potatoes australia

| Summer - 2021/22

COVER STORY | ZERELLA FRESH: A FLOURISHING, INNOVATIVE GROWING OPERATION

INTERNATIONAL TRADE | DROP IN EXPORTS, INCREASE IN FROZEN IMPORTS SQUEEZING GROWERS

FEATURE | MESSAGES FROM AG MINISTER DAVID LITTLEPROUD AND INDUSTRY LEADERS

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PotatoLink

Flip over the magazine to read *PotatoLink*.

Bill Bulmer
AUSVEG CHAIR

Michael Coote
AUSVEG CEO

Shaun Lindhe
COMMUNICATIONS MANAGER

Michelle De'Lisle
EDITOR

EDITORIAL ENQUIRIES: AUSVEG
Phone: 03 9882 0277
communications@ausveg.com.au

PRINT
RA Printing

GRAPHIC DESIGN
Stray Orbit

COVER PHOTOGRAPHY
L-R Renee and Mark Pye
Photography by Glenn Power

ADVERTISING
Tim Withers
AUSVEG Account Executive – Advertising
Phone: 03 9070 0704
tim.withers@ausveg.com.au

CONTRIBUTORS
Chloe Betts
Justine Coates
Growcom – Fair Farms team
Phillip Lasker
The Hon. David Littleproud
Zali Mahony
Ian Thomas

ausveg.com.au/infoveg

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Editorial

The COVID-19 pandemic has resulted in significant hardship on our primary producers and our regional communities, with worker shortages, reduced tourism revenue and the personal toll from repeated lockdowns weighing heavily on every regional and rural community.

Potato and vegetable producers have been heavily impacted by repeated state lockdowns, disruptions to business operations and the heavy impact on the hospitality sector, which is a significant avenue for fresh and processed product.

AUSVEG has spoken with growers of many commodities and of all sizes and the message is clear – the cost of growing is going up and there is no end in sight to the current rises in production input costs.

While there is significant upside for the industry's trajectory in 2022 and beyond, there are serious labour and cost challenges that need to be overcome.

The sector's labour shortage is estimated to reach up to 24,000 harvest workers in early 2022 for the coming peak harvest season. On top of this, cost increases on items such as fertiliser, fuel, chemicals, freight containers, packaging and wood pallets and other vital farm inputs are significantly impacting growers' bottom lines.

This is not a problem that is unique to the Australian potato and vegetable industry – global freight and shipping issues, labour shortages and rising fuel and energy prices are causing costs to skyrocket across the sector.

While all vegetable and potato businesses vary in terms of their production costs, growers' businesses are facing between 25-40 per cent increase to their cost base across the board. Industry experts from a range of sectors are reporting that increased costs are expected to continue for 12-18 months due to global supply chain issues.

If growers can't cover the cost of production, the best-case scenario is that we see businesses accrue debt and limp through the nation's COVID recovery unable to innovate or expand. The worst-case scenario is that businesses will go under, and people in regional and rural communities will lose their jobs and their livelihoods.

It is important that all businesses throughout the supply chain work together to ensure the viability of farming businesses to continue to supply fresh produce to Australian families and our neighbouring markets.

AUSVEG has raised the issue of increased input costs directly with Agriculture Minister David Littleproud, Trade Minister Dan Tehan and with the office of the Prime Minister to make this issue high on their agendas. Check out our latest advocacy update on page 22 for more information about the work AUSVEG is undertaking on behalf of potato growers.

Michael Coote
CEO
AUSVEG

Message from the CEO

The Australian vegetable and potato industries are one of Australia's strongest performers in the agriculture industry due to their growing value of production, prominence in retail and market settings across the country as well as the rising technical and innovative nature of their many growing businesses.

Vegetables and potatoes have a farmgate value of nearly $5 billion, which – according to ABARES data – is larger than many other agriculture sectors, including most domestic meat markets (except cattle and calves), all fisheries and forestry industries, all pulses and oilseed crops, and is comparable to our milk and the combined fruit and nut industry.

The potato industry, which produces over 1.46 million tonnes with a farmgate value of over $800 million, is far and away the biggest commodity that sits within this sector.

This tremendous effort is possible because of the hard work and determination of potato growers, who are major contributors to agricultural employment and provide economic benefits to all businesses throughout the agricultural supply chain. We know that cost increases on items such as fertiliser, fuel, chemicals, freight containers, packaging and wood pallets and other vital farm inputs are significantly impacting growers' bottom lines.

Potato growers are the backbone of this significant industry and the lifeblood of many regional and rural communities that rely on a thriving agriculture sector.

This is why AUSVEG – as the only national industry body that represents the interests of growers to government and the broader supply chain – advocates strongly on their behalf on issues that are important to their businesses and their crops.

We have raised the issue of increased input costs directly with Agriculture Minister David Littleproud, Trade Minister Dan Tehan and the office of the Prime Minister to make this issue high on their agendas.

It is in the interests of growers that AUSVEG is working with its state members and growers to develop a Federal Election platform that best meets the needs of growers all around Australia.

It is in the interests of growers that AUSVEG delivers projects in biosecurity, trade and market access, increasing consumption through the Fruit & Vegetable Consortium (see page 25), and undertakes its legislative role in overseeing the investment of biosecurity and research and development levies through Plant Health Australia and Hort Innovation on growers' behalf.

It is in the interests of growers that AUSVEG funds the production of *Potatoes Australia* magazine and makes available the Hort Innovation-funded *PotatoLink* publication as part of this magazine.

As the industry works to rebound from the COVID-19 pandemic and take advantage of the increased focus on nutritious, versatile, and delicious vegetables, it is critical that the potato industry's growers have a united voice to speak to government and that stands up for growers on issues that relate to all components of the value chain.

As Agriculture Minister David Littleproud notes in his column to potato growers on page 8, *"the industry has a positive future going forward"*. This future is intrinsically linked to the success and prosperity of its growers, and AUSVEG will work in 2022 and beyond to ensure that potato growers are afforded the best opportunity to succeed and thrive.

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A message to potato growers from Agriculture Minister David Littleproud

Agriculture Minister David Littleproud.

The Australian vegetable industry is an economic powerhouse. In 2019-2020, the industry produced 3.7 million tonnes of vegetables, valued at over $4.8 billion. Our veggie farmers are a vital part of the Australian lifestyle.

Our consumers agree that our fresh veggies are the best in the world, with the average consumer chomping down almost 87 kilograms of vegetables a year. 99 per cent of the vegetables consumed in Australia are grown here.

Never has the role of Australian veggie producers and our farmers been more important or appreciated by the Australian public than during the last two years of a global pandemic.

Through the pandemic, the Australian Government has recognised the critical importance of the agriculture and horticulture sectors to our rural, regional, and national economies. We have worked hard to ensure that farmers can continue to provide agricultural product and keep our consumer both here and overseas supplied, even as other parts of the economy were placed on ice.

Through our national *Delivering Ag2030* plan, the Australian Government has committed to support the agriculture industry's goal of growing to $100 billion in farmgate production by 2030. Under the plan we are investing in actions across seven themes – Trade and Exports, Biosecurity, Stewardship, Supply Chains, Water and Infrastructure, Innovation and Research, and Human Capital – to support the agricultural industry to achieve its goal.

I'm pleased to see that we are on the way with a forecast record harvest in 2021-22, worth $73 billion. This is underpinned by the hard work and ingenuity of farmers, and the strong growing conditions and prices.

I am also pleased that in 2021 the Australian Government was able to deliver on the introduction of the Australian Agriculture Worker Visa – the Ag Visa. This is the biggest structural reform to agricultural work in this country's history.

While our farmers and industries have gone about their work keeping Australians and the world fed and clothed, they have done so under workforce constraints.

Not only will the Ag Visa give the agricultural industries the workers they have been so desperate for these past two years, but it will also give a permanent pathway to residency for those who come under this visa in the future.

It will provide a long-term, reliable workforce for our critical industries while solving one of regional Australia's greatest challenges in recent history. This is going to bring the next generation of migrants to Australia who will grow our regions and grow our agricultural sector.

Access to workers underpins the future success of the industry. In this regard, I would like to acknowledge the role workers from the Pacific have played in our horticulture and agriculture sector more broadly through the pandemic. Workers from the Pacific have played an invaluable role in making sure our markets and supermarkets have been stocked.

Since we restarted the Pacific Labour Mobility Scheme in September 2020, we have seen over 12,000 workers arrive in Australia and we have committed to a further 12,500 arriving by March next year. We know that together with workers arriving under the Agriculture Visa they will be critical to the ongoing prosperity of vegetable producers and the farming sector into the future.

It was great to be able to address delegates at Hort Connections in Brisbane earlier this year and meet so many vegetable producers at the Trade Show. The horticulture industry is at the forefront of technologies and innovations, and I look forward to meeting with you at future Hort Connections conferences and other industry events.

2020 and 2021 have been challenging years for vegetable producers. But they have also been a period in which all Australian have found comfort and solace in the important service they have provided. I am confident that the industry has a positive future going forward, and like you look forward to a more open and safe Australia in 2022.

Industry leaders look to 2022 *Twenty Twenty-Two*

From bushfires to a global pandemic, the last two years have resulted in significant disruptions to the potato and vegetable industries. AUSVEG asked some of the horticulture industry's leading figures about trends, insights and developments to look out for in 2022.

Paul Luxton:
Managing Director and Country Head, Syngenta ANZ

Syngenta has witnessed many growers across the country this year again expertly balance risk and opportunity.

It is with some admiration we observe the industry continuously moving forward and at times adapting on-the-run to meet labour shortage challenges and enact in-house covid management strategies.

The global pandemic has led to many changes in our lives, and we will have to face challenges with global supply chains as freight services worldwide have become increasingly hard to source. Reliability of shipment dates has reduced, and production of crop protection active ingredients is being constrained in key countries.

While we continue to manufacture a significant amount of our crop protection volume locally, the influence of global disruptions on raw material and freight availability will lead to supply disruptions so I encourage you to work with your retailers to plan ahead. Despite these challenges, growers have and will continue to find a way forward and ensure households are fed healthy and nutritious vegetables each and every day across Australia.

With limited travel options available across the major growing regions, it has reminded us all just how critical local connections, initiatives and partnerships are. The ability to demonstrate, position and deliver new genetic technologies and crop protection innovations is something we are proud of within Syngenta, and we thank all growers for welcoming our local Syngenta team members into your businesses.

We value this engagement and the opportunity to understand your requirements better.

Industry leaders look to 2022

Ian Muir:
Chairman, E. E. Muir & Sons

As a result of the unprecedented times that we have all experienced over the last 18 months, there is now a focus on the continued secure supply of those inputs that we all require to continue to run our businesses and lives.

This focus is appearing across all industries and lifestyles, and ranges from necessities to the labour we all need to operate our businesses.

Border closures have certainly caused issues to many businesses, and this has been reflected globally, where the international demand for basic commodity inputs has escalated.

In addition to this increased demand, there has also been significant shortage in shipping container availability, leading to considerable increases in the cost of international freight. Shipping companies are now making selected decisions on what goods and containers they are accepting and prioritising for shipment.

The impact on our industry is yet to be fully felt, and it can be expected that product prices will reflect this increase in demand, and the increases in freight rates.

As an industry, we are very dependent on the importation of many of the seeds, crop protection and nutritional products that we use. Many Australian suppliers have made considerable plans to bring their products into the country earlier than normal.

Seasonal factors such as weather conditions and rainfall will naturally influence the use of these input products, and as such will determine their availability.

We would hope that nature is kind to us over the summer and autumn seasons, and that everyone can experience a very good business period as we all emerge from the lockdown period that has dominated our recent lives.

Stephen Titze:
President, Incitec Pivot Fertilisers

Sustainability has increasingly become a top priority for businesses across all sectors. This is especially true for agriculture as global demand for food and sustainable produce increases.

Looking into 2022 and beyond, growers will need access to a range of specialised agronomic products and services if they are to meet the profitability, productivity and sustainability challenges before us all.

Plant nutrition, similar to human nutrition, is essential to growing a quality crop and ensuring the health of the soil, which is many farmers' most important asset.

Data driven decision making based on solid science and precision farming technologies will be integral to improvements in plant nutrition, soil health, environmental outcomes and profitability.

Whether it's using soil health testing and tailored agronomic advice to better understand and improve overall soil health and productivity outcomes – or leveraging precision agriculture technologies and custom blending techniques to accurately meet the nutritional needs of crops – data and technology will be the key to success.

The role of research and development will continue to be critical in delivering new technologies that will help shape the future of our sector.

Our recent investment in the Australian Research Council Research Hub for Smart Fertilisers at the University of Melbourne brings together more than 20 researchers from plant and soil science, chemistry and chemical engineering. This is to improve our understanding of Australian soils and their microbiome with the aim of developing a new class of more sustainable 'smart fertilisers' and inhibitors to increase the efficiency of nitrogen use by up to 20 per cent, making a significant contribution to agriculture and the environment.

The challenge of profitably and sustainably producing increasing volumes of food in the Australian context is one we understand well.

Our aim is to deliver a range of market leading products and services that give growers more sustainable plant nutrition solutions, helping them manage input costs, increase crop yields and improve the health of their most valuable asset: their soil.

Knowledge grows

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Drop in exports, increase in frozen imports adding pressure to potato growers

Apart from the rising freight costs and pressure asserted from the current pandemic, frozen potato imports have been rising in recent years, and at a lower price. This has been placing extra pressures on the Australia potato industry, which has already suffered from the impacts of the pandemic and rapidly rising farm input costs. *Potatoes Australia* reports.

According to the *Australian Horticulture Statistics Handbook*, the Australian potato industry produces over 1.3 million tonnes of potatoes, valued at AUD$794 million. From January to September 2021, fresh potato exports comprised only 2.5 per cent of the total Australian potato production while frozen potato imports are accounted for 6.3 per cent.

Fresh potato exports highlight from January to September 2021

Total fresh potato exports have declined slightly in export value and volume during the first nine months of 2021. Based on Global Trade Atlas data, there was a 5.3 per cent decrease in fresh potato export value, from $28.6 million to $27.1 million. Total fresh potato export volume declined by 3.1 per cent, from 36,255 tonnes to 35,117 tonnes over the same period.

Potato trade to South Korea, the Philippines, and Middle Eastern countries – such as United Arab Emirates, Saudi Arabia and Kuwait – has increased substantially in trade value and volume from January to September 2021.

Fresh potato exports to South Korea recorded an increase of 24.4 per cent from $7.7 million to $9.6 million, and a similar increase in volume of 26.4 per cent from 13,061 tonnes to 16,512 tonnes. These increases are almost on par with the 2019 pre-COVID trade level ($10.2 million at 17,006 tonnes) over the same period.

The Philippines recorded an increase of 14 per cent in value from $4.3 million to $4.9 million and an increase of 14.8 per cent in volume from 7,298 tonnes to 8,380 tonnes.

Singapore recorded a slight dip in value by 1.2 per cent from $3.01 million to $3.02 million, while export volume to this market has increase by 7.9 per cent from 1,863 tonnes to 2,011 tonnes (refer to Table 1).

Table 1

Change in fresh potatoes exports by top 10 destinations January to September 2020-2021 *(Source: Global Trade Atlas 2021).*

Trade partner	2020		2021		% ▲ 20-21	
	AUD$	Tonnes	AUD$	Tonnes	AUD$	Tonnes
Total to the world	**$28,645,966**	**36,255**	**27,118,641**	**35,117**	**-5.3%**	**-3.1%**
South Korea	7,748,869	13,061	9,642,314	16,512	24.4%	26.4%
Philippines	4,336,702	7,298	4,945,799	8,380	14.0%	14.8%
Singapore	3,052,009	1,863	3,015,177	2,011	-1.2%	7.9%
Malaysia	2,869,622	2,752	2,848,794	2,646	-0.7%	-3.9%
Hong Kong	2,941,717	2,517	2,610,339	1,682	-11.3%	-33.2%
United Arab Emirates	1,384,248	1,069	1,509,411	1,280	9.0%	19.7%
Taiwan	1,185,670	1,156	1,051,655	1,060	-11.3%	-8.3%
Indonesia	2,875,176	4,656	376,233	626	-86.9%	-86.6%
Qatar	1,514,153	1,291	331,461	231	-78.1%	-82.1%
Brunei Darussalam	255,662	187	215,698	164	-15.6%	-12.3%

Frozen potato imports from January to September 2021

While fresh potato imports into Australia are challenging, the frozen potato imports markets have expanded quietly since it peaked in 2018. According to the data from Global Trade Atlas, there was an 11.9 per cent increase in frozen potato import value during January to September 2021, from $106.5 million to $119.1 million. Import volume also increased at a similar pace of 13.1 per cent, from 77,164 tonnes to 87,245 tonnes.

The Netherlands, Belgium, New Zealand, United States and South Africa are the top five markets for frozen potato imports.

Frozen potato imports from the Netherlands recorded a significant increase of 41.2 per cent, from $21.3 million to $30.2 million; import volume increased by more than half (56.6 per cent), adding nearly 9,000 tonnes to the Australian potatoes market.

Frozen potato import value from Belgium grew by 19.5 per cent from $24.3 million to $29 million, and import volume also jumped by 31.7 per cent from 14,729 tonnes to 19,401 tonnes.

New Zealand and Germany are the only two markets that have recorded a dip in its frozen potato exports to Australia. Frozen potato imports from New Zealand have dropped 21.1 per cent from $36.1 million to $28.5 million and decreased 26.9 per cent in import volume from 33,346 tonnes to 24,371 tonnes. Germany recorded a significant decrease in its frozen potatoes export to Australia by 62.5 per cent from $4 million to $1.5 million, slashing more than three quarter in volume by 71.2 per cent, from 1,583 tonnes to 456 tonnes (refer to Table 2).

Find out more R&D

Growers interested in identifying export events or discussing export opportunities can contact the AUSVEG Export Development team on 03 9882 0277 or email export@ausveg.com.au.

Table 2

Change in frozen potato imports by top 10 destinations January to September 2020-2021 *(Source: Global Trade Atlas 2021).*

Trade partner	2020		2021		% ▲ 20-21	
	AUD$	Tonnes	AUD$	Tonnes	AUD$	Tonnes
World	**106,566,686**	**77,164**	**119,197,796**	**87,245**	**11.9%**	**13.1%**
Netherlands	21,438,491	15,665	30,273,220	24,535	41.2%	56.6%
Belgium	24,348,051	14,729	29,089,588	19,401	19.5%	31.7%
New Zealand	36,162,083	33,346	28,525,209	24,371	-21.1%	-26.9%
United States	14,703,427	8,550	19,098,712	11,813	29.9%	38.2%
South Africa	3,204,175	1,769	4,420,679	1,847	38.0%	4.4%
Argentina	167,882	140	1,738,640	1,499	935.6%	970.7%
Germany	4,075,644	1,583	1,529,639	456	-62.5%	-71.2%
India	61,400	45	1,475,610	988	2303.3%	2095.6%
China	1,336,385	969	966,540	638	-27.7%	-34.2%
Canada	19,968	4	513,814	1,143	2473.2%	28475.0%

Aerial application of MIRAVIS® in potato crops.

Fungicide now registered for aerial application in potatoes

MIRAVIS® fungicide is in a class of its own for powerful and dependable control of target spot (early blight) in potatoes. Now, aerial registration makes it more accessible to potato growers all around the country.

In some potato growing regions, wet soil conditions make it difficult for timely application of fungicides when conditions are conducive for target spot.

Aerial application of MIRAVIS® offers growers the option and flexibility to protect the crop when it matters most, while minimising crop and soil damage.

Rainfast within an hour, the product contains the active ingredient pydiflumetofen (Group 7), which gives superior long-lasting disease control for up to 21 days.

It moves quickly into the leaf wax where it forms a reservoir of the active ingredient in the plant. MIRAVIS® is very stable in the plant, inhibiting spore germination, germ tube and mycelium growth to stop target spot development.

When to use

It should be applied preventatively just prior to row-closure for improved coverage on lower leaves before the disease occurs. This timing ensures it can penetrate the canopy where target spot is more often seen on lower, older leaves.

For flexibility based on localised conditions, there is a rate range of 250-375 mL/ha. The higher rate should be used when disease pressure is high, when extending the spray interval beyond 14 days or later in the season when canopies are larger.

Trials showed aerial application provides equivalent effective disease control to ground boom spray equipment. For adequate coverage, Syngenta recommends a medium spray quality at 50–60 L/ha water volume. Being a suspension concentrate, MIRAVIS® is easy to apply and has excellent tank mixing compatibility with a range of crop protection and fertilisers.

When following CropLife Australia fungicide resistance management strategies, a maximum of three sprays of MIRAVIS® per season is allowed when using more than seven sprays in a crop to control target spot, with a withholding period of seven days.

Find out more

Please contact your local Syngenta representative syngenta.com.au/crops/potatoes for more information on MIRAVIS® or other potato crop protection products.

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Photography by Glenn Power.

Revisiting Zerella Fresh: A flourishing, innovative growing operation

AUSVEG last profiled Zerella Fresh nearly five years ago. Since then, not only has the world changed drastically, but the business has gone from strength to strength: developing its Spud Lite brand of potatoes, adopting new technologies and opening a new washing a packing shed – and winning a slew of industry and government awards along the way. Shaun Lindhe reports.

Back in early 2017, AUSVEG profiled Zerella Fresh, one of South Australia's leading domestic and export supplier of potatoes, carrots and onions, with farms in the Riverland, South-East, Mallee and Northern Adelaide Plains. In that profile we focused on the past, learning about the history of the business.

We learned how Mark Pye, the business's Managing Director, immigrated from New Zealand with his wife Fiona in 1990; having grown up helping his parents grow potatoes.

We learned how they established Parilla Premium Potatoes in Parilla, a town nestled in the Murray Mallee region about 225 kilometres east of Adelaide.

We learned how Mark bought the business Zerella Fresh around five years later and was even then rewarded for his dedication and innovation, taking home the Young Leader gong at the South Australian Food Industry Awards in 2001.

Back then, Mark's vision for the future of the business was "to be the market's preferred potato supplier both today and for the long-term" – lofty ambitions for a business in a $800 million industry.

However, it is fair to say that Zerella – only an hour's drive from Mount Lofty – has spent the last five years realising this vision, continuing to assert itself as one of the most innovative businesses in the industry.

Focus on production, process, people ... and potatoes

The business has gone from strength to strength, gaining significant competitive market advantage through its implementation of several transformational technologies and the development of its low carbohydrate potato variety, Spud Lite.

According to Zerella Fresh Marketing and Media Manager Renee Pye, the business has continued to focus on improving potato products that appeal to customers and improving processes in the business to grow the highest quality potatoes efficiently and effectively.

"Since we last spoke to *Potatoes Australia*, we have continued to grow and seek more efficient and tasty varieties of potatoes," Renee says.

"Additionally, we have continued to adopt new technology across the business, from farming through to washing and packing."

One of the most significant developments that the business has undertaken is building a new $35 million potato washing and packing shed, located in the heart of the Mallee at its Parilla site, which will inject an estimated $42 million into the regional Mallee economy and create 40 new local jobs.

"This new packing shed has allowed us to streamline our process and implement a number of different technologies," Renee says.

The facility features the best available

optical grading and automated packing technology to process potatoes – and doubles the production capacity of the company's existing Virginia potato packing facility.

The business is also focused on broader industry initiatives. This includes focusing on its waste products, joining other South Australian leading potato growing businesses and researchers to invest in research to save up to 100,000 tonnes of potatoes currently going to waste every year, with the aim of converting 100 per cent of their potato waste into commercial benefit.

"We believe it is incredibly important to engage with industry activities as it helps give a wider perspective and understanding on what changes are occurring outside of our own world," Renee says.

"It also links back to the adoption of new products and innovation. A number of our adoptions have come from engaging in industry activities and incentives."

There is a strong focus on listening to customers and suppliers so that the business can respond to ever-changing consumer preferences to deliver products that people love.

"We are listening to our customers through social media and direct calls to our business. We have had an incredible amount of positive feedback and support through all of these platforms," Renee says.

"Additionally, we are also listening and understanding through our customers, the supermarkets and other businesses. This constant communication has helped our business keep on track and give a realistic view as well as build a strong relationship."

Potato growing in a pandemic

It's safe to say that the COVID-19 pandemic has provided a mixed bag for the business.

At the start of the pandemic, sales increased as people bought food to cook at home. Sales of Spud Lite were up 60 per cent and other potatoes up about 50 per cent, while carrots and onions sold around 40 per cent more.

"COVID-19 has affected a number of different parts in our business. The most obvious impact was the increase in supermarket consumer purchasing as states went into lockdown and different restrictions were imposed across the country," Renee says.

"Our staff have done an amazing job to adapt to the changes and get the necessary supply out to the different states, keeping the staples on the shelf in supermarkets."

The downside of COVID-19 has been the obvious drop in sales to the food service sector, including restaurants and cafes, which makes up 20 per cent of the business.

"There was unfortunately a decline in the food service side where we generally supply the second and processing grade, which helps with the sale of the entire crop – not just the premiums," Renee says.

"As many businesses would be dealing with now, we are still experiencing the effects of COVID-19 with external suppliers, including pallet shortages and increases in input costs.

"On the export side of thing, we have seen a continued demand; however, there have been slight difficulties in getting the produce from A to B.

"There is definitely still opportunity and growth when looking overseas."

Industry recognition

Over the last five years, Zerella Fresh has been recognised for its innovative business practices and its journey. The business was recognised by the horticulture industry when it won the 2019 Hort Connections Innovation Partner Award.

Zerella Fresh was also recently recognised as a leading South Australian business by winning the 2021 Innovation in Business award at the South Australian Premier's Food and Beverage Industry Awards.

Renee Pye herself was awarded the Next Generation Award at 2021 South Australian Premier's Food and Beverage Industry Awards for her work on the company's Spud Lite brand, and for her growing involvement in industry initiatives. This includes serving on the South Australian Produce Market Next Generation Committee as well as holding the position of AUSVEG SA Deputy Chair and AUSVEG Director.

"Winning these awards is an incredible honour for us a business – and me individually. These awards also recognise the hard-working people within our business team," Renee says.

"Additionally, it was a great driver to continue on the path of innovating and adopting new components within our business."

The next five years – and beyond

Mark Pye, his daughter Renee and the entire Zerella Fresh team are not known for resting on their laurels. The next five years will be busy for the business as it navigates the new COVID-normal and looks to continue innovating and expanding the business.

"We would like to continue with streamlining the business and adopting best practice plus efficiencies," Renee says.

"We also hope to continue to demonstrate how diverse and thriving our industry is helping to attract additional skilled workers and people we wouldn't have captured in the past.

"The industry we operate within offers great opportunities for people all over Australia and has really proved how essential it is within the last 19 months."

Growers facing rising input costs – with no end in sight

While much of the focus of the pandemic has centred around labour shortages, input costs across the board are soaring, with growers forced to bear the brunt for the foreseeable future unless prices for fresh vegetables increase. AUSVEG National Manager – Communications Shaun Lindhe investigates.

Growers from all over Australia have spoken with AUSVEG and the message is clear – the cost of growing is going up and there is no end in sight to the current rises in production input costs.

This is not a problem that is unique to the Australian vegetable and potato industries – global freight and shipping issues, labour shortages and rising fuel and energy prices are causing costs to skyrocket across the sector.

The consequence of increased farm input costs may not be felt by the average consumer yet, but the economic conditions are forcing growers to make difficult decisions within their business, including reducing production levels or deal with forecasted significant losses if farmgate prices for produce do not rise.

Industry experts from a range of sectors are reporting that increased costs due to global supply chain issues are expected to continue for 12-18 months and retail prices must increase accordingly.

Impact on growers

Farm inputs have increased across key areas, including fertiliser, fuel, chemicals, freight, packaging and wood pallets.

"While all vegetable and potato businesses vary in terms of their production costs, vegetable growers' businesses are facing between 25-40 per cent increase to their cost base across the board," AUSVEG CEO Michael Coote said.

"Growers are typically unable to pass on these increasing costs, which is particularly concerning considering analysts can't tell us how high these cost increases will go or whether there is an end in sight.

"AUSVEG has highlighted the need for farmgate prices of all vegetables to increase by at least 10 per cent to ensure the financial viability of vegetable and potato producers.

"If growers can't cover the cost of production, the best-case scenario is that we see businesses limping through the nation's COVID recovery and unable to innovate or expand. The worst-case scenario is that businesses will go under and people in regional and rural communities will lose their jobs and their livelihoods."

Using independent analysis from Thomas Elder Markets, we break down some of the context behind some of these cost rises.

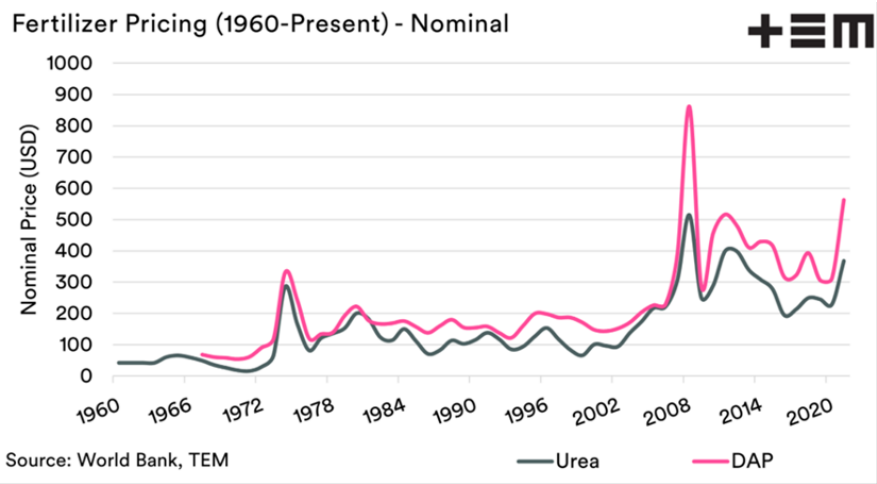
Fertiliser

The cost of DAP fertiliser and urea have rapidly increased to levels not seen since the high of 2008 (see Figure 1). Much of the world is struggling with energy cost and supply, which increases fertiliser production costs as it is highly energy intensive. In Australia, most urea comes from the Middle East and most DAP from China; both which are experiencing energy issues.

On top of this, fertiliser plants are closing in regions that are suppliers of Australian fertilisers. Governments in Europe, China and Russia are also discouraging exports, or capping their exports, creates global scarcity of these products, which could increase prices further and reduce supply.

As demonstrated in Figure 1, fertiliser prices have been rising since the start of the year but have skyrocketed since August. The result of these price increases is that growers may be forced to use less fertiliser because which brings the potential for lower yields.

Figure 1 Nominal price of fertiliser from the 1960s to the present.



Fuel

High energy costs are the driving force behind the rise in fertiliser. So, it's not surprising to also see higher diesel prices since the crash during 2020, given crude oil is the feedstock for diesel.

Figure 2 shows that there is a strong correlation between both Australian diesel pricing and crude oil.

While energy prices are notoriously difficult to predict, the consensus is that energy prices will remain high for the coming months as the northern hemisphere demand ramps up.

Freight

The impact of the pandemic on both sea and air freight has affected many exporting growers, particularly those who export high volumes of carrots, onions and potatoes whose margins are tight given the competitive global market for these commodities.

Many growers from around the country have raised with AUSVEG the shipping disruptions, port congestion and delays, shortage of containers and the rising costs to export vegetables. This situation is not unique to Australia, as markets all over the world are adapting to the changed global

trading environment brought on from the pandemic, particularly the shortage of refrigerated containers for exporting produce.

The high cost of containers around the world is increasing the cost of export goods such as meat, wool, pulses and horticultural products, as well as increasing the cost of importing parts and chemicals.

Disruption to ports across Australia due to industrial actions in Melbourne, Sydney, Brisbane and Fremantle have also caused cost increases and delays.

Figure 3 shows how the price of containers out of China has diverged massively from normally expected levels, moving from the around US$2k to averaging more than US$16K, whereas containers into China are moving at not far off normal levels.

Chemicals

High energy costs are also the driving force behind the rise in chemical prices, including glyphosate. Most of Australia's glyphosate comes from China, which is experiencing energy issues.

Glyphosate pricing has increased dramatically. Typically, 95 per cent glyphosate has traded around the A$4 to A$5 per kilogram. As at the end of August 2021, glyphosate has increased to A$11 per kilogram.

Expectations are that glyphosate costs will likely increase further due to the higher energy costs during September, with coal prices up 42 per cent since the end of August.

Wood pallets

Timber prices in Australia, and in many areas around the world, are increasing due to heightened demand. As a result, there are fewer wooden pallets being made or repaired, which is leading to a shortage. This shortage is compounded by the disruptions in supply chain and freight movement.

Without pallets, goods cannot be shipped into warehouses, leading to forced production stoppages and fewer goods for sale. There are reports that some businesses throughout the global supply chain are hanging on to pallets rather than recycling them.

Figure 2 Cost per litre of crude oil and diesel.

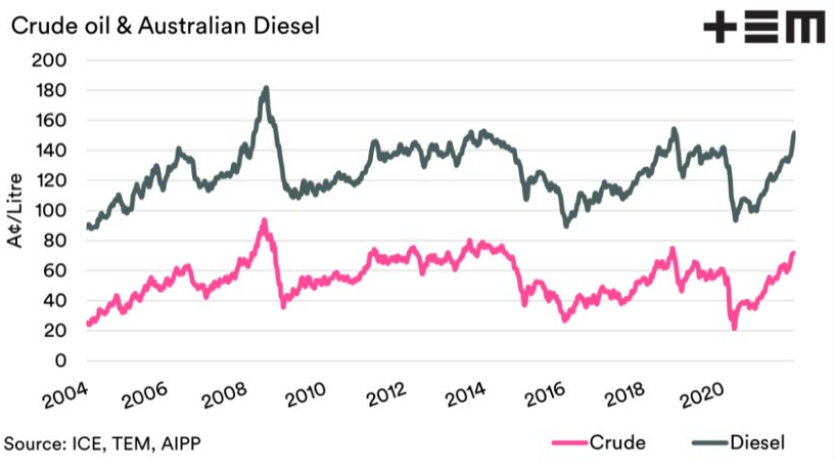
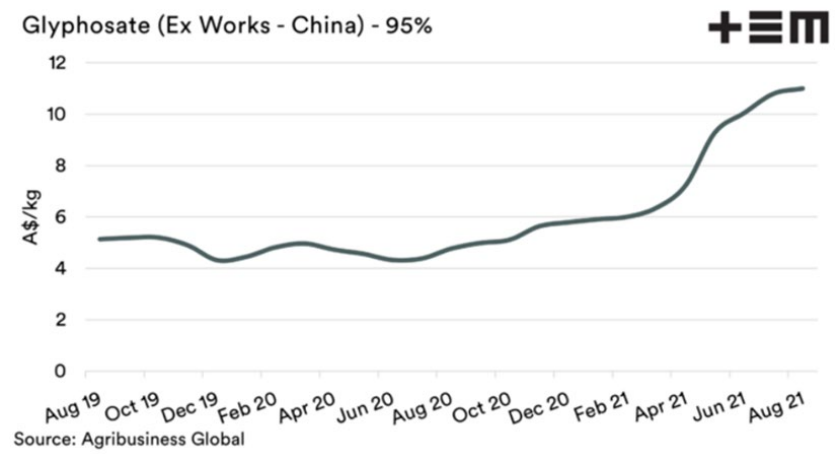


Figure 3 Container rate in and out of China.

Figure 4 Glyphosate prices.



Find out more

The information presented in these charts is accurate as of 29 October 2021.

Please contact Andrew Whitelaw from Thomas Elder Markets at andrew.whitelaw@thomaseldermarkets.com.au for more details.

Australian farmers leading the way with a transformative irrigation system

We all know that water is one of our most precious resources – talk to any farmer and they will tell you that it is also one of their most expensive inputs. A new irrigation technology that uses gravity-powered micro-irrigation is hoping to reduce water use worldwide by transforming flood irrigation, which could save farmers' water and energy costs.


Gary Spotswood

Queensland grower Gary Spotswood prides himself on being ahead of the game.

"Some of my neighbours look over the fence and think I'm doing crazy stuff. I just think it's about being adaptable and open-minded, and willing to learn and try things," he says.

Gary's grandfather started the operation now known as Mt Alma Organics in 1927. It was a venture that began as 364 hectares of scrub and wetlands, which was cleared for conventional livestock farming before the introduction of sugarcane in 1967.

Gary and his wife Angela, aided by their son Daniel, have been running the farm near Inkerman in the Lower Burdekin region since 2011. It's now a 430-hectare property.

In some ways, the operation has turned full circle.

"We're back to farming how my grandfather used to farm without using synthetic chemicals," Gary says.

But there are major differences too. The farm is now larger and more diverse, growing organic fruit and vegetables as well as organic sugarcane and beef. Managing the wetlands around the farm is also important to Gary.

"Being close to the Great Barrier Reef, we're always getting fingers pointed at us," he says.

"But farmers are modest. They're reluctant to talk about the good things they do. You only hear about the bad things."

Focus on sustainability

Mt Alma Organics is focused on becoming a leader in sustainability, which starts with produce grown in a sustainable, regenerative circular farming system.

"That's why I was keen to give the new gravity-powered, micro-irrigation system N-Drip a go," Gary says.

It is a technology that does not require an external energy source or a pressure-based water filtration system.

Gary has installed it on fields where flood irrigation was used to grow sugar cane.

"Our infrastructure wasn't set up for drip irrigation in those fields, but I could see how we could set up an N-Drip system using the same infrastructure as the sugarcane. We've simply tapped into the same outlet," he says.

Some fields are still using a previously installed conventional drip system to irrigate organic zucchinis while other fields use N-Drip, so a direct comparison is simple.

Because N-Drip works with very low pressure, Gary's energy savings are significant.

"Energy consumption is about two thirds less with N-Drip, while yields are the same with both systems," he says.

Setting up the infrastructure is another advantage.

"Conventional drip can't be plumbed everywhere across the farm. With N-Drip, I can move to another field further away without having to run a high-pressure system to the new location. It helps me rotate crops," Gary adds.

A disruptive technology

According to N-Drip Australia General Manager Udi David-Stern, the technology is a game-changer for the agriculture sector for big or small operators.

"There is huge potential for N-Drip to replace conventional irrigation practices for many broadacre crops like cotton, maize, sorghum and most vegetables including potatoes," Udi says.

"In many cases the system has paid for itself in one season."

N-Drip's unique technology received the World Bank's Excellence in Disruptive Technologies award because it can potentially replace less efficient flood irrigation – the most common irrigation practice around the world.

"Many people in Australia think N-Drip is a tiny start-up, but that's not the case," Udi says.

"We are operating in 20 countries with major corporations, NGOs and governments in the US, Asia and Africa."

PepsiCo has recently partnered with N-Drip to test its technology in pilot projects on farms across India, Vietnam, and the U.S.

The results are very impressive, with crop yields improving using less fertiliser and 50 per cent less water than flood irrigation.

Following these successful pilots, PepsiCo and N-Drip will continue their partnership to help farmers grow crops more sustainably.

Success in the cotton industry

Cotton growers– who are among Australia's biggest water users– are also reporting excellent results with N-Drip.

It's been an extraordinary season for Queensland cotton farmer Howard Rother. His achievements have surpassed all expectations. He has credited the system with delivering record yields and causing him to rethink the way he grows cotton.

To top it all off, the Nangwee farmer has been nominated for Cotton Grower of the Year, a recognition he never thought would be possible.

Howard expects the revolutionary

system will eventually replace flood irrigation, saving the cotton industry millions in water costs and significantly boosting profitability.

It was used on 11 hectares of his 70-hectare crop. It yielded 11.5 bales per hectare compared with 7.5 bales produced in the flooded fields. The record yield was delivered using 26 per cent less water.

"You can see a massive difference between my fields with and without the new drip system," Howard says.

"The trial has been particularly effective because we had a dry spell from November to January. It caused problems for the flooded fields, but the N-Drip system continued to operate well."

The exceptional results meant the system paid for itself in one season, so Howard is keen to extend its use. The cost of a single skip row configuration ranges from $1,100 to $1,300 a hectare, while solid is between $1,400 to $1,700 a hectare.

Bore water supplied the first two fields irrigated with N-Drip and a third block, which was to be added in September, uses dam water.

"A system like Howard Rother's 11 hectares could easily be scaled up 10 times provided there is adequate water," Udi says.

"There are no technical limitations preventing much larger scale projects and that is starting to happen. We are currently working on several blocks ranging from 70 to 140 hectares.

"N-Drip is outperforming any flooded block. The better the field is levelled, the greater the outperformance in terms of yield and water usage."

N-Drip system used in a PepsiCo site in Nebraska, U.S.A.

Find out more

Please visit ndrip.com.


Chloe Betts.

AUSVEG advocacy update: Monitoring ongoing industry issues

Over recent months, vegetable and potato growers have faced evolving challenges that include labour shortages, border closures, rising farm inputs, and COVID-19 restrictions. These are complex issues that impact on how vegetable growers operate. The AUSVEG advocacy team has been actively working through these situations and voicing the needs of growers at state and federal level. AUSVEG Policy Officer Chloe Betts reports.

Farm inputs

Farm inputs have been increasing since the beginning of the pandemic. However, the unwavering increase is squeezing growers' margins and forcing many to rethink their options as prices look to continue to rise. AUSVEG has been working closely with growers to monitor the rise in farm input costs and will be providing further details via its advocacy update newsletter.

Overall, growers are seeing a 25-40 per cent overall increase in production costs including fertilisers, chemicals, and fuel. Complementing these increases are the skyrocketing freight costs. Containers coming out of China are recording an eight-fold increase in price. Struggling ports are inundated with containers, COVID cases, lockdowns and strikes, which are causing problems all the way down the supply chain.

Growers will continue to face pressure if farmgate prices don't increase. Many growers have been left with the difficult decision to either decrease production or bear the brunt of the losses. AUSVEG will continue to monitor this situation. We encourage growers to get in touch so we can continue to track the increases in cost of production.

Australian Agriculture Visa

In what has been an extensive process between a number of Federal Departments and industry bodies, AUSVEG is confident the visa will meet much of the expectations from growers of being able to access an efficient and competent workforce.

However, it is important to recognise that the Agriculture Visa will not be a Backpacker Visa 2.0. It will be a visa that is designed for workers to come into the country to work in agriculture and horticulture. With that comes a level of responsibility from the employer, whether it be a grower or a labour hire business.

AUSVEG is advocating strongly that while there will be expectations on employers under the visa, growers are not overburdened with costs or slow processing times, and unreasonable responsibilities.

There will be a trial phase, which is currently underway through a selected number of Approved Employers. This trial will allow workers to come in and for government and industry to gather feedback and learnings before further rolling out the visa in full.

AUSVEG is also aware of a range of businesses offering workers under the Agriculture Visa already, and growers should treat any advances from businesses with caution, as the visa is not yet fully operational.

Growers who have any concerns, or would like further information about the visa, are advised to please contact the AUSVEG office.

Federal Election

Over the past few months, AUSVEG has been working through its Federal Election priorities, with a document to be released in the coming weeks. We have been working closely with our state members and constructing our asks around a survey that was released to all members in September/October 2021.

The major themes of our priorities are:

- Driving increased consumption.
- Developing more efficient businesses.
- Becoming a more resilient industry.

Our focus is to develop strong long-term solutions for persistent issues such as labour, biosecurity, and low vegetable consumption; ultimately helping to promote the growth and health of our community and environment.

Further information on our Federal Election priorities will be released later in the year.

Market price transparency

Unlike many other agricultural commodities, the vegetable and potato sectors there isn't any free, daily, accurate market data available.

Data can be used by growers and other stakeholders along the supply chain to identify consumer and market trends

Access to free, timely, and accurate data can allow stakeholders to respond to changes and capitalise on opportunities. The current high farm input costs are another example where growers and industry struggle for a reference point to demonstrate accurately and freely what is happening in major markets across the country.

A strong potential area for development is around technology to track and record data. Improving technology could help to streamline and create an impartial system, which could standardise produce – a transition away from a paper-based system to further assist with timely data collection.

The Department of Agriculture, Water and Environment (DAWE) has begun a process to look at how better market price transparency could benefit various agricultural commodities.

Many industries such as grains and dairy already have a streamlined and automatic system in place. The meat and livestock industry has a real time data system such as The Eastern Young Cattle Indicator (EYCI), that compiles data nationally. The system utilises technology that promotes a level playing field, allowing all stakeholders to benefit.

While the above is an advanced model, it displays core priorities that could lead to a free, timely, accessible and accurate system available to all growers and stakeholders.

Fair Work Commission rules on piece work rates

In November, the Fair Work Commission (FWC) ruled that '*pieceworker provisions in the Horticulture Award were not fit for purpose.*'

AUSVEG – through the National Farmers' Federation (NFF) Horticulture Council – together with other horticulture industry bodies, had banded together to fight against the proposed changes to introduce a minimum floor by the Australia's Workers Union (AWU).

The decision is a draft variation determination and is a provisional view by the full bench of the FWC. An excerpt of the decision is below:

> *The Full Bench expressed the view that the existing pieceworker provisions in the Horticulture Award are not fit for purpose; they do not provide a fair and relevant minimum safety net as required by s.134 of the Act.*
>
> *The Full Bench was satisfied that the insertion of a minimum wage floor with consequential time recording provisions in the piecework clause is necessary to ensure that the Horticulture Award achieves the modern awards objective. The Full Bench expressed the provisional view that it is necessary to vary the Horticulture Award in the terms of the draft clause.*

It is the Horticulture Council's strong belief that a fair day's work should always receive a fair day's pay, and the piece work rate – when used appropriately – offers that.

The NFF and its members have invested a significant amount of time, money and resources to put the best case forward on behalf of the horticulture industry to ensure a positive outcome for growers.

The Horticulture Council and its members are extremely disappointed with the decision and the impact this will have on growers throughout Australia, particularly at a time when the industry is already grappling with significant labour shortages.

At the time of writing, there has been no date yet set for when this will come into effect.

Find out more

Please contact AUSVEG National Public Affairs Manager Tyson Cattle on 03 9882 0277 or email tyson.cattle@ausveg.com.au. Further details can be found at ausveg.com.au/ausveg-advocacy.

Catherine Velisha.

Helping industry to navigate the horticultural business world

VEG Education was born from a need to think differently about horticulture workforce development, safety and business security. In this article, founder Catherine Velisha speaks about why she established VEG and what it can offer Australia's vegetable and potato industry members.

Third-generation horticultural business owner, Catherine Velisha, has learnt the hard way that keeping your team educated drives not only compliance, but also productivity, loyalty, and satisfaction.

"There was always something missing in our ability to develop the people in our business. We often take the best worker and make them a team leader or manager with little or no training and then wonder why they fail," Catherine says.

"When I purchased the Velisha Farms business off Dad, I quickly realised that things needed to change. Safety, education and investing in our people became a priority."

Developing a people-first approach and investing in education to improve the skills of her workforce, Catherine has been able to change the culture of her family-run business.

Farming and the horticulture sector are seen by the broader community in very simple terms; however, the truth is so much more complex.

In 2020, Catherine joined forces with employment and work, health and safety lawyer, Neil Salvador, to establish VEG Education as a vehicle to assist other horticulture businesses to take the leap into real, value-adding, industry specific education.

"Taking back the narrative from people outside of the industry has been so important for me," Catherine explains.

"I am so sick and tired of people who have no skin in the game, no understanding of the pressures of our industry coming in and telling us what we need. That is why I have dedicated significant time, resources and my own money into VEG Education – to create something *by* us, *for* us."

VEG Education is now a Registered Training Organisation and is also approved by WorkSafe to deliver the Health and Safety Representative Initial Occupational Health & Safety Training Course.

Catherine's passion for improving the industry is clear.

"Training and developing your team is so vital to tackle the challenges facing business over the next 10 years," she says.

"We can provide induction programs, safety training, compliance, management and leadership skills that are specific to horticulture and remove the stress of workplace training."

Building an education support network

VEG Education programs are designed to support farming businesses from the ground up, and inspire a new generation of smarter, safer workers both in horticulture and the wider food and fibre sector industries.

By providing real-life examples and case studies, VEG ensures its comprehensive programs demonstrate how to run a thriving business and assist in navigating the ever-changing legal and compliance landscape within horticulture.

"We are about providing solutions, tangible examples that can help horticulture businesses," Catherine explains.

"It's about giving farmers and owners the tools that will meet their needs – and not simply telling people they have to do better."

A recent article in *The Guardian* entitled 'Farmers manage more than half of Australia. We all have a stake in them getting it right' highlights the increasing challenges faced by the industry.

Farmers need real support and real solutions that can help their business to survive and compete in this increasingly difficult environment.

Catherine sums this up perfectly.

"Yes, there are more fatalities on farms as a percentage of the workforce in agriculture. Yes, there are workforce labour shortages and yes, the industry is expected to adapt to change with little support," she says.

"But I believe this is not the time to release a new review or government strategy paper. This is the time to take real action. The industry is ready to make the changes needed, and VEG Education is here to support that."

Find out more

Please visit vegeducation.com or email info@vegeducation.com.

A fresh approach to boosting vegetable consumption

The Fruit & Vegetable Consortium (FVC) exists to provide the strategic direction and collaborative action required to achieve a significant and sustained increase of Australian consumers' fruit and vegetable intake. In this column, Fruit & Vegetable Consortium Managing Director Justine Coates answers some questions about the organisation and outlines its plans to boost vegetable consumption.

Over the last few years, the Fruit & Vegetable Consortium (FVC) has made notable progress as a collective of 12 organisations united by purpose and committed to collectively raising the alarmingly low levels of fruit and vegetable consumption in Australia.

What is the FVC?

The membership of the FVC is unique and powerful in that it starts at the paddock with Aussie farmers and collectively has the expertise and capability to collectively influence what's on the plate.

Led by Nutrition Australia and AUSVEG, the FVC comprises 12 key partners, including VicHealth, Heart Foundation, CSIRO, Health and Wellbeing QLD, Wellbeing SA, Cancer Council Victoria, Deakin University, Stephanie Alexander's Kitchen Garden and The Good Foundation.

The motivators for the FVC are anchored in human health and wellbeing (preventative and primary care including physical, social, and mental health), with benefits flowing across sectors to agriculture and the supply chain, food service and operators, climate change and the environment, regional communities, and the economy.

What has the FVC achieved to date?

Since March 2019, the FVC has produced a Position Statement, developed a dedicated website, acquired over 250 supporter organisations, and gathered considerable media and institutional interest in its activities.

Importantly, it has also produced in a compelling business case with six propositions that have been researched, validated, and ratified by member organisations. The business case outlines the compelling case for investment and material support for a behavioural change strategy to increase vegetable consumption nationally.

These propositions are:

1. The vast majority of Australians are not eating the recommended serves of vegetables.
2. Low vegetable consumption is causing poor public health outcomes and escalating the health cost burden.
3. Attempts to lift vegetable consumption in Australia have not improved the national position.
4. The economic, social and environmental payback from investing to lift vegetable consumption is compelling.
5. Pooled resources would more effectively deliver the scale of shift that is now required.
6. There is much goodwill among stakeholders to collaborate on addressing this national crisis.

The business case was launched in March 2021 and with it there has been a shift in gears, with FY22 set for collective action. To read the business case, please visit the FVC website: thefvc.org.au.

What is a behaviour change strategy?

Behaviour change programs are essentially social marketing that 'stiches together' and coordinates the collective efforts of multiple interested parties around a common framework.

In this case, the various interventions will be linked by a common umbrella brand (e.g. an active brand such as the Slip Slop Slap or Quit brands), supported by an advertising campaign.

It is intended that the interventions would be able to embrace many of the current activities of the program partners.

The behavioural change model proposed is evidence based and has been successfully employed in an Australian context for such diverse programs such as safety at work and women's fitness.

Why is this behaviour change strategy recommended?

The recommendation for a behaviour change strategy – rather than a marketing program alone – is that there are a range of factors constraining vegetable consumption, which vary across different cohorts and meal occasions. Therefore, a wide range of targeted and nuanced interventions is required beyond advertising alone.

Although advertising can be targeted to some degree, it is essentially 'broad brush', focusing on just one touch point with a 'one size fits all' messaging.

A behavioural issue such as vegetable consumption needs to be far more nuanced in its approach, with distinctly different interventions for each consumer segment that infiltrate their various meal occasions.

Furthermore, the strategy needs to evolve over the years to reflect the changing dynamic as behaviours begin to shift.

Looking to 2022

As the economy starts to resurge in early 2022, it is the intent of the FVC to match state/federal investment by way of commercial fund-raising plus in-kind member contributions (where appropriate).

AUSVEG is working with the FVC ahead of the pending Federal Election to prioritise funding for this behaviour →

$100 million p.a.
reduction in the health burden
(Deloitte, 2016)

$634 million p.a.
in increased economic value
(McKINNA et al, 2018)

$1 billion
in economic value over 11 years
(Deloitte Access Economics, 2018)

Every dollar and job created in the industry creates another in the regions
(Deloitte Access Economics, 2018)

change strategy, given the health benefits to the public and the returns to industry from increased sales.

There is a compelling case for public investment in demand driving activity to support vegetable growers noting the significant rises in cost base due to COVID-19 (labour, freight, global volatility) and climatic change (fires, floods, drought).

There is also an urgent need for government and invested organisations to increase investment and collective efforts in effective funding of broad and narrow cast communications that 'meet consumers where they are' (physically, mentally, and socially in a post-COVID world) to achieve the same increased intake goal.

Find out more

Please contact Fruit & Vegetable Consortium Managing Director Justine Coates on jcoates@nutritionaustralia.org. Further details can be found at thefvc.org.au.

Climate positive practices: Aussie veg producers acknowledged on the world stage

Shane Radford and his daughter Caitlin. Shane and wife Sharni were named runner-up in the Australian Climate Positive Leaders Program award.

In September 2021, two members of the AUSVEG-led EnviroVeg Program were acknowledged for their implementation of climate positive practices and the ecosystem benefits on-farm. Western Australian mixed cropping/livestock producer Jake Ryan and Sharni & Shane Radford from north-west Tasmania were among those honoured, with nominees named from right across the globe.

Corteva Agriscience's 2021 Climate Positive Leaders Program is a nomination-based farmer and rancher recognition program designed to uplift the voices of early adopter producers around the world who are implementing, scaling and sharing climate positive practices.

Launched in March 2021, the program will amplify their successful experiences with the intention of accelerating the broad adoption of those practices where applicable.

Farmers who met the program criteria were nominated by regional third-party groups including grower groups, nonprofits, universities or other technology assistance partners.

A panel of industry-leading judges completed an anonymous review of the farmer applications and confirmed the winner and runner up producers.

The program focused on growers in the U.S.A., Canada (except Quebec Province), Brazil, Argentina, Germany, France, Australia, and Kenya.

Australians recognised

Sharni and Shane Radford, runner-up

Sharni and Shane Radford from Moriarty is Tasmania's north-west were named as a runner-up in the Australian awards. The pair – along with their daughter Caitlin – produces potatoes, onions, carrots, green beans, broccoli, wheat, grass seed, hay, prime lambs, and beef cattle, and apply numerous practices to retain water and prevent run-off in hilly terrain.

As soon as crops are harvested, natural grasses and other cover crops are planted for the 90-day period between cropping to improve soil structure, build organic matter, improve microbial activity, and reduce compaction. Wheat straw is also used in run-off vulnerable locations to reduce soil erosion.

These practices have increased crop yield as well as improved on-farm biodiversity and support for coastal water quality preservation. The Radfords have made a long-term commitment to the conservation of area birds, specifically the ground nesting Swamp Harriers that offer natural pest management. Water quality is monitored to protect the frog and eel populations. Leveraging livestock manure to increase dung beetle populations has also increased soil fertility and moisture retention.

"Climate positive is about thinking differently, focusing on managing the farm so that it can be productive for future generations. The Climate Positive Leaders Program will help us to continue improving the health of our soils with new methods and technologies as they emerge," Sharni says.

Australian Climate Positive Leaders Program award winner, Jake Ryan.

Jake Ryan, winner

Jake Ryan received the Australian Climate Positive Leaders Program award. Alongside his parents Gary and Tracey, Jake runs The Three Ryans – a mixed cropping/livestock operation in Manjimup, Western Australia. The operation uses holistic grazing, minimal tillage, cover cropping, and mineral nutrition to produce a wide variety of winter vegetables; cereal and oilseed commodity crops; ewes for wool and lamb production; first cross Angus Friesian heifers; and pasture-raised laying hens.

Jake has implemented a strip-tilling and cover crop process for his vegetable crops, ensuring there is a living root feeding carbon into the soil and stimulating soil microbes. Acres are rotated with one year of vegetable production, followed by four years of pasture production for livestock and soil regeneration. Cover crops are planted on the entire operation to improve soil, then are grazed or cut for silage.

Further practices

In addition to traditional cover crops, Jake has recently begun intercropping with flowering cover crops to increase the population of beneficial insects and reduce the number of predatory insects that are damaging to crops and livestock. With the adoption of holistic grazing and a focus on mineral nutrition and tracking minerals proportions, he has been able to dramatically reduce the need for nitrogen base fertilisers from the pasture/cover/vegetable crops as well as reducing the phosphorous requirements. Profits have increased consistently five to 10 per cent annually.

Jake says the Climate Positive Leaders Program will help him to communicate to other farmers that climate positive practices are for the betterment of agriculture and the environment.

"Farmers learn best from other farmers, especially when they can see the results in-person. Through this program, I will help demonstrate to other farmers that regenerative practices not only will improve their land but increase productivity and lead to potential financial gains," he says.

Having a voice

Winners – including Jake Ryan – will receive a global platform to share their experience and advocate for climate positive practices. They will also engage with a strong network of other early adopters and leaders in agriculture.

Other opportunities include:

- An expenses-paid international trip, lifetime membership and other benefits with the Global Farmer Network.
- Access to other early adopters and agriculture leaders through engagement with Global Farmer Network and its broad platform.
- Leadership and communications training to support farmers as they share their experience.
- Soil sampling and soil health guidance, including carbon sequestration measurements and an estimation of carbon from Dr Rattan Lal and his team from the Carbon Management and Sequestration Center, based at Ohio State University. Producers will also receive a personalised report with recommendations along with a lecture and interactive discussion with Dr Lal and the program winners.

Sustainability key to family's on-farm success

Sharni and Shane Radford made the decision to participate in the online pilot EnviroVeg Program in 2019. Through their participation, they provided valuable feedback ahead of the program's roll out from 2020.

The Radfords are involved in training the next generation who might be working in the farming sector. They are very proactive in being involved in industry programs, including the Australian vegetable industry's environmental sustainability program EnviroVeg, and regularly share what they have learned with others for the betterment of their industry and growing community.

The EnviroVeg program allowed the Radfords to benchmark their practices against other vegetable producers, and guided changes and improvements on-farm.

The decision to participate in the revised EnviroVeg program led to the business successfully undertaking its first Freshcare Code of Practice Environmental audit in March 2021.

The *EnviroVeg Program 2017-2022* (VG16063) is a strategic levy investment under the Hort Innovation Vegetable Fund.

Find out more

For further details about the Corteva Climate Positive Leaders Program and the 2021 winners, please visit corteva.com/sustainability/climatepositive/leaders-program.html.

The LHP can't provide a certificate of currency for insurances such as workers compensation and public liability. ✗

The LHP has WHS policies and procedures, and a process for induction and supervision of employees. ✓

The LHP has been prosecuted for breaches of WHS, Fair Work or Migration laws. ✗

The LHP has a system for checking that employees have the right to work in Australia (e.g. VEVO). ✓

The LHP can't identify the correct industrial instrument (Award) and pay rates. ✗

The LHP maintains good time and wage records, and pay slips are provided to employees. ✓

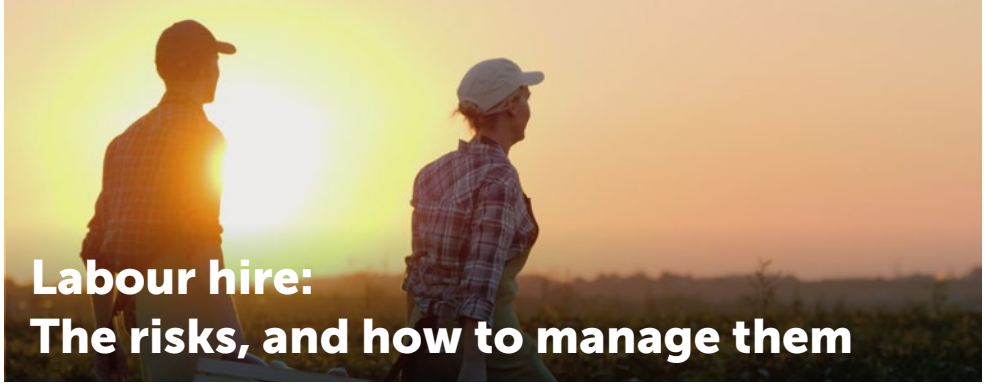
The LHP has written employment agreements and does not use ABNs. ✓

The LHP won't rule out subcontracting to another LHP without consent. ✗

The LHP is currently registered (ABN or ASIC) and has been in business a while. ✓

The LHP has quoted rates that may not enable obligations to employees to be met. ✗

The LHP is a StaffSure certified provider (see staffsure.org). ✓



Labour hire: The risks, and how to manage them

Using a labour hire provider (LHP) does not mean that labour laws don't apply to your business – far from it. If the LHP you use does the wrong thing by its workers, then your business could be liable. The main areas of risk relate to workplace health and safety (WHS), employee wages and conditions, and Right to Work and you should have a system to manage that risk. Fair Farms Program Compliance Officer Adam Carter reports.

Step 1: Due diligence

Your business should apply a process of due diligence before engaging a LHP.

> **Queensland, Victoria, and South Australia have laws that now require the licensing of LHPs. It's unlawful to use an unlicensed LHP in those states.**

To verify that a LHP is licensed, check the relevant online register:

- Queensland: ols.oir.qld.gov.au/licence-register/
- Victoria: register.labourhireauthority.vic.gov.au/LhSearch/
- South Australia: secure.cbs.sa.gov.au/OccLicPubReg/index.php

Labour Hire Provider or contractor?

The business you are considering engaging may claim that they do not need to be licensed because they are a contractor and not a LHP. It is unlawful to enter into an arrangement that is designed to avoid licensing obligations. Whether or not a business meets the definition of an LHP under state laws depends on a range of factors.

Making sure a LHP has a current license is just the first step.

Refer to the checklist of red flags and good practices to consider when preparing to engage with a LHP.

Step 2: Get it in writing

The cost of labour is likely to be one of the most significant expenses for your business. With so much at stake, it's good business practice to have a written and legally enforceable agreement.

If your LHP does do the wrong thing by their employees – and regulators are asking you some hard questions – a written agreement will help in establishing that your business should not bear any liability. A good agreement will require the LHP to provide your business with evidence that it is meeting its legal obligations and should ensure that there is no sub-contracting without consent.

Step 3: Ongoing monitoring

Effectively managing the risk to your business involves implementing a system to regularly check that the LHP is doing the right thing. Check time and wages records on a regular basis and spend some time talking to the employees of the LHP working on your farm. Make sure you investigate any complaints or issues that arise. Applying this process may take a little time and effort but it could prevent a lot of expense and heartache.

Further resources

To view free training videos, please visit growcom.com.au/projects/managing-labour-hire-risks.

Find out more R&D

Please visit the Fair Farms website at fairfarms.com.au.

Visit fairwork.gov.au and growcom.com.au for more information regarding your obligations as an employer.

Fair Farms is developed and delivered by Growcom with support from the Federal Department of Agriculture, Water and the Environment and AUSVEG.

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Foodbank Hunger Report 2021: The reality of the food crisis facing Australia

One in six Australian adults haven't had enough to eat in the last year. On top of this, 1.2 million children have gone hungry during the same period. The Foodbank Hunger Report provides a snapshot of the prevalence and depth of the issue of food insecurity, as well as insights into the day-to-day experience of people living with this fundamental vulnerability.

For a decade, the annual Foodbank Hunger Report has been describing the growing prevalence of food insecurity in Australia. The first report in 2012 was met with disbelief that there were people going hungry in 'the lucky country'.

Year-on-year the awareness of the issue has grown, but so too has the problem. What has become clearer since this report was first published is the diversity of people touched by the issue.

Food relief is not only being sought out by those who are homeless and unemployed, but working families, refugees, single parents, school leavers, First Nations People and many more.

When the global pandemic hit, it radically transformed our day-to-day reality, bringing unexpected challenges and suffering and exacerbating existing societal issues. Those already struggling have been hit even harder, while others find themselves fighting to pay the bills, feed their family and keep the lights on for the first time in their lives.

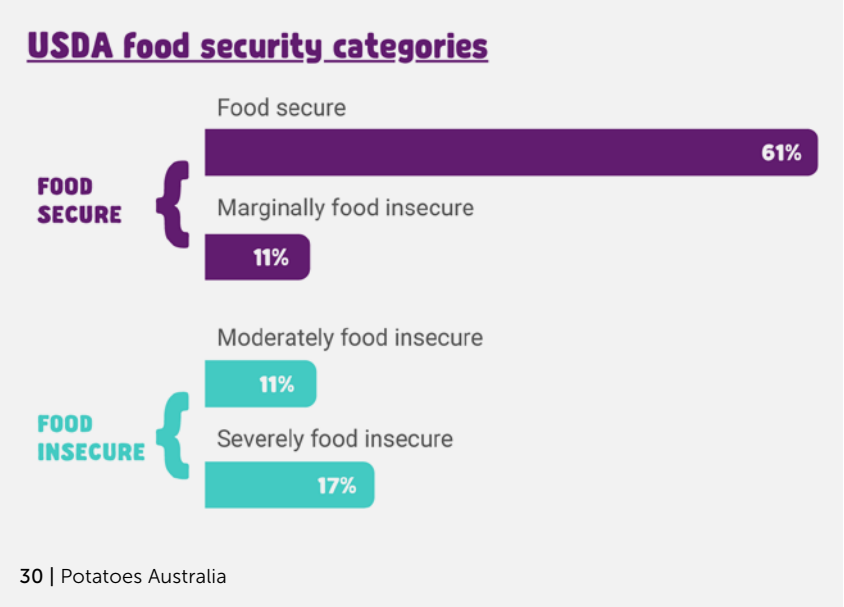
How many people are food insecure?

One in six Australians (17 per cent) can be categorised as being severely food insecure and a further 11 per cent can be categorised as moderately food insecure. Combined, these two categories represent a quarter of Australian adults (28 per cent) who are categorised as food insecure.

In addition to the adults who are severely food insecure, 1.2 million children are living in food insecure households. More than two in five severely food insecure parents (45 per cent) say their children go an entire day without eating fresh fruit and vegetables at least once a week. A similar proportion (43 per cent) of severely food insecure parents say their children go a whole day without eating at least once a week.

What does hunger look like in Australia?

More than seven in ten severely food insecure Australians cut down on the size of their meals (73 per cent) or skip a meal (76 per cent) at least once a week. More than half (57 per cent) go a whole day without eating at least once a week.



What circumstances lead to food insecurity?

The most common reasons why people report experiencing food insecurity are unexpected expenses or bill shock (35 per cent) or overall low incomes (30 per cent).

Of those who were food insecure, what percentage had you experienced food insecurity before the COVID-19 pandemic?

COVID-19 impacts of food security?

While food insecurity is a long-term experience for many, COVID-19 has caused others to experience it for the first time. In fact, more than one in three food insecure Australians (38 per cent) during the last year had never experienced food insecurity prior to COVID-19.

How often are people accessing food relief?

More than three in five food insecure Australians (62 per cent) access food relief up from 59 per cent pre COVID-19. Three in ten food insecure people (31 per cent) are seeking food relief at least once a week.

Are people seeking food relief more frequently?

With so many finding it difficult to make ends meet in 2021, more than half of those seeking food relief (58 per cent) say they are seeking it more often than last year, with a further 26 per cent seeking it just as often. Reflecting this demand, last financial year Foodbank provided food relief to over 1 million people per month.

Find out more

To read the 2021 Foodbank Hunger report please visit foodbank.org.au/foodbank-hunger-report-2021

The Foodbank Hunger Segments

Regional Indigenous

Young First Nations families (77 per cent) living in regional and remote communities on very low incomes in overcrowded households. There are 60,784 people in this segment, of which 1 in 2 (25,852) are food insecure.

Battling Families

Low-income urban families and single parents who are regularly reliant on government assistance to make ends meet. There are 1,239,091 people in this segment, of which 1 in 3 (439,471) are food insecure.

Young Working Families

Young urban families with blue collar or low-income jobs coping with the increasing costs of children's schooling and other activities. There are 2,595,080 people in this segment, of which 1 in 3 (920,638) are food insecure.

Home Leavers

Well educated home leavers at the beginning of their careers struggling with the high cost of independent living on entry level incomes. There are 857,140 people in this segment, of which 1 in 3 (278,039) are food insecure.

Empty Nesters

Retirees and Empty Nesters living in regional communities struggling to manage increasing costs on fixed incomes. There are 1,544,869 people in this segment, of which 1 in 3 (570,918) are food insecure.

Professional Couples

Couples and young families with higher education and above average incomes contending with short-term financial shocks and cash flow issues. There are 4,509,010 people in this segment, of which 1 in 4 (1,071,083) are food insecure.

Low Income City Retirees

Older recently, or soon to be, retired empty nesters facing increasing costs on low fixed incomes. There are 1,685,183 people in this segment, of which 1 in 4 (468,085) are food insecure.

Low Income Country Retirees

Older couples and families living in regional communities on low household incomes with already extremely modest lifestyles. There are 1,755,828 people in this segment, of which 1 in 4 (448,415) are food insecure.

Established Country Homeowners

Established regional households thinking about their retirement and the challenge of maintaining quality of life. There are 2,455,770 people in this segment, of which 1 in 4 (709,268) are food insecure.

Established City Homeowners

Established families with higher asset wealth, some of whom own their own businesses and many with older children still at home contending with financial shocks and cash flow issues. There are 3,096,218 people in this segment, of which 1 in 5 (630,046) are food insecure.

New recycling initiative on offer for Australian ag

CropLife Australia – in partnership with the Australian Seed Federation – has announced its bagMUSTER initiative. This is Australia's first not-for-profit, whole-of-industry genuine collection and recycling program for agricultural bags.

bagMUSTER is an industry-led, not-for-profit recycling initiative for agricultural product bags, including those used to distribute seed and pesticides. It is led by CropLife Australia in partnership with the Australian Seed Federation.

bagMUSTER complements the existing waste stewardship programs drumMUSTER and ChemClear™, which CropLife has developed and delivered for almost 30 years through its wholly-owned stewardship program, Agsafe.

Important recycling partnership

Matthew Cossey is Chief Executive Officer (CEO) of CropLife Australia, the national peak industry organisation for the plant science sector. He said plastic packaging plays an essential role in Australia's agricultural industry by protecting seed, pesticide and other ag products for transport, use and storage.

"What is also essential is that this packaging is collected and processed in a genuine and environmentally sustainable way onshore, here in Australia," Mr Cossey said.

"bagMUSTER is being developed as a hybrid program, taking the best and most suitable components from drumMUSTER and ChemClear™ to deliver an industry-led and fit-for-purpose stewardship solution for agricultural seed, pesticide and other farm input product bags."

Australian Seed Federation is the national peak industry organisation for the Australian seed industry. CEO Osman Mewett welcomed the partnership with CropLife to launch this important recycling initiative for all agricultural product bags.

"bagMUSTER is going to support our industry to meet its obligations in the Australian Packaging Covenant and the broader agricultural sector in its efforts to address the vitally important Recycling and Waste Reduction Act," Mr Mewett said.

"Through bagMUSTER, collected bags will be processed locally, on shore in Australia – further supporting recycling capability and technology development in Australia."

Industry stewardship

Mr Cossey said the implementation of bagMUSTER further shows that the members of both CropLife and the Australian Seed Federation are leaders when it comes to a genuine whole-of-life-cycle approach to industry stewardship.

"Through bagMUSTER and all of CropLife's Stewardship First initiatives, we are continuously adopting and promoting ethical and responsible practices. This is from discovery and development of agricultural products through to their use and the final disposal of associated waste, which allows us to better assist farmers and play our part in protecting the environment," he said.

Mr Mewett added that partnerships with governments will be crucial to ensure a viable and sustainable model is delivered for the benefit of Australia's farmers when the pilot stage begins in 2022.

"Following the pilot phase, bagMUSTER will be delivered through an industry-funded model. Those who import, manufacture and supply bags, or import pre-packaged products will contribute on a fee-for-service basis. This will mean no farmer levy and minimal costs for the agricultural sector," Mr Mewett said.

Find out more

Please visit bagmuster.org.au. For further details about CropLife's Stewardship First initiatives, please visit stewardshipfirst.org.au.

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Spotted winged drosophila (*Drosophila suzukii*) larvae. Image courtesy of Hannah Burrack, North Carolina State University, Bugwood.org.

Giving Australian agricultural diagnostics a booster shot

A number of Australasia's top research institutions have joined forces to develop diagnostics tools that aim to keep pests at bay and maintain good biosecurity across plant production industries. In this article, AUSVEG's Ian Thomas outlines the extension activities being undertaken as part of the *Boosting Diagnostics for Plant Production Industries* project.

Plant pests and diseases have been the burden of growers since the beginning of agriculture. The disruption to trade while diagnostic decisions are being made can be costly to businesses and trade, and reducing this timeframe will be crucial in the coming years as disease and pest pressure rises due to increased global trade and climate uncertainty.

To prevent incursions and stay on top of good biosecurity practices, modern, quick, and accurate diagnostic tools need to be available to growers and diagnosticians Australia-wide.

In 2019, a Rural R&D for Profit program entitled *Boosting Diagnostic Capacity for Plant Production Industries* (Boosting Diagnostics) commenced. Led by the Grains Research and Development Corporation, Boosting Diagnostics seeks to increase Australia's ability to detect, contain, and eradicate plant pests and disease outbreaks.

In recent years, the development of DNA identification tools such as LAMP, qPCR, and MinION (Oxford Nanopore) make it easier than ever to identify pests and diseases on-farm, but for these tools to be effective there is a lot that must first happen. Assays for identification must be developed and tested, both in the field and the laboratory. Reference samples must be secured and categorised. Protocols need to be developed, tested, and tested again.

Boosting Diagnostics supports the development of new diagnostic tools, underpinned by strong communication and extension activities to raise awareness of these tools among diagnosticians and industry. This will assist in early, rapid, and accurate detection of pests and diseases on-farm and allow swift and precise responses from industry.

It is not solely about detecting the presence of pests and diseases, but also their absence. Australia is free from many pests and diseases that plague the rest of the world. This absence – and our ability to prove it – allows Australian growers access to markets all over the world. The extra capacity provided by Boosting Diagnostics will help provide strong scientific evidence that our growing regions are free from pests and diseases.

Extension and communication activities

Throughout the remainder of 2021 and 2022, AUSVEG will be coordinating the extension and communications component of Boosting Diagnostics to deliver the many and varied project outcomes into the hands of those who will use them day-to-day. These activities will be delivered in two streams: the Diagnostic Stream and In-field Stream.

The Diagnostics Stream will focus on delivering developed technologies, protocols and expertise to diagnosticians and lab-based personnel through relevant diagnostic events and activities. Meanwhile, the In-field Stream will focus on in-farm triage and translating the diagnostic knowledge to actionable on-farm capacity and capability. This component will target professionals working in the field, ranging from agronomists, field pathologists, biosecurity officers, state surveillance staff and growers.

AUSVEG will run seven workshops in different regions across Australia, each focusing on the pests and diseases impacting each region's industries and addressing their specific requirements. During this process, AUSVEG will increase the awareness and knowledge of selected National Priority Plant Pests (NPPPs), provide updates on project activities, and deliver updated resources to diagnostic personnel across the plant production industries.

Pest and disease targets

Boosting Diagnostics will focus on a variety of target plant pests and diseases affecting a broad range of plant industries. These include the cyst nematodes of the genus *Heterodera* (pests of grains and vegetables), *Xanthomonas citri* subsp. malvacearum (the cause of bacterial blight of cotton), and spotted wing drosophila (*Drosophila Suzuki*; a potential threat to berry and wine production), among many others.

The individual projects are broad and varied, and approach the issue from different angles.

Dr Andrew Weeks from Cesar Australia

Xanthomonas citri subsp malvacearum symptoms on cotton. Image courtesy of Clemson University – USDA Cooperative Extension Slide Series, Bugwood.org.

Scouting a citrus crop for white fly. Image courtesy of Shutterstock.

is developing diagnostic tools that use environmental DNA (eDNA) to identify pests without needing direct insect collection. eDNA is left behind in frass; that is, excrement from the digestive system of various pests, or on feeding sights. It can be used to help identify pest species presence – even when they may not be found.

"The eDNA diagnostic tools, sampling approaches and factsheets developed through this project will enable more rapid identification of some high priority plant pests, allowing more effective management intervention to be undertaken to prevent or limit incursions or outbreaks," Dr Weeks said.

"The project will assess the feasibility of moving the technology into the field. We envisage the technology could be rolled out in some form within the next two-to-three years."

Specific to potatoes, the wider project also looks at strengthening diagnostic capability for potato cyst nematode and tomato potato psyllid as well as bioblitzes and industry training workshops. Stay tuned for more details in future editions of *Potatoes Australia*.

Each Boosting Diagnostics sub-project is a small piece of a larger puzzle. As each one falls into place, the picture of what improved diagnostics and better biosecurity looks like for Australia's potato growing sector will begin to take shape.

Industry collaboration

The Boosting Diagnostics for Plant Production Industries project is a partnership between the Grains Research and Development Corporation; Cotton Research and Development Corporation; Horticulture Innovation Australia Ltd; Wine Australia; Sugar Research Australia Ltd; Forest and Wood Products Australia Ltd; AgriFutures Australia; Commonwealth Scientific and Industrial Research Organisation (CSIRO); Minister for Primary Industries and Regional Development (SARDI); Western Australian Agricultural Authority; Department of Jobs Precincts and Regions (VIC); Department of Agriculture and Fisheries (QLD); Department of Primary Industries (NSW); Department of Primary Industry and Resources (NT); Biosecurity Tasmania; Plant Health Australia; Plant and Food Research; AUSVEG Ltd; Cesar Pty Ltd; and Bio-Protection Research Centre.

Find out more R&D

For further details about the Boosting Diagnostics project, please contact AUSVEG Project Officer Madeleine Quirk on 03 9882 0277 or email madeleine.quirk@ausveg.com.au.

This project is supported by the Grains Research and Development Corporation through funding from the Australian Government Department of Agriculture, Water, and the Environment – as part of its Rural R&D for Profit program – and the Cotton Research and Development Corporation, Hort Innovation, Wine Australia, Sugar Research Australia, and Forest and Wood Products Australia.

Australian Government
Department of Agriculture, Water and the Environment

Symptoms of *A. solani* on a potato leaf .Image courtesy of Gerald Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org.

A destructive potato fungus: *Alternaria solani* under the microscope

Alternaria solani causes the disease early blight (or target spot), which is one of the most significant foliar fungal diseases of potatoes in Australia. High disease pressure is most damaging to crops earlier in the season, so it is important to keep an eye out for symptoms when crop monitoring. AUSVEG Biosecurity Officer Zali Mahony discusses early blight of potatoes and best management practices you can implement to ensure losses are minimal.

Alternaria solani is a persistent fungus that causes disease on the stem, leaf and tubers of potato plants, known as early blight or target spot. This fungus can also infect tomato plants. The name given to the disease refers to the plant growth stage when it is most prevalent. Early blight refers to the infection of young, emerging plants and target spot refers to leaf lesions, occurring mostly on older plants or leaves.

Distribution

The fungus is widely distributed throughout Australia's key potato production regions. Good on-farm hygiene practices and disease risk preparedness measures can safeguard your property against this fungus.

Other key species of *Alternaria* (i.e. *A. grandis* and *A. protenta*) are not yet present in Australia, but have been observed to cause similar diseases on potatoes in Brazil, Algeria and Belgium. These species represent a biosecurity risk to Australia's potato production – if these exotic species were to arrive in Australia, they could have a devastating impact to the industry with severe yield losses and impacts to marketability.

Symptoms

A. solani can infect the stem, leaf and tuber of potato plants and symptoms vary depending what part of the plant is infected.

Leaf symptoms are initially small (1 to 2mm) and are black/brown. Under favourable environmental conditions, pin-point lesions will enlarge (more than 10mm) and develop visible concentric rings, with a 'yellow halo' surrounding the dark lesion. Often, this symptom is referred to as a 'bullseye' lesion and is

Symptoms of *A. solani* on a potato leaf.
Image courtesy of Howard F. Schwartz, Colorado State University, Bugwood.org.

Lesions caused by *A. solani* on an infected potato tuber.
Image courtesy of Sandra Jensen, Cornel University, Bugwood.org.

highly characteristic of *A. solani*. In cases of high disease pressure, entire leaves can die and drop off.

On stems, symptoms commonly present as sunken, lens-shaped lesions with visible concentric rings. Tuber lesions differ again, and are often characterised by sunken, irregularly shaped lesions and surrounded by a purple border.

Environmental conditions that favour the disease

There are several environmental conditions that can contribute to greater disease establishment in potato crops. These include:

- Hot and dry conditions with extended wet periods – eight hours of leaf wetness (or greater) is a crucial requirement for the fungus to infect plants.
- Stressed crops are more susceptible – this may include plants with physical damage or those experiencing water stress or low foliar nitrogen.

A challenging disease cycle to control

There are two key aspects that make *A. solani* a difficult fungus to control. In a single season, the disease can undergo several cycles meaning fungal spores build up in favourable conditions increasing disease load. Additionally, the fungus can survive cold or unfavourable conditions in soil, on plant debris (including tubers), weeds and other volunteer plants.

The fungus can be spread by wind, rain splash, irrigation water and on insects. After spores land on a plant surface, germination followed by infection will occur once environmental conditions are favourable.

Management

A. solani can be controlled effectively by cultural practices that aim to reduce the number of fungal spores present in a crop, which in turn reduces infection levels. These practices include:

- Purchasing certified disease-free seed potatoes.
- Choosing a less susceptible variety to grow (if possible).
- Implementing a crop rotation system (avoid other solanaceous crops, control potential weed hosts, practice a two-year crop rotation at least if a paddock is known to have *A. solani*).
- Removing or cleaning up crop debris, weed and volunteer hosts.
- Limiting plant stress – ensure plants have adequate nitrogen available and are exposed to minimal water stress or prolonged leaf wetness.
- Using preventative fungicides, rotating with different mode of actions.

By implementing sound cultural practices and keeping the crop in good health, early blight can be kept below economic levels.

Farm pest and disease preparedness

On-farm preparedness is the best defense against harmful pest and diseases that are not yet present in your production area but are likely to arrive, either seasonally or through natural spread.

A. solani is easily spread through soil and infected plant material that is transported to new locations via vehicles, equipment, footwear, and clothing. Preventative practices that can be incorporated into everyday farm business will reduce the likelihood of being impacted by this disease.

Some of these practices include:

- Use farm biosecurity gate signage (available from AUSVEG, please see details below).
- Direct all staff and visitors to a designated parking area.
- Provide footbaths or vehicle wash down facilities.
- Record on-farm visitors via a sign-in register.

Find out more R&D

Please contact AUSVEG on 03 9882 0277 or email science@ausveg.com.au.

Biosecurity signage is available from AUSVEG free-of-charge (limits apply). The Farm Biosecurity Project is funded by the Plant Health Levy.

Clare Peltzer.

What potato growers can learn from leading agriculturalists

For 70 years, Nuffield Australia has built capacity for individual producers, their businesses and the agricultural industry more broadly by offering scholarships for farmers to travel and gain a global perspective on critical industry issues. Nuffield Australia is part of a global Nuffield network that aims to increase practical farming knowledge and management skills and techniques generally.

While Australian potato growers have received Nuffield scholarships and undertaken important research, there are many other topics researched by members of the broader agriculture industry that can offer a broader industry and global perspective on topics that all growers can learn from.

Topic: Attracting young people into agriculture

Title: *Attracting Youth into Agriculture: Developing a strategic framework to encourage young people into agriculture – a model for Tasmania*

Author: Clare Peltzer

Supporter: Clare's Nuffield Scholarship was supported by Meat and Livestock Australia

To meet future workforce challenges, there needs to be greater alignment between industry bodies to ensure secondary school students are exposed to the benefits and opportunities of a career in Australia's agricultural sector.

That's according to a report by Clare Peltzer, who with support from Meat & Livestock Australia, investigated global programs that sought to better attract and retain young people into pursuing a career in agriculture.

Travelling across Belgium, Bulgaria, Canada, the Czech Republic, England, Germany, Ireland, Italy, Kenya, the Netherlands, New Zealand, Qatar, Romania and the United States of America, Clare met with schools, universities and agricultural industry advocates to identify global programs that would be applicable in an Australian context.

Engaging students in agriculture

Motivated by her part-time work as a secondary education agriculture teacher, Clare said to meet future food supply targets and ensure the continuum of individuals entering the agricultural workforce, it's vital students are frequently exposed to agriculture during pivotal times in their education.

"The full spectrum of career prospects available in agriculture are not well understood and therefore not pursued, so we need to expose students to authentic agricultural experiences across both urban, regional and remote schools," she said.

"Through my travels I identified a number of established and successful programs working to attract students into post-16 agricultural studies. However, like Australian-based programs, they are frequently implemented in isolation and not revisited during pivotal schooling years."

Using science education as a model

When travelling in the United Kingdom, Clare met with an industry representative from the National Farmers Union who introduced her to the Science Capital framework, a tool which measures an individual's exposure to and knowledge of science (see page 40 for more details).

"Adopted in the UK to identify reasons why a student pursues a career in science, the Science Capital framework has created coordinated change in science education policy and practice," she said.

"From implementing professional training programs to changing language used in the classroom to better

encapsulate the diversity of the sector, this framework has enabled students to broaden their understanding and perception of career opportunities within the science sector."

"Though designed for the teaching of science, the parallels that can be drawn between perception, barriers to entry and the science-based nature of the work, could be of significant value to an Australian agricultural context."

Broadening understanding of careers in ag

In the report, Clare outlines the need for coordinated effort within the industry to deliver programs that broaden understanding and showcase the diversity of careers within agriculture and its various industries.

"In Ireland for example, teachers often utilise the 'FaceTime a Farmer' initiative to directly connect classroom with farm; harnessing the power of digital communications to inspire, engage and educate young people," she said. "Australia would greatly benefit from developing an Agricultural Capital framework, to align various industry bodies and ensure youth are frequently exposed to the diversity of the sector."

"A coordinated approach will ensure that students between 12 and 16 years from farming and non-farming backgrounds are exposed to the diversity and viability of a career in agriculture."

"Applying the Science Capital framework in the context of Australian agriculture will not only identify deficiencies in the interface between early schooling years and a career in agriculture, but will help ensure all efforts aimed at attracting the next generation are strategic and coordinated."

"The state of Tasmania would be an ideal pilot study for this framework, as it's economically dependent on agriculture and has a strong foundation of existing programs in which global examples could be integrated or altered to suit."

"This framework would act as a common document to be utilised by schools, industry bodies and other stakeholders to equip young people with the knowledge of the vast career opportunities within agriculture, building capacity and futureproofing our workforce."

"It's vital that we place a greater focus on encouraging the next generation into agriculture, by ensuring frequent and coordinated interactions with the sector during pivotal schooling years."

Clare's recommendations following her scholarship report:

- Industry-wide acceptance and use of Dr Hlami Ngwenya's acronym PERFECT opportunities in agriculture (see below for more details).
- All within PERFECT agriculture to help address any misperceptions about a career in agriculture.
- Apply the Agricultural Capital framework to the current system in Tasmania to attract youth into pursuing agriculture in post-16 studies.
- Find successful programs/activities from other countries to integrate into the Tasmanian Agricultural Capital framework for further use.
- Potential to apply the Agricultural Capital framework to other states or countries.

Report extracts

Chapter 2: Broadening the perceived definition of agriculture

Anecdotally, the majority of interviewees across multiple countries stated that it is imperative to "reframe agriculture as a business choice that is intellectually, socially and financially rewarding, as well as one in which young people can have an incredible impact on issues such as climate change, hunger, displacement, poverty and more" (International Agri-Food Network, 2018).

In order to reframe agriculture, there is a dire need to be more inclusive of all sectors of agriculture under the one umbrella. Currently, agriculture is perceived by youth as 'just farming' which is the largest and most influential limiting factor to attracting more into the industry.

As perception equals reality, the industry needs to change the language used and allow a broader range of career options to fall under the agricultural banner. Within the agriculture industry, it is common knowledge that farming is an important, but not the only sector to be considered, while others outside the industry do not have a grasp on the full extent of jobs available.

The need to sell the full breadth of career options within agriculture is a concept explored by South African, Dr Hlami Ngwenya, where she identified the PERFECT opportunities available in agriculture as an acronym for all sectors and their associated career paths (table to the right).
She created it to challenge people to broaden their view to seek alternative pathways to attract brilliant and innovative youth, including those out of the mainstream agricultural field.

All career options under the PERFECT banner, at all levels (local, state, national and global), need to incorporate the term agriculture into their dialogue to increase the proportion of the population involved in agriculture. This will lead to a higher probability that youth will interact with someone involved in agriculture on a daily, weekly or annual basis.

Furthermore, parents, family and close friends may find themselves under the agricultural banner, which creates a more powerful dialogue with the interested youth.

Table 1
Dr Hlami Ngwenya's PERFECT opportunities in agriculture (2019).

	Career opportunities
P	Policies
E	Education and Training
R	Research
F	Finance and Farming
E	Extension and Advisory Services
C	Communication
T	Technologies and Trade

Chapter 4: Agricultural capital

4.1 Applying Science Capital Framework to agriculture

4.1.1 Why the Science Capital Framework can be used

Similarities exist between the challenges of attracting youth into post-16 studies in both science and agriculture. Although science is the basis of many aspects of agriculture, there are other parallels to be drawn between the two, allowing the Science Capital Framework to be successfully applied for the same purpose in agriculture. For example, both careers are perceived with stereotypical older, white males working hard in low-paying jobs. Although this perception is generally incorrect, it is difficult for both industries to alter these views to attract more youth into pursing post-16 studies in either field.

4.1.2. Differences between science and agriculture

Although there are several obvious similarities, there are still some differences that need to be identified to allow for the application of this model while knowing its limitations.

Table 2
Differences between science and agriculture as subjects delivered at secondary schools in Tasmania.

	Science	Agriculture
Enrolment	Every school has science courses available and due to it being compulsory for most of those years with strong enrolments.	The number of viable programs is declining, consequently the number of students served by the program are declining too.
Availability	Available in every school from lower primary to upper secondary. Compulsory for majority of those years.	Generally, it is up to the individual school to choose to include it into their curriculum.
Current curriculum	Updated as often as the other core courses. The concepts taught in science are generally static, but the applications adapt to the current climate.	Some of the content taught has failed to keep up with modern agriculture, e.g. the recent Irish agricultural curriculum had not been updated for the past 30 years.
Uneven quality	The quality is carefully monitored by teachers from consecutive years as content is cumulative.	Due to a low number of available courses, measures are not in place to ensure even quality of courses.
Academic rigour	Carefully monitored by adjustments made in the curriculum, within assessments and remains high through feedback from tertiary providers.	Generally lower than other sciences.
Cohort of students	Science is compulsory for Year 7-10, then a choice for Year 11-12. A prerequisite for many university degrees.	Routine processes are required to evaluate the curriculum content to ensure it continues to attract a cross-section of students in terms of academic ability and tertiary education aspirations.
Access to Continuous Professional Development (CPD)	Higher number of courses available that theoretically reduces the distances to travel to the CPD.	Limited number of courses, which leads to larger distances to be travelled. Online courses could be a successful method to connect teachers.
Teacher support in school	As it is compulsory in every school, generally, there is a team of science teachers who can provide and receive support with their content, pedagogy or assessment tasks.	As an option in some schools, generally there is a limited number of agriculture teachers so lack of timely support with their content, pedagogy or assessment tasks.
Teacher education	Many science and specialised science teaching degrees at tertiary providers.	Very limited number of specialised agriculture teaching degrees at tertiary providers.

4.2. Agricultural capital

The Science Capital 'carry all' can be further dissected into eight key dimensions identified as reasons why students pursue science in their post-16 studies. These have been adapted to an agricultural setting as seen in Table 3. The definitions will ensure that the dimensions are correctly interpreted and can be applied to a range of different programs/activities both in and out of school to ensure targets are being reached.

Table 3
Agricultural capital with definitions and examples of the eight key dimensions.

Agricultural capital defined as:	
1. Knowledge of agriculture	A young person's knowledge and understanding about agriculture and how agriculture works. This also includes their confidence in feeling that they know about agriculture.
2. Agriculture-related attitudes, values and dispositions	The extent to which a young person sees agriculture as relevant to their everyday life (for instance, the view that agriculture is 'everywhere').
3. Knowledge about the transferability of agricultural skills	Understanding the utility and broad application of agricultural skills, knowledge and qualifications (e.g. that these can lead to a wide range of jobs beyond, not just in, agricultural fields).
4. Consumption of agriculture-related media	The extent to which a person, engages with agriculture-related media including television, books, magazines and internet content.
5. Participation in out-of-school learning activities	How often a young person participates in informal agricultural learning contexts, such as agricultural museums, farming and country shows.
6. Family agriculture skills, knowledge and qualifications	The extent to which a young person's family have agricultural-related skills, qualifications, jobs and interests.
7. Knowing people in an agriculture-related job/role	The people a young person knows (in a meaningful way) among their wider family, friends, peers, and community circles who work in agricultural-related roles.
8. Talking to others about agriculture in everyday life	How often a young person talks about agriculture with key people in their lives (friends, siblings, parents, neighbours, community members) and the extent to which a young person is encouraged to continue with agriculture by key people in their lives.

5.3 Applying the Agricultural Capital Framework to Tasmania

The Agricultural Capital Framework will work well within the Tasmanian system as it is a small island with a high concentration and economic dependency on agriculture. With short distances to a wide range of agricultural enterprises and examples of PERFECT agriculture, interactions of youth with agriculture has the potential to be more accessible compared to other states of Australia. Additionally, the large discrepancy between the quality and quantity of schools teaching agriculture, there is a need to include non-school based methods to attract youth into agriculture.

The strengths of this framework in Tasmania are:

- The number of highly professional businesses within suitable distances of the major metropolitan areas – Hobart, Launceston and Devonport.
- The high number of stakeholders from government positions through to business owners interested in having a strategic approach to attracting youth into the industry.
- Well-resourced, funded and successful programs currently exist.

Despite the strengths with this framework, limitations within this state include:

- Accessibility to willing people within all aspects of PERFECT.
- True collaborations between PERFECT agriculture for a common goal.
- The need for annual reassessments of this framework to be modified and adapted to suit changes within the forward-moving agricultural sector.
- Remaining as a non-political framework.
- The difficulty of ascertaining its success as a numerical piece of data to compare its success year-on-year.

Find out more R&D

To read Clare's report *Attracting Youth into Agriculture: developing a strategic framework to encourage young people into agriculture – a model for Tasmania*, please visit nuffield.com.au/clare-peltzer-2019

For more information, or to read more reports like Clare's, please visit nuffieldscholar.org/reports.

Nathan Richardson
Tasmanian Farmers and Graziers Association
Vegetable Council Chair

56a Charles St
Launceston TAS 7250
Phone: 03 6332 1800
Website: tfga.com.au

Tasmanian Farmers and Graziers Association

With Tasmania having just experienced one of the wettest Octobers on record, growers have been battling to prepare ground for potatoes and are now encountering delays with planting.

The Bureau of Meteorology have also predicted that the next three months will be wetter than average for some parts of the state, creating some significant barriers for growers to face. Perhaps an equally significant obstacle that growers not only in Tasmania, but across the country have faced so far this season, is the rapidly increasing cost of inputs and land prices.

The most recent Rabobank Land Price Outlook shows that between 2019 and 2020, land prices in Tasmania have increased by 28.3 per cent. These major price increases for inputs such as fuel, fertiliser, chemicals and freight are having a huge impact on gross margins and Tasmanian growers are certainly feeling the effects. There continues to be strong demand for fresh and processing vegetables and provided we can get the crops in the ground, growers are set to make the most of this.

There have been a few changes in leadership within both TFGA Potato Committees, following on from two very successful negotiation periods with Beau Gooch stepping down as Chair of the TFGA McCain Potato Committee as well as Trevor Hall as Chair of the TFGA Simplot Potato Committee.

Both Beau and Trevor have committed significant amounts of time over several years to represent growers and achieved some outstanding results. The TFGA would like to thank them both for their efforts in what can be a challenging role.

Tim Withers
AUSVEG VIC
Executive Officer

3 Glenarm Road
Glen Iris, VIC 3146
Phone: 0427 098 461
Website: ausvegvic.com.au
Email: info@ausvegvic.com.au

VGA trading as AUSVEG VIC

AUSVEG VIC

AUSVEG VIC recognises the future benefits of Victoria lifting its COVID-19 vaccination rate and is supportive of greater access for rural and regional communities to get the jab.

However, we will continue to collaborate with the Department of Jobs, Precincts and Regions (Agriculture Victoria) and the Department of Health and Human Services regarding COVID-19, vaccinations and the widespread impact the pandemic will have on farms in the latter half of 2021 and early 2022. AUSVEG VIC will also continue to pose growers' questions and concerns to these organisations.

Currently, there is a large information gap around the mandate. Legal practitioners are currently unable to specify what this will mean for Victorian growers. AUSVEG VIC is speaking with various government departments and is awaiting legal advice to clarify the rights and obligations of employers and employees.

In the meantime, AUSVEG VIC encourages all members to contact their GP if they have any medical concerns or questions regarding the COVID-19 vaccine. We will keep members updated with any further developments on the developing situation, including a response from Victorian Agriculture Minister, the Hon. Mary-Anne Thomas, and her policy team about the possibility of rapid antigen testing.

Additionally, AUSVEG VIC is in constant communication with Agriculture Victoria's Seasonal Workforce Coordinators, labour hire companies, Minister Thomas's office and growers surrounding the Victoria-Tasmania quarantine extension announcement.

In September 2021, AUSVEG VIC welcomed the long-awaited announcement that the Victorian Government will extend the quarantine pathway with Tasmania to allow up to 1,500 workers from the Pacific Islands as part of the Seasonal Worker Programme and Pacific Labour Scheme.

However, it has been noted that there are large delays for many growers, as the workers are only able to present on-farm in December. This is due to the large volume of workers coming into Victoria via the Tasmania hotel quarantine system. AUSVEG VIC will continue to monitor the situation, and members with labour issues are encouraged to reach out and share their concerns.

Jordan Brooke-Barnett
AUSVEG SA
Chief Executive Officer

South Australian
Produce Markets
Burma Road
Pooraka, SA 5095
Phone: 08 8221 5220
Website: ausvegsa.com.au

AUSVEG SA

As we move closer to the March 2022 State Election, AUSVEG SA is engaging with all sides of politics to put forward an agenda to grow horticulture in the state.

Central to our discussions have been breaking the impasse on long-standing issues such as a sustainable pricing model for the Northern Adelaide Plains Irrigation scheme and securing funding for key infrastructure projects, such as Gawler River Flood Mitigation works.

In addition, securing long-term access to labour is a key priority for our association moving forward; in particular ensuring South Australia has the access to quarantine places and flights necessary to facilitate in-bound workers through both the Seasonal Worker Scheme and soon to be finalised Agriculture Visa.

With our industry located in many of the expected battleground states in the coming election – be it in the hills or Adelaide's north – it is AUSVEG SA's intention to have many of the longstanding issues impeding our industry feature in the upcoming election.

Likewise, AUSVEG SA continues to engage strongly with the AUSVEG national policy team around the development of policy for the expected Federal

Election in early 2022. Key issues such as access to labour, water issues and infrastructure are expected to feature and AUSVEG SA will ensure that the perspective and views of our SA growers are accounted for in these critical national discussions.

After a tough couple of years with COVID-19, it is clear that both sides of politics have developed a new-found interest in food production as a critical industry and the potential for agriculture (and horticulture) to help lead Australia's recovery moving forward.

It is critical we harness this interest and put forward our vision as a collective industry at a time when the Federal Government is allocating significant funds towards areas like drought mitigation, biosecurity and other areas to assist primary production.

In the final quarter of 2022, we will hold our first-ever Ag-tech Meetup Breakfast at the SA Produce Market. The breakfast will bring together a number of Ag-tech start-ups in the state along with key growers with a view to better understanding the needs of horticulture.

I am hopeful that better dialogue and understanding of the opportunities in Ag-tech will help assist our growers to trial new emerging technologies available in their business. We are already seeing some exciting work in areas such as field robotics trials in the Mallee potato industry, and AUSVEG SA wants to ensure that we support industry to build these important relationships with Ag-tech moving forward.

Seed Potatoes Victoria (SPV)
Committee

PO Box 123,
Toongabbie VIC 3856
Email: seed.potatoes.victoria@outlook.com
Website: spv.org.au

Seed Potatoes Victoria

The season in most regions is shaping up to be very good, with essential rainfall and temperatures warming up from sunny days. Land is being prepared for the next crops with only a few growers commencing planting thus far.

Seed Potatoes Victoria held its Annual General Meeting on 28 October 2021, where Gordon Jones was re-elected as SPV Chairman while Portland seed grower Mark Peters was elected to the role of Vice Chairman. Ballarat grower Mark Labbett will continue as Treasurer.

The new edition of the Victorian Seed Buyers Guide and new version of the SPV website are being finalised and will be available shortly.

The Committee is keen to support projects and activities for members. Please contact your local delegate or email admin@spv.org.au with ideas or suggestions for things you would like to learn more about in the potato industry.

Thank you to all industry members for their support and work in preparing for the coming season.

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POTATO LINK

Hort Innovation Strategic levy investment | POTATO – FRESH FUND

Hort Innovation Strategic levy investment | POTATO – PROCESSING FUND

POTATO LINK
AUSTRALIAN POTATO INDUSTRY EXTENSION PROJECT

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Communications Manager

Hort Innovation

Level 7, 141 Walker Street
North Sydney NSW 2060
Australia

Email: communications@horticulture.com.au

Phone: 02 8295 2300

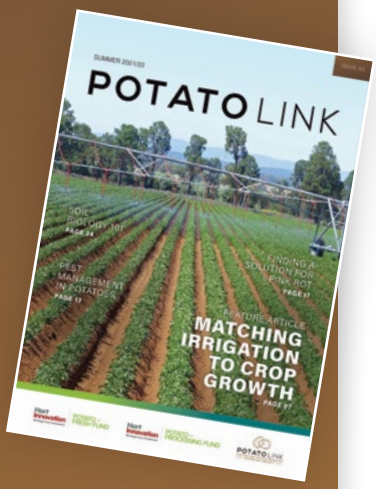
POTATO LINK
AUSTRALIAN POTATO INDUSTRY EXTENSION PROJECT

TECHNICAL CONTENT
Dr Jenny Ekman
comms@potatolink.com.au

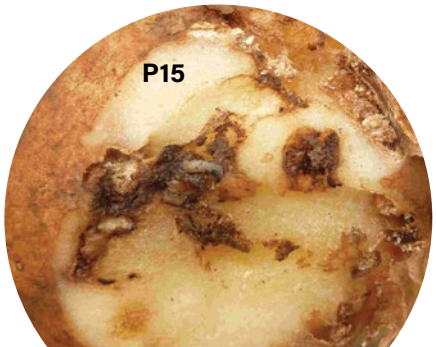
EDITOR
Linda Drake
info@potatolink.com.au

PROJECT COORDINATOR
Peter O'Brien
peterob@potatolink.com.au

DESIGN
Jihee Park
hello@jiheeparkcreative.com



Cover photo by Marc Hinderager



POTATO LINK
AUSTRALIAN POTATO INDUSTRY EXTENSION PROJECT

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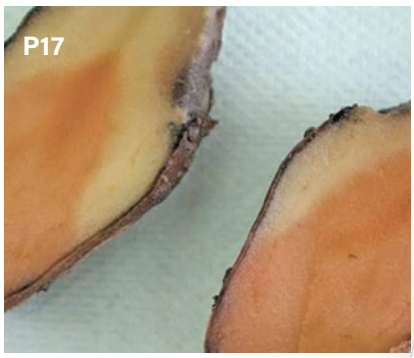


EVENTS GUIDE

Project update From Peter O'Brien

As we finally emerge from lockdowns the PotatoLink team is very much looking forward to increasing our face-to-face involvement with the potato industry. It will be great to finally leave our local government areas and engage directly with growers, advisers and processors through regional workshops, training events, field days and so on. Now that we feel more confident planning such events, they will soon be appearing through the e-news bulletin as well as on the potatolink.com.au website. Please keep a look out for these events and make sure you register so you don't miss any events near you.

Rain is creating havoc for many parts of the country trying to get crops planted. It has been a long time since we have had planting interrupted across the east coast and Tasmania as much as this.

Despite this, some demo sites are underway, with plantings often made at short notice due to the limited dry windows for getting out into the field.

In the coming months you will also see a number of webinars featuring international speakers. These will be focussed on important potato diseases. It's a great time to firm up these opportunities as our speakers go into the Northern hemisphere off season. As with field days and the like, these webinars will be promoted through the e-news and website on our calendar of events.

Remember you can watch any of our webinars you might have missed simply by visiting the Featured Resources section of the website. Or simply type in the topic you are interested in. For example, the recent masterclass on Soil Biology in potato production is now available, split into four parts for easy watching – or binge if you please!

We look forward to making real contact with you all in 2022.

EVENT	CONTACT / PRESENTERS	DATE AND TIME (AEDT)
F2F Growing right workshops – Getting a better crop stand, to optimise quality and yield		
Victoria, Potato virus management	Nigel Crump, with AusPICA	21 December 2021, 09:00 – 5:00 location TBD
Tasmania, Final crop management and canopy recovery	Frank Mulcahy	13 January 2022, 16:30 – 17:30, location TBD
SA (Naracoorte), Potato crop rotation and soil health	Peter Philp, in coordination with Bayer and SARDI (PredictaPt)	31 January 2022, timing and location TBD
SA (Parilla), Soil health workshop on calcium and salinity	Peter Philp, in coordination with Bayer	March 2022, timing and location TBD
Webinar – Cover crops		
Cover crops for fresh and processing potatoes	Kelvin Montagu, Darren Long	24 February, 12:00 – 13:00
Webinar – Disease series		
General potato diseases	Gary Secor (USA)	timing TBD
Black dot	Alison Lees (UK) and Len Tesoriero, TBD	timing TBD
Blackleg, and other bacterial diseases	Steven B Johnson (USA), TBD	timing TBD
Rhizoctonia diseases	Rudolf de Boer, Michael Rettke, TBD	timing TBD

MATCHING IRRIGATION TO CROP GROWTH

Dr Jenny Ekman reports

"Potatoes don't eat, they drink. Potatoes drink, but they don't swim."

F. Mulcahy

Potatoes are mostly water, packaged with starch plus various minerals, vitamins and other nutrients. While they are often regarded as being a high water use crop, they are more productive per megalitre of water than many other horticultural crops.

Potatoes have a relatively shallow root zone and are very sensitive to water stress. They are often grown on soils with low water holding capacity, which makes irrigation management difficult. Too much water increases disease and reduces quality, while too little water reduces productivity, yield and nutrient uptake.

Water is not necessarily free, and neither is distributing it across a paddock or pivot. The potential gains in yield and dry matter from managing water correctly are huge, so controlling and accurately managing irrigation should be a top priority for all growers.

POTATO DEVELOPMENT

Irrigation requirements change as the potato plant grows and matures (Figure 1). Understanding growth stage is therefore essential to understand the water needs of the crop. Physiological development of the potato plants is commonly divided into five stages;

Stage 1 – Establishment: Planting and emergence (20 to 35 days)

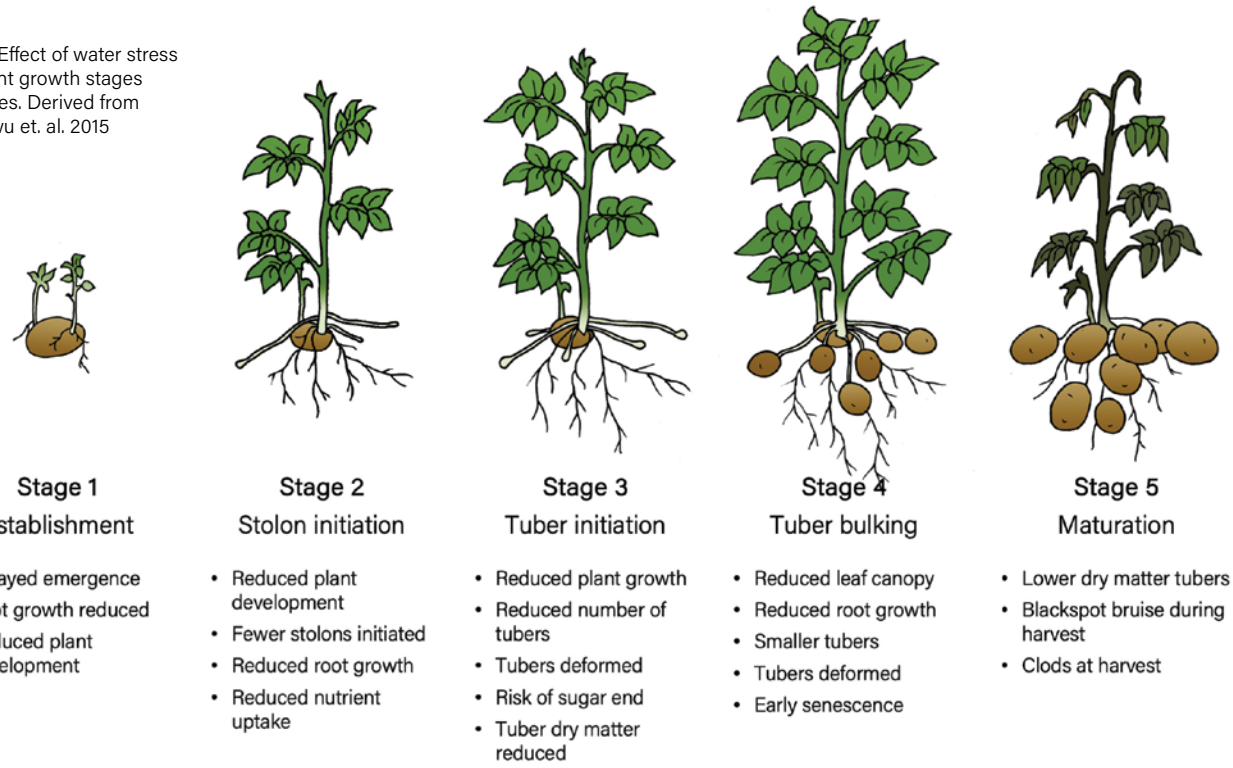
Stage 2 – Stolon initiation: Early vegetative growth and stolon development (15 to 25 days)

Stage 3 – Tuberisation: Tuber initiation at the end of the stolons (10 to 15 days)

Stage 4 – Tuber bulking: tubers fill and expand (30 to 60 days)

Stage 5 – Maturity: Tuber maturation and vine death (15 days or more)

Figure 1. Effect of water stress at different growth stages of potatoes. Derived from Obidiegwu et. al. 2015



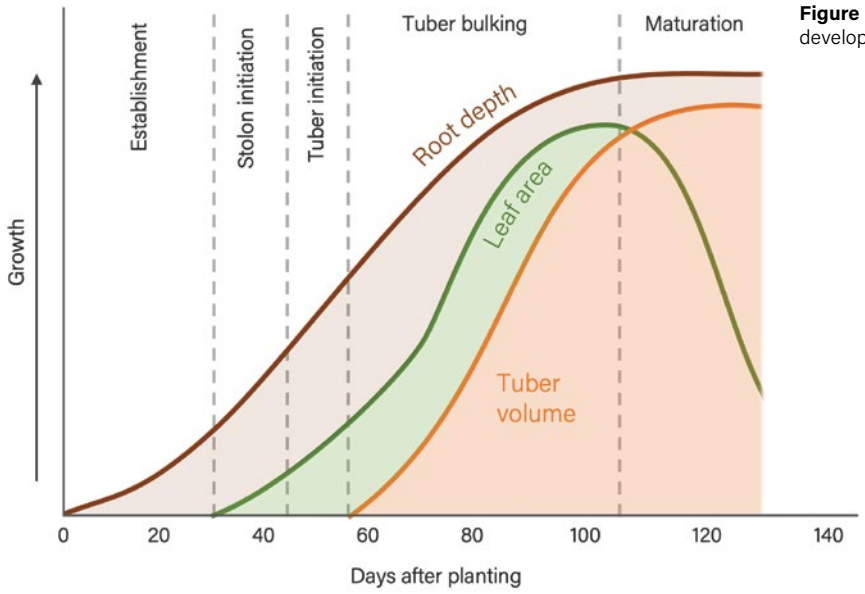


Figure 2. Potato plant development stages.

Potatoes are normally regarded as a cool-climate plant. It was once thought that photosynthesis by potato plants was almost completely inhibited at temperatures over 30°C. However, it is now known that this effect was mainly due to water deficits. In fact, potatoes can adapt to high temperatures (~40°C) and continue to photosynthesise, but only if adequate moisture is available[2].

WHAT IF PLANTS HAVE TOO LITTLE WATER?

The first physiological response to water stress is closure of the stomata (breathing holes) on leaves. Moisture inside the leaves evaporates through open stomata (Figure 3). While this cools the leaf canopy, keeping temperatures below the ambient air, it also results in moisture loss.

If the plant closes stomata to reduce moisture loss, carbon dioxide movement into the leaf is also reduced. This inhibits photosynthesis, limiting accumulation of starch and sugars. Potato yield and quality (e.g. specific gravity) depends on photosynthesis exceeding the everyday energy needs of the plant, allowing storage of excess carbohydrate in the developing tubers.

Water deficits also reduce the internal pressure which is necessary for cell expansion and growth. Leaf canopy and root growth can be significantly reduced. Although tuber development resumes when water becomes available, the disruption can result in deformed tubers with bottlenecks or pointed ends. It also increases the likelihood of tuber cracking (Figure 6).

It is well established that insufficient water at any stage will reduce yield. Overall, the penalties for under-irrigating are greater than those for over-irrigating (Figure 4). Moreover, avoiding moisture stress is more critical during some parts of the cropping cycle than others – as discussed on the following pages.

WHAT IF PLANTS HAVE TOO MUCH WATER?

Over-irrigation leaches nitrogen from the root zone. This reduces fertiliser use efficiency, potentially restricting plant growth as well as contaminating ground water. It also increases disease, often obvious in damper

Figure 3. Stomata control gas exchange between cells inside the leaves and the outside environment.

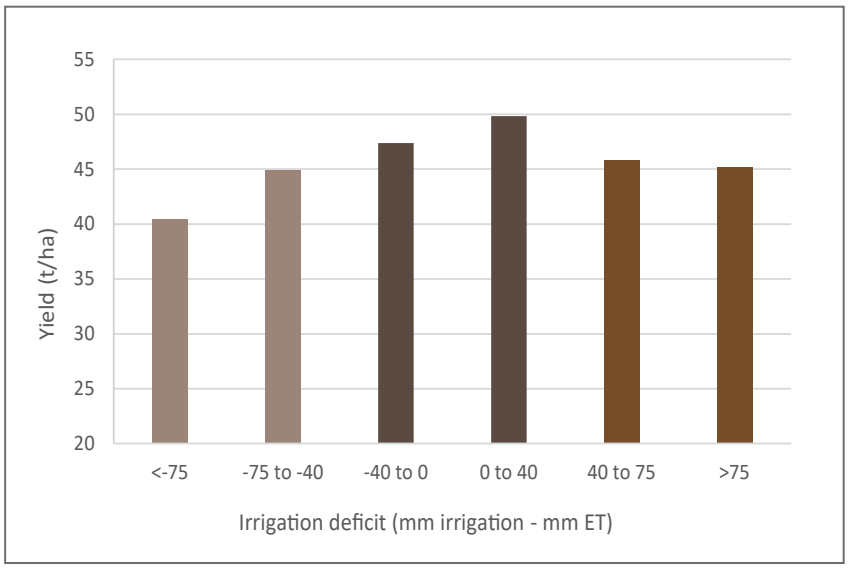


Figure 4. Total tuber yield as influenced by the difference between total irrigation and evapotranspiration (ET). Data from 45 commercial potato farms in Idaho (Stark, 1996[3]). *N.B. divide by 2.47 to convert to t/acre.*

patches of the paddock, and can have long term effects on tuber quality and storability.

Initial symptoms of anaerobic, waterlogged conditions are puffed lenticels on the tubers (Figure 5). If the soil profile remains fully saturated for more than 8-12 hours, anaerobic conditions can damage roots and tubers. This can cause "black heart" of the tubers, where the inner tissues collapse due to oxygen starvation (Figure 7). More than 36 hours of waterlogged conditions will also result in denitrification, or loss of soil nitrogen to the atmosphere.

Figure 5. Puffed lenticels on potatoes harvested from a wet area.

GROWTH STAGES AND IRRIGATION

Stage 1. Establishment

Ideally, soil moisture should be relatively high before planting. If this is the case, irrigation after planting may not be required. Some light watering to replace surface evaporation can be useful if soil moisture is marginal. In damp soil, the seed itself has enough internal water to support the developing sprout.

If soil moisture is too high, the saturated soil will restrict the rapid respiration rate of the sprouts. It can also potentially allow infection by soil-borne pathogens. For example, early dying has been linked to high moisture during emergence[4].

Excess soil moisture at planting can also increase seed piece decay and delay emergence, as soils remain colder for longer (e.g. for early spring plantings).

Stage 2. Stolon initiation

Although tubers have not yet started to develop during stage 2, water use increases as the leaf canopy expands. The leaf area index generally reaches around 50-80% row closure during this period, with increased transpiration as a result.

Water deficits during this period can reduce the number of stolons that form, as well as negatively affecting plant growth and maturation.

The most critical period for accurate management of irrigation is during stage 3 – tuber initiation and stage 4 – tuber bulking.

Stage 3. Tuber initiation

Water stress (and/or high nitrogen status) leading into this stage can delay tuber initiation by several weeks. The effects are often greatest for indeterminate varieties, increasing the length of the cropping cycle and potentially creating other issues. In contrast, some determinate varieties are relatively insensitive to water stress during this period and will mature normally.

Studies have certainly confirmed strong varietal effects. For example, water stress during early tuber initiation reduced yield by more than 50% for cv. "Luky" whereas cv. "Alpha" was not significantly affected[5].

Similarly, research in Western Australia found that yield and quality of cv. Russet Burbank (indeterminate) and cv. Delaware were significantly reduced by low soil moisture during emergence and tuber initiation, whereas cv. Cadima and cv. Kennebec (determinate) were less affected[6].

While irrigation deficits during tuber initiation can affect yield, it is the effects on tuber quality that are the most significant. Even short periods of dryness that do not reduce total yield can greatly affect tuber quality. Dumbbell shapes, cracks and other deformities all result from uneven soil moisture during tuber initiation and early development (Figure 6).

Another potential effect of water stress during tuber initiation and early bulking is the development of "translucent end" or "sugar end", especially when combined with high temperatures. Dry conditions mean that sugars produced by photosynthesis are not fully converted into starch in the tuber. The result is a colour gradient from the light tip to the dark stem end following processing (Figure 6).

Maintaining high soil moisture during tuber initiation and early bulking is essential for good dry matter. However, over-moist conditions during tuber initiation combined with cool conditions increases the risk of susceptible varieties developing brown centre or hollow heart (Figure 7).

Stage 4. Tuber bulking

Water stress during tuber bulking typically affects yield more than quality. These effects cannot be recovered; total yield will be reduced.

Maintaining a large, actively photosynthesising leaf canopy is essential for tuber expansion. The leaf

canopy continues to grow during this period, reaching row closure near the end of stage 4.

Dry conditions interrupt shoot growth and hasten the decline of older leaves. Reduced photosynthesis slows tuber development.

The root system also expands during stage 4. Mature roots can access water up to around 50cm deep within the soil profile. However, as most roots remain within the top 30cm of the soil, plants are still susceptible to moisture stress.

Moreover, the relatively weak root system of potato plants means they are often unable to penetrate tillage pans or restrictive layers within the soil. Field traffic can cause soil compaction, which also limits penetration depth of roots.

Understanding the depth of root penetration is critical to managing irrigation volume and frequency during this growth stage. Varieties that have greater root branching, better root architecture and increased root depth are likely to be less sensitive to water deficits than those with less efficient root systems.

Tubers enlarge approximately linearly over time so long as environmental conditions are maintained.

All this means that potato plants' water requirements reach their maximum right when it is most critical to avoid water deficits[7].

It is also important to avoid excess irrigation during this stage as wet conditions increase disease, leach nutrients and may reduce dry matter.

Stage 5. Maturity

Irrigation needs drop as plants begin to die off during stage 5. Tuber growth rates decline, and skins start to mature and harden.

Translocation of nutrients from the leaves, stems and roots into the tubers leads to a small amount of further expansion, even as the tops die.

However, the soil should not be allowed to fully dry, as this can increase number and hardness of clods at harvest, as well as dehydrate tubers.

Figure 6. Disorders associated with dry conditions during tuber initiation and bulking include (from left) sugar end (M. Thornton, Uni Idaho); dumbbell (JM Gravouille, INRA); growth cracks (K Bouchek-Mechich, INRA) and internal heat necrosis (A Robinson NDSU).

Figure 7. Disorders associated with too much water include (from left) brown centre (JM Gravouille, INRA); hollow heart (JM Gravouille, INRA) and black heart (A Robinson NDSU).

Dehydrated tubers are more likely to suffer bruising during harvest (Figure 8). Blackspot bruises are not visible externally, as the skin itself is undamaged. Instead, the damage is localised in the flesh, close to the vascular tissues. The damage is usually not visible straight away but develops 24 to 48 hours after harvest.

Excessive irrigation after the vines have died off increases risk from pythium leak (*Pythium* spp.) and pink rot (*Phytophthora erythroseptica*), as well as secondary infection by soft rots. It can also reduce tuber dry matter.

Wet conditions during harvest can lead to cracks and shatter bruise damage.

IRRIGATION METHOD AND FREQUENCY

The sensitivity of potatoes to soil moisture levels, combined with their shallow root system, means that irrigation needs to be applied before the crop is affected by water stress. Frequent irrigations have been found to result in higher yield and tuber dry matter compared to intermittent irrigation (Figure 9)[8].

Drip irrigation is frequently cited as the gold standard in irrigation for potatoes. Drip allows soil to be kept continually moist and avoids wetting leaves, thereby reducing foliar diseases. However, it is expensive and not compatible with current Australian growing practices.

Figure 8. Potatoes that are dehydrated at harvest are more susceptible to blackspot bruising (M Thornton, Uni Idaho).

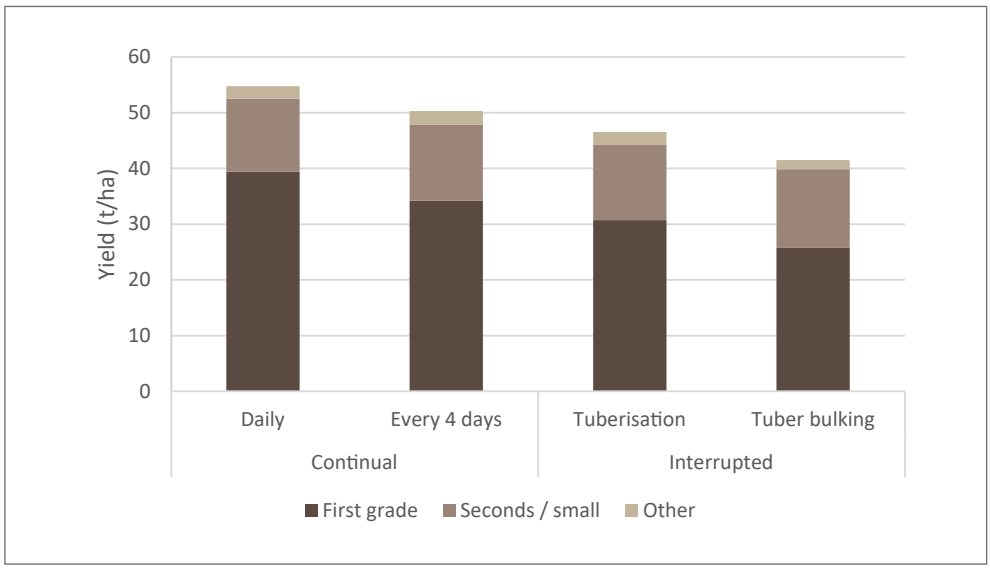


Figure 9. Effect of irrigation frequency (daily or every 4 days) and interruption during either tuber initation or tuber bulking, on average yield divided into grade 1, seconds and smalls (<114g) and waste. Derived from Miller and Martin, 1990[10].

Linear move and centre pivot are the next best options, followed by side-roll systems.

Furrow irrigation allows large and undesirable fluctuations in soil moisture content.

As sprinkler systems wet the leaves, it is often recommended that plants are not irrigated in the late afternoon or evening if leaves will remain wet overnight. Leaf wetness increases risk from diseases such as black scurf, common scab and early blight[9].

Large volume and infrequent irrigation events not only fail to maintain even soil moisture, they contribute to runoff, can pollute ground water with nitrates and are more likely to oversaturate soil than frequent irrigation. According to King and Stark[3], this is most likely with side roll and hand-move sprinkler systems, where soil water holding capacity and root depth may be overestimated.

MEASURING SOIL MOISTURE

See p12 for a comparison of different soil moisture sensors

Tensiometers

Tensiometers work like plant roots in that they measure the 'suction' required to extract water from the soil. Tensiometers are basically a sealed, water filled tube with a porous tip at one end and a pressure gauge (kPa) at the other. As the soil dries, moisture moves from the tensiometer into the soil, creating a partial vacuum in the tube. This is equal to the soil water potential (kPa). Fully saturated soil gives a reading of 0kPa, whereas -40kPa or less indicates the soil is dry.

To get reliable readings, the cylinder must be sealed against air leakage and there must be excellent contact between the soil and the porous tip.

Time domain reflectometry (TDR) sensors

These sensors measure volumetric soil moisture content. TDR sensors have two or three parallel metal rods. The time taken for an electromagnetic wave to travel from one rod to the other indicates soil moisture content.

TDR sensors are a well-established technology and widely used in agriculture to measure soil moisture. Small portable systems have been developed that allow data to be uploaded to a website, where it can be easily accessed.

The TDT (time domain transmissometry) sensor is a variation on the TDR. Instead of parallel rods, the sensor consists of a "U". TDT sensors are less portable than TDR but sample a larger soil volume.

Soil moisture capacitance sensors

Capacitance sensors also measure volumetric moisture content, but by measuring the charge time for a capacitor with electrodes separated by the soil. Fast charge times indicate high moisture contents. There are many brands available commercially, with associated equipment for transmitting and storing data.

IN SUMMARY

- **Too little** moisture affects yield more than **too much** moisture
- The effects of water stress vary at different crop growth stages
  - Tuber initiation and tuber bulking are the most critical times to get irrigation just right
  - Water stress during tuber initiation can have major effects on quality
  - Water stress during tuber bulking has the greatest effects on yield
- Too much soil moisture can increase disease and may reduce specific gravity
- Potato plants prefer small amounts of water often, avoiding water stress, compared to large, less frequent irrigation events
- There are lots of devices available to monitor irrigation and get soil moisture into the goldilocks zone: **Not too damp, not too dry, but.... Just Right!**

Figure 10. A tensiometer (Irrometer) and a, TDR sensor (Wildeye), two types of soil moisture probes

	Tensiometer	TDR	TDT	Capacitance
Accuracy	Variable	Very good	Excellent	Good
Cost	$150 – $500	$300 – $500 per sensor + comms	$300 – $500 per sensor + comms	$300 – $400 per sensor + comms
Life expectancy	5 years	10 years	10 years	5 years
Remote access?	Normally manual	Yes	Yes	Yes
Needs calibration by soil type?	No	No	No	No
Affected by salinity?	No	Yes but can be compensated	Yes but can be compensated	Yes but can be compensated
Sensing area	Small	Moderate	Moderate-large	Small
Notes	Easy to install and use, needs regular maintenance	Can be portable	Normally permanently installed	Requires good contact with soil

Table 1. Comparison of types of soil moisture sensors

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PEST MANAGEMENT IN POTATOES

By **Dr Paul Horne**

Dr Paul Horne is well known to many as the Director of IPM Technologies. His 5-year project "An IPM extension project for the potato and onion industries" has supported growers adopting IPM on farm, improving their pest management while reducing chemical use and costs. Now at its conclusion, Paul reflects on successful implementation of IPM on potato farms.

POTATO PESTS

Each agricultural crop has its own set of pests and potatoes are no different. The range of pests that Australian growers deal with varies a little between regions, but there are some that most have in common.

The main pest species in Australia are potato tuber moth and various aphids (as potential vectors of virus). Caterpillar species such as loopers and Heliothis (*Helicoverpa* species) can also be important, while several species of thrips are potential vectors of tomato spotted wilt virus (note that the seasonally abundant plague thrips does not vector TSWV). Soil-dwelling pests such as the larvae of African black beetle, whitefringed weevil and potato wireworm are very important in a few regions but absent in others.

The importance of these pests not only varies in importance by region but also by crop type. For example, aphids are of most concern to seed growers, while potato tuber moth is more important for growers wanting to harvest high-setting varieties in mid-summer. Thrips and TSWV are a concern in a few localities, where there are reservoirs of both the virus and species of thrips that vector it (particularly tomato thrips and onion thrips).

PEST CONTROL

So, what are the options for control of these pests, in whatever combination they occur? As with any crop, growers have three categories of options to select from:

- Biological controls (predators and parasitoids of the pests)
- Cultural controls (management methods that help encourage beneficial species or discourage pest populations)
- Pesticides

Figure 1. Brown lacewing adult and larva (Photos IPM Technologies)

If growers choose to use all three in a compatible way, then that is integrated pest management (IPM).

Each species of pest has other insects that attack it. Some are extremely effective and can be relied upon to give substantial levels of control. Predators and parasitoids of aphids and potato moth include parasitoid wasps, brown lacewings, hoverflies, ladybird beetles and damsel bugs. They are particularly effective in providing a high level of control of these key pests, although at times they need some extra support from cultural and pesticide controls. These beneficial species occur naturally in all potato growing regions of Australia. They can reach extremely high levels in potato crops so long as broad-

> *"We started using IPM just a few years ago, and now we are seeing much better control of potato moth and aphids. Our use of insecticides is much more precise and effective."*
>
> - Ben Hotchkin, Thorpdale, Victoria

Figure 2. Hoverfly adult and larva (Photos IPM Technologies)

spectrum insecticides are not applied. Pest thrips are attacked by other species of thrips, true bugs, mites and beetles.

However, it is more difficult to manage soil dwellers such as beetle larvae and wireworms. There are no really effective biological controls, so other techniques are needed – such as cultural controls.

Some cultural control measures are extremely important for reducing damage by insect pests. For example, certified seed, weed control (including control of self-sowns), rotation and isolation reduce the risk of virus transmission.

Potato tuber moth damage to the tubers can be reduced by ensuring there is fine soil tilth and large hills, rolling and using overhead irrigation.

Variety selection, time of planting and harvest can also help manage a range of pests and insect vectored diseases.

The third and final method of controlling pests is using chemical pesticides. Applying broad-spectrum insecticides before or immediately after planting will not usually reduce the impact of the beneficial species described above, as they will fly into crops only after they emerge.

However, application of these products to growing foliage will severely disrupt populations of beneficial species. This can induce 'pest flare', where populations of a particular pest (e.g. aphids) increases dramatically in the absence of competitors and predators.

Broad-spectrum insecticides can also be applied without disrupting beneficial species if sprayed at or after crop senescence (or when applying a herbicide to kill the plants).

However, if selective products are applied (e.g. for caterpillars or aphids) then the beneficial species and pesticides can work together, giving better control than either on their own. This is the "integrated" part of integrated pest management.

Over the last few years many growers around the country have switched to using IPM rather than relying on insecticide applications alone. Some have already told this story through articles in Potatoes Australia e.g. Victorian grower Wayne Tymensen [February/ March 2019], South Australian grower Pat Virgara ["Grower Success Stories" January 2019] and Kangaroo Island seed grower Peter Cooper [June/July 2017].

"We first met Paul and his team at a conference down south. At the time, pest numbers in the potatoes were un-manageable. We attended one of the workshops Paul and Angelica ran in the Lockyer and then they visited us on our farm to talk to us about our own pest management program. Since then, we have totally changed our approach to pest management. We have gone from a situation where pest numbers were out of control to now, where we are flat-out finding a pest in the crop. Our total pesticide usage is maybe 5% of what it was. And our agronomist tells us he feels sorry for all the beneficial insects in the crop because there is nothing for them to eat."

- **Kerry Hauser, Hauser Farms, Lockyer Valley Qld**

With few new chemicals coming on the market, increasing legal restrictions and costs associated with the ones still registered, and development of resistance among key pests, it makes sense to use all the tools in the toolbox – *and that means IPM.*

"The impression I get speaking to potato growers in my region is that they are comfortable with how they are managing pests in potatoes. Most of them are familiar with the IPM Technologies approach to pest management and have adopted this style of management for a number of years now. The impression I get is that pest management is "old hat" to them now – they don't view insect pests as a major problem anymore and they attribute this to the practice changes they have made through involvement in this project."

- **Zara Hall, Industry Development Officer Southern Queensland**

This project, *, An IPM extension program for the potato and onion industries (MT16009)* is funded by Hort Innovation, using the processing and fresh potato research and development levies and contributions from the Australian Government.

BRINGING BALANCE TO POTATO TUBER MOTH MANAGEMENT

Potato tuber moth (*Phthorimaea operculella*) is a pest of potatoes in many potato production regions around the world, including Australia and New Zealand. It has proved difficult to control with insecticides alone but can be effectively managed using biological and cultural controls with support from strategic use of insecticides.

- By **Dr Paul Horne**, IPM Technologies P/L

Potato tuber moth (*Phthorimaea operculella*) (PTM) is an important pest of potatoes in many countries, including Australia. The caterpillars can feed on a wide range of solanaceous plants, so can be serious pests of eggplants and tomatoes; in Queensland PTM is also known as tomato leafminer. Although there is a wide host range, potato (followed by eggplants), are the preferred hosts on which the female moths lay their eggs.

Larvae of PTM feed either on tubers of potato or within the leaves of potato plants (Figures 2 and 3). Leaf-mining activity makes them difficult to control with insecticides and control failures have been reported frequently. This is in part because of where they feed but also because of insecticide resistance.

Moreover, spraying the foliage may kill caterpillars but damage to tubers can still be serious. This is because moths can lay eggs on or near the soil surface, and the tiny caterpillars

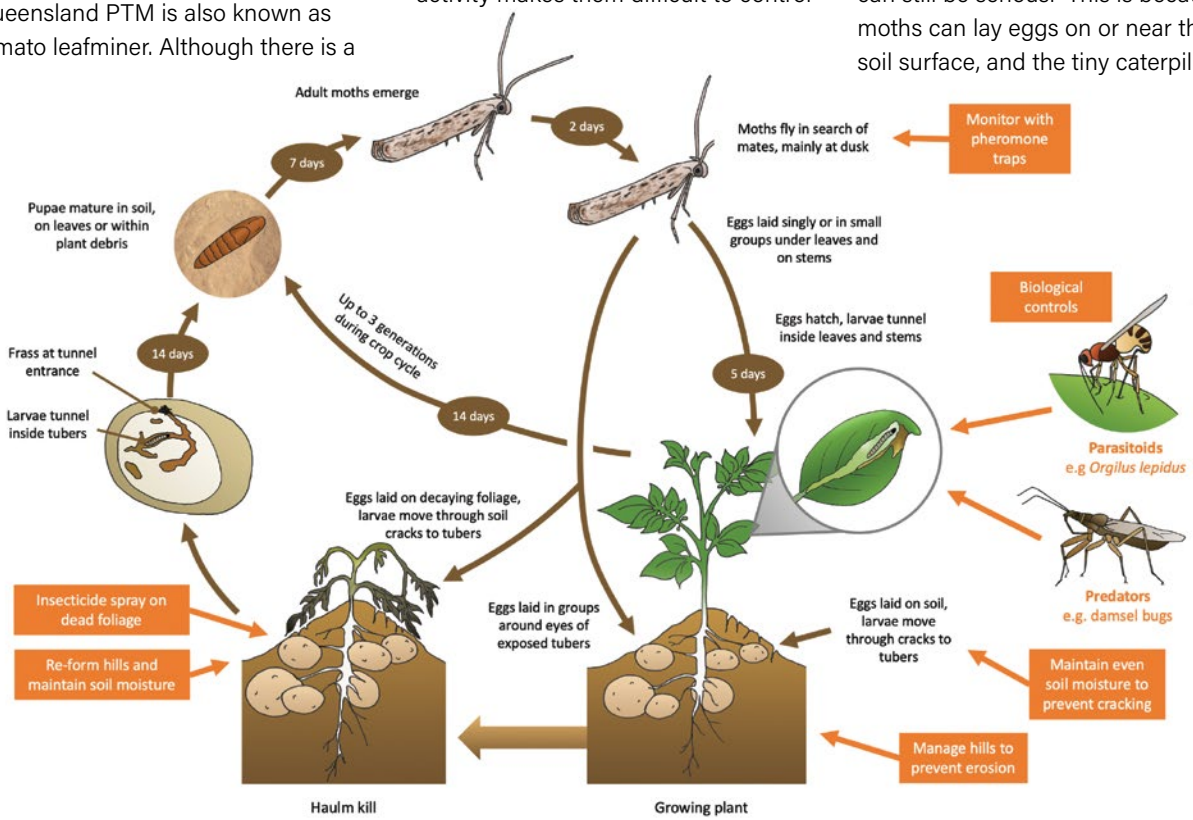

Figure 1. PTM lifecycle, indicating the approximate number of days for each stage under close to optimal conditions and potential control strategies (orange) at each lifestage. Note that speed of development and fecundity are highly temperature dependant. - Illustration J. Ekman

that hatch out can move onto tubers through cracked soil.

During the warmer months of the year potato moth eggs develop into adults in about four weeks. That means that three generations can develop in the life of a crop (Figure 1). Where plantings are made over several months, there can be many generations over the course of the year.

MANAGING THE MOTH

Instead of relying on insecticides, a better way to deal with this pest is to use its natural enemies (parasitic wasps and predatory insects) and some important cultural (management) methods.

If necessary, selective insecticides may be used during the growing period that don't kill the beneficial species. Broad-spectrum insecticides can be used at or after crop senescence to provide a chemical barrier over the tubers, as the beneficial species will no longer be present.

There are three species of wasps in Australia that parasitise and kill PTM caterpillars. Two species (*Orgilus lepidus* and *Apanteles subandinus*) produce one wasp from one caterpillar whereas the third (*Copidosoma koehleri*) produces around 50 wasps per caterpillar. Levels of parasitism on farms that have been using IPM for years are often above 80%.

The main predator of PTM caterpillars is the damsel bug, *Nabis kinbergii*. Other predators of importance in Australian potato crops are brown lacewings, *Micromus tasmaniae*, and hoverflies of several species. All these species occur naturally in potato growing regions of Australia and develop at the same rate as their caterpillar hosts.

Figure 2. PTM leaf mine - P. Horne

Figure 4. Adult PTM - P. Horne

A range of cultural control options to minimise damage by PTM are available to potato growers. Two key options are overhead irrigation and soil management. The aim here is to maintain an intact soil barrier over the top of the tubers, preventing access by caterpillars. So, a fine tilth without clods or cracks is ideal. Irrigation can be used to keep the soil barrier intact and to wash fine soil particles into centre-line cracks that might develop.

Related to this is variety selection. Deeper setting varieties will naturally have a potentially thicker layer of intact soil over the tubers. In some circumstances growers might want or need to plant a shallow setting variety. In this case they need to be aware that the risk of damage by PTM is greater and additional control measures may be needed.

Figure 3. PTM larvae developing inside a tuber and emerging to pupate - S.I. Rondon, Oregon State University

Where cultural methods are not used and the biological controls are killed (by insecticides targeting PTM or other pests), then damage to tubers is likely. This is the situation in many other countries, including parts of New Zealand. Loss of control also occurs in hot conditions in Australia, where cracks in the soil or erosion of the hills allows larvae to access the developing tubers.

Using an IPM approach, which incorporates biological and cultural control options together with selective insecticides, is much more effective than cover-sprays alone. With less reliance on insecticides, the onset of insecticide resistance is reduced, so growers will have sustainable control options.

Most Australian potato producers are controlling PTM without over-reliance on cover sprays. With care it will remain so.

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MANAGING PINK ROT IN POTATOES

Pink rot, caused by P*hytophthora erythroseptica*, is an important disease worldwide. It is found widely in Australia, particularly in Tasmania, and can cause devastating losses both before and after harvest. Even if symptoms are not severe, its presence increases harvesting costs, as diseased tubers must be culled before storage or transport.

CURRENT MANAGEMENT OPTIONS

Pink rot is a potato specialist, in that it does not grow readily on other hosts. Despite this, long crop rotations are necessary due to production of long lived oospores. These can persist in the soil for up to seven years (Figure 1). Volunteer potatoes, and other Solanaceous hosts, must be scrupulously removed in order to break the cycle of infection.

The pathogen spreads rapidly in warm, wet soils through the movement of swimming zoospores. Improving drainage and soil structure to reduce the potential for waterlogging is therefore an important control strategy.

The fungicides Metalaxyl, Metalaxyl-M and Amisulbrom are currently registered for control (check for your

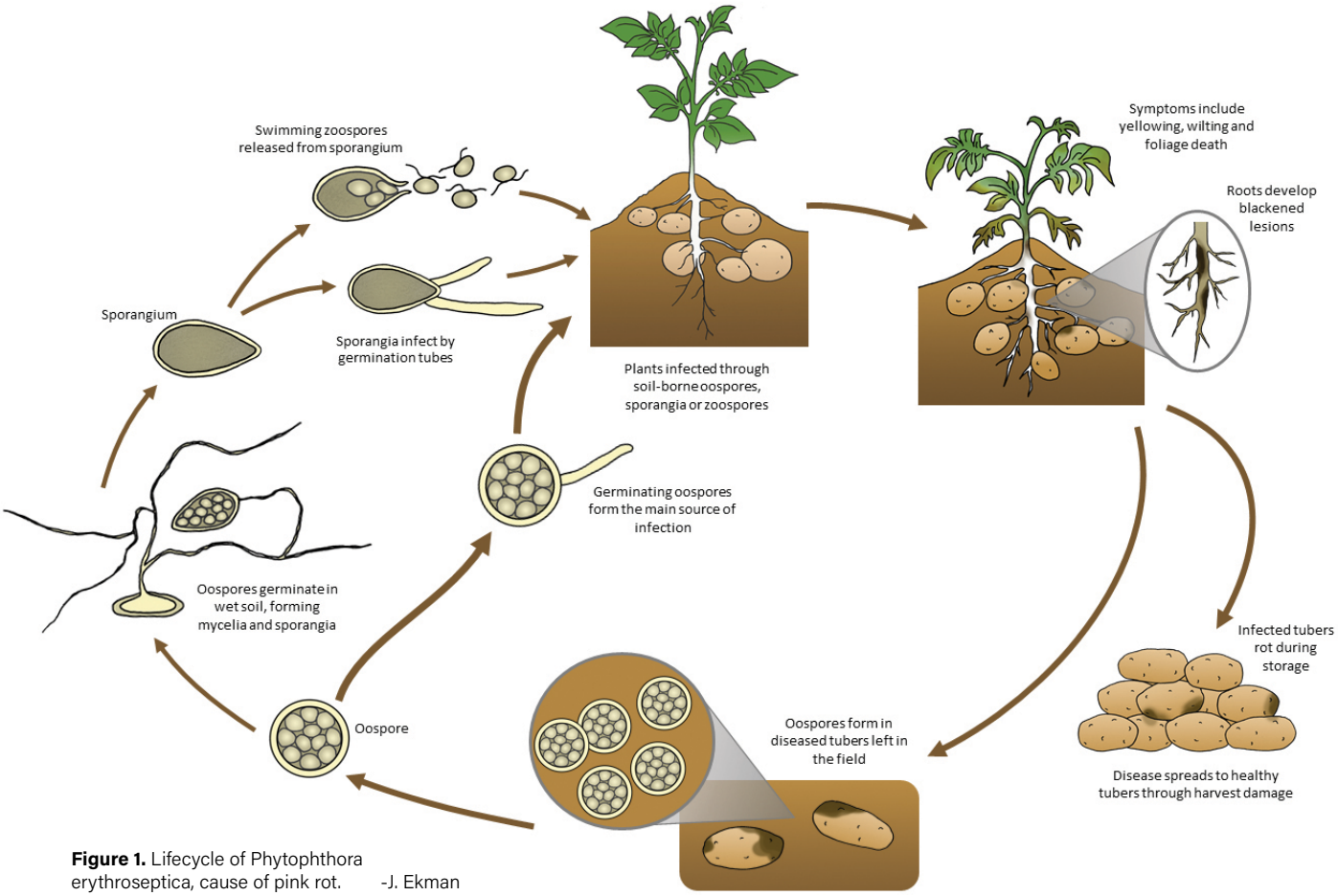

Figure 1. Lifecycle of Phytophthora erythroseptica, cause of pink rot. -J. Ekman

region, use according to instructions), but there are concerns regarding possible resistance.

In 2009, American research[1] indicated that calcium nutrition was important in suppressing the disease, with significant reductions in pink rot as plant calcium content increased.

The same team also determined that low pH amplified disease development, with an almost linear increase in the pathogen population between pH 5 and pH 8[2]. However, these trials were done using a hydroponic system, so it was unclear if these effects would be repeated under field conditions.

As a result, the potato industry together with Hort Innovation, have funded a project to examine these potential management strategies under Australian field conditions.

AUSTRALIAN PINK ROT RESEARCH

Dr Robert Tegg from the University of Tasmania is a research plant pathologist working on pink rot of potatoes. He is currently examining this issue through the project "Investigating soil pH and nutrition as possible factors influencing pink rot in potatoes (PT19000)."

The first year of trials are now complete. Eleven different sites were studied across four distinct regions: Sisters Creek, Devonport, Scottsdale and Epping forest. Six of the field sites included specific field trials with research strips of calcium amendments (Nanocal and/or Calciprill/OzCal). These were either pre-spread, applied in-furrow or surface sprayed.

Individual growers, as well as field officers, helped select and set up the trial sites. . Soil chemistry, pathogen levels, soil quality and disease outcomes were measured as were the relationships between these factors.

The objective was to assess whether the addition of calcium treatments impacted pink rot disease development and to also identify whether high levels of pink rot pathogen in the soil translated into increased disease in the crop.

SO, WHAT ARE THE RESULTS SO FAR?

Seven of the 11 sites suffered significant pink rot, with disease most severe in the NE regions. Unfortunately, according to Dr Tegg, "Calcium amendments failed to prove a silver bullet for control of pink rot, as benefits were negligible. However, there may be other benefits from increasing calcium". These could include tuber quality and pest resistance more generally.

Figure 3. Area where pink rot occurred in a field at Sisters Creek (left, - E. Blanchard, Simplot), and compacted zone along the bottom of the paddock that was expressing significantly more pink rot that the higher, non-compacted area (right, - R. Tegg).

Figure 4. Typical pink rot symptoms (left) and pink rot in combination with Spongospora galling and sclerotinia on the potato stem. Images taken in the field shown at right in figure 3. - R. Tegg.

The researchers did, however, find that soil quality and topsoil depth were good indicators of where pink rot was likely to appear within a paddock. Areas which were compacted, had thin topsoil or poor soil health were the most likely to suffer disease.

Similarly, other damage within the field, such as wind damage or stem canker, also increased the likelihood of pink rot. This makes sense, because if plants are stressed due to other factors, the opportunistic pink rot pathogen is more easily able to break through the plant defences and cause infection.

Another interesting discovery was that many of the cropping soils studied were highly acidic. Moreover, pH dropped by up to 0.6 units during the growing season, putting them into the sub-optimal pH 5 to 5.5 range.

"The PreDicta Pt test also provided some insights into the way the pink rot pathogen survives and proliferates in the soil" commented Dr Tegg. "Detection usually occurred mid-way through the growing season. Detecting the pathogen before planting was more difficult, probably due to its' sporadic distribution around the field as well as significant temperature and weather effects on the soil population".

NEXT STEPS?

Some complementary pot trials are currently underway. So far, these indicate that very high levels of calcium (>10 tonne/ha OzCal) are required to reach the efficacious levels recommended in the US studies (>7 – 7.5). Such high rates may not be practical commercially, particularly for red ferrosols. These soils are highly buffered, making it difficult to significantly modify pH.

The field work will also be repeated this coming season, with the aim of gaining a fuller understanding of factors that increase – or decrease – field incidence of pink rot.

For more information on the project please contact Dr Robert Tegg at robert.tegg@utas.edu.au

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This project, , *Investigating soil pH and nutrition as possible factors influencing pink rot in potatoes (PT19000)* is being funded by Hort Innovation, using the processing and fresh potato research and development levy and contributions from the Australian Government.

POTATO VIRUS Y

- flattening the disease curve

- By **Dr Nigel Crump**

The COVID-19 global pandemic means we are all aware of the need to suppress disease by "*flattening the curve*". That is, stopping the spread of COVID-19 throughout the population. It is now common to hear about the use of laboratory testing to identify known cases of COVID-19 in the population. We even understand the importance of genomic sequencing to identify the various strains of COVID-19, including delta.

The management of Potato Virus Y (PVY) shares similarities to COVID-19. Actions taken by the Australian Seed Potato Industry Certification Authority (AuSPICA) have resulted in the successful "flattening of the curve" for PVY and provided assurance of "clean" certified seed potatoes.

Just like COVID-19, PVY has several strains such as PVY^{O}, PVY^{C} and PVY^{N}. Around the world PVY is evolving and new strains of PVY are being discovered using genomic sequencing.

PVY is vectored by aphids feeding in the potato crop and PVY can be spread with infected seed lots.

SEED POTATO CERTIFICATION AND PVY

Potato seed certification programs aim to prevent or limit initial levels of virus in potato seed. Consistent with certified seed programs around the world, the Australian seed certification schemes limit the number of times a seed lot can be recertified to a maximum of five generations. The initial G0 minituber seed stocks are derived from pathogen-tested tissue culture material known to be free from virus (Figure 1).

PVY SYMPTOMS

Symptoms of PVY can vary across different potato varieties. In some varieties, the virus may show no visible symptoms. Alternatively, symptoms can range from very mild mosaic leaf yellowing to plant death or tuber necrosis. The impact of infection is therefore an interaction between potato cultivar and strain of PVY (Figure 2).

PVY STRAINS IN AUSTRALIA

Historically, Australia reported the PVY strains PYV^{O}, PVY^{N}, PVY^{C}, PVY^{Z} and PVY^{D} (1,2,3). A more recent study has shown Australian isolates belonged to the PVY^{NTN} strain. Sequence analysis of the whole genomes of three isolates suggested a single introduction of the PVY^{NTN} strain to Australia (4). PVY^{NTN} produces mild symptoms in potato, making them more difficult to manage through visual inspections. In addition to reducing yield, necrotic isolates may also cause external and internal

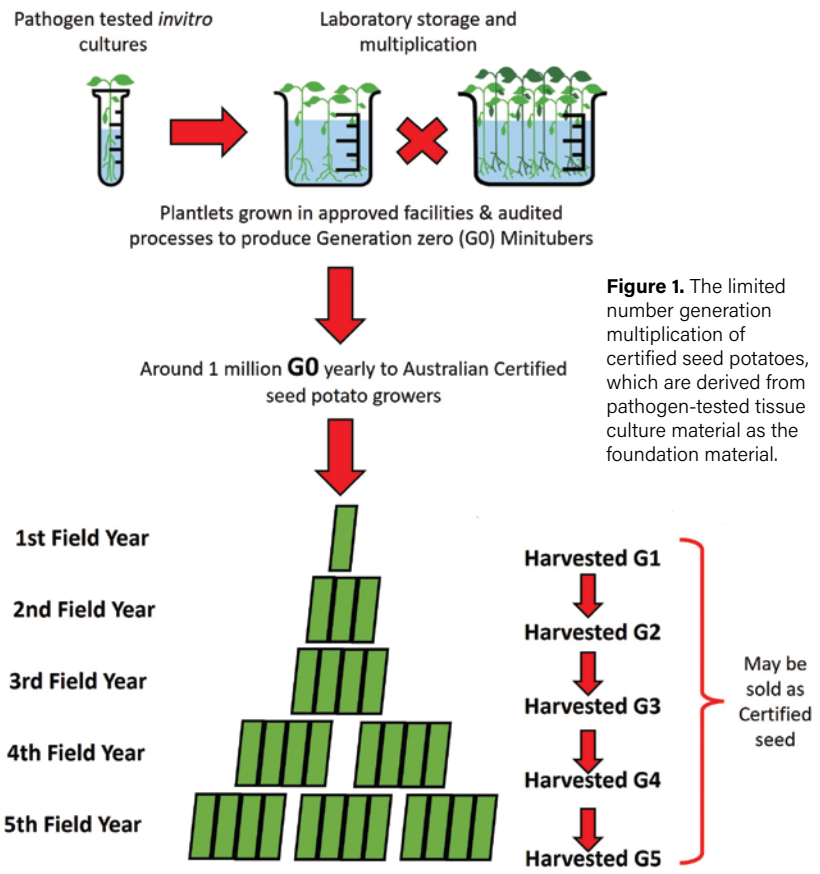

Figure 1. The limited number generation multiplication of certified seed potatoes, which are derived from pathogen-tested tissue culture material as the foundation material.

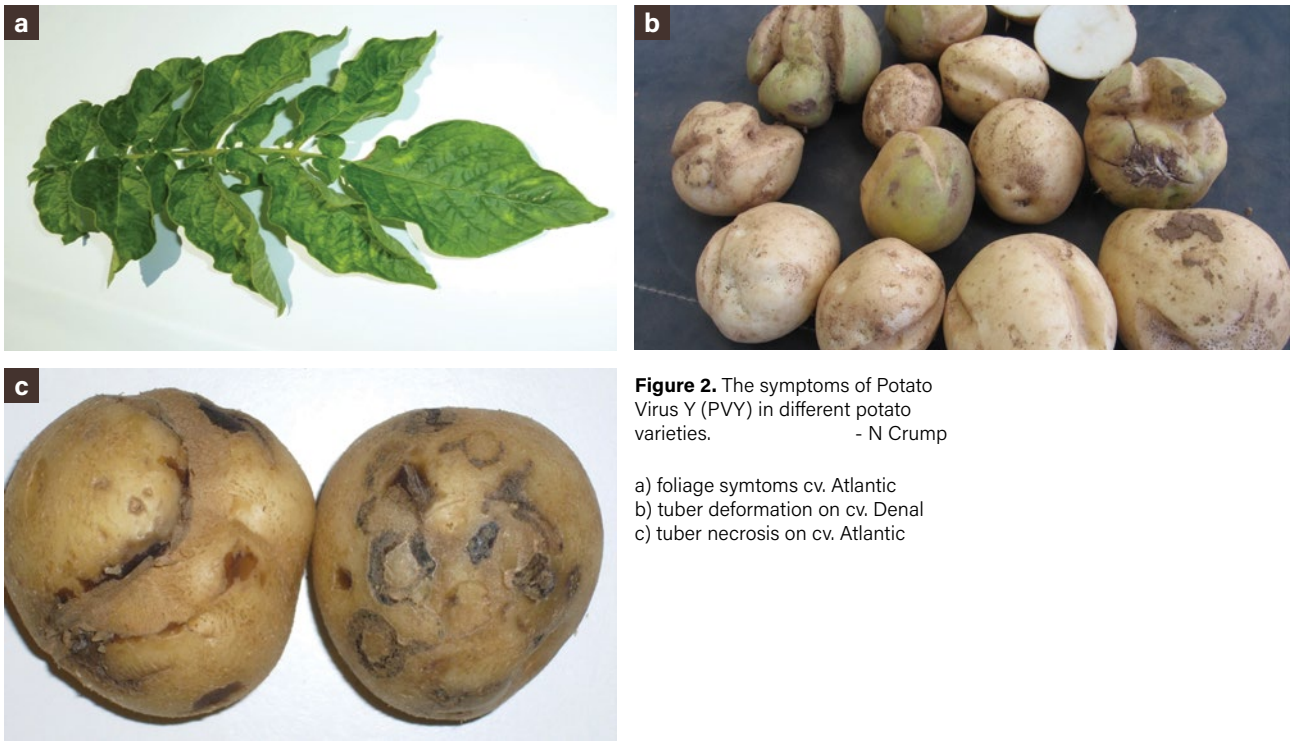

Figure 2. The symptoms of Potato Virus Y (PVY) in different potato varieties. - N Crump

a) foliage symtoms cv. Atlantic
b) tuber deformation on cv. Denal
c) tuber necrosis on cv. Atlantic

damage in tubers of susceptible cultivars, which is known as potato tuber necrotic ringspot disease (PTNRD).

PVY COST TO POTATO PRODUCTION

PVY is a potyvirus that causes significant economic loss in yield and quality of potatoes worldwide. A study in the US found that for every 1% of PVY in the seed, the yield of the subsequent crop was decreased by 0.18 t/ha, as PVY decreased marketable yield and tuber size (5).

In the US state of Idaho, which produces about 7.1m tonnes of potato worth US$1b annually, the losses due to PVY were valued at US$34m (6). It was estimated that 10% PVY infection in seed could decrease commercial crop returns by US$225–300 per hectare depending on the market sector.

In Australia, there has been no economic study on PVY. However individual crop losses of up to 90% have been reported when crops were grown from seed with high levels of PVY. If not effectively managed, PVY will have significant economic impact on the Australian potato industry.

FLATTENING THE CURVE ASSOCIATED WITH PVY

Until recently, seed potato crops were entirely assessed for PVY symptoms using visual inspections during the growing season. This became problematic as PVY strains that have very mild or no symptoms in foliage can therefore be missed by visual inspection.

In 2010, AuSPICA introduced mandatory leaf testing of all seed stocks, including all generations of certified seed potatoes that were issued with official certification labels. This involved the collection and laboratory testing of over 17,000 samples of leaves annually from around 2000 ha of seed crops throughout Victoria, South Australia and Northern New South Wales. This large surveillance program supplements the visual inspection of seed crops for certification, and – importantly – identifies seed lots that have shown no visual symptoms of PVY. The plants showing no symptoms can act as a reservoir for PVY to carry over between seasons.

The PVY surveillance program conducted by AuSPICA has been successful in mitigating the risk of PVY in certified seed potato crops. We have reduced the amount of seed crop rejection due to viruses, which includes PVY, from 7% in 2010/11 to 0.3% in 2021 (Figure 3). This surveillance has resulted in the flattening of the curve associated with PVY. This provides the Australian potato industry with high-quality certified seed that has the potential to achieve maximum yield and quality, without the adverse impact of Potato Virus Y.

SUCCESS IN RELATION TO THE SUPPRESSION OF PVY

Significant effort has been made by the entire seed potato industry to reduce PVY to extremely low levels. This should be celebrated by the whole industry. The use of laboratory diagnostics to support certification provides verification as to the quality of certified seed crops, especially in relation to PVY. Seed buyers have

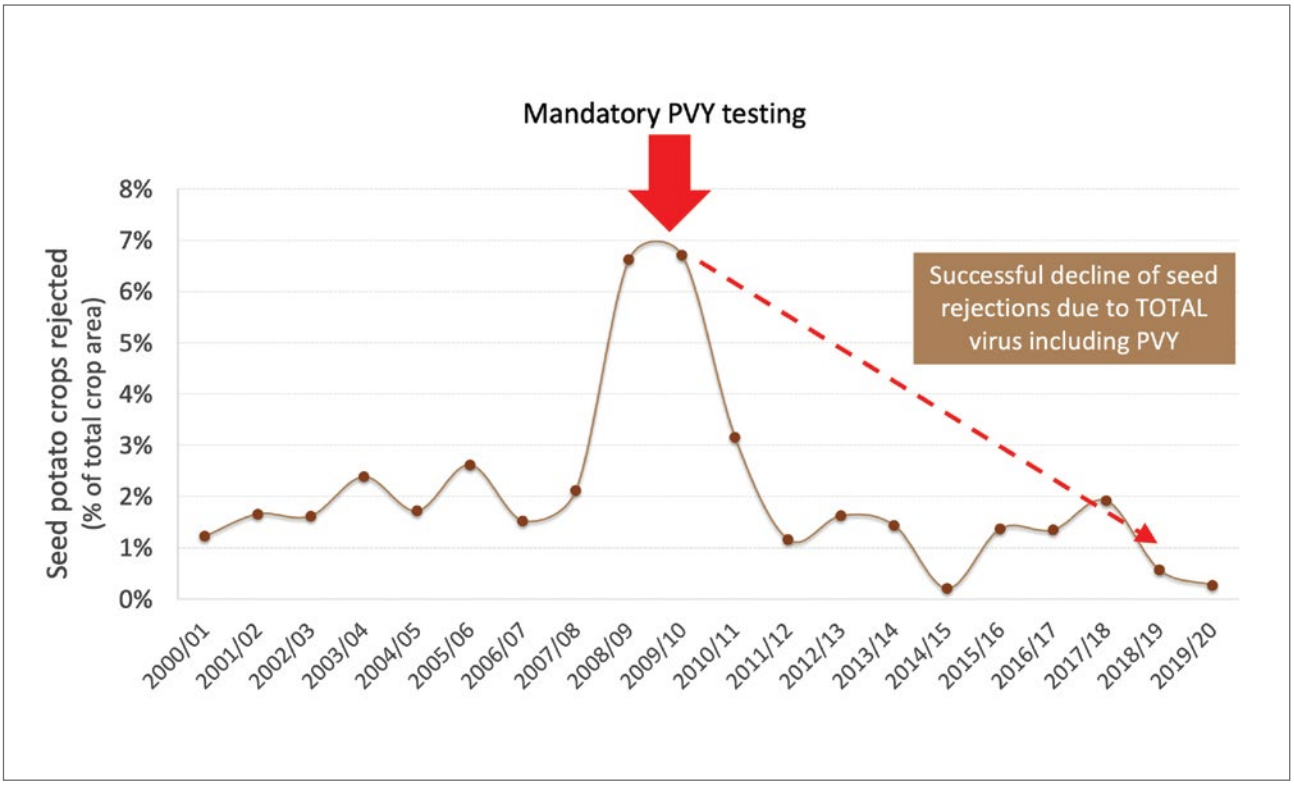

Figure 3. Crop rejection due to presence of viruses (including PVY) as a percentage of the total crop area submitted to the AuSPICA seed potato certification scheme, from 2000 to 2021.

confidence in the extremely low levels of PVY in certified seed potatoes. Certified seed producers have greater awareness of PVY and have adopted integrated management strategies to mitigate PVY in seed crops.

NEW DIRECTIONS

AuSPICA has now adopted DNA-based diagnostics to detect PVY in potato leaves and tubers to ensure high-throughput testing capacity and more affordable tests are available.

New technology is available to sample insect populations and determine the presence of known insect vectors of PVY. This technology will provide growers with more information about the movement of aphids that can spread PVY and allow for more informed management decisions.

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Dear Spud GP

We have had a lot of rain lately, and now my leaves have gone curly! The plants also seem to have some sort of leaf blight.

Are they linked or are these two separate problems?

Wavy Dave

ASK THE SPUD GP

- By **Dr Len Tesoriero**

Dear Wavy Dave

Wet weather is generally favourable for a range of diseases and physiological disorders affecting leaves, stems and tubers. In this case it is probably wise to send a sample for laboratory testing as there are a few lines of investigation to determine if all the symptoms are related.

Leaf roll could be due to a virus infection by Potato leaf roll virus (PLRV) which is spread by some aphid species. There has been widespread aphid activity over the past spring so it would be important to also check for aphids on the plants. Unfortunately, potato aphid feeding can also cause leaves to roll in the absence of PLRV, so a laboratory test is required.

There are also several non-viral causes of leaves rolling. It can occur when sugars formed during photosynthesis are prevented from translocating away from the leaves, causing starch to accumulate. Some varieties are particularly prone to this. Excess nitrogen, and extremes in soil moisture, can also cause similar symptoms.

PLRV and a bacterium (a phytoplasma causing Purple Top in potatoes) only infect the phloem in the vascular tissue of potatoes. Phloem is responsible for movement of sugars produced in the leaves down to the tubers. This explains why these pathogens cause leaves to roll. As the name suggests, Purple Top is also accompanied by a red or purple discoloration towards the margins of emerging leaves.

The fungus *Rhizoctonia* can also reduce carbohydrate translocation, causing leaf rolling and sometimes leaf margin reddening. The disease infects the stolons, tubers and stem bases. It commonly forms a whitish growth at the stem base as well as typical brown lesions on the stolons. Both Purple Top and *Rhizoctonia* are often accompanied by formation of aerial tubers.

Finally, the symptoms on the older leaves could be early signs of infection by *Alternaria* species (which cause Early Blight, Brown Leaf Spot and Target Spot diseases), or possibly Late Blight (caused by *Phytophthora infestans*). Alternatively, wet weather can cause physical damage which can then be invaded by any number of environmental organisms leading to lesions and their premature senescence.

Contact the spud GP by emailing info@potatolink.com.au

SOIL BIOLOGY 101 FOR POTATO GROWERS

Soil biology is a key driver for nearly all functions within the soil. Biological activity affects soil structure and aeration, nutrient cycling and availability, breakdown of organic materials, plant growth and disease.

Dr Jenny Ekman reports

Fungi, bacteria and other soil dwelling organisms are what build soil structure. Their activity creates the air pockets that allow potato plant roots and tubers to breathe. Those same spaces also allow water to infiltrate soil, holding it where it's available for plant growth. In contrast, structureless soils are likely to form a crust, so that water just runs off.

Tillage breaks down soil aggregates into smaller units. Regular tillage also tends to favour bacteria over fungi, as it breaks up the strands of fungal hyphae in the soil. Populations of larger soil dwellers such as nematodes, worms, insects and mites are also reduced by regular tillage.

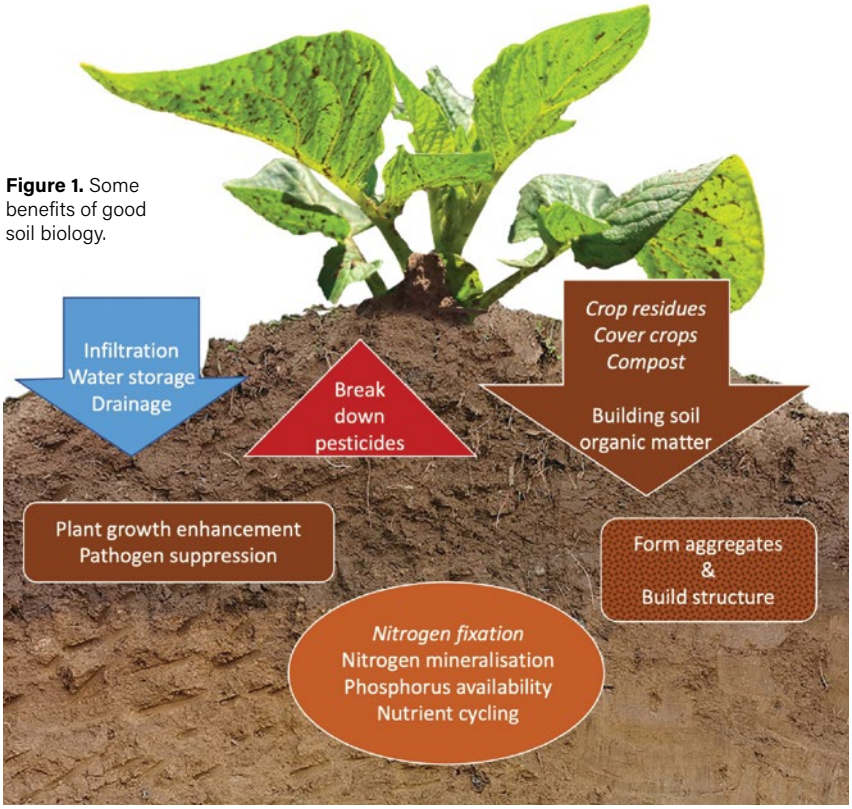


Figure 1. Some benefits of good soil biology.

SOILS TEEM WITH LIFE

Vegetable growing soils are rich in microbial life. There may be hundreds or even thousands of different species of bacteria, fungi and eukaryotes ('critters'). Even worn-out soils can still contain large numbers of different organisms.

Dr Kelvin Montagu has been examining the range of organisms present in soils used to grow vegetables and potatoes. "Soil from a potato farm in Forthside contained more than 500 species of bacteria, 200 species of fungi and 50 species of critters (e.g. nematodes, worms and springtails)".

"Even worn-out soils still have big microbial populations. For example, we worked on a farm in South Tasmania that was completely thrashed. Compared to some of the other farms we tested, there were a lot more species of bacteria than fungi present in the soil (Figure 2). This likely reflects regular cultivation. Despite this, significant populations of fungi and critters still remained, so the soil can be rehabilitated."

Soil biology means that when a potato seed sprouts, it is not into an empty space, but one already full of other inhabitants. As the shoot starts to grow into the soil, cells are shed from the root tips and exudates are

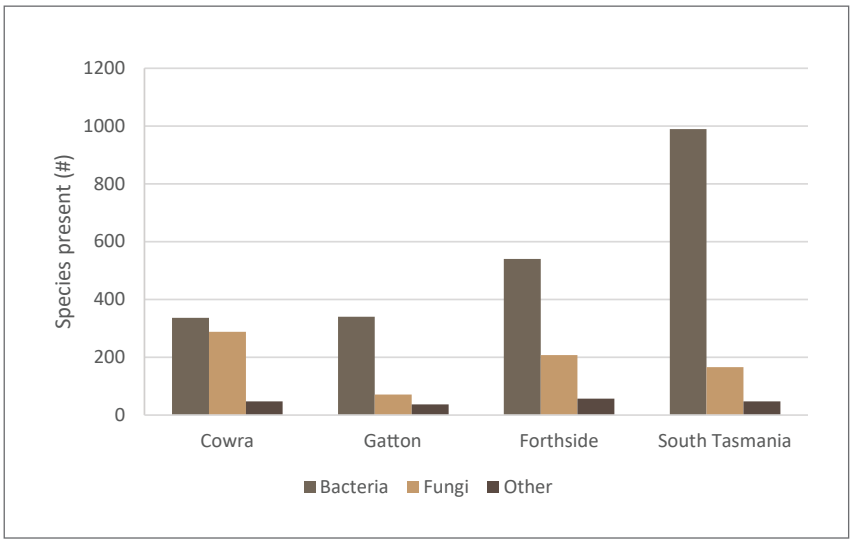


Figure 2. Number of species of bacteria and fungi and other phyla (e.g. nematodes, mites, insects) in soils used to grow potatoes and/or vegetables. - Data from K. Montagu

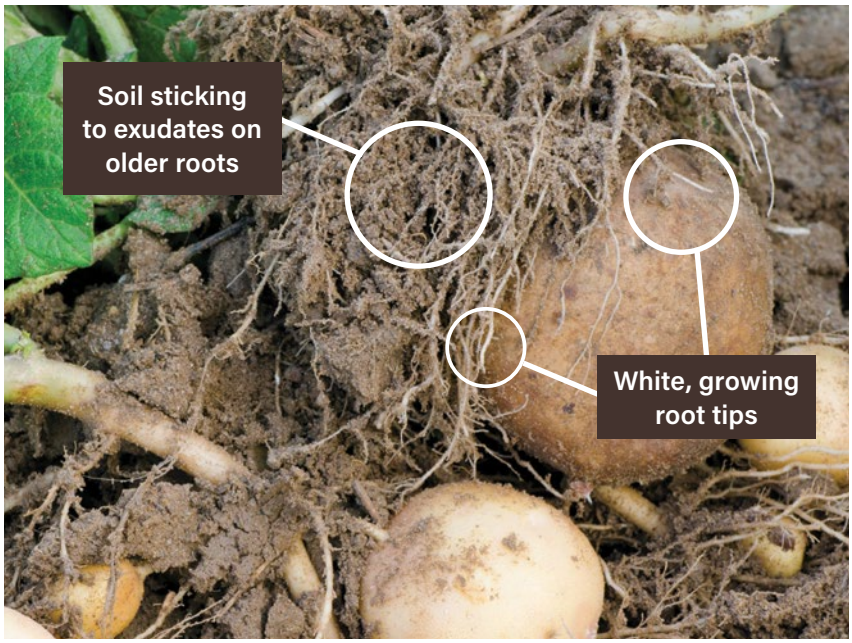


Figure 3. Roots and their surrounds are a biological hotspot

Figure 4. Mycorrhizal fungi can help plants capture more nutrients from the soil. - UC ANR.

N.B. Mycorrhizae are not usually visible to the naked eye

released. These attract specific fungi and bacteria – which may be either beneficial or pathogenic.

After a few days of expansion the roots shed their fine hairs and form a waxy coating. Microbes become embedded in sticky compounds exuded from the surface, forming a barrier around the roots (Figure 3).

This means that beneficial organisms need to be already in the soil, ready to colonise the young potato plant right at planting. Otherwise, the young roots can be swamped by other organisms.

The benefits of mycorrhizal fungi to plants are well established. They improve moisture and nutrient uptake and can help to protect against disease.

Mycorrhizae live on carbohydrates produced by the plant. In exchange, they provide the plant with phosphorus and other nutrients from the soil (Figure 4).

Cultivation reduces natural populations of mycorrhizal fungi, which are often low in vegetable growing soils. Moreover, if the soil contains high levels of available phosphorus, the plant doesn't need its mycorrhizal partner, so the fungi may fail to establish.

HELPING THE GOOD GUYS

The two main things needed to activate soil biology are:

1. **Structure** – building them somewhere to live, with the right balance of air and water
2. **Food** – providing the raw materials needed to feed soil organisms

Bulk food includes crop residues, pasture (including roots) and cover crops incorporated into the soil. "These materials are like Weetbix for soil fungi, bacteria and earthworms. They use them as carbon sources as well as for the sulphur, phosphorus and other nutrients they contain" explains Dr Montagu. "Bulk feeding

is incredibly important for improving soil structure. As bacteria and fungi feed on these materials they excrete the proteins and sugars that bind the soil particles together. Essentially, the microbes help build their own house."

Soil organic matter is a great indicator of soil health. Two of the best ways to increase soil organic matter are through use of cover crops and including pasture in the rotation.

It's possible to manage how quickly organic materials break down in the soil through crop selection, as well as manipulating the carbon:nitrogen ratio.

Dr Montagu gave the example for a cereal rye cover crop. "Terminating two weeks later than originally planned increased biomass from 7 t/ha to 9 t/ha as well as changed the C:N ratio from 30 to 45. The result was a much slower breakdown after incorporation into the soil."

"Wheat stubble has a C:N ratio close to 80, so it's really slow to break down. What's more, soil microbes may initially take nitrogen from the soil to help break down the stubble, making it unavailable to the plant. At the other end of the scale, a legume such as vetch has a C:N ratio of 15, so it breaks down extremely rapidly" explained Kelvin.

High C:N ratios favour fungi over bacteria. While fungi are slower, they convert more of the crop residue into soil organic matter, so effectively yield more soil organic matter for the same biomass inputs.

Soil microbes not only break down organic matter, but they are also vital to breaking down agrichemicals. Many chemicals would persist much longer in the environment if no biological activity is present. Essentially, the microbes use such chemicals as sources of nitrogen, carbon and other nutrients.

According to Dr Montagu "A side effect of repeated use of some agrichemicals is that you effectively select for microbes that feed on them. So they will be there in the soil, waiting for their next feed of metham sodium, or pre-emergent herbicide, or whatever.

The result is reduced chemical efficacy, because the biology breaks those products down so fast they aren't able to work."

Figure 5. Volunteer potatoes are a major issue, as they allow soil borne disease to persist. - R. Barrett.

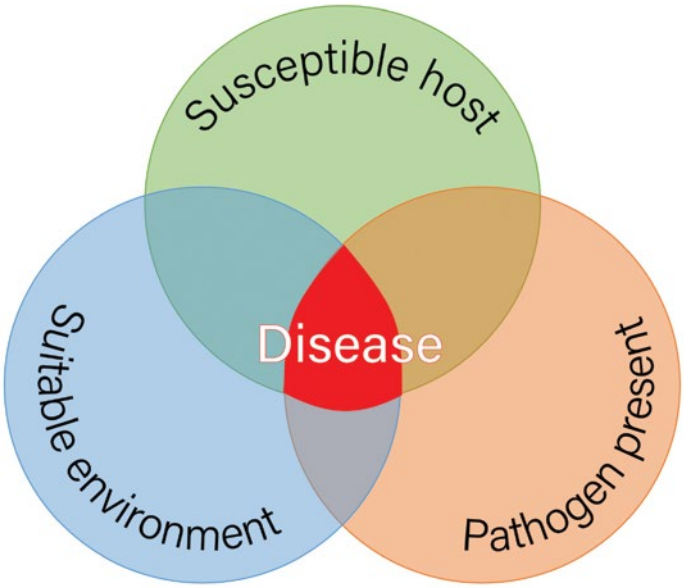


Figure 6. For disease to occur, the potato plant must be susceptible, pathogen present and environment suitable for infection – the classic "Disease triangle".

FIGHTING THE BAD GUYS

Just as the soil is rich in beneficial microbes, it is also inhabited by those that would do potatoes harm. Nematodes, bacteria, fungi, protists (such as powdery scab) and even viruses are ready to pounce on an unprotected potato plant and proliferate at its expense. Some are potato specialists (e.g. powdery scab and pink rot), whereas others have a broad range of hosts (e.g. *Sclerotinia*, *Rhizoctonia*).

Dr Calum Wilson is a plant pathologist and expert on soil-borne diseases of potatoes. "Most pathogens that multiply on potatoes die off if the

40 days 68 days 92 days

Figure 7. Breakdown of a ryegrass green manure crop in Cowra 40, 68 and 92 days after spraying out with glyphosate. - M. Hinderager.

potato or an alternative host is not there. This is the basis of crop rotation" states Dr Wilson.

"However, some diseases are good at surviving between potato crops, either by having a broad host range, or persisting on decaying organic matter. Certain pathogens form resting structures that can persist in the soil for years – powdery scab is particularly difficult to control due to this factor. Pathogens can also hitch a ride on contaminated seed, which is why clean seed is so important."

Volunteer potatoes are another big problem (Figure 5). According to Dr Wilson, volunteer potatoes are one of Tasmania's worst weeds; "if there are volunteer potatoes within the rotation, all you are doing is following a good potato crop with a bad one. That's why managing volunteers is critically important for disease control".

In general, poor soil biology favours infection. Poor soil structure reduces drainage and aeration, extending the time plants stay wet. Plants grown in non-biologically active soils are more likely to be stressed, making them susceptible to disease. Finally, low biological activity means there is less competition from other microbes compared to a soil with high organic matter. This can make it easy for the pathogen to persist and spread.

"Green manures, composts and cover crops all help improve soil biology, while tillage is frequently disruptive, especially to fungi," commented Calum. "Encouraging the beneficial soil microbes helps control the bad guys, as they will feed on them."

BALANCING SOIL BIOLOGY AND PLANT NUTRITION

Plants need nitrogen

Potatoes require balanced nutrients, and that includes a lot of nitrogen. Some varieties will use over 30kg of nitrogen a week during their early bulking stages, so that means somewhere between 150 to 300kg N/ha, depending on variety.

Estimating soil nitrogen requirements relies on three things:

1. **Available nitrogen within the root zone**
   - Requires strategic soil testing for inorganic nitrate and ammonium
2. **Soil organic carbon**
   - Estimate of in-season mineralisation
   - Test for organic matter, pH and CEC
   - Understanding the environment, including temperature, moisture and aeration in combination with soil biology

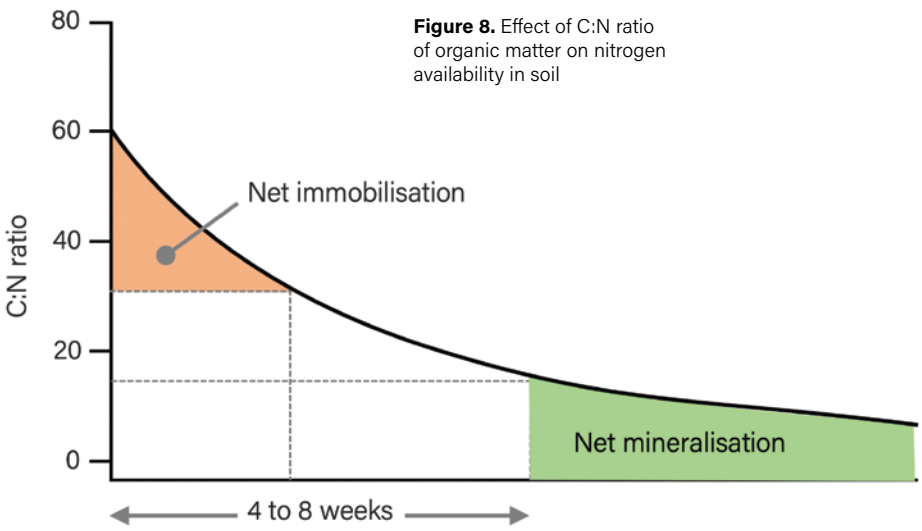


Figure 8. Effect of C:N ratio of organic matter on nitrogen availability in soil

3. **Previous crop residue**

- Estimate whether nitrogen will be tied up or released as crop residue degrades
- Amount of dry matter in the residue, its condition and position within the row
- Effects of climate and soil biological activity

Standard practice for soil testing is to sample the top 30cm. However, according to AHR agronomist Marc Hinderager, conducting separate tests of the top 0 – 15cm and 15 – 30cm gives far more information. "This is really useful if you're coming out of long-term pasture, or making decisions on whether to add soil amendments such as compost," suggests Marc.

NITROGEN IS UNLOCKED BY SOIL BIOLOGY

The conversion of organic nitrogen sources to nitrate depends on the activity of microbes in the soil. This process starts at around 5°C, accelerates as it approaches 20°C and peaks between 30 and 40°C. Between 50 to 125kg N/ha can be mineralised annually from Australian soils, although ten-fold fluctuations are not uncommon.

"This means that soil tests are just a snapshot in time. It's important to consider this when estimating how much N the crop needs as the plants grow," commented Marc, "especially when considering breakdown of organic materials."

"For example, at our Cowra site we knocked down a green manure crop of ryegrass with glyphosate in mid-September. Ryegrass has a C:N ratio of 20:1. Combined with warm temperatures and 200mm of rain, this meant it was rapidly broken down by microbes (Figure 7)."

"By early December 60% of the organic N had been mineralised, effectively recycling 60kg N from the 100kg organic N contained in 2.5t/ha ryegrass residue. If the ryegrass had been incorporated, rather than left on the soil surface, it would have broken down around 10-15% faster".

At the same time as mineralisation is occurring, so is immobilisation. This is also driven by soil biology, in combination with temperature and moisture.

Crop residues with C:N ratios above 25:1 (like wheat stubble) will initially immobilise (tie up) soil inorganic nitrogen, making it unavailable to the plant (Figure 8). The factors that drive soil biology – temperature, moisture, aeration, pH and soil organic matter content – all influence the time taken to remobilise nitrogen, resulting in net mineralisation.

The biological activity within the soil can be estimated by measuring respiration. Microbes within the soil respire, absorbing oxygen and releasing carbon dioxide. The rate at which this is occurring reflects metabolic activity.

Sealing a portion of soil inside a container and measuring atmospheric changes provides an indicator of total microbial activity.

NITROGEN FROM LEGUMES

"As the price of fertilisers has increased, a lot of my farmers have been getting more interested in legumes," says Marc. "Legumes can fix around 20kg of N per tonne of dry matter, so long as good nodulation occurs. The roots can add another 35%. However, if the seed is harvested as a cash crop, that reduces fixed N to around 13kg/tonne".

Getting the right strain of Rhizobium bacteria is essential to get good nodule formation. Just as roots of potato plants signal to mycorrhizal fungi, so do the roots of legumes to Rhizobium.

Although Rhizobium are naturally present in soil, artificially inoculating seed with a good strain of Rhizobium will usually pay for itself. Commercial Rhizobium strains have been bred for effectiveness, and provide more reliable results than native Rhizobium in soil.

The total N fixed by legumes is also affected by soil nutrition. Good levels of molybdenum and a neutral pH help optimise results. Some research has indicated that phosphate and potash increase both the number of nodules, and the amount of N fixed (Figure 9).

Conversely, acid soils reduce N fixation for most legumes. Lupins are an exception, as they prefer acid soils.

Figure 9. Nodules on roots of legume
- Neutrog Fertilisers

	Urea (CH_4N_2O)	Ammonium (NH_4^+)	Nitrate (NO_3^-)
Transformation in soil	Enzymes convert urea to ammonium.	Ammonium converted to nitrate by bacteria.	Bacteria convert nitrate to gas in warm, waterlogged conditions.
Plant available and efficiency	Can be taken up as a foliar. Limited availability (1-5 days) to roots due to rapid conversion to volatile ammonia by urease enzyme in soil.	Immobile in soil. Can be taken up directly. Potatoes prefer combination of ammonium and nitrate.	Mobile in soil (so can leach out). Can be taken up directly, potato plants.

Table 1. Biological processes and commercial fertilisers

High soil plant available N (>35kg/ha or 20ppm) will reduce N fixation by a similar amount; effectively, the rhizobia get 'lazy' if N is already abundant.

According to Marc, "Rhizobium species are the most proven biological product on the market. Peat inoculants should be kept cool and dry – in the refrigerator is good – and used as soon as possible after mixing with water to get best results. Just remember that some seed dressings and some chemical fertilisers can be toxic to them, so be careful of that".

NITROGEN FROM COMMERCIAL FERTILISERS

Nitrification is the conversion of NH_3 (ammonia) and NH_4^+ (ammonium) to NO_2^- (nitrite) and then to NO_3^- (nitrate). This mobilises nitrogen, turning it into the form most easily taken up by plants, but also potentially allowing it to leach into the environment. The process occurs rapidly in warm soils, so at 20°C a top dressing of ammonium sulphate will be converted to nitrate within a week.

Nitrification is driven by soil bacteria, including species of *Nitrosomonas*, which converts ammonia to nitrite, and *Nitrobacter*, which converts nitrite to nitrate. The bacteria are sensitive to low soil pH (pH<6), which is close to the optimum pH range for potatoes of pH 6.3 to 6.8. Managing pH is therefore essential to allow nitrification to occur.

Stabilised release fertilisers slow down nitrification by soil bacteria. This reduces nitrate leaching and emissions of nitrous oxide, making more nitrogen available to the plant and reducing the total number of top-dress applications required.

For more information on biological processes and fertilisers, a fact sheet is available on the Soil Wealth site at www.soilwealth.com.au/resources/fact-sheets/quick-guide-to-farm-nitrogen

WATERLOGGING SENDS NITROGEN BACK TO THE AIR

De-nitrification is the process by which nitrate is converted to nitrogen gas and lost from waterlogged soil. This process depends on soil bacteria and fungi – starved of soil oxygen, they utilise the oxygen in NO_3^-. De-nitrifiers are most common in the top layers of soil and active at above 15°C, especially if the soil remains waterlogged for 36 hours or more.

IN SUMMARY

A healthy soil is full of life. Bacteria, fungi, insects and larger creatures such as earthworms, all have a role to play in maintaining a healthy and productive soil. Biologically active soils will have better water infiltration and soil structure, improved nutrient management, and help potato plants resist the inevitable attack of soil-borne diseases.

Improving soil biology is not necessarily easy, especially given the tillage which is standard practice within commercial potato production. However, using suitable rotations, establishing cover crops, managing nutrition and avoiding soil becoming overworked or waterlogged can all help valuable soil microbes flourish.

As the silent workers in the field, they are well worth cultivating.

EYES ON THE WORLD

Recent advances in potato research and innovation

Transplanting hybrid potato seedlings at increased densities enhances tuber yield and shifts tuber-size distributions.

Van Dijk LCM., de Vries ME., Lommen WJM, Struik PC. 2021. Potato Research https://doi.org/10.1007/s11540-021-09522-z

WHAT'S IT ABOUT?

Diploid hybrid potato breeding is a new technology that allows faster production of new varieties with desirable traits.

Normal potatoes have four copies of every gene. Only one of these genes needs to work for the function to be expressed. The result is that potatoes have a lot of genes which do nothing, or may even have negative effects. As gene expression is unpredictable, this also means that crossing two varieties will not necessarily result in a hybrid with the desired traits.

New breeding techniques have produced self-fertile diploid potatoes, with two copies of each gene and stable traits. Crossing two of these lines results in an F1 hybrid. As only two copies of each gene are present, the characteristics are more predictable.

True potato seeds (TPS) are harvested when the F1 hybrid parent forms berries. A single gram contains 2,500 genetically identical TPS, allowing thousands of disease free seedlings to be produced from a single F1 hybrid parent.

TPS seedlings grown in the glasshouse are planted into the field. In contrast to plants grown from seed tubers, TPS seedlings form only one main stem. Plant density therefore equals stem density and may be manipulated to produce tubers in a preferred size range.

This Dutch study examined the effects of planting density of TPS seedlings on size and count of tubers. Densities ranged from 6 to 200 plants/m^2 grown in a flat bed system on sandy soil, and 3 to 50 plants/m^2 on a traditional ridge system with 75cm row spacings in clay soil.

WHAT WAS CONCLUDED?

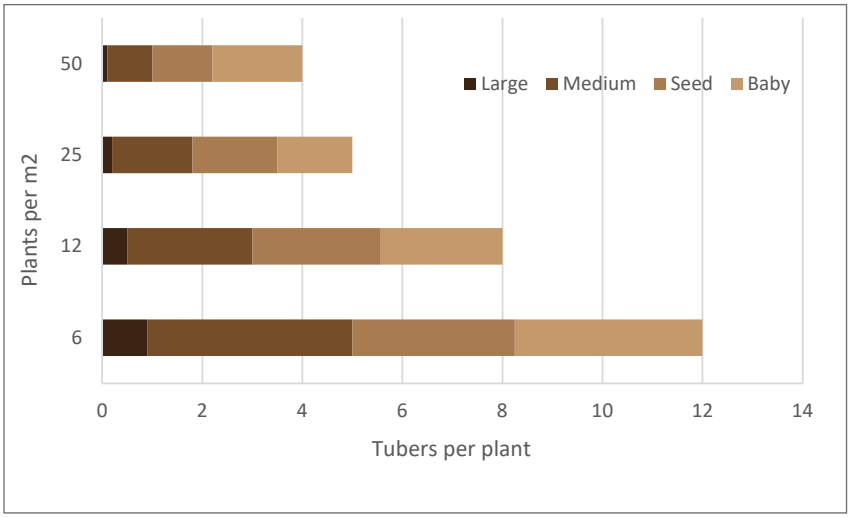
The highest tuber yields were 107 t/ha and 45 t/ha for the flat bed and ridge systems respectively. These were achieved with high planting densities, and correspondingly smaller tubers.

A maximum seed tuber (28-50mm) yield of 64 kg/ha was achieved planting 50 plants/m^2 on the flat beds. On the ridges, seed tuber yield was maximised at 25 plants/m^2.

Yields of large tubers (>50mm) were low, even at the lowest planting densities, and negligible in the ridge growing system.

The researchers suggest that greenhouse derived seedlings may lack the capacity to lay down the carbohydrates needed for tuber bulking following tuber initiation.

However, it is concluded that this method may have commercial application in producing hybrid seed potatoes, or 'baby baker' ware potatoes. Further research is needed to determine how many seed production cycles would be needed to produce seed tubers that develop into plants with large size tubers.



Effect of TPS seedling spacing on the number and size of tubers per plant. Results shown for ridge system. Size ranges are large >50mm; medium 35-50mm; seed 28-35mm and baby 20-28mm. Data derived from van Dijk et al, 2021.

NEW POTATO INDUSTRY STRATEGIC INVESTMENT PLAN (SIP)

- By **Kim Saville**

Your levies working for you ... at a glance

The potato Strategic Investment Plan (SIP) 2022-2026 provides a 5-year roadmap to guide Hort Innovation's investment of both fresh potato and processing potato industry levies and Australian Government contributions, ensuring investment decisions are aligned with industry priorities.

Top priorities are to reduce the cost of production and improve the sustainability of production practices with effective management of pests, diseases, weeds and biosecurity threats. Growth in domestic and international consumer demand is also a focus for the fresh (non-processing) potato industry.

These are the strategies for the four key outcomes:

OUTCOME 1
Extension and capability

- Support industry best practices in biosecurity, precision input management, soil and plant health, and meeting quality expectations and trade development (for fresh potato industry)
- Engagement between industry, across potato and vegetable industry members and stakeholders, domestically and internationally
- Grow industry leadership through initiatives and training for the current work force, increasing horticulture as a career choice and bringing new people into the industry

OUTCOME 2
Industry supply, productivity and sustainability

- Improve productivity and sustainability through effective integrated pest and disease management (IPDM), weed control, soil health and cover crops
- Biosecurity preparedness and resilience, including surveillance and diagnostics
- Automation and emerging technology opportunities to support labour use efficiency, compliance and input management
- Prioritise the major crop protection gaps through a SARP
- Crop protection regulatory activities with the potential to impact plant protection product access, both in Australia and internationally
- Generate residue, efficacy and crop safety data to support applications to the Australian Pesticides and Veterinary Medicines Authority (APVMA)

OUTCOME 3
Create demand

- Increase domestic and international consumer demand for fresh, quality Australian potatoes
- Increase consumer demand in high value export markets
- Deliver an up-to-date export strategy and access to trade expertise for fresh potatoes
- Improve technical access to high value markets as identified within the export strategic plan

OUTCOME 4
Business insights

Increase fresh potato industry alignment with quality and brand-positioning opportunities driven by consumer insights

Use trade data to guide ongoing export development opportunities for fresh potatoes

You can access the comprehensive potato SIP here.

Hort Innovation
Strategic levy investment

POTATO – FRESH FUND

Hort Innovation
Strategic levy investment

POTATO – PROCESSING FUND

POTATO LINK
AUSTRALIAN POTATO INDUSTRY EXTENSION PROJECT