include mowing, harrowing, seeding, fertilising, weed spraying and soil sampling.

It can run for 20 hours (up to 60 hours for the LR model) before needing to be refuelled and uses only 3 to 6 L/hour making it more economical than a tractor. It has an operational width of 3 m, is available in any width from 1.65 to 3.65 m, weighs 3.1 t and has an operational speed between 0 and 5 km/h.

The Robotti is currently being trialled in horticulture and broadacre crops, and the robot demonstrated at the field day is commercially available now.

**Information.** For information contact Braden Hellmuth, braden.hellmuth@corematic.com.au

### **Do your research**

The advantages of using autonomous technology on the farm are obvious. Robots and autonomous vehicles can be operated from a central base and used to record data that can be incorporated into the farm management system. At time where input costs are increasing, they can also provide savings in time and labour, freeing up staff time for complex tasks.

When considering whether the technology is right for you, it is wise to do some research. One of the limitations with all the machines at the field day, and most autonomous technology, is the need for connectivity, which in most rural settings is a challenge. This means that when considering these technologies, it is crucial to identify digital connectivity, coverage and reliability on your orchard. In many cases, this will also require you to also invest in a connectivity solution whether it be satellite, mobile network, Wi-Fi or some other option.



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## Fibreglass stakes: a grower experience

Robbie Commens, 2te, E: robbie@2te.com.au



Trees are tied to the stakes with rubber zip ties. The ties are strategically placed to allow the canopy to move around when it is windy.

In the last few years, macadamia production has expanded into new locations such as Emerald, Rockhampton, Maryborough and the coastal floodplains of NSW, and one of the things that growers are finding is that with these new territories come new challenges. One of these pioneering growers, Robbie Commens, has planted more than 200 ha (> 75,000 trees) in the last four years on the coastal floodplain near Ballina. In this time, he has discovered that one of the key challenges in this area is wind, specifically strong south-easterly winds coming straight off the Pacific Ocean.

Robbie has investigated options for protecting the trees and, after some trial and error, has come up with a strategy, including installing fibreglass stakes, that works for him. Robbie explains the process of coming up with this successful solution. Our orchards (Salt Spray Farm, DKM Flatmac and others) are located along the South Ballina peninsula with little to no natural wind barriers from the ocean to the paddock. A 4 to 6 m mound with coastal scrub is the only natural line of defence against the monstrous winds, which can vary from 40 to 60 kph (common in the afternoons), over 80 kph in modest storm events and over 100 kph in major storm events. These winds have had harmful effects on our trees, as follows:

- blowing trees over
- creating a loose "socket" of soil around the base of the tree (we have heavy clay soil, not sand, as in the northern regions)
- damaging the tips of leaves
- preventing leaves from fully sizing up
- stunting vegetative growth.

### Search for a solution

Since we planted the trees and identified the threat posed by these winds, we have implemented a range of management actions to mitigate their negative impact. These have included:

- Planting our trees closer to each other down the row (we have planted 2.7 m within the row and have 9 m rows).
- Planting only north-south rows and avoiding eastwest rows at all costs. We have done this because the prevailing wind is a south-easterly, i.e., not because of the impact on access to sunlight. In fact, the two blocks we did plant on an east-west row orientation have suffered the most wind damage.

- Planting sorghum beside the trees to act as a vegetative windbreak.
- Planting all trees with a fiberglass stake.

All these actions have contributed to lowering the impact of wind, however, this article focuses on our experience of using fiberglass stakes.

### **Flexibility is strength**

We reviewed staking systems other growers used in across the industry and found at the outset that whether to stake is a contentious issue in itself. The "Rolls Royce" system is the double 2 x 2 inch hardwood stake, but it is expensive (estimated to be >\$12.50/tree once fitted). We also liked the idea of wire supports (a low trellis) but found the cost too prohibitive once we got engineering advice on the load from young trees and the number of large strainer posts that would be needed.

Pistachio growers in southern Australia are using metal rods to support their young trees. It looked like a good path forward as it is based on getting high strength from a single, denser stake closer to the tree, instead of two large stakes further away from the tree.

After going through a range of options, we decided to use 10 mm girth fiberglass stakes that are 1.8 m long. We felt that this off-the-shelf sizing would provide the best strength and length to support our young trees. We use rubber zip ties, strategically tying them up the trunk of the young tree. The stakes and ties combined came in at a cost of around \$2.00 per tree (three years ago), with installation and tying costs another \$0.75/ tree, on average.

We install the fiberglass stakes on the day of planting as we have found that helps support nursery trees in the orchard. We use a homemade stake rammer to get them at least 500 mm deep into the soil. The process is quick and simple.



The fibreglass stakes 1.8 m long are installed using a homemade rammer at the same time as trees are planted.

On windy days I have noticed that the top of the stakes move with the trees, which has proven our theory that flexibility is strength and was reason we decided to go with the fiberglass instead of the wooden or metal stakes.

We wanted the stake to move with the tree and provide some movement above the soil, while also keeping the base of the tree firmly in the ground and providing a vertical support for young floppy growth.

The stakes have been a success, so much so that we now plant all new trees in our region with them and we have noticed others in the region are doing this too.

### **Lessons learnt**

On reflection, some areas for improvement on this system are as follows:

**Use larger diameter stakes**. We have noted that diameter is the key driver for the rigidity of the stake and feel that the new larger girth stakes of 12 or 14 mm would deliver a superior result.

**Use shorter stakes.** The stake support to the tree at the top of the tree (>1.2 m above the ground) can have a negative effect on the tree support, as that taller linkage between it and the tree can put unwanted pressure on the bottom of the stake and cause it to move at the base in extreme conditions. We think that 800 mm above the ground would most likely be sufficient, which translates to a total stake length of 1.2 m.

**Colour coding.** We used slip-over pipe (cheap irrigation pipe) to identify different cultivars, however, colour-coded stakes would be much more suitable.

**Ribbed stakes.** On occasion, the rubber ties can slip down the smooth fiberglass stake and strip young leaves off the main trunk. We have resolved this with an improved tying process, but ribbed stakes would probably prevent this issue.

**Support for trees under 2.5 m.** The fiberglass stakes provide excellent support for young trees under 2.5 m. With our tighter within-row spacing, we only want support for those sized trees, as we will have our trees touching and protecting each other once they are taller than 2.5 m. This is a reason that we think wider within-row spacing will have challenges on our NSW coastal floodplain region.

### Critical part of a wind management system

While fiberglass stakes are only one component of our wind management system, they are a critical part and have delivered success for our orchard. Other important elements of this system are that we ensure we use jumbo sorghum to provide a vegetative wind buffer right next to young trees less than four years old, we plant our trees closer within the row (2.7 m) and we only plant on north-south row orientation.

We hope this insight helps other growers make informed decisions and helps our industry take a positive, open and collaborative step forward.

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## **Concrete matting an option for erosion control**

High rainfall in most growing areas this year has highlighted the importance of managing erosion, especially for those growers whose orchards are on undulating or steep topography and for areas that are subject to high traffic. A range of solutions is possible, including installing drains and diversions such as hay bales, redesigning roadworks and retaining vegetation in the inter row to slow the flow of water and decrease its destructive impact. Importantly, whatever solutions are decided on, they should be part of an integrated plan whose aim is to maintain healthy, productive soil in the orchard rather than allow it to be eroded or washed away from trees.

The Macadamia Integrated Orchard Management Drainage Guide, published in 2017 by NSW DPI, emphasised that an effective integrated plan to manage drainage in the orchard should be designed to ensure that:

- there is minimal soil movement during rain events
- concentrated water flows are managed away from
- macadamia treesblocks are protected from run-on water
- good conditions for macadamia feeder roots are maintained
- the orchard floor is trafficable and harvestable.

Recently, several growers in the Northern Rivers have incorporated a different solution into their drainage management plans – flexible concrete erosion matting. The matting has traditionally been used in remediation, construction and maintenance works in civil and infrastructure projects as a way to overcome erosion issues. Now the agricultural sector has discovered that they are a cost-effective option for controlling run off, surfacing roads and for crossing waterways.

### About the mats

The mats are manufactured by Australian Concrete Mats at their factory near Ballina. According to the company, the matting has multiple uses on farm. For example, it has been used by farmers on roads to prevent washouts and to allow access to orchards sooner than would be normal during wet weather. It has also been used on dam spillways and overflows, and to minimise issues with orchard drains being filled and blocked by debris.

The mats are made with concrete and geogrid. Textured concrete shapes create a hard, protective surface for the soil, while the space between the concrete shapes makes the mats flexible and permeable, which helps stop water from pooling on top of the ground and creating boggy conditions. The flexible mat protects the soils from washing away and prevents deep rills and gullies advancing into the orchards.

Mats are delivered pre-rolled with an underlay geotextile. The underlay is biodegradable and helps to promote the growth of vegetation, which also helps to anchor the mat in the long term. The vegetation also has a secondary role in filtering sediment contained in water flowing over the mats during wet weather and flooding. This helps minimise valuable sediment and top soils from washing away into waterways.



### Concrete matting comprises concrete shapes embedded into a high strength, polyester, woven geogrid with a geotextile underlay. Mats can be either flexible or firm.

No special equipment is needed to install the mats once the area where they are to be laid has been prepared, e.g. grading or forming of drains. Rolls are unrolled into position and anchored on each side with steel U-bar anchors. After vegetation has established the matting can be mowed, and machinery can be driven on it as soon as it is installed.

### **Crower experience**

At the beginning of this year, Kurt Braunstein installed concrete matting in his orchard at Alstonville in the Northern Rivers. Kurt has 3,450 trees between 20 and 25 years old with a 50/50 cultivar mix of A16s and assorted Hawaiians. As with most of the Alstonville Plateau, the soils are red ferrosols.

While most of the orchard is flat, a gully runs through the middle. Usually this is not a problem but when it rains Kurt said that it can fill up with water and become a fast flowing river.

With all the wet weather in the last two years, water running down the gully has resulted in flash flooding and erosion, especially towards the bottom of the orchard where the gully gets steeper and deeper making crossing it hard. Two years ago, Kurt started looking at his options, dismissing his first thought, which was profiling.

"Unless the soil was compacted and grassed immediately, the effort would have been wasted in the first rain event, particularly as there has been no opportunity to do this with the continual wet weather. As well, taking soil from the sides to fill the gully would have been like robbing Peter to pay Paul," he said.

Instead, Kurt decided to install a 250 mm pipe underground along with a sump at the steepest section



Concrete matting is unloaded and placed so they can be unrolled and installed in the orchard. Photo: Australian Concrete Mats.



Vegetation established in the matting. Photo: Australian Concrete Mats.

at the bottom of the gully. This ended up being a "waste of time" because the volume of water coming down the gully was too great to be channelled through the pipe.

Taking a different tack, six months ago he decided concrete matting could be the solution. Initially, he prepared the base of the gully by getting in several loads of cheap blue metal road base. Based on his experience, Kurt said that this preparation was important as it provided a bed to roll the concrete mats onto.

To keep his costs down as much as possible, he bought reject matting, which came in two widths – 2.4 m and 1.2 m – and in lengths ranging from 6 to 12 m. He laid the narrower mats at the top of the orchard where the gully was not as wide or the sides so steep. The total length of the gully area laid was about 240 m.

Once the mats were unloaded using a front-end loader, installation was a breeze and took a day and a half. Kurt used the forks on his tractor to unroll the mats and said that a bobcat would work well too. He did note that some of the heavier rolls of matting were about 1.5 t so it is important to have a tractor or loader that can manage this weight when unloading and rolling them out.

After rolling the mats out, he applied a layer of soil so the concrete blocks were just covered and "threw out" a seed mix to quickly establish some vegetation to hold the soil. He said that this mix established quickly, and he is now looking to put in something with runners such as kikuyu as a permanent cover.

He was able to drive over the matting soon after it was installed. While he can mow it, this is with the blades set higher than normal, otherwise they will hit the concrete blocks and be damaged. Kurt believes that when the permanent cover has established itself, mowing will



Matting after it has been installed.



After vegetation has established, the matting can be mowed, and machinery can be driven on it straight after installation. Photo: Australian Concrete Mats.

be easier. While he doesn't need his mats to provide a harvestable surface because of its location in the orchard, he said that once they are bedded down and vegetation permanently established, nuts should be able to be harvested from them.

A test of the mats was in the most recent heavy rains in October and Kurt couldn't be happier, saying that they performed "very well".

"Some soil was washed out by the rains and water flowing down the gully, but it wasn't a big issue and, importantly, there was no erosion," he said. "I can't think of anything else that would have worked in this situation, especially with the continual wet weather."

According to Kurt, it is obvious that you can't stop water from going where it wants to go, as instanced when he installed the underground pipe, so the best solution is to work with the environment rather than trying to install barriers or redirect it.

### **Lesson learned**

When asked what he would advise growers looking to install concrete mats, Kurt said that it was essential to prepare the area well by getting the profile shape right and providing a good bed to lay them on. He thought the blue metal he used worked very well.

One of the things he learnt from experience was that the mats should be pegged.

"I didn't do this when I installed them and after the first heavy rains, the mats at the top of the gully start to roll up so I had to go back and put the pegs in," he said.

And finally, he said that a key is to get grass cover as this helps keep the mats in place and is essential to water flow and to stop more soil being washed away in rain storms.

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Karina Griffin, Project Support Officer E: karina.griffin@macadamias.org and

Leoni Kojetin, Industry Development Manager, AMS E: leoni.kojetin@macadamias.org

With the development of technology to remotely monitor a range of factors such as nutrients, soil moisture and weather status, more growers are adding this capability to their orchard management. Amongst the most popular equipment being installed is the on-farm weather station. To help macadamia growers identify how they can best use onfarm environmental monitoring technology, an 18-month project, co-funded by the AMS and the Queensland Government's Agribusiness Digital Solutions Grant program, was designed and implemented.

The project has just wrapped up and in this article Karina Griffin, who managed it, and Leoni Kojetin look at the key findings to help growers maximise the benefits of installing an on-farm weather system.

## What to consider when choosing a weather station

Before buying a weather station, consider your situation, what data you want to collect and how best to collect it. Some key considerations are as follows:

- If buying online, check compatibility and user support for Australia, e.g. wireless or mobile network access, and if units from the northern hemisphere need to be recalibrated. Check if there is technical support and spare parts for the station here in Australia.
- Check how you access data and how it's downloaded. Most modern units have apps and/or a website, many of which come with subscription costs.
- Decide whether corded, wireless or a combination best suits your site. This is particularly important for auxiliary monitoring devices like soil moisture probes. While wireless devices are convenient, they are often solar powered, which can be an issue in tree crops as you must install tall poles along the row to compensate for shading.
- If connecting to auxiliary devices, e.g. soil probes, frost fans or irrigation solenoids, check that they are compatible with the weather station. Find out if they talk to each other directly or through specialised software and whether there are hidden subscription costs and/or relay devices required.

 While a lot of Australian growers use Delta T for determining if conditions are appropriate for spraying, many countries don't so it's generally not a standard data output. For example, Davis weather stations are common in Australia but they are produced by an American company. While the Davis WeatherLink platform does not currently include a Delta T reading, the data feeds into several thirdparty applications that approximate Delta T.

### Pay attention to position

Your weather station should come with a technical support service to provide correct positioning recommendations. It is important to be aware that there is conflicting information between different companies selling the same units, and even in user manuals. The following table summarises key factors to consider when placing a weather station on the farm.

Some user manuals use vegetable or broadacre cropping as a guide in their anemometer placement recommendations and the focus is on collecting data for evapotranspiration readings. In macadamias, we rely on wind speed and direction when spraying and in our records. If your anemometer and wind vane are located lower than the height you are spraying at, readings will be inaccurate. This is important because if a complaint is made and you are investigated, you will not be able to rely on the readings to prove you were doing the right thing. This could result in you being fined.

Never install a weather station on a shed as the data will not be accurate. There are several reasons for this; the rain bucket will be too high and affected by wind, and the radiant heat from the shed will render sensor readings like temperature and relative humidity useless and the shed roof could alter wind currents.

## Maintenance and critter control are crucial

It is important to regularly check and clean your weather station to ensure data accuracy. Station manufacturers specify schedules for full maintenance but having a quick look once every one or two weeks is a good practice, particularly for automated rain gauges that can easily get clogged with debris and dust.

Ants can get into even the smallest gaps, and weather stations, sensors and hollow poles provide perfect



Table. Important factors to consider when deciding where to position a weather station on the farm.

\*\* An exception to the rule is for anemometers and wind vanes mounted in a high position for the measurement of evapotranspiration. This combines factors of soil and plant surface evaporation, plant transpiration and wind speed for application in water management. Anemometers for this purpose should be placed about 2 m above ground.

homes. Put caps on poles and place ant deterrents or baits inside weather station components. Insecticide impregnated cattle tags and camphor products can deter ants from nesting.

Loose, hanging cords can get in the way of machinery and they can be a trip hazard. They are also enticing for curious birds to play with, and one researcher recalled seeing cockatoos cut right through cables with their beaks.

Spending more time at the installation phase to think through functionality will save you time down the track and prevent equipment malfunctions.

### Views from the farm

Seven Davis Instruments weather stations were installed on macadamia farms in Queensland and growers provided feedback on how they used the information.

"The weather station has provided high-resolution data to allow an analysis of all services (probes etc) and yield/quality data." John Vaughan, Macadamias Australia.

"The weather station has helped me with getting reliable localised weather and soil moisture data," Joseph Muscat, JCS Enterprises, Mackay.

### The bottom line

As with many things you get what you pay for. If you pick up a cheap weather station while getting a sausage at your local hardware store you will likely be disappointed with the accuracy and reliability. Take the time to do your homework and find a system that matches your technology skills and delivers the critical weather data you need to make timely on-farm decisions.



Weather station battery boxes like the one shown are perfect shelters for ants to infest and nest. In severe infestations they can destroy electronic components.



Placing weather stations in an open area is critical to data collection accuracy. You will also need more than one pole to position different sensors at their ideal heights. Notice the positions of the manual and automatic rain gauge in this photo, they are unlikely to give the same readings due to different heights and bucket sizes.



Australian agent for Bag-A-Nut (USA), Crackadamia (NZ), Kern Kraft (Germany), Feucht-Obstechnik (Germany)



## **Protecting and restoring macadamia habitat**

Denise Bond, Executive Officer, Macadamia Conservation Trust, M: 0488 432 226 E: denise.bond@macadamias.org

MCT is keeping up the pace partnering with growers, groups and research organisations to extend our knowledge of wild macadamias and to protect habitat crucial to their survival, including in Queensland at White's Hill and Amamoor.

### White's Hill

White's Hill Reserve is a rare patch of original forest, only seven kilometres from the Brisbane CBD. Its 170 ha support a range of vegetation communities including open eucalypt forest and a small, 1 ha patch of dry rainforest known as Sankey's Scrub.

Sandwiched between a council quarry and Pine Mountain Road, Sankey's Scrub grows either side of a small tributary of Bulimba Creek, providing a refuge for two threatened plants, wedge-leaf tuckeroo (*Cupaniopsis shirleyana*) and Queensland nut (*Macadamia integrifolia*). As we research the "lost Brisbane clade", evidence is mounting that this tiny area of dry rainforest, smaller than most macadamias orchards, may be the last place where *M. integrifolia* from the Brisbane valley still grows in its original habitat.

The MCT is working with the Bulimba Creek Catchment Coordinating Committee to protect Sankey's Scrub from the weeds that invade from up-stream and the council quarry.

### Amamoor

MCT has teamed up with the Gympie and District Landcare Group to address the threat of cat's claw and other invasive species that threaten the wild macadamias of Amamoor State Forest.

MCT will provide \$15,000 over three years and 60 hours of in-kind support to the project, which has leveraged a grant of \$20,000 from the Queensland State Government Community Sustainability Action grants program. The project will work with local groups through the Gympie and District Landcare Group to clear weeds, release jewel beetles (*Hylaeogena jureceki*) as biocontrol for cat's claw creeper, and replant native riparian species. The project area centres on habitat surrounding the recently opened "Walk with Wild macadamias" at Amama and will also support community education events with guided tours of the walk followed by a barbecue.

### **Cenetic diversity in habitat restoration**

A lesson from all our projects that involve growing from cuttings is that some genotypes strike roots much more readily than others – across all four macadamia species. As a result, we end up with spare trees from some genotypes, and not enough from others. Spare plants are offered to community habitat restoration projects and school plantings, and so far we have donated 66 trees from 12 genotypes. Trees planted in habitat restoration projects will increase the genetic diversity available to the existing macadamia population and act as pollination stepping-stones across the landscape.

### Macadamia Longevity

An historic Gympie orchard has made a valuable contribution to answering the intriguing question of how long macadamias live for. To complement the sample taken from the fallen Jordan tree, we needed to find a tree of known age from which to extract a disk. Ian McConachie tapped into his network and came up with Geoff Garratt's old orchard near Gympie, planted



New Flush on M. tetraphylla ready for habitat restoration



Geoff Garratt, Tony Burridge and Marty Griffith selecting suitable trees to sample for Macadamia longevity project. Inset is disk being cut from felled trunk.

in the 1940s by Bernie Mason. The orchard's current owners, Martin and Megan Griffith, could not have been more helpful, and showed us some of the remaining old trees, scheduled to be cleared, but still standing and with undamaged, single trunks.

Geoff was able to confirm that the trees were planted in 1945, so we had hit the jackpot. Tony Burridge, Senior Research Officer from the Forest Production and Protection branch of Agri-Science Queensland, kindly organised to fell the trees, cut a disk and get it prepared for the dendrologist.

### **MCTI pollen parents**

In February 2022, MCT joined forces with Stephen Trueman and his team at Griffith University to investigate the impact that different varieties have as pollen parents of MCT1 nuts. MCT is providing some funding and organising the supply and collection of MCT1 nuts.

Thanks to collaboration with commercial growers who now have bearing MCT1 trees, we are looking at nuts from MCT1 growing next to varieties 344, 741, A16 and A203 as potential pollen parents.

In addition to knowing which varieties are successful at producing nuts, the pollen parent may also influence NIS, kernel recovery and oil content, so the nuts are collected at maturity to enable measurement of kernel size and recovery as well as oil content. The results should be available by the end of 2022.



2021 MCT1 harvest courtesy of Jarrod Agostinelli

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## Cracking the Indian market: why now is the time for Australian macadamias

Jacqui Price, Market Development Manager

For several years, the Australian macadamia industry has been focused on driving demand for macadamias ahead of a forecast rise in global supply. New market development is an important element of this strategy, and India has been on the Australian macadamia industry's radar for some time as the next major market for our product. It represents a big opportunity for macadamias, and while it comes with complexities, there are several reasons why the ideal time to undertake an entry strategy into this fascinating market could be now.

### **Major shifts unfolding**

At the 2022 Australian Nut Conference, Yemee Fernandes, business development specialist and co-founder of Four Pillars Trading, gave a keynote presentation on India market expansion. Yemee spearheaded research\* carried out for the Australian macadamia industry examining nut consumption in India. She says there are several factors that make it a good time to develop and execute an Indian market entry strategy for Australian grown macadamias.

"India is the fastest growing large economy in the world, and there have been some remarkable shifts in the last couple of years," she says. "It has long been a highly fragmented market that is difficult to penetrate but it is becoming more organised, making it a more accessible market."



Rapid digitisation in the last few years has revolutionised the way India's population shops. Almost half of India's population uses the internet, mostly by mobile phone.

According to Yemee, the pandemic has created opportunities for products like macadamias that have proven health credentials. "COVID has heightened the focus on food, health and wellbeing in India. There is huge interest in protein, immunity and healthy ingredients, and buying habits are reflecting this."

However, the most significant change to occur in India recently is its rapid digitisation. Growth in mobile phone ownership and data consumption has been enormous. More Indian consumers than ever before are shopping for new products from the palm of their hand.

Of India's 1.4 billion population, 658 million use the internet (47%) and 91% of those do so with a mobile phone. Since 2018, the number of internet users has grown between 5 and 8% per year, with a rise of 81 million users since January 2020<sup>1</sup>. By 2030, it's expected India will have more than 850 million internet users<sup>2</sup>.

## A new free trade agreement sweetens the macadamia opportunity

For the macadamia industry, the Australia-India FTA is an added advantage. Due to enter into force in late 2022, it will see tariffs on imports of Australian macadamias in India reduced from the current rate of 30% down to zero over the next seven years.

With the removal of the tariff will come more competitive macadamia pricing in the Indian market. Beginning the task of sharing the many layers of the macadamia story with Indian consumers in anticipation of this will help the Australian industry to capitalise on this advantage.

### Unpacking the opportunities for macadamias in India

Indian consumers love nuts. They associate them with good nutrition, and regularly use them in a variety of ways. They're also seen as exotic and a status symbol. Origin matters to Indian consumers, and they will ask for products by origin when shopping.

\* The work was a part of the Nut Export Expansion Program funded under Agriculture Trade and Market Access Cooperation program (ATMAC), by the Commonwealth of Australia represented by the Department of Agriculture, Water and the Environment (DAWE).

Australia is held in high regard for its clean, green and positive reputation. MasterChef Australia enjoys sky-high popularity in this market, and consumers have become quite experimental in their home kitchens.

While familiarity with nuts and Australia is high, there is much to be done in terms of educating Indian consumers on what a macadamia is. Macadamia awareness in India is currently around 35%, significantly lower than established markets where it sits at about 80%. Raising the profile of macadamias among the Indian target market will be key, as will engaging with the trade to help the commercial sector capitalise on the opportunities that will arise as Indian consumers get to know and love macadamias.

### Hitting the right target

As in all other markets, a premium positioning will be developed for Australian grown macadamias in India. To execute this successfully, it's essential that we identify and target the right consumers. As Yemee Fernandes



Research has identified a segment of the Indian population who uses nuts regularly for snacking. This group will be targeted by the Australian industry.

points out, India is an incredible country, but it's full of "chaos, randomness and complexity".

"There are 1.4 billion people and 270 million homes, but really there are 'three Indias'," she explains. "India A is the upper class and contains around 50 million households. These consumers use nuts regularly for snacking. India B is the middle class with 100 million homes, and for these people nuts are considered a treat. India C is the least affluent class with 120 million homes and limited nut consumption."

The macadamia industry will target the niche yet sizeable India A segment. Effectively penetrating the fragmented retail environment will be critical, with many channels to be considered including wholesale, e-commerce, neighbourhood grocery stores, specialised bricks and mortar nut stores, supermarkets and premium grocery stores.

### **Balancing the risks and rewards**

Entering new markets always presents challenges and India will be no exception. Navigating changes in duties and tariffs, the market's price sensitivity, regulatory and compliance requirements, and contract negotiations will be among the hurdles.

But the rewards will be there if we get the strategy right. Macadamias hold huge potential for an array of Indian packaged food products, bakeries, boutique patisseries, private label, skin and personal care, and even children's food products, considering India's lack of food allergy issues.

It will be exciting sharing the Australian Macadamias story in this dynamic market.

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<sup>1.</sup> Simon Kemp / Kepios, Digital 2022 – India – The Essential Guide To The Latest Connected Behaviours

<sup>2</sup> Peter N Varghese – An India Economic Strategy to 2035 Navigating from Potential to Delivery – A report to the Australian Government, 2018



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## While self-pollination drives down kernel recovery, most macadamia nuts are produced by cross-pollination

Professor Stephen Trueman, Griffith University, Mark Penter, Agricultural Research Council – Tropical and Subtropical Crops (South Africa), Dr Wiebke Kämper, Anushika De Silva, Joel Nichols, Dr Shahla Hosseini Bai, Professor Helen Wallace, Griffith University, Dr David Hawkes, Trent Peters, Australian Genome Research Facility, Adjunct Associate Professor Steven Ogbourne, University of the Sunshine Coast



Professor Stephen Trueman examining initial nut set

Growers are aware that macadamia flowers are pollinated mainly by honey bees and stingless bees and that they are partly self-incompatible. This explains why self-pollen from the same cultivar is much less effective than cross-pollen from a different cultivar in growing down the style of the flower and causing initial nut set.

In previous research, we showed that self-pollinated fruitlets are shed from cultivar 816 trees during premature nut drop in October. Almost all the remaining nuts at maturity are cross-pollinated, i.e., outcrossed. High levels of outcrossing have also been found in cultivars A4, A16 and Daddow in Australian orchards. This includes in the middle of wide blocks of a single cultivar, where the opportunities for cross-pollination are probably fewer than the opportunities for selfpollination. These results suggest that, like almond, many macadamia cultivars are effectively self-sterile.

To discover whether this applies more generally, in this research project we analysed nuts from a wider range of macadamia cultivars in Australian and South African orchards to determine whether they were also highly outcrossing.

### Snapshot

- While previous research has shown that most nuts of cultivars 816, A4, A16 and Daddow in Australian orchards are produced by crosspollination rather than self-pollination, this research set out to find out if this was also true of other cultivars.
- The research teams analysed the DNA of nuts from 18 macadamia cultivars in Australian and South African orchards to determine whether nuts were produced mostly by cross-pollination, and whether cross-pollinated nuts were larger and had higher kernel recovery than selfpollinated nuts.
- A major finding was that macadamia nuts are produced by cross-pollination, even in the middle row of single-cultivar blocks. This is good news for growers because self-pollinated nuts can drive down nut size and kernel recovery.

### **Kernel DNA identifies the father**

We sampled nuts from 17 cultivars in Australian orchards, including two orchards of cultivar 344 in Queensland and NSW, and nuts from four cultivars in South Africa, including cultivar 695 (Beaumont), which was not sampled in Australia. We targeted, wherever possible, the middle row in wide blocks of a single cultivar. If the nuts there were mostly cross-pollinated, then the cultivar may be self-sterile. In each orchard, ten fruit were sampled from each of six trees per cultivar. We sampled fruit from every fourth, fifth or tenth tree along the row, depending on the length of the orchard rows.

As part of sampling, we extracted DNA from the kernel and determined the pollen parent of each nut, i.e., the father, which allowed us to calculate the level of outcrossing in each orchard. We then assessed effects of self-pollen versus cross-pollen on nut size and kernel recovery, whenever we had enough self-pollinated nuts to make comparisons.

## High levels of outcrossing in most cultivars

Most nuts in Australian orchards were produced by cross-pollination, i.e., by outcrossing (see figure). The lowest level of outcrossing in Australia (49%) was found in nuts of cultivar 344 in the NSW orchard, but a high level of outcrossing (90%) was found among cultivar 344 nuts in the Queensland orchard. Complete outcrossing was seen in cultivars 814, 816, A4, A203, A268 and MCT1 in Australia. Almost complete outcrossing was seen in cultivars 842, 849, A16, A38, Daddow, H2 and Own Venture. Outcrossing levels were lower in cultivars 246 (62%) and A29 (72%).

Cultivar A4 was also highly outcrossing (97%) in South Africa, while cultivar 695 (Beaumont) was 64% outcrossed. However, cultivars 814 (10%) and 816 (41%) had low levels of outcrossing in South Africa. The very low level of outcrossing in cultivar 814 might have been due to the trees being located at the end of an orchard, with bushland on three sides of the block and Beaumont trees on the other side. The Beaumont trees were likely not flowering at the same time as the cultivar 814 trees.



**Figure.** Levels of cross-pollination (i.e. outcrossing) among nuts from 18 macadamia cultivars in Australian and South African orchards. 3441 and 3442 refer to orchards in QLD and NSW, respectively. Means are provided with standard errors (six trees).

| Mother<br>cultivar ´<br>pollen parent | Nut-in-shell<br>mass<br>(g) | Kernel mass<br>(g) | Kernel<br>recovery<br>(%) |
|---------------------------------------|-----------------------------|--------------------|---------------------------|
| 246 ´ 246                             | 7.21 ± 0.25a                | 2.23 ± 0.11a       | 30.4 ± 0.9a               |
| 246 ´ 344                             | 7.63 ± 0.33a                | 2.56 ± 0.13ab      | 33.6 ± 1.1ab              |
| 246 ´ 508                             | 8.12 ± 0.19a                | 2.86 ± 0.12b       | 35.2 ± 1.3b               |
| 246 ´ 741                             | 6.80 ± 0.29a                | 2.31 ± 0.10ab      | 34.3 ± 1.0b               |
| 344 ´ 344¹                            | 6.79 ± 0.74a                | 1.87 ± 0.33a       | 26.4 ± 2.6a               |
| 344 ´ 842¹                            | 8.58 ± 0.31b                | 2.70 ± 0.14b       | 31.4 ± 0.7ab              |
| 344 ´ 849¹                            | 8.90 ± 0.24b                | 2.72 ± 0.11b       | 30.6 ± 0.8ab              |
| 344 ´ Daddow¹                         | 8.40 ± 0.26b                | 2.77 ± 0.12b       | 32.8 ± 0.9b               |
| 344 ´ 344²                            | 6.69 ± 0.32a                | 1.86 ± 0.14a       | 27.1 ± 0.9a               |
| 344 ´ 246²                            | 8.35 ± 0.64b                | 2.61 ± 0.23b       | 31.2 ± 1.3b               |
| 741 ´ 741                             | 5.82 ± 0.26a                | 1.95 ± 0.08a       | 33.9 ± 1.1a               |
| 741 ´ 842                             | 7.13 ± 0.21b                | 2.64 ± 0.10b       | 37.0 ± 0.7ab              |
| 741 ´ A16                             | 8.75 ± 0.32c                | 3.46 ± 0.09c       | 39.7 ± 1.4b               |
| A29 ´ A29                             | 8.26 ± 0.40a                | 2.95 ± 0.19a       | 35.4 ± 1.0a               |
| A29´<br>(H2´741)                      | $8.32 \pm 0.44a$            | $3.14 \pm 0.23a$   | 37.7 ± 1.5a               |
| Daddow ´<br>Daddow                    | 8.40 ± 0.70a                | 3.01 ± 0.28a       | 35.7 ± 0.9a               |
| Daddow ´<br>344/741                   | 7.66 ± 0.38a                | 3.08 ± 0.18a       | 40.1 ± 1.0b               |
| Daddow ´ 849                          | 8.91 ± 0.48a                | 3.45 ± 0.15a       | 39.0 ± 0.6ab              |
| 695 ´ 695³                            | 5.05 ± 0.16a                | 1.96 ± 0.07a       | $38.8 \pm 0.8a$           |
| 695´788                               | 5.63 ± 0.26a                | 2.49 ± 0.15b       | 44.0 ± 1.1b               |
| 695´814                               | 5.67 ± 0.39a                | 2.39 ± 0.17ab      | 42.2 ± 1.1b               |
| 695´816                               | 4.99 ± 0.17a                | 2.10 ± 0.09ab      | 42.1 ± 0.9b               |
| 816´816⁴                              | 5.52 ± 0.23a                | 2.74 ± 0.13a       | 49.6 ± 0.9a               |
| 816 ´ 695                             | 6.33 ± 0.45a                | 3.35 ± 0.30a       | 52.4 ± 1.7a               |
| 816 ´ 741                             | 5.57 ± 0.29a                | 2.95 ± 0.19a       | 52.8 ± 1.5a               |

 $^{1.2}$ Orchards in Queensland and NSW, respectively, for cultivar 344. <sup>3</sup>Cultivar 695 = Beaumont. <sup>4</sup>Cultivar 816 orchard in South Africa. Means  $\pm$  SE with different letters within a mother cultivar at one site are significantly different (ANOVA, with Tukey's HSD test for > 2 means; P < 0.05; n = 6–38 nuts)

**Table.** Size and kernel recovery of macadamia nuts with different pollen parents. Pollen parents that provided at least 10% of nuts are shown for each mother cultivar

### Cross-pollination often increased nut size and kernel recovery

Cross-pollinated nut-in-shell (NIS) and kernels were often significantly larger than self-pollinated NIS and kernels (see table), e.g., cross-pollinated NIS and kernels were always much larger than self-pollinated NIS and kernels in cultivars 344 and 741. Cross-pollinated kernels were sometimes significantly larger than selfpollinated kernels in cultivars 246 and 695, although this depended on the cross-pollen parent. Cultivar 814 nuts were extremely small at the one site in South Africa with very low levels of outcrossing – there, on average, selfpollinated NIS weighed only 4.45 g and self-pollinated kernels weighed only 1.67 g.

Cross-pollination often increased kernel recovery significantly, with this effect also depending on the

pollen parent (see table). These increases in kernel recovery due to cross-pollination were large, ranging from 3.3% to 6.4%.

## Rootstocks as pollen sources in macadamia orchards

The DNA results revealed that a surprising number of nuts in some orchards were fathered by seedling rootstocks. In fact, H2 seedling rootstocks were the main source of cross-pollen for A29 nut production (see table). These results partly explain how cross-pollination can occur in isolated blocks that are supposedly comprised of only one cultivar. Failure of the scion on some grafted nursery trees or outgrowth of sucker shoots from rootstocks can provide a covert source of rootstock cross-pollen in orchards. This may actually help to ensure cross-pollination and nut production.

DNA technology could even identify the father of the H2 seedling rootstocks, i.e., the grandfather of some of the nuts. The main father of H2 seedling rootstocks in the A29 orchard appeared to be cultivar 741 although some rootstocks were fathered by cultivar 816, 835 or 849. As well, the DNA analyses of cultivar 695 (Beaumont) in South Africa identified several pollen parents among its nuts, including selfs and three main crosses, 788, 814 and 816 (see table). These nuts would sometimes be used to raise Beaumont seedling rootstocks.

Our results highlight how seedling rootstocks introduce tree-to-tree variability into macadamia orchards. Seedling rootstocks in an orchard have the same mother – typically either H2 or Beaumont – but they have a range of different fathers.

### **Cross-pollination good news**

Most macadamia nuts are produced by crosspollination, even in the middle row of single-cultivar blocks. These high levels of outcrossing are fortunate for growers because self-pollinated nuts can drive down nut size and kernel recovery. Nuts were extremely small at the only site where most nuts were produced by self-pollination. Closely inter-planting different cultivars and stocking orchards with sufficient beehives are two recommended strategies to ensure cross-pollination, increase nut size, and maximise kernel recovery.

#### Information

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## **Trunk girdling revisited**

**Dr Grant Thorp** and **Ann Smith**, The New Zealand Institute for Plant and Food Research Limited **E:** Grant.Thorp@plantandfood.co.nz

### Snapshot

- Trunk girdling is used in some tree and vine crops to increase flowering on young plants and so improve production. The application of this technique on young macadamias was tested in a girdling trial six years ago on 3- and 4-year-old 344 macadamias, which resulted in increased yields.
- A new trial to investigate the timing of girdling treatments in a range of cultivars was started in 2021, one in an orchard at Yamba and the other at Woodburn, under project AS18000 National Tree Crop Intensification in Horticulture Program. Two girdling treatments were applied, in February and in April 2021, flowers counted later that year, and fruit hand harvested in August 2022.
- While the trial results indicated that girdling can increase yields and advance the timing of first commercial harvest, more work is needed to determine when is the best time for this to be done and to identify whether some cultivars respond better than others.

Reducing the time to first commercial harvest is a key target for growers establishing new macadamia farms. Trunk girdling is a technique used in several tree and vine crops to increase flowering on young plants. In a previous Hort Innovation project with macadamia (Macadamia – Propagation and Precocity - MC13014) we reported increased yield on girdled 3- and 4-year-old HAES 344 trees growing at Knockrow in NSW.

Trunk girdles applied in March 2016 more than tripled the number of inflorescences in spring compared with non-girdled control trees. At harvest, nut-in-shell (NIS) yields on 3-year-old girdled trees averaged 0.83 kg/tree compared with 0.37 kg/tree on control trees. Four-year-old girdled trees yielded 3.2 kg/tree while control trees yielded 1.6 kg/tree. The significance of this result for 4-year-old trees was that the yields were sufficient to warrant machine harvesting rather than the more expensive option of harvesting by hand.

### New project tests more cultivars

Following up on this encouraging result with girdling one cultivar once, we commenced a new trial as part of the AS18000 National Tree Crop Intensification in Horticulture Program funded by Hort Innovation. Established in 2021 in the Northern Rivers region of NSW, the objective of this new project is to investigate the timing of girdling treatments across a range of macadamia cultivars.

Trials were established in February 2021 at private grower sites near Yamba and Woodburn, NSW. Treatments were applied to 3-year-old trees on H2 seedling rootstocks, with MCT1, MIV1-G and 344 trees girdled at the Yamba site and 741 and 344 trees at the Woodburn site. Four sets of ten trees of each cultivar at



Fresh 5 mm wide girdle in February 2021 (left) and healed girdle in April 2021 (right) on 3-year-old macadamia trees at Yamba.



Fresh 5 mm wide girdle in February 2021 (left) and healed girdle in April 2021 (right) on 3-year-old macadamia trees at Yamba.

| Cultivar | Treatment           | No. of inflors<br>(Sept 2021) | Yield <sup>1</sup> (kg)<br>(June 2022) | Fruit set<br>(g/inflor) | Tree height (m)<br>(Dec 2021) |
|----------|---------------------|-------------------------------|--|-------------------------|-------------------------------|
| MIV1-G   | Control - no girdle | 36 ± 5 b                      | 0.50 ± 0.10 b                          | 13.0 ± 1.3              | 2.9 ± 0.07                    |
|          | Feb 2021 girdle     | $80 \pm 8 a$                  | 0.88 ± 0.14 a                          | 11.1 ± 1.3              | 2.9 ± 0.10                    |
|          | Apr 2021 girdle     | 43 ± 6 b                      | 0.49 ± 0.08 b                          | 11.2 ± 1.6              | $2.8 \pm 0.07$                |
|          | Significance        | ***                           | (*)                                    | NS                      | NS                            |
|          | p-value             | <0.001                        | 0.036                                  | 0.599                   | 0.850                         |
| MCT1     | Control - no girdle | 178 ± 21                      | $3.82 \pm 0.53$                        | 21.1 ± 2.2              | $2.6 \pm 0.06$                |
|          | Feb 2021 girdle     | 170 ± 20                      | $3.63 \pm 0.54$                        | 22.6 ± 2.6              | $2.6 \pm 0.08$                |
|          | Apr 2021 girdle     | 139 ± 24                      | $3.34 \pm 0.52$                        | 25.7 ± 2.9              | 2.6 ± 0.11                    |
|          | Significance        | NS                            | NS                                     | NS                      | NS                            |
|          | p-value             | 0.427                         | 0.818                                  | 0.453                   | 0.919                         |
| 344      | Control - no girdle | 157 ± 19 ab                   | $1.93 \pm 0.36$                        | 11.9 ± 1.5              | 3.1 ± 0.10                    |
|          | Feb 2021 girdle     | 209 ± 30 a                    | $2.00 \pm 0.41$                        | 9.1 ± 1.3               | $3.2 \pm 0.06$                |
|          | Apr 2021 girdle     | 113 ± 23 b                    | 1.16 ± 0.24                            | 10.8 ± 1.1              | 3.1 ± 0.12                    |
|          | Significance        | *                             | NS                                     | NS                      | NS                            |
|          | p-value             | 0.034                         | 0.17                                   | 0.331                   | 0.807                         |

 Table 1. Effect of trunk girdling treatments applied to 3-year-old macadamia trees at Orchard 1 near Yamba NSW in 2021, on the number of inflorescences, yield per tree, fruit set and tree height.

<sup>1</sup> Yield = whole fruit (kg)

**Note.** Data are treatment averages (n = 10 trees). Significance: (\*) = <0.10; \* = <0.05; \*\*\* = <0.001; NS = not significant. Values in each column followed by the same lower-case letters were not significantly different (p<0.05).

each site were selected for treatment, with one set of trees left as a non-girdled control trees.

The first set of treatment trees were girdled in February 2021 and a second set in April 2021. The intention was to girdle a third set of trees in March, but a combination of COVID-19 travel restrictions and orchard flooding prevented us from doing this. All girdles healed over within a few weeks of treatment, with no obvious effects on tree growth.

Inflorescence counts were made by hand in September 2021 and fruit were harvested by hand in August 2022. Unfortunately, harvests were substantially delayed as a result of frequent devastating floods and were not possible at all at the Woodburn site. Yields at the Yamba site were calculated as total fruit weight per tree, so including hull, shell and kernel, and converted to weight of fruit per inflorescence to crosscheck the flowering and yield data. Inevitably, some yield will have been lost during the flooding events.

### **Responses to girdling varied**

MIV1-G and 344 trees at the Yamba site generally responded to the February girdling treatment with more inflorescences and crop on these trees than the control or April-girdled trees (see Table 1). Fruit set data, in terms of the weight of fruit produced per inflorescence per tree, were similar across treatments and cultivars. In contrast, data from MCT1 trees at Yamba indicated no effect of girdling treatments on the number of inflorescences or yield. It is possible that floral initiation occurs earlier with this cultivar than with MIV1-G and HAES 344 such that a response might be expected if girdles are applied in January or earlier in February. COVID-19 travel restrictions had prevented us from applying girdling treatments at these earlier dates. It was interesting, however, that the MCT1 trees produced the highest yields per tree and highest rates of fruit set per inflorescence compared with the other cultivars. There was no evidence that the girdling treatments reduced the height of the trees at this site.

There was a similar, consistent trend for the February girdling treatments to increase the number of inflorescences on trees at the Woodburn site (see Table 2). Unfortunately, with the frequent flooding in 2022, we were not able to return to this site to harvest the crop, so we only have the inflorescence data. As with trees at the Yamba site, there was no substantial effect of the girdling treatments on tree height at the Woodburn site.

At both sites and with all cultivars, there was no response to the April girdling treatments, so this timing is obviously too late to be able to influence floral development and fruiting.

| Cultivar   | Treatment            | No. of inflorescences<br>(Sept 2021) | Tree height (m)<br>(Dec 2021) |
|------------|----------------------|--------------------------------------|-------------------------------|
| 'HAES 741' | Control - no girdle  | 123 ± 16 b                           | $2.7 \pm 0.06$ a              |
|            | February 2021 girdle | 293 ± 30 a                           | 2.7 ± 0.05 ab                 |
|            | April 2021 girdle    | 161 ± 42 b                           | 2.5 ± 0.05 b                  |
|            | Significance         | **                                   | (*)                           |
|            | p-value              | 0.001                                | 0.062                         |
| HAES 344'  | Control - no girdle  | 184 ± 28                             | 2.8 ± 0.07                    |
|            | February 2021 girdle | 285 ± 50                             | 2.7 ± 0.06                    |
|            | April 2021 girdle    | 195 ± 38                             | $2.8 \pm 0.05$                |
|            | Significance         | NS                                   | NS                            |
|            | p-value              | 0.155                                | 0.490                         |

**Table 2.** Effect of trunk girdling treatments applied to 3-year-old macadamia trees at Orchard 2 near Woodburn NSW on the number of inflorescences per tree and tree height.

Note. Data are treatment averages (n = 10 trees). Significance: (\*) = <0.10; \*\* = <0.01; NS = not significant. Values in each column followed by the same lower-case letters were not significantly different (p<0.05).

### **Cirdling promising but timing needs work**

In this latest trunk girdling trial we examined variables such as cultivar and timing of girdling treatments. Consistent with our previous study, there were strong indications that trunk girdling young macadamia trees can increase yields and advance the timing of first



**Figure.** Individual value plot of the number of inflorescences per tree in response to girdling treatments applied to 3-year-old 'HAES 344' trees, showing the wide spread of data for the February girdle.

commercial harvest. Unfortunately, with COVID-19 travel restrictions and orchard flooding events there are still many questions remaining.

For example, the MCT1 trees were precocious and had a high fruit set in terms of weight of fruit per inflorescence, but they did not respond to the girdling treatments. Would this cultivar need to be girdled earlier in the year, in say January?

It is also possible that earlier timing of girdling treatments might produce a more consistent result. We often observed high rates of variability among individual trees within the same treatment, which means some trees responded to treatments, but other trees did not (see figure). This could mean the timing of girdling treatments has not yet been optimised for the different cultivars.

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## The latest on new industry cultivars G, J, P and R

**Roger Broadley,** Queensland Strawberry Growers' Association (QSGA) **E:** macadamiacommercialisation@macadamiainnovation.com.au

In 2017, four new industry cultivars (G, J, P and R) were released for commercial planting by the Australian macadamia industry. Performance data for these cultivars came mostly from the regional variety trials, which were conducted by the Queensland Department of Agriculture and Fisheries over many years.

In the last five years, there has been much progress on providing information about performance in the field and in building up budwood reserves. In this article, Roger Broadley brings us up to speed with the latest developments with these industry cultivars.

### **Performance data**

A website was set up in 2020 to provide macadamia producers with more detailed information on the four new industry cultivars. It has been very popular and has had many visitors (950 in 2020-21 and 1227 in 2021-22), indicating the level of interest in the cultivars from members of the industry.

The website also lists contact details for sub-licensed nurseries in Queensland and NSW, and provides an economic evaluation of the new cultivars and a description of their breeding history, macadamia innovation and licencing, including why the macadamia industry RD&E fund will benefit from sales of these four cultivars.

The website was set up two years ago in a very different environment, when the nut-in-shell price was over \$6/kg and before COVID hit. While the price for NIS has decreased significantly in the last two years, two things that have not changed are that per hectare productivity and percentage kernel recovery are still critical determinants of profitability for macadamia producers. The new industry cultivars are very productive and generally have high kernel recovery percentages, and three of the four are early bearers.

### Our planting recommendations

Our current thinking is that G, J and P are well suited to the Bundaberg districts and surrounding areas, while G and R are suggested for northern NSW. It can be seen from these recommendations that G appears to be widely adapted to a range of geographic areas.

P is a smaller tree which is highly productive, and for this reason, we believe that increasing the number of P trees per hectare in the Bundaberg region may result in higher per hectare productivity.

## Other varieties expected to be available in the future

In recent times, additional trials have been set up in non-traditional macadamia environments such as Emerald in central Queensland and in the Mackay region. It would not be surprising to find that different cultivars might be better adapted to more extreme environments, i.e., environments where macadamia is not endemic. For example, this appears to be the



A website providing information about cultivars G, J, P and R and their background and performance has been set up. You can access the website at https://macadamiainnovation. com.au. case in the Emerald's hot summer environment, where cultivars other than the four released seem to be performing better. It is therefore possible that other industry cultivars will be released in the future, when this testing is completed.

### **Cood news about a royalty reduction**

G, J, P and R are protected by Plant Breeders' Rights, which means that their Intellectual Property (IP) owners, Queensland Department of Agriculture and Fisheries and Hort Innovation, receive a small royalty per tree from variety sales. As it takes more than 20 years to breed and test new macadamia varieties, it is not unreasonable for the breeder investors who have spent large sums of money to receive a small return.

There is some very good news from DAF and Hort Innovation, however, about the royalty. If a macadamia grower buys 5,000 or more industry cultivar trees from a sub-licensed nursery, the royalty per tree is reduced from \$4 to \$3 per tree (plus GST). In practice, this means that if a grower buys 2,500 trees of one variety and 2,500 trees of another variety (or other combinations, as long as they total at least 5,000), the royalty discount will apply.

### **Budwood availability**

With all new tree crop cultivars, the availability of budwood has an important impact on the ability to service plantings and orders. It is not unusual for it to take some time to build up budwood reserves to service large demands for grafting budwood.

So far, we have encouraged macadamia growers to plant small numbers of each cultivar and observe their performance in that situation, in those soils and under that farm management systems. The primary reason for this is that we did not wish to generate demand for grafted trees that could not be satisfied. However, there have still been some large commercial plantings where individual growers have been able to source enough budwood, and these blocks can themselves now be used as possible sources of budwood.

QSGA has also set up specialist budwood supply blocks to ensure future budwood supply, and individual sublicensed nurseries have also set up their own blocks.

We now have significant supplies of budwood and this will only increase with time. For example, we currently have enough budwood to supply 5,000 cultivar G trees, and we expect budwood will not be limiting from 2023 onwards.

## Important – the Australian macadamia industry benefits from royalties paid

One of the two IP owners of the new cultivars is Hort Innovation, and they are paid a share of the royalty from every tree sold. This money is held in trust for the Australian macadamia industry and can be allocated for further R&D by the industry. This means that when you buy these industry varieties, you are further investing in the future of your industry.



Cultivar G flowering in spring 2022



Cultivar J



Cultivar P showing a raceme in 2022. Photo credit - Michael Cameron.



Cultivar R tree



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## New macadamia cultivars to lower production costs

Macadamia growers could significantly reduce their labour costs in the future through new tree cultivars that are shorter and enter production earlier.

The Hort Innovation-funded national macadamia breeding program led by Queensland Alliance for Agriculture and Food Innovation (QAAFI) has found one trait which produces a shorter tree cultivar and a second that triggers earlier nut production from young trees.

Dr Mobashwer Alam said the research into macadamia rootstock breeding targets genetic characteristics which are highly desired by industry.

"The first trait involves reducing the height of mature trees from an average of 15 metres down to around five," Dr Alam said. "This means pruning the trees is less labour-intensive and costly and harvesting the nuts is easier.

"The second trait reduces the time before new plantings produce nuts from five to three years, meaning growers will be earning an income sooner after the costly establishment of an orchard."

Trial plantings of trees with those traits are ongoing but there have already been significant improvements.

So far, yield with the new tree architecture has reached as much as 7 kg/tree after just four years, which equates to 2.1 t/ha nut-in-shell.

Farm Manager at Alloway Macadamia near Bundaberg, Johan Oosthuizen, worked closely with the research team and said the new tree cultivars had made a positive difference.

"We are seeing production of good quality kernels starting in the third year after planting, where in the past we had to wait a further two years," he said.

According to Johan, some of the cultivars are also smaller in structure so tree maintenance overall is reduced and delayed, which has a positive effect on return on investment. He recommended the cultivars to growers so that they can make the most informed decision for new orchards.

"Orchards are a long-term investment, and the grower needs to get it right from the start," he said.











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## Australian macadamia minor use and emergency permits

Current at November 2022

| Chemical   | Permit no. | Pest/Disease use   | Application rate   | Withholding period<br>(no. days)                                       | Minor use permits                        |  |
|--|------------|--|--|--|--|--|
| Minor use pern   | nits       |  |  |  |  |  |
| Abamectin  | PER87510   | Thrips and flat or<br>broad mites  | <ul> <li>Product containing 18 g/L abamectin:<br/>750 mL /ha plus 5 L summer spray oil/ha</li> <li>Product containing 36 g/L abamectin:<br/>375 mL /ha plus 5 L summer spray oil/ha</li> </ul>   | 28   | All states and<br>territories except VIC |  |
| Chlorpyrifos<br>& maldison   | PER13642   | Australian plague<br>locust  | <ul> <li>Product containing 500 g/L chlorpyrifos:<br/>350 mL/ha</li> <li>Product containing 440 g/L maldison:<br/>1.4 or 1.9 L/ha</li> <li>Product containing 500 g/L maldison:<br/>1.2 or 1.7 L/ha</li> <li>Product containing 1000 g/L maldison:<br/>600 or 850 mL/ha</li> <li>Product containing 1150 g/L maldison:<br/>520 or 750 mL/ha</li> <li>Ground application</li> </ul> | Chlorpyrifos: 30<br>Maldison: Not<br>required when used<br>as directed | All states and<br>territories except VIC |  |
| Diazinon   | PER14276   | Macadamia lace<br>bug  | <ul> <li>Product containing 800 g/L diazinon:<br/>120 mL product/100 L</li> </ul>  | 14   | NSW, QLD & WA only                       |  |
| Ethephon   | PER11462   | Promote nut fall<br>after maturity<br>reached  | <ul> <li>Product containing 480 g/L ethephon:<br/>65-250 mL/100 L water</li> <li>Product containing 720 g/L ethephon:<br/>55-165 mL/100 L water</li> <li>Product containing 900 g/L ethephon:<br/>44-132 mL/100 L water</li> <li>Do not spray stressed trees</li> <li>Refer to critical comments for varietal<br/>rate adjustments</li> </ul>                                      | 7  | NSW, QLD, WA &<br>NT only                |  |
| Indoxacarb   | PER86827   | Macadamia seed<br>weevil   | <ul> <li>Product containing 150 g/L indoxacarb:<br/>50 mL product/100 L</li> <li>Product containing 300 g/kg indoxacarb:<br/>25 g product/100 L</li> </ul>   | 42   | NSW & QLD only                           |  |
| Methomyl   | PER90592   | Banana fruit<br>caterpillar  | <ul> <li>Product containing 225 g/L methomyl:<br/>1.5–2 L/ha</li> <li>Spraying ground mulch/soil surface up<br/>to treelines only</li> <li>Do not spray tree foliage, flowers or<br/>developing nutlets</li> </ul>   | Not required when<br>used as directed                                  | QLD only                                 |  |
| Petroleum oil  | PER11635   | Macadamia felted<br>coccid   | <ul> <li>Product containing between 763 and<br/>861 g/L petroleum oil: 1 L/100 L water</li> </ul>  | Not required when<br>used as directed                                  | NSW & QLD only                           |  |
| Trichlorfon  | PER13689   | Macadamia lace<br>bug, fruit spotting<br>bug, banana<br>spotting bug and<br>green vegetable<br>bug | <ul> <li>Product containing 500 g/L trichlorfon:<br/>200 mL/100 L</li> <li>Do not apply a spray volume exceeding<br/>1500 L/ha</li> <li>Do not apply by aircraft or to plants in<br/>flower</li> <li>Not compatible with integrated pest<br/>management</li> </ul>   | 2  | NSW & QLD only                           |  |
| Emergency permits  |            |  |  |  |  |  |
| Chlorantran-<br>iliprole   | PER89353   | Fall armyworm  | <ul> <li>Product containing 350 g/kg<br/>chlorantraniliprole: 18 g product/100 L +<br/>15 g active/100 L non-ionic surfactant/<br/>wetting agent</li> <li>Product containing 200 g/L<br/>chlorantraniliprole: 30 ml product/100 L +<br/>5 g active/100 L non-ionic surfactant/<br/>wetting agent</li> </ul>  | 10   | All states and<br>territories except VIC |  |
| Indoxacarb   | PER89278   | Fall armyworm  | <ul> <li>Product containing 300 g/kg indoxacarb:<br/>25 g/100L</li> </ul>  | 42   | All states and territories except VIC    |  |
| Methomyl   | PER89293   | Fall armyworm  | <ul> <li>Product containing 225 g/L methomyl:<br/>1.5–2 L/ha</li> <li>Product containing 400 g/kg methomyl:<br/>0.84–1.13 kg/ha</li> <li>Spray ground mulch/soil surface only</li> </ul>   | Not required when used as directed                                     | All states and territories               |  |
| Spinetoram   | PER89241   | Fall armyworm  | <ul> <li>Product containing 120 g/L spinetoram:<br/>40 mL product/100 L</li> </ul>   | 7  | All states and<br>territories except VIC |  |
| All efforts have been made to provide the most current, complete and accurate information on these permits, however, AMS and NSW DPI recommend that you confirm the details at the APVMA website portal: |            |  |  |  |  |  |

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Growers wishing to use a chemical in the manner approved under a permit should obtain a copy of the relevant permit from the APVMA and must read and comply with all the details, conditions and limitations relevant to that permit.





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