The Nutshell

MARQUIS MACADAMIAS

CEO REPORT

Larry McHugh

NIS BONUS PAYMENT

It is nearing the end of a very testing year in which we experienced COVID-19 lockdowns, US elections and world trade wars. However, I am pleased to report that Marquis has made it through the year relatively unscathed, producing an excellent result for our Growers.

Whilst COVID-19 prevented us from holding our annual Christmas party at which we traditionally announce our NIS Bonus Payment for the year, I have the pleasure in advising you that our **NIS Bonus Payment for 2020 season deliveries will be $0.20*/kg for conventional and organic NIS, bringing our final NIS prices to $6.20*/kg conventional and $6.70*/kg organic**. This NIS Bonus Payment will be made prior to 31 March 2021. The price for <17mm NIS will be announced in the new year.

This result has been achieved in an uncertain world economy with many logistical challenges that have arisen as a consequence of COVID-19, and I would like to thank all our Staff, Growers and Directors for their support and efforts during the year.

The macadamia industry remains resilient, and Marquis is working hard to open new markets and expand existing markets as we introduce our product to people around the world. There is no doubt that 2021 will be another year full of challenges and surprises as the world continues to deal with COVID-19. The strengthening Australian Dollar and trade tensions with China present us with some challenges, but the good news is that demand in the snack sector remains high, and the ingredient sector is slowly returning to normal.

In lieu of this year's Christmas party, we have made a $5,000 contribution to Are You Bogged Mate, a charity that goes the extra mile in helping farmers battle depression, and a $5,000 contribution to the Lismore Westpac Lifesaver Rescue Helicopter. We are looking forward to the new year and planning a season opening function where we can all get together and celebrate the year that was, whilst looking forward to the 2021 crop.

Once again, a big thank you to all our Growers – we truly appreciate your support. I wish you and your families a Merry Christmas and a Happy New Year and look forward to working with you again in 2021.

**NOTE: Pricing at 33% saleable kernel recovery and 10% moisture.*

December 2020

MARKETING REPORT

Charles Cormack, General Manager

As 2020 draws to a close and we start to look back on the season that was, I think we can agree that despite all of the economic and political uncertainty that has shaped this year, the macadamia industry as a whole has weathered the storm well, and The Marquis Group has done better than most.

In many ways, the industry was fortunate that 2020 was not the best of years for global macadamia production, with the two largest producers of Australia and South Africa experiencing less than ideal growing conditions.

South Africa in particular, had a very poor harvest, and the latest official crop forecast is now 46,256MT*. This is 30% down on the original forecast of 66,000MT* and 22% down on the 2019 crop. Australia fared much better than expected with a late harvest (particularly in the Northern Rivers region) boosting the final crop forecast to 46,900MT*. Despite the harshest of hot summers during the early crop set months, the trees obviously responded well to later rains and filled the crop out. This result is 28% up on the original forecast and 9% up on 2019 but still 5% down on the high-water mark of 49,300MT* in 2018. Kenya, as the third largest macadamia producer, had a reasonable crop this year of between 35,000MT* and 40,000MT* but probably did not commercialise the entire crop due to uncertainty over demand in the COVID-19 year. The China crop, which is harder to determine with certainty, will likely be upwards of 20,000MT* but nowhere near the ambitious numbers predicted a couple of years ago.

Taking into account the growth from some of the smaller emerging markets, the global crop for 2020 is probably somewhere between 5% down and on par with 2019.

**NOTE: All crop weights are at 3.5% moisture.*

All in all, The Marquis Group will close out the 2020 season in a very strong position. Despite the late surge in the Australian crop forecast this year and our own NIS intake, we remain heavily contracted in kernel and will only carry strategic inventory into next year to satisfy pre-season demand.

With both the 2021 Australian and South African crops still filling out on the trees, it is too early to determine with any certainty the size of the crop for next year. Early predictions are that Australia will have a crop similar to, or slight up, on 2020 and South Africa will have a better year. South Africa has already experienced some early season challenges with heavy frost, followed by damaging hail and too much wet weather in some areas. This has had the effect of making the crop patchy and harder to predict but early talk is it may be between 50,000MT* and 60,000 MT*.

There are certainly still some head winds facing the industry for 2021 but also some positive outlooks. The demand and therefore pricing for snack styles of kernel (wholes and larger halves) will remain reasonably firm as retail sales continue to prove resilient. On the other hand, demand for ingredient styles will continue its slow but steady recovery with lower pricing driving sales. With COVID-19 largely under control in Asia, demand should pick up early in the New Year. If the Tokyo Olympics take place which is looking likely, this could drive good demand in Japan. Despite the vaccine rollout, COVID-19 will likely remain a big influencer of demand in North America and Europe, but we expect demand in the snack area to remain strong. The easing of prices on ingredient styles should drive product innovation and hopefully lead to increased demand in the longer term.

Marquis Marketing's recent investment in a New Product Development Manager (NPD) is well timed, and we are now positioned to help drive product development amongst our current and potential customer base to find new applications for our ingredient kernel. Our

new NPD Manager (Kat Richie) and Quality Assurance Manager (Katie Sariyiannis) joined the business in September, and our increased focus on new market and product development is already paying dividends with a Marquis branded Style 5 baking product launching in Costco Australia in December and a new Vanilla Sawn NIS product launching in 8 overseas markets, including China, Japan, Korea, Taiwan, USA and UK in January 2021.

FACTORY OPERATIONS

Steven Lee, Chief Operating Officer

The 2020 season is drawing to a close and the factories are now beginning to prepare for the 2021 crop. On reflection, the 2020 crop in the Northern Rivers performed exceptionally well despite the extreme heat and drought conditions in late 2019. Macadamia trees have evolved in Australia over millions of years, and their hardy nature really shone through with most Growers pleasantly surprised at the quantity and quality of crop harvested. The Bundaberg crop didn't fare quite as well, although most Growers achieved a reasonable yield. Immaturity was prevalent along with some internal discolouration, particularly in the early crop.

Lismore's new cracking room has performed well as our staff become more confident in driving the new equipment at consistently higher speeds. The Bundaberg upgrades, including sorting and grading, have also worked well with the additional capacity being critical to efficiently processing the 2020 crop.

We are now working on future proofing the Bundaberg site with expansion plans that will double the capacity to meet the ever-increasing plantings and future production from the Bundaberg region.

Whilst the challenges of COVID-19 are not yet over, we have been able to reduce some of our controls allowing limited visitors to our sites. One of our recent visitors was the Leader of The Nationals in the Senate, the Honourable Bridget McKenzie, pictured below touring the facilities.

Staff Milestone

Tracey Bayliss, Administration Assistant, recently completed 20 years of service with Marquis Macadamias. Many of you would have had dealings with Tracey when she was the receptionist for many years.

Tracey is pictured below receiving her 20 years of service award and gift.

Factory Closures

We wish all our valued Growers and their families a very Merry Christmas. We will be closing both factory

offices at 12pm on 24 December and re-opening on 4 January. Just a reminder to please ensure you have picked up your Christmas orders prior to the closure.

2020 SEASON REVIEW

Kevin Quinlan, Supply Chain Manager

The 2020 season has been one of the most unusual seasons the macadamia industry has ever seen. Over the last 12 months, we have experienced: bushfires, one of the driest summers on record, little rain during the harvest season, record nut-in-shell prices and a global pandemic to top it off! However, it is pleasing to say that Growers and Marquis Macadamias have dealt with these challenges and managed to work through them, with a better than anticipated season being recorded. In this article, a review of the 2020 season will be provided.

Weather

All growing regions experienced a drier than usual Spring and early Summer. Thankfully, in mid to late Summer, some much needed rainfall was received (although variable by region), which helped to mature the crop and put some moisture back into the soil profile.

In the following three figures, a comparison between the long-term average rainfall received each month and the actuals for April 2019 to March 2020 has been undertaken.

Lismore

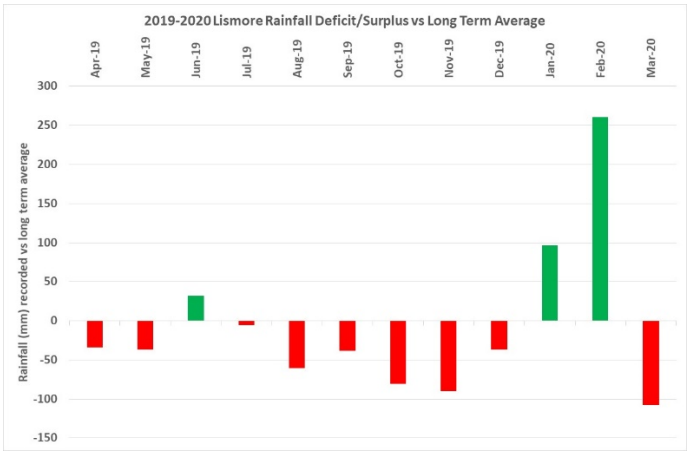

Figure 1: 2019-2020 Lismore airport rainfall deficit/surplus vs. long-term average
Source: BOM

In the Northern Rivers, the average rainfall (April – March) is 1,184mm. The measured rainfall for 2019-2020 was 1,082mm. This is a 102mm deficit or a 9% reduction in rainfall over this period. As can be seen in Figure 1, above average rainfall was received in January and February during the oil accumulation phase.

Mid-North Coast

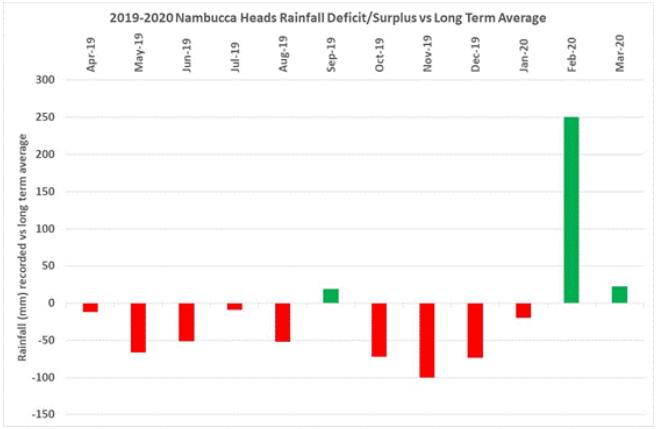

Figure 2: 2019-2020 Nambucca Heads rainfall deficit/surplus vs. long-term average
Source: BOM

In the mid-north coast region, the April to March (of the subsequent year) average rainfall received is 1,371mm. In 2019-2020, it was 1,208mm, a 163mm below average or a 12% reduction in rainfall over this period. There is a small amount of above average rainfall in September, and then well above average rainfall was received in February 2020.

Bundaberg

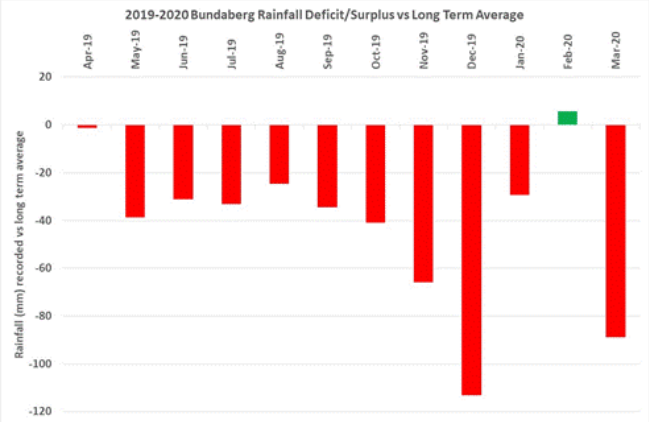

Figure 3: 2019-2020 Bundaberg airport rainfall deficit/surplus vs. long-term average
Source: BOM

In the Bundaberg region, the April to March of the following year average rainfall is 1,002mm, but in 2019-2020, 507mm of rainfall was received for this period, a reduction of 495mm from the average and a 49% reduction in rainfall over this period. Thankfully, the Bundaberg region is irrigated, so Growers have been able to deliver water to alleviate the severe deficit in available water, but there is no substitute for rainfall to assist with recharging dams, increasing humidity and reducing anxiety. There was above average rainfall in February, but this was only slightly above average and insufficient to recharge the soil moisture profile.

Quality Trends

Despite the difficult summer weather conditions of 2019/2020, the 2020 season's quality has been reasonable, with the saleable kernel recovery being up at the highest level ever recorded for the Lismore factory (Figure 4). The reject kernel recovery is slightly up on the 2019 season but is below the long-term industry average of 3% reject kernel recovery (Figure 5). The main change is an increase in heavy shrivelled (immaturity) reject and an increase in internal discolouration (brown centres).

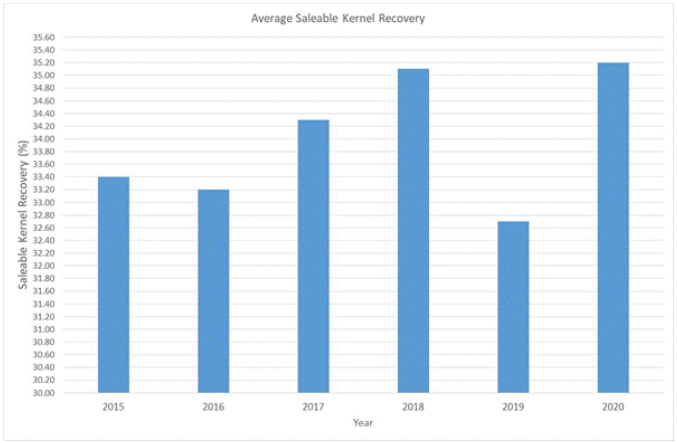

Figure 4: Saleable Kernel Recovery for the Lismore Factory from 2015 to 2020

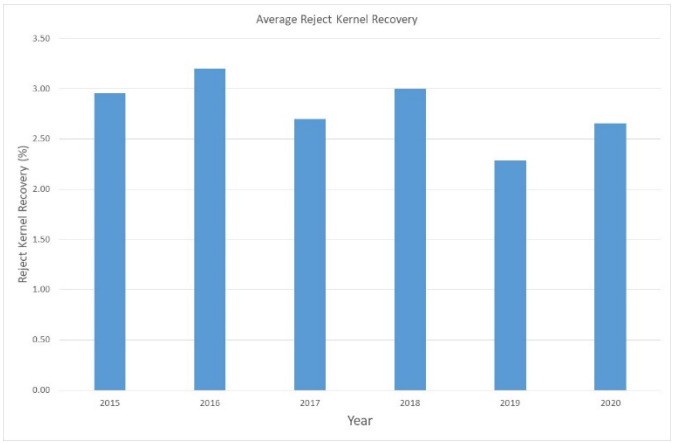

Figure 5: Reject Kernel Recovery percentage from 2015 to 2020 for the Lismore Factory

Insect Damage

The average insect damage level recorded in 2020 is at the lowest level seen in the last 10 years (Figure 6). The main insect damage seen at the factory is from the fruit spotting bug. Reports from pest consultants have been that the in-field pressure during the 2019/2020 season was extremely low and the increasing awareness of the significance of timing and coverage to achieve control have all contributed to a decrease in this pest's levels. It is known that FSB pressure is linked to the flowering and fruiting patterns of various host crops, and the intensity and timing of these are largely driven by rainfall and/or available soil moisture. Generally, the FSB pressure is higher in wetter seasons and in the 2020/21 season we have seen an increase in the pressure from FSB due to the higher Autumn and Spring rainfall compared to the previous season.

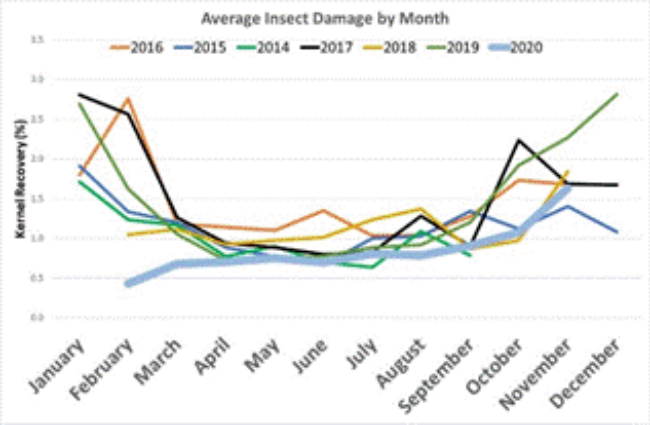

Figure 6: Average factory insect damage

Internal Discolouration

The level of internal discolouration in 2020 was above that of 2019, but lower than 2018, 2016 and 2015 (Figure 7). Please note that data in Figure 7 is for the Lismore factory only, and as internal discolouration has been a significant issue in the Bundaberg region, the results are different for the Bundaberg factory.

Internal discolouration is a defect with causes not fully understood, and different types of internal discolouration can be produced. The overall trend observed has been a decrease in the levels since 2015, which are likely to be due to improved post-harvest storage and handling by growers, driven by the results from the Brown Centre's research project undertaken by QDPI. There is still further research required to better understand the causes of the defect, which would assist in allowing the industry to reduce the levels further.

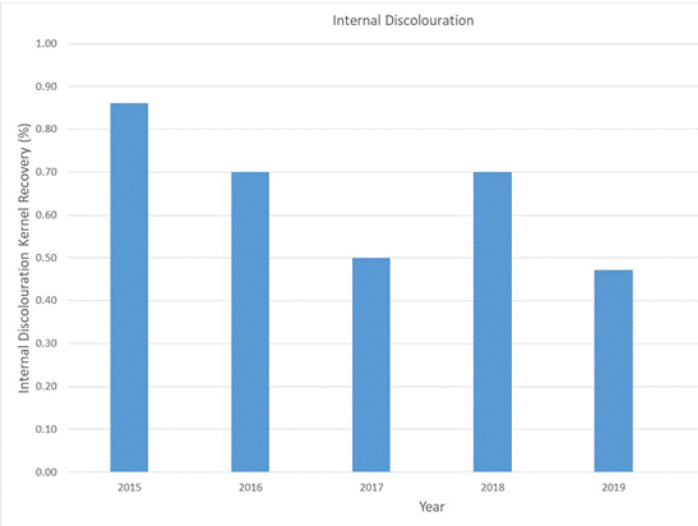

Figure 7: Factory internal discolouration

MARQUIS GROWERS RECOGNISED IN AMS PRODUCTION AWARDS

Karina Griffin, Grower Liaison Officer

The Australian Macadamia Society recently released the winners for the Awards of Excellence 2020, and it is great to see some of our Marquis Growers nabbing the top spots for 'Best Productivity' and 'Best Quality' for the 2019-20 crop.

Congratulations to QLD Growers Garry and Andrea Sheppard for 'Best Productivity' (large farm) and 'Grower of the Year'. For the Northern Rivers NSW, 'Best Productivity' went to David and Sharon Wardrop (large farm) and Wally and Hildegarde Carter (small farm). 'Best Quality' for the Northern Rivers NSW went to Martin Forer and Graeme Fleming (large farm). For the Mid North Coast NSW. 'Best Productivity' went to Chris Cook (large farm; Thurgoods) and Fern Hinchcliffe (small farm). Tim Zeck and Dru Marshall (small farm) won the 'Best Quality' for Mid North Coast NSW.

We also extend our congratulations to all of the other award recipients and a special mention for Northern Rivers NSW consultant, Jarrah Coates, who was recognised as the 'Young Achiever of the Year'.

To be eligible for these awards, you need to be part of the Benchmarking Project undertaken by the Queensland Department of Agriculture and Fisheries (QDAF). Benchmarking is undertaken annually, and Growers who sign up for benchmarking will receive personalised reports on how their properties compare to the rest of the industry. Being involved doesn't require a lot of time, and to collect information you just need to complete some base level data about your farm, and provide authorisation to the benchmarking team for them to ask for your production information from us as your processor. If you would like to be involved in benchmarking or want more information, you can contact Jeremy Bright (NSWDPI) jeremy.bright@dpi.nsw.gov.au or Grant Bignell (QLDDAF) grant.bignell@daf.qld.gov.au.

EAL & MM REDUCING COST OF SOIL & TESTING

Mark Whitten, Grower Liaison Officer

Soil and leaf tests are powerful monitoring tools, which are aimed at ensuring optimal tree health to maximise productivity. Consistent soil and leaf testing enables early identification of nutrient imbalances and allows fine tuning of nutrition programs.

To reduce the cost of soil and leaf testing, Marquis Macadamias (MM) has teamed up with Environmental Analysis Laboratory (EAL) to develop a macadamia specific soil testing package (*Table 1) that covers the essential testing requirements and can be provided at a discounted rate. The leaf testing package remains as the standard analysis offered but at a discounted rate.

The EAL lab is located within the Southern Cross University campus in Lismore.

*Table 1: RA-PACK-19 Extractions

Parameter
Total Carbon (TC) Total Nitrogen (TN)
pH (w) Conductivity (EC) dS/m Cation Exchange Capacity (CEC) Sulphur (S) mg/kg
Phosphorous Buffering Index (PBI) Colwell P mg/kg
Calcium (Ca) cmol+kg Magnesium (Mg) cmol+/kg Potassium (K) cmol+/kg Aluminium (Al)% Sodium (Na) ESP%
Zinc (Zn) mg/kg Manganese (Mn) mg/kg Iron (Fe) mg/kg Copper (Cu) mg/kg Boron (B) mg/kg

Pricing:

- Soil analysis: RA-PACK-019 $80.00 + GST
- Leaf analysis: PA-PACK-001 $40.00 + GST

To have access to the discounted pricing, you will need to quote the code: **EALQ5948.**

For more information, feel free to contact one of your MM Grower Liaison Officers. Alternatively, you may contact EAL on (02) 6620 3678 or eal@scu.edu.au.

PRILLED & LIQUID LIMES:

ARE THEY VALUE FOR MONEY WHEN CORRECTING SOIL pH?

Mark Whitten, Grower Liaison Officer

Soil acidification occurs naturally as a part of normal weathering. However, this process is generally accelerated by agriculture. Acid soils can negatively impact production by reducing soil biological activity and reducing the availability of elements, such as phosphorus, while increasing the availability of elements, such as aluminium, which is toxic to plants. To neutralise acidity and increase soil pH to a preferable minimum value of approximately 5.7 $pH_{(w)}$, periodic applications of lime or dolomite are required. As such, this article will focus upon correction of soil pH and the value of different products to achieve this outcome.

Sources of Bulk Aglime

While other suppliers exist, Graymont (previously Sibelco) are the primary suppliers of good quality lime into the major macadamia growing regions. Growers in the Northern Rivers will generally source bulk aglime from their Riverton quarry, while Growers in Southern and Central Queensland are supplied from their Murgon and Calliope quarries.

How Lime Works

Firstly, it's important to remember that pH is measured on a scale of 0 -14 and is determined by the concentration of hydrogen ions (H^+). The higher the concentration of hydrogen ions, the more acidic the soil is. Secondly, the pH scale is logarithmic, which means the concentration of hydrogen ions increases by a factor of 10 every unit drop in pH. Consequently, there are 10 times more hydrogen ions at a pH of 4 than there are at a pH of 5. The practical implication is that 10 times the amount of neutralising product is required to take the pH from 4 to 5, than if you wanted to take the pH from 5 to 6.

To neutralise the hydrogen ions (acid), it is advised to use either lime or dolomite. Lime is calcium carbonate ($CaCO_3$). Dolomitic limes contain magnesium carbonate ($MgCO_3$) in addition to the calcium carbonate. Good quality lime is generally ~40% calcium (Ca) with the rest being made of carbonate (CO_3). Importantly, when neutralising acidity and increasing soil pH, it's not the calcium component at work, rather it's the carbonate component. The calcium is just a bonus that will increase soil calcium levels and improve soil structure. The carbonate fraction of the lime reacts with the acid in the soil (H^+) to give calcium, carbon dioxide (CO_2) and water (H_2O), as seen in Figure 1. Based on this reaction, the key metric for pH correction really should be tonnes of carbonate per ha, as the more carbonate applied per hectare the more acidity (H^+) is neutralised or 'mopped' up.

$$\underset{\text{(lime)}}{CaCO_3} + \underset{\text{(acid)}}{2H^+} \longrightarrow \underset{\text{(calcium)}}{Ca^{+2}} + \underset{\text{(carbon dioxide)}}{CO_2} + \underset{\text{(water)}}{H_2O}$$

Figure 1: Lime – acid reaction

Lime Quality

Confusingly for Growers, there are various lime products being promoted that claim to be just as effective as normal aglime but at much reduced rates. As a result, the question often arises - how is it so? Well, these claims all leverage off differences in lime quality, with the main factors being Neutralising Value (NV) and particle size distribution.

Neutralising Value

Neutralising Value (NV) has become a standard measure of the lime's ability to neutralise acidity (Figure 1) and is a proxy for its purity. The purer the lime is, the higher its NV. Pure calcium carbonate is taken as the standard with a NV of 100%. As an example, Figure 2 shows that approximately 1.7t/ha of 60% NV lime is required compared to 1.1t/ha of 90% NV lime to achieve the same pH change. While some limes can have NVs in the 50 – 70% range, the macadamia industry is lucky to have access to good quality limes from the Graymont quarries, which all have limes with NVs above 97%.

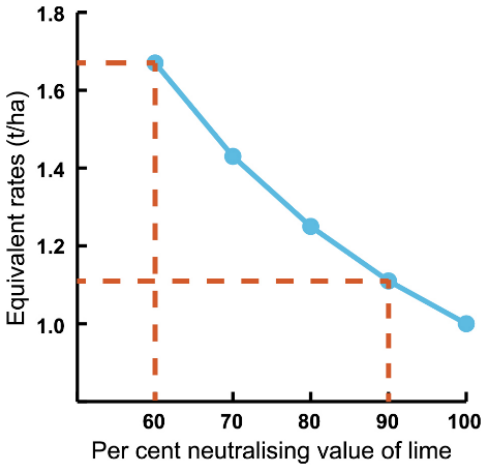

Figure 2: NV vs. required lime rates
Source: DPIRD 2020

Particle Size Distribution

The second part of the lime quality debate is particle size. The size of the lime particles determines how quickly the lime can neutralise acidity, as lime with a higher proportion of finer particles has a larger surface area to react with the acid in soil. Therefore, a finer lime will reduce soil acidity quicker than a coarser lime. A 2015 study by Southern Farming Systems illustrates the change in pH over time using **equal rates**, but different lime particle grades. The study, illustrated in Figure 3, demonstrates that the finest lime (<0.075mm or 75 micron) produced the fastest reaction; however, over six years this initial advantage was negated by the second grade (0.15 – 0.25mm). The third grade (like most third grades I've played in) reacted much slower than the higher

grades. This is because the larger particles create a high pH zone around them, which inhibits further reaction with the acidity in the soil, slowing the pH change.

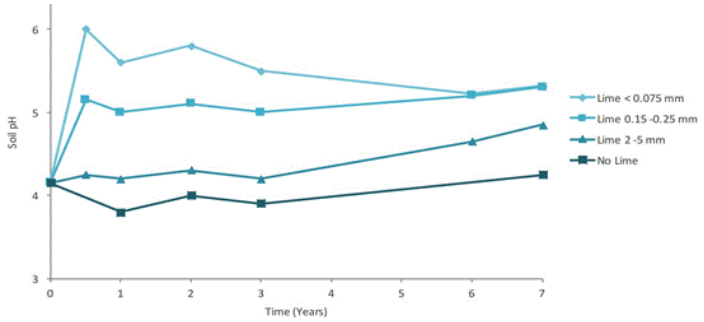

Figure 3: The change in pH over time using different lime particle sizes
Source: Miller, S. 2015. *Choosing lime*. Southern Farming Systems (SFS)

Efficacy of Different Particle Sizes

In order to compare different limes, a number of tools have been created. These tools use NV and particle size distribution to arrive at an efficiency value. Particle sizes are divided into size grades and allocated efficiency percentages. The smaller the particle the greater the efficiency percentage. While different percentages have been given in research reports, there is general agreement that the majority of lime should be under 0.5mm (500 microns), as this will generally achieve pH correction within 18 months. Figure 4 shows how the efficiency of lime increases as particle size decreases.

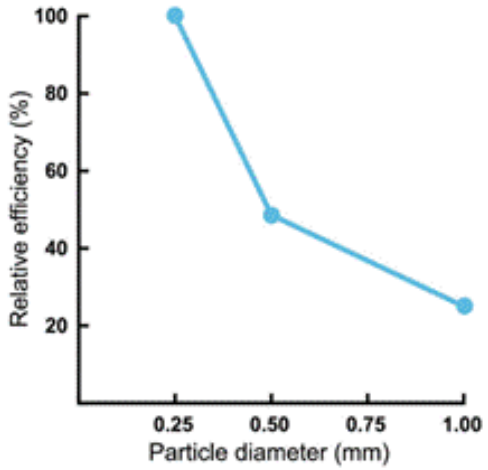

Figure 4: Impact of particle size on pH change
Source: GRDC GroundCover™ Issue: 118

What's the Particle Size of my Bulk Aglime

Bulk aglime is made up of a range of particle sizes. To find out how fine your lime is, reputable suppliers will provide a technical data sheet specifying mean particle size distribution. Figure 5 below shows the mean particle size distribution of lime from the Riverton and Murgon quarries. When we compare Riverton lime with the particle grades used in Figure 3, we don't see any particles in the 2-5mm grade, 20% in the 0.15-0.25mm grade and 50% of particles are <0.075mm. Because Riverton lime has such a high proportion of fine particles, the response curve would actually be in between the first grade (<0.075mm) and the second grade (0.15 – 0.25mm) response curves shown in Figure 2.

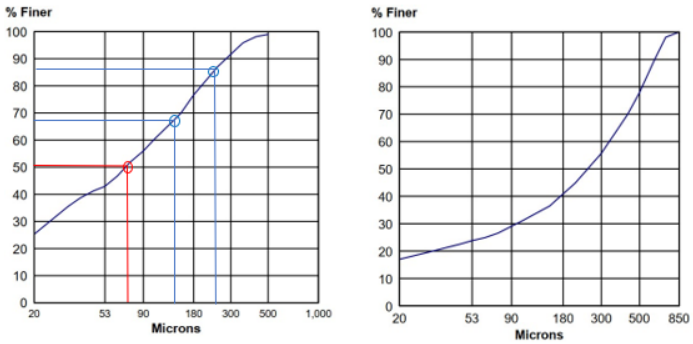

Figure 5: Mean particle size distribution of Riverton Lime (left) and Murgon Lime (right)
Source: Graymont

Comparing Products

There are numerous lime products for Growers to consider. As such, it is useful to have an impartial, quantitative process to compare limes. The NSW DPI comparison calculator (2003) is one such tool. The calculator first divides the lime into five grades and gives each grade an Efficiency Factor (EF). The smaller the particle, the higher the EF with anything smaller than 0.075mm having an EF of 100%. Each grade is then multiplied by the EF, which is then added up and divided by the NV to give an Effective Neutralising Factor (ENF). Cost per tonne is then divided by the ENF to calculate unit cost ($) per Effective Neutralising Value (ENV).

Example calculations for Riverton lime are shown in the following equation…

ENV = NV x (EF x percentage particle size)
= 99 x [(0.42 x 0.35) + (0.58 x 0.15) + (1 x 0.5)]
= 99 x [0.147 + 0.87 + 0.5]
= **73**

Table 1 compares liquid lime, prilled lime, Riverton bulk lime and Murgon bulk lime.

Table 1: Quality and cost factors for different lime products

Quality & Cost Factors		Liquid Lime	Prilled Lime	Riverton Bulk Lime	Murgon Bulk Lime
NV %		99	99	99	99
Size Grades (mm)	**Efficiency Factor**	**Percentages of particle size distribution**			
1 -2mm	**0.22**	0	0	0	0
0.5 - 1mm	**0.34**	0	0	0	0.22
0.15 - 0.5mm	**0.42**	0	0	0.35	0.43
0.075 - 0.15mm	**0.58**	0	0	0.15	0.1
< 0.075mm	**1**	1	1	0.5	0.25
Effective Neutralising Factor		99	99	73	56
Approximate cost ($/t)		3500	425	95	95
Unit cost ($) per ENV		$35.35	$4.29	$1.31	$1.70

**NOTE: The prices used for the limes are approximate and spreading/application costs have not been included in the calculations. NV for liquid lime is assumed to be 99; however, on the SDS for one liquid lime product it states the proportion of calcium carbonate, i.e. lime, to be 30-60%. As such, the NV could be much lower.*

<u>Things to Look for When Comparing Products and Interpreting Trial Results</u>

When comparing products, there are a few key points to look for that will allow for a more accurate comparison:

- Know the neutralising value and particle size distribution of the control treatment. Quite often data on the quality of the control treatment is omitted and using poor quality lime as the control treatment will make comparison products look much better.
- Know the rates of all treatments. Sounds simple, but often rates for one or all treatments are omitted.
- Is the trial length realistic? We know it takes at least 12-18 months for good quality lime to fully react and even longer for poor quality lime. Therefore, any trial using bulk aglime as a comparative treatment should run for a minimum length of 18 months.

<u>Do Liquid and Prilled Limes Have a Place?</u>

Well, yes and no. Liquid and prilled limes can be a solution when you need a fast pH change. However, at the drastically reduced rates that are suggested by the manufactures of these products any pH change achieved will be short lived. Also, as demonstrated in Table 1, these products are an expensive way to adjust soil pH.

Interestingly, one tonne of prilled lime with a particle size (<0.05mm or 50 micron) will cost approximately $425, while 2.3t of bulk aglime from Riverton will also provide you with one tonne of sub 50-micron lime and cost around $220. Added to this, you will get significantly more calcium and carbonate.

Application of bulk aglime does require a purpose-built spreader that can handle the product. Prilled limes can therefore be useful for producers who only have a normal fertiliser spreader, can't get a spreading contractor, or only need to treat small areas.

"But I was told I need more available calcium?"

If your soil pH is over 5.7(w), generally there'll be plenty of calcium. Calcium availability will instead be dictated by factors like soil moisture and root health. If your pH is lower than 5.7(w) and closer to 5.2(w), calcium availability can become an issue due to increasing levels of aluminium.

"Aglime gets lost too easily!"

If you attempt to spread lime or dolomite in windy conditions, there's a good chance you'll donate a large portion of the finer particles to the neighbour's property. Older macadamia orchards are sheltered to some degree from wind; however, to reduce the risk of losing lime to wind, spread early in the morning and cancel the application if conditions become windy. Additionally, as we don't have the luxury of being able to incorporate our lime in the soil, where possible, apply mulch over the lime soon after spreading.

Summary

There are many different lime products in the market, but when choosing a product to correct soil pH remember:

- Limes with a higher NV contain more carbonate per tonne and can therefore treat more acidity. Limes with a higher proportion of fine particles can treat the acidity quicker. **Don't fall into the trap of confusing the speed of the reaction with the size of the reaction**.
- Buy lime from a reputable source, and ensure the majority of the lime is under 0.5mm (500-microns), preferably 0.25mm (250-microns). If in doubt, a lime comparison calculator is a handy resource.
- Know the quality of lime, and appreciate the effect of NV and particle size.
- Being proactive with lime applications will save you money on inputs in the long term and help to ensure a productive orchard.

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MAKING BIOCHAR WITH MACADAMIA WASTE:

IAN PERKINS, HUGOLU MACADAMIAS

Karina Griffin, Grower Liaison Officer

Ian Perkins, a grower in the Northern Rivers NSW, has been making biochar on his farm using waste nut from his dehusking and sorting line. Biochar is a charcoal that is produced using pyrolysis - burning under high temperatures with low oxygen.

Figure 1:
This image shows macadamia nuts before and after burning - the biochar/black nut is very brittle and can be ground down to a powder.

Research into biochar has demonstrated that it can improve soil health through improved nutrient storage, soil structure, water holding capacity, and increasing abundance of beneficial mycorrhizal fungi and humic materials. The primary driver of these effects is the carbon structures present in biochar. However, it is recognised that field trials can produce highly varying results depending on soil type, climate and the quality of the biochar.

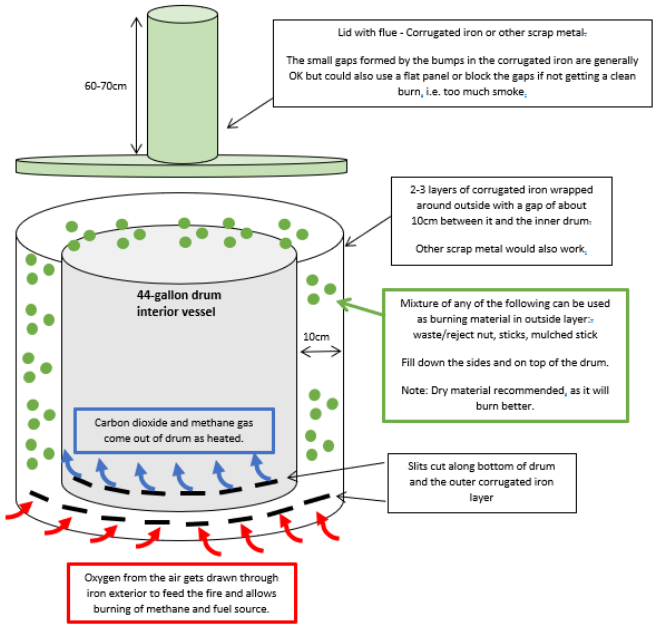
When making biochar, Ian says, *"You will get about 1/3 of the volume you put in back as finished biochar, so it would take a lot of burns to get enough biochar to be of use in the orchard"*. Ian says, *"Being involved in SoilCare has been great, it got me interested in soil microbiology. So, I started reading about biochar… I always have a pile of reject nuts and bits of husk from the shed that I have to dispose of, so I thought why not use it"*.

As the yield of biochar is small, incorporating biochar into planting holes when establishing an orchard or in potting mixtures are areas where biochar could be used for macadamias.

Ian's enthusiasm for soil microbiology does not stop there - he has bought himself a microscope and set up his own home lab in his shed. He brews compost teas and other microbial mixtures for the orchard and uses his microscope to see what different fungi and bacteria he has produced. Ian is particularly interested in *Lactobacillus* bacteria (present in fermented foods like yogurt) for its potential in plant disease control.

There are many different methods that can be used for creating biochar and after many hours reading and on YouTube, Ian settled on the retort system. He built his retort using scrap materials from around the shed. The following diagram shows the design of Ian's retort biochar maker and gives an overview of how the system works to create a high-temperature, low-oxygen environment for successful pyrolysis.

Figure 2:
Slits in the side of the drum and corrugated iron outer
Note how narrow slits are



Warning: FIRE SAFETY Material inside can burn up to temperatures of 500°C. Outside can become hot and glow.

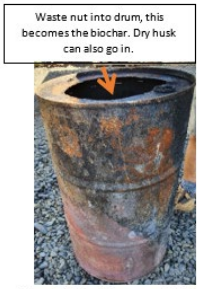
Position the unit away from flammable materials. Have water on hand and keep an eye on it when using.

Biochar Retort System Steps

Step 1: Leave waste nut in a field bin to dry for a few weeks. You can also have some dried husk in the mix, but reject nut makes the best biochar.

Step 2: Fill inner drum with dried nut and then flip it over so the opening is facing the ground. Note: Use the removed circle from the drum lid to cover the hole before flipping. You can wedge a stick in to keep the lid in place while flipping. It is best to have the inner drum sitting on soil rather than gravel.

Step 3: Place outer corrugated iron casing around the drum, leaving a gap of about 10cm all the way around. Fill up the gap with material to burn (e.g. wood, woodchip, reject nut, etc) and cover the top of the inner drum also with this material. Note: All material used to fire the system should be dry.



Step 2: Cut hole in one end of drum. Fill with dried waste nut/dry husk. Then flip over.

Step 3: Place corrugated iron casing around the outside of drum. Aim for a gap of about 10cm.


Figure 3: Ian's biochar maker assembled

Step 4: Start a fire in the top. Then, when burning well cover with lid and flue. The burn should be clean and not smoky. If smoke continues to come out of the flue, there is too much oxygen entering the system and you will not get a pyrolytic burn. This could be due to there not being a good seal between the lid and the exterior casing, the flue being too short or the holes in the bottom being too big.

Step 5: Leave to burn for about 8 hours. By this time, all the material in the exterior should have burnt to the bottom. The length required to complete a burn will take some experimentation to determine how long you need for your system.

Step 6: After the burn of the material in the outer ring is complete, tip the whole thing over to expose the char material and hose this material down to stop the reaction. Note: If left for too long, the biochar material in the 44-gallon drum will continue to burn and be destroyed.

Step 7: Inoculate biochar with biology (homemade or commercial formulations are available).

How to Know that Your System is Working

"It can take a bit of trial and error to get the retort system producing good biochar," says Ian. *"A good biochar will be black, light and powdery; it will also have little or no odour. If it does smell or is sooty, the pyrolysis process has not been completed properly and indicates that the burning parameters will need adjusting, e.g. longer, hotter, reduced oxygen availability."*

"It might not be everyone's cup of tea (or compost tea), but if you are interested there are many things that you can experiment with on your farm to improve soil microbiology," says Ian.

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