

SEGMENT

ISSUE 5

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Science & wine

blending innovation & craft

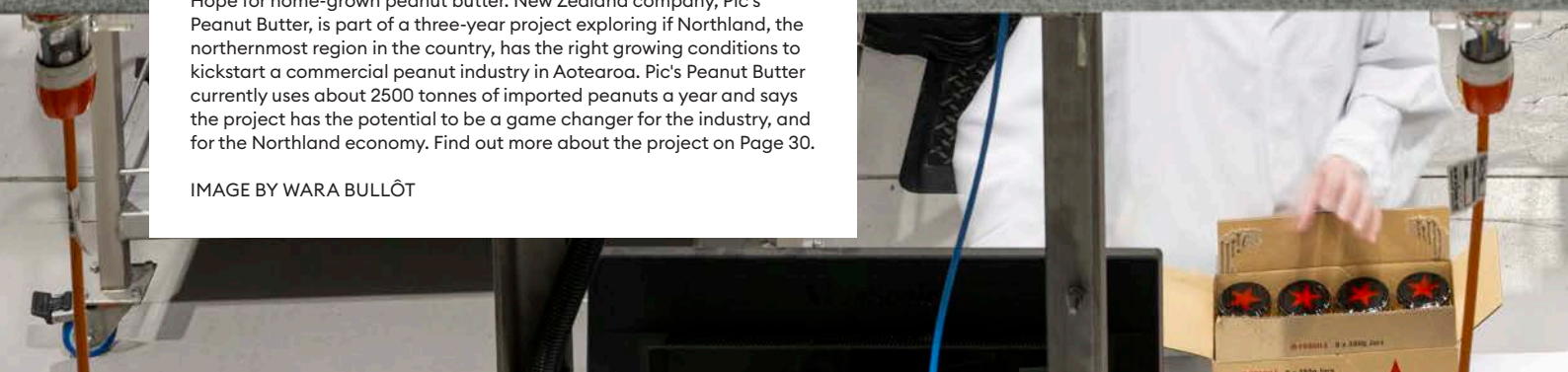
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Hope for home-grown peanut butter. New Zealand company, Pic's Peanut Butter, is part of a three-year project exploring if Northland, the northernmost region in the country, has the right growing conditions to kickstart a commercial peanut industry in Aotearoa. Pic's Peanut Butter currently uses about 2500 tonnes of imported peanuts a year and says the project has the potential to be a game changer for the industry, and for the Northland economy. Find out more about the project on Page 30.

IMAGE BY WARA BULLÔT





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PUBLISHER

Segment is published by Plant & Food Research. It can be found online at www.segmentmag.nz
Published April 2024
120 Mount Albert Road
Mount Albert
Auckland 1025
www.plantandfood.co.nz

EDITORIAL, DESIGN & PHOTOGRAPHY

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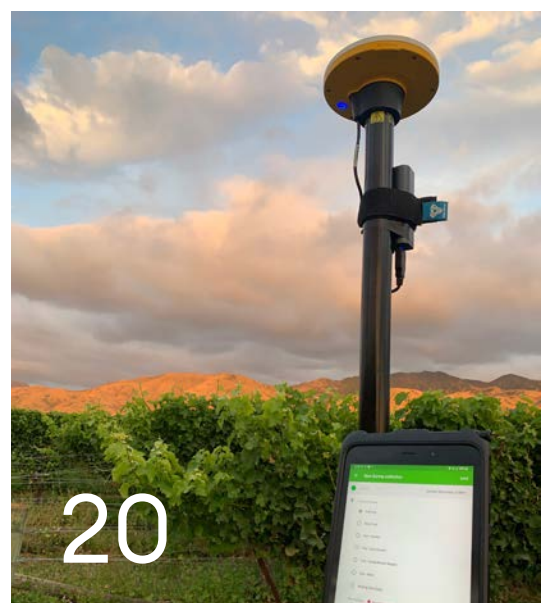
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Welcome to Issue 5 of Segment magazine

This issue of Segment magazine explores the changing face of food production, and the threats and opportunities that exist around that.

As climate change tests our landscapes and the resilience of our food systems, the science community is working alongside industry to explore opportunities for adaptation. In this issue, Andrea Graves speaks to scientists working in four countries about the different climate extremes they're experiencing and how research is helping to support food production.

Matt Philp looks at how the wine industry is embracing technology and innovation while staying true to its heritage; Richard Rennie uncovers the fascinating world of soil science; and Sally Blundell digs into the response to a pest species deemed to pose one of the greatest biosecurity threats to global horticulture.

We also speak to the co-founder of a humanitarian vanilla business, learn more about New Zealand's pea industry, and take a photographic view of an exciting project which could lead to the establishment of commercial peanut production in Aotearoa New Zealand.

I hope you enjoy learning a little more about how our food is produced through these insights into science and its impact.

Mark Piper

Mark Piper
CEO Plant & Food Research



SCIENCE NEWS

Snippets of news from the science of food

Unlocking the power of peas

In a significant genetic breakthrough, researchers at the John Innes Centre have unlocked the potential for iron-fortified vegetables and cereal crops that could play a pivotal role in addressing the global health challenge of anaemia, all thanks to pea plants. Using a recently developed map of the pea genome, scientists have pinpointed the genetic sequence responsible for two high-iron mutations in peas. The discovery may help address the persistent problem of iron deficiency, a nutritional health issue that particularly affects girls and women.

FIND OUT ABOUT NEW ZEALAND'S PEA INDUSTRY ON PAGE 36



Pepper X — the world's new hottest chilli pepper

The world has a fiery addition to its list of super-hot chillies with the development of Pepper X, now deemed the hottest chilli pepper in the world. Created by chilli breeder and PuckerButt Pepper Company founder, Ed Currie, Pepper X registers an astonishing 2.69 million Scoville Heat Units (SHU), surpassing its predecessor, the Carolina Reaper, which averaged 1.6 million SHU. SHU is a scale of spiciness based on the concentration of capsaicinoids – the chemical irritant that makes peppers hot.

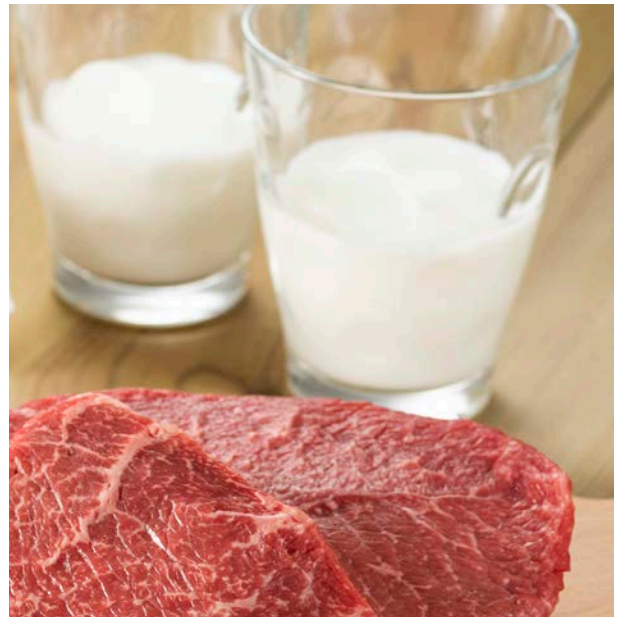
Plant waxes uncover potential for stronger crops

Researchers at the University of Toronto Scarborough have discovered that the waxy protective barrier found on plants, known as cuticular waxes, may serve as a means for sending chemical signals to other plants and insects. Contrary to previous beliefs that these waxes were stable and unreactive, the study found that some waxes break down when exposed to air and light, releasing other compounds in the process. This discovery could be harnessed to develop plants capable of dealing with challenging environments.



Plants emit ultrasonic sounds when stressed

Scientists have recorded plants producing ultrasonic 'popping' sounds in response to stress. Researchers at Tel Aviv University tested the response of tomato and tobacco plants to dehydration and having their stems cut. Using a specialised microphone, they discovered that different types of stressors generated unique acoustic signatures. This innovative approach to detecting plant sounds could offer a new way to monitor water stress in crops.



Nutrient found in meat and dairy improves cancer defence

Scientists at the University of Chicago have discovered that trans-vaccenic acid (TVA), a fatty acid found in beef, lamb and dairy products, improves the ability of immune cells to fight tumours. The research also shows that patients with higher levels of TVA circulating in their blood responded better to immunotherapy, suggesting that it could have potential as a nutritional supplement to complement clinical treatments for cancer.

Mussels aiding muscles

No pain, no gain – sore muscles are a common side effect of physical activity. Researchers have found New Zealand Greenshell™ Mussel powder can help men recover faster from injuries caused by exercise. The clinical trial, conducted by Plant & Food Research, found that after four weeks of taking Sanford's Greenshell™ Mussel powder product, PERNAULTRA®, study participants reported accelerated muscle recovery following exercise-induced damage and decreased soreness of target muscle groups.





Growing food in extreme climates

BY ANDREA GRAVES

Floods, storms and droughts are increasing, just as climate models have predicted. Even people who aren't directly affected are likely to be shaken by the way such disasters undermine food availability. They can destroy crops, kill livestock and interfere with distribution chains, resulting in shortages that increase prices. To shore up supply, scientists are investigating how to produce food in increasingly harsh environments, drawing from the experiences of food producers in countries where extreme weather conditions are already present. From the chilly far north to deserts, they're working to ensure food is available even when the climate isn't conducive.

Deserts are inhospitable places. Despite that, the United Arab Emirates (UAE) aims to be the world's top-ranking country for food security by 2051. It's currently ranked at 23rd of 113 countries by Economist Impact (New Zealand is 14th and Finland is 1st). Achieving that aim includes plans to grow 100,000 additional tonnes of strategic food items domestically.

The desert country could serve as a model for coping with extreme drought. But it also grapples with groundwater reserves that are saline and becoming increasingly so – a problem that has helped topple past civilisations. Additionally, the population has grown 30-fold in the last 50 years and draws more water from aquifers than the extremely scanty rainfall can replenish.

All potable water is desalinated seawater, but crops are irrigated by the aquifers, which are somewhat less salty than sea water. To protect this resource, the Environment Agency – Abu Dhabi regulates the maximum amount of water that growers can extract.

Plant & Food Research Principal Scientist, Dr Brent Clothier, has been providing physics expertise to the Agency to ascertain how much irrigation each crop requires. Clothier and his colleagues measure factors such as sap convection rates to calculate plants' water requirements in various environments.

Dates are one of the UAE's main crops. Date palms are relatively salt tolerant, but how much salinity can they cope with? Experiments conducted with an Emirati PhD student Clothier supervised, Ahmed Al-Muaini, showed that desalinating the irrigation water doubled the date yield to 74 kilogrammes per tree. Now many growers use solar-powered desalination units, says Clothier.

"For a farmer it's worthwhile buying a desalination unit because the operating costs will be outweighed by the extra yield," says Clothier. But it's not an ideal solution, because desalination produces very salty wastewater, which is dumped on the soil and percolates through to groundwater in a vicious salty cycle.



Scientist Ahmed Al-Muaini working on a water conservation and food security project in the United Arab Emirates, which has some of the harshest growing conditions in the world.



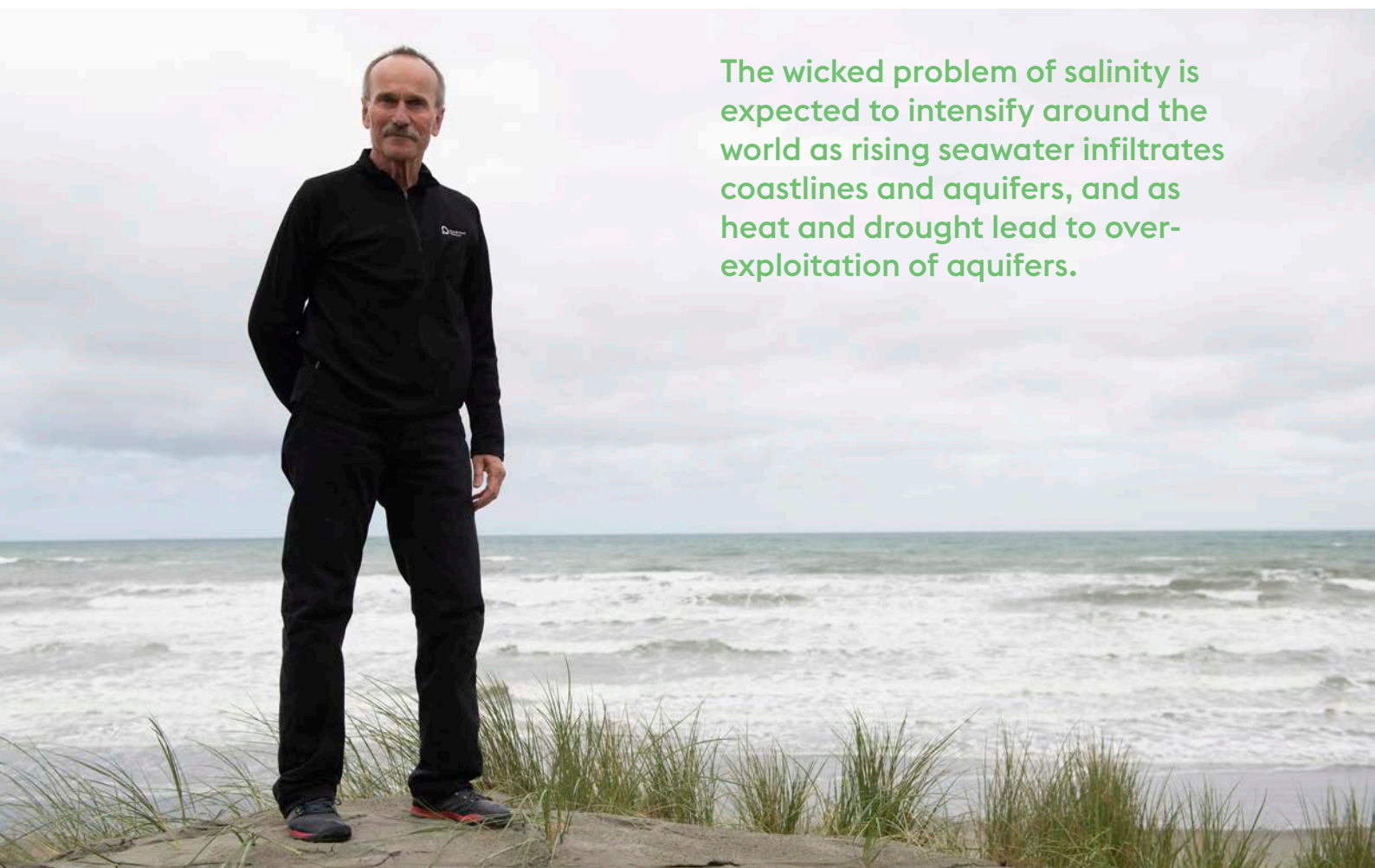
Salicornia bigelovii (sea asparagus), a vegetable and fodder crop, being irrigated with aquabrine, a by-product from the use of desalination brine in inland aquaculture.

BELOW: Plant & Food Research Principal Scientist Dr Brent Clothier.

But desalination brine can be used to farm salt-water fish in inland aquaculture tanks. This works well, and once it has served its purpose there the tanks' salty effluent – known as aquabrine – is then used to irrigate a halophytic (salt-tolerant) plant known as sea asparagus (*Salicornia bigelovii*). Clothier, his current Emirati PhD student, Mansoor Al Tamimi, and their team have shown that sea asparagus irrigated with this nutrient-rich brine has a higher yield. The plant's fresh tips fetch high prices as a vegetable delicacy, and the remainder is camel and goat fodder.

But again, there's a drawback. Halophytes withstand salty water because they pull freshwater out of it. "They leave water in the soil that's three times the saltiness of the aquabrine. So you need to flush that salt out of the soil," says Clothier. This salt, too, percolates back into groundwater, increasing groundwater salinity under sea asparagus growing areas by about 10% a year.

The wicked problem of salinity is expected to intensify around the world as rising seawater infiltrates coastlines and aquifers, and as heat and drought lead to over-exploitation of aquifers. Most plants can't cope and yield poorly or die. The only hope of sustainable outcomes, says Clothier, is careful management backed up by scientific evidence.



The wicked problem of salinity is expected to intensify around the world as rising seawater infiltrates coastlines and aquifers, and as heat and drought lead to over-exploitation of aquifers.



Dr Akhlasur Rahman examines trial plantings of rice crops in Bangladesh. Dr Rahman leads rice cultivar development for saline-prone parts of the country.

Getting wet

In Bangladesh, coastal salinity is a long-standing problem that's worsening as the planet heats. The country is notoriously prone to flooding and cyclones, whereas inland areas suffer from heat and drought. Nevertheless, rice must be grown, being the staple food of Bangladesh's 173 million people.

The multiple challenges facing rice growing are under the watch of the Bangladesh Rice Research Institute. It develops improved rice varieties and production technologies to protect and sustain Bangladesh's food security. Dr Akhlasur Rahman is a principal scientific officer and plant breeder there, leading cultivar development for saline-prone areas. Other teams are developing cultivars that yield well despite drought, flash floods or heat.

To create new cultivars, breeders use modern breeding tools such as single-seed descent, rapid generation advancement, genomic prediction and molecular marker-assisted breeding. This can halve the time required to five or six years. No genetic modification is used. "Farmers can produce and maintain their own seed for these rice varieties. The genotypes are homozygous so there's no surprises in the next generation," says Rahman. There's an emphasis on rice farmers having the tools they need to

be in control, including a mobile app that allows them to upload photos of pests or diseases and advises on the required treatment.

Rice is usually salt sensitive, but farmers in coastal areas have long grown a saline-resistant rice, reflecting the centuries for which rice has been grown there and farmers' skill at selecting successful varieties. But the yield of traditional salt-resistant cultivars is low. "We use the local cultivars as donors and transfer these useful genes via the breeding process to develop new high-yielding varieties. We've been able to double the yield compared to the local variety in some cases," says Rahman. Farmers now grow the new saline-resistant rice.

Rahman cautions that because salinity fluctuates seasonally and within small areas, the aim is to develop rice varieties that resist high salinity rather than require it. The breeders target mechanisms that include the plants' abilities to exclude sodium and to adjust osmotically. "Sometimes a single mechanism doesn't work. It's a complex trait," says Rahman.

There's another trait that's essential for all rice, and the only way to tell whether a variety possesses it is to perform the cooked rice test. "It has to taste good or the price farmers get for the rice will be low, and they might not adopt it," says Rahman. "There's no genetic marker for tastiness – that's our challenge."

That other staple

Rice is the staple food for half the world's population, but wheat remains hugely important. It's a focus for researchers at the Australian science agency, CSIRO. Like the Bangladeshi scientists, they have called upon genetic diversity from seed material stretching back more than a century. By exploring historical wheat collections from the Old and New Worlds, and using Australia's own genetically diverse crops containing genetics that spawned the Green Revolution, they've curated a gene bank helpful for future climate change resilience.

CSIRO Research Scientist, Dr Jessica Hyles, explains that Australia grows wheat across varied environments. Long-season types are cultivated in regions with cold winters and high frost risk, and they grow slowly over winter until lengthening days stimulate seed-setting. In hotter, drier climates, shorter-season types are grown.

Regardless of wheat type, yield is optimised only if flowering time avoids extremes such as frost, heat and drought. Fortunately the major genes underlying

the timing of all wheat's lifecycle stages, known as phenology, are now known. "I'm now looking at some of those minor genes we know less about," says Hyles of her historical wheat research.

The information will soon be available in a gene bank, helping wheat breeders make targeted decisions about phenology genes that suit different climates, along with other agronomically important genes such as for disease resistance. "That could be through either traditional breeding or genetic engineering," says Hyles.

Also on the team's radar are future target traits for wheat varieties that need less input, such as water or fertiliser. "Inputs are a cost to the grower, but there's also an environmental cost," says Hyles. One ambitious project aims to develop plants that produce their own fertiliser, and another published in *Nature Climate Change* in 2022 looks at genes for coleoptile length. A long coleoptile – the sheath that protects the first emerging wheat leaves – means wheat can be sown deeper, further from high surface temperatures and closer to deeper-down soil moisture.



CSIRO Research Scientist Dr Jessica Hyles' work aims to design future wheat crops for Australian growing environments.



Tomato production in a research greenhouse at the Norwegian Institute of Bioeconomy Research (NIBIO.) Carbon capture technology is being trialled at the facility, in partnership with GreenCap Solutions.

Undercover growers

For some crops the vagaries of outdoor growing can be skipped entirely. Greenhouses are synonymous with the Netherlands, and its Wageningen University leads innovation in this sphere. Dr Michel Verheul did his postgraduate study there, but he's now a research professor in the Department of Horticulture at the Norwegian Institute of Bioeconomy Research (NIBIO).

While Norway's climate is more extreme than the Netherlands', he says its advantages include a warm gulf stream that props up coastal temperatures. Summer days are extremely long, with the flipside of too little light in winter. Norway's 100% hydroelectricity makes for low-emission heating and lighting.

Ongoing refinement of growing systems for tomatoes, cucumbers and lettuce during the 25 years Verheul's been working there means tomato plants can now yield 120 kilogrammes of fruit per square metre instead of 40 kilogrammes, and cucumbers yield 150 kilogrammes instead of 50 kilogrammes. That's when scientific advances are put into practice via systems that use computers to control lighting (wavelength, intensity and timing) and the indoor temperature, humidity and carbon dioxide level. When the Arctic sun shines around the clock, the air is artificially cooled for a few hours to give crops a false night.

But production should ideally also be low-emissions and financially sustainable. In response to NIBIO's research, some growers have invested in heat pumps, heat exchangers, heat buffers and LED lighting.

Heating without gas sharply reduces the produce's carbon footprint.

Gas is also traditionally used to replenish the carbon dioxide that photosynthesis depletes from greenhouse air. Instead, Verheul's team is working with GreenCap Solutions, a carbon-capture company. "By capturing carbon dioxide from the outside air, carbon dioxide emissions from greenhouse production will approach zero," says Verheul. This is now ready to be tested in commercial greenhouses.

Sophisticated infrastructure and renewable electricity reduce emissions, and increase yield and quality, but they're expensive. That makes it hard to compete with cheaper imports. Spanish produce in particular has abundant sunlight and low labour, energy and infrastructure costs, although it's comparatively land and water hungry, relies heavily on plastic covers and gas, and is transported long distances.

Then there's food security. "Since the Ukraine war, we've noticed in Norway that food security is not a thing we can depend on in a global market," says Verheul. "From May to October we have regulations so imports of tomatoes and cucumbers are taxed to protect Norwegian production. But it's grocery companies that decide how much can be produced locally and how much is imported. In the end, it's up to consumers to choose to buy Norwegian products for lower carbon emissions or food security." Shoppers can therefore help complete Norway's transition to sustainable greenhouse production, he says. ●

FEATURE



The forgotten life force

An undervalued and over used resource

BY RICHARD RENNIE

As the planet warms, the discussion about how to protect the precious blanket that envelopes the planet and makes life possible has intensified. But this focus has tended to eclipse a much thinner resource, one under our feet — the earth's soils.

While just as critical as the air we breathe, soils tend to be less talked about, possibly less cared about, but no less important for maintaining life on earth.

Mankind's understanding of just how important soils are to life is still unfolding. It took until 2023 to catalogue just how great that importance is, and the data has blown away previous studies in terms of the importance of the thin brown layer beneath our feet.

Rich in life

Back in 2006 it was estimated a quarter of life on earth resides in our soils. But in 2023 a paper published in the journal *Proceedings of the National Academy of Sciences* saw this figure boosted significantly.

Dr Mark Anthony of the Swiss Federal Research Institute for Forest, Snow and Landscape Restoration and colleagues estimated soil is actually home to about 60% of all life on the planet.

More than double the earlier estimate, this ranged from the simplest microbial organisms to the most complex. Predictably, soil is home to almost 100% of all earthworms, through to 85% of all plants.

The results of the survey prompted researchers to maintain soil is "the most biodiverse, singular habitat on earth."

The survey also provided valuable data for those seeking better protection of soils when advocating for the earth's thin brown line of life.

For a country like New Zealand, intensely dependent upon that thin brown layer to grow food to feed a nation of 5.2 million and almost 40 million around the world, preservation and improvement of the country's soils should be a national past time.

But the combination of food growing demands, fragile geology, a maritime climate, and the sheer youth of our soils means the task of preserving and improving them is a fraught one.

When valuing New Zealand's 'natural capital', of which soil is an integral part, estimates made in 2012 were that the country's land-based ecosystem services contributed \$57 billion to human welfare, at the time equating to 27% of New Zealand's GDP.

Down the drain

But the vulnerability of soil in that natural capital portfolio was underscored in a recent estimate that New Zealand is losing about 190 million tonnes per year of soil to erosion.

This is the equivalent to 38 million of the country's largest truck and trailer units fully loaded, carting soil to the sea and dumping it there every year.

In 2015 researchers estimated the direct economic losses from soil erosion and landslides to be at least \$250–\$300 million a year, but this doesn't account for wider impacts on the environment and ecosystem services that are known to be many times higher.

Those losses are being most sorely felt along New Zealand's North Island eastern coastline, whose vulnerability was sharply highlighted by Cyclone Gabrielle which struck in February 2023.


Gisborne is estimated to lose 40 million tonnes per year, with the intensity of soil loss estimated to be as great as 20,000 tonnes per square kilometre or 100 hectares. Hawke's Bay, also hit hard by Cyclone Gabrielle, accounts for about 7 million tonnes per year in losses, with Northland and Manawatu-Wanganui running out at 15 million and 13 million respectively.

Measuring soil losses

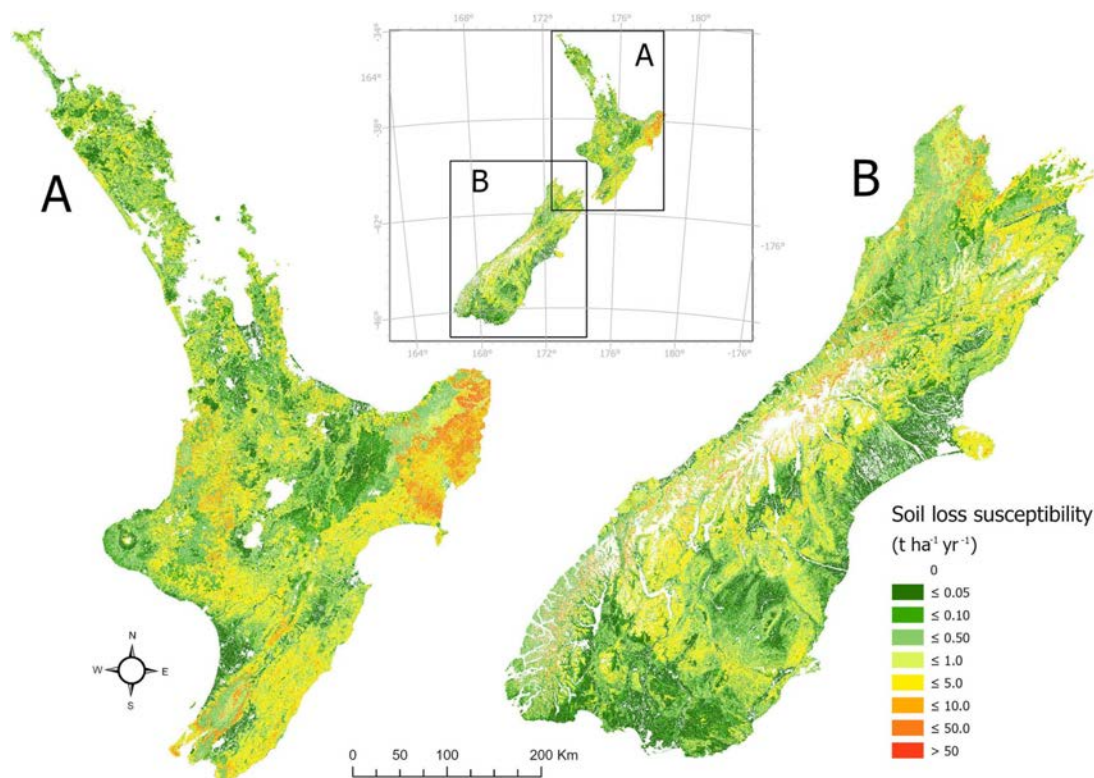
To try and help better understand soil losses, a national scale map on erosion risk that incorporates the impact of livestock grazing has been developed through the Our Land and Water National Science Challenge's land use sustainability programme.

AgResearch landscape scientist, Dr Mitchell Donovan, headed up the project. He now resides in Utah but continues to work with both New Zealand and United States farmers, advising on land use options that can preserve soil quality.

"The groundbreaking aspect of the map is that it manages to get to a resolution of 15 square metres, delivering a level of detail on soil loss susceptibility that is really quite granular, and not seen elsewhere."



New Zealand is losing about 190 million tonnes per year of soil to erosion — this is the equivalent to 38 million of the country's largest truck and trailer units fully loaded, carting soil to the sea and dumping it there every year.



Scientists at AgResearch have developed a national scale map on erosion risk that incorporates the impact of livestock grazing.

But further to that is the map's inclusion of pasture, rainfall, and livestock densities in its modelling.

"It makes its estimates far more nuanced than other maps. To incorporate livestock intensity and pasture means the seasonal variation can be allowed for in erosion events, something simply not captured by using averages.

"It can also help to identify where to place soil loss mitigation tools like bunds and sediment traps."

Future advances include work underway proving the map is capable down to resolutions as detailed as one square metre.

Meantime, Donovan says the map has helped identify hotspot areas for soil erosion.

"Take intensive winter grazing practices for example. In less than one percent of the landscape we are seeing very high winter forage grazing densities that have a big impact upon soil losses in catchments.

"For the wintering part of the year, a catchment may experience 15% of soil losses across the entire year from that activity alone."

Capturing carbon down under

Beyond simply being a platform for food production and export earnings, more attention is also being paid to the role soil can play in helping salvage surplus carbon from the atmosphere.

The idea of soils being a carbon 'sink' is not new, and has had greater profile in Europe, United States and even Australia more recently. New Zealand soil scientists have

been mixed in their opinions on how much of a role soils can play as sinks for carbon sequestration.

This country's younger, less cropped soils record less carbon depletion than those of broadacre cropping areas in the United States, or from generations of cropping in Europe. In effect, New Zealand soils' carbon 'tank' is considerably fuller than many in the northern hemisphere.

Manaaki Whenua – Landcare Research soil scientist, Dr Paul Mudge, is heading up the national soil carbon benchmarking and monitoring programme, taking samples from 500 agricultural sites across the country.

The benchmark sampling and measuring of soil carbon on these sites is coming to its conclusion, with the sites first sampled at the start of the programme almost six years ago about to be re-sampled.

So far, the carbon survey Manaaki Whenua is overseeing has revealed few surprises, with the expected results of lower carbon levels in crop land than perennial pastures.

Mudge emphasises the study is at a national scale and more focused on gains and losses over time than actual carbon amounts. He says it will provide quantitative information on whether broad sectors including dairy or red meat are experiencing increases, decreases or no change in soil carbon over time.

"At a farm level, what we do know is that you can drive carbon losses faster than you can drive gains, through how long paddocks are sprayed out for, how long soils are exposed prior to re-planting, how much rainfall they experience, all affect carbon losses."



Research by Dr Mike Beare (top) and his team suggests that full inversion tillage (bottom) can sequester more soil carbon and could be used by farmers to help offset greenhouse gas emissions.

Tapping out the topsoil

Plant & Food Research Principal Scientist, Dr Mike Beare, has been going beyond the topsoil, to learn there may well be the potential for soils to store more carbon deeper down.

‘Full inversion tillage’ trials conducted by him and his team from Lincoln in Canterbury in collaboration with Massey University and Manaaki Whenua involve literally turning soils upside down, incorporating the carbon dense topsoil further down, while bringing low carbon subsoil to the surface where it benefits from high carbon inputs from plants’ roots.

Modelling by his team suggests the practice can increase carbon levels significantly over time following a ‘one time’ tillage event on grasslands resown to a highly productive pasture.

“Our estimate is that it will take 20 years to reach a new equilibrium before you start to see carbon gains level off. Depending on the soil type, it could be longer.”

Expectations are gains of about 0.6–0.7 tonnes per hectare per year over that time.

While those amounts may seem small, Beare says the key is to be able to practice it over a large area of land, making it capable of delivering a sizable lift in total stored carbon.

Pastures resown after full inversion tillage also tend to have 50–60% lower nitrous oxide emissions from livestock urine or fertiliser, another greenhouse gas the sector has to manage.

As the pastoral sector wrestles with greenhouse gas emissions, sequestering more soil carbon may yet prove a valid offsetting tool for farmers.

“We need more evidence to base this on, but the ideas we have been testing fit with normal best practice, and importantly are easily adopted by farmers.”

Holding onto what’s there

Preserving soils while still ensuring they can be used in a way that keeps farming sustainable and economic can be as much of a challenge on flat country as it is on steep hill country.

Nowhere is this more apparent than with intensive winter grazing practices.

They provide an effective means of feeding livestock such as sheep, cattle and deer over winter a quality, high energy diet prior to the stress of calving and lambing but come with a cost on the soil below.

Intensive livestock treading can damage the soil structure, while extended periods over late winter-spring of bare soil post-grazing can result in ponding, sediment loss and nutrient leaching, particularly of nitrogen.

Plant & Food Research Senior Scientist, Dr Brendon Malcolm, says even the most apparently flat paddocks can be susceptible to loss and damage. His team’s work incorporating ‘catch crops’ into post wintered paddocks is proving a simple, yet highly effective means of addressing the soil quality and environmental challenges.

“We have found that cereals are particularly valuable as catch crops, with their tendency to absorb more nitrogen than they need helping soak up a nutrient that would otherwise be leached out of the soil.”

Nitrogen leaching from cattle urine patches, the main source of leaching, can be reduced by up to 60% planting oats, a crop that is robust and offers particularly good feed value when harvested in late spring as green chop silage.

“And we have found adding Italian ryegrass to the seed mix can provide additional grazing after harvest.”

The practice is growing throughout areas like Southland and Canterbury, and early trials are proving it is effective on steeper Hawke’s Bay hill country, reducing sediment loss by 40%.

“There are still farmers to be convinced, it is hard to say exactly how many are doing it now, but the practice seems more familiar to many now and the focus has to be on more extension work with farmers.

“The benefits may also feed into better carbon accumulation, but certainly bring improved soil structure, biology and better nitrogen immobilisation.” ●

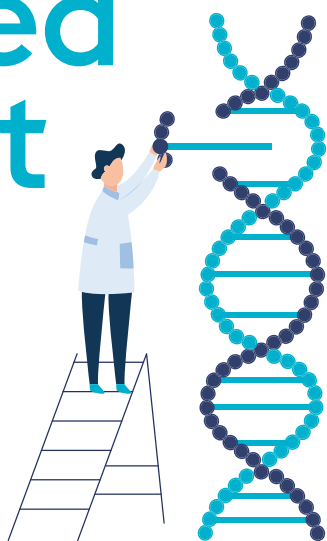


Intensive winter grazing practices cause damage to soil, and nutrient leaching.

Trials run on commercial dairy farms by Scientist Dr Brendon Malcolm (below left) and team, have found that planting catch crops shortly after stock have grazed winter forage crops from an area can help mop up nitrogen, to reduce the risk of leaching.



Five steps to a gene edited plant



Gene editing is a new genetic technology where an organism's DNA can be modified at an exact point in its genetic code. As well as offering the ability to make precise genetic changes, the technique also does not necessarily involve the addition of DNA from another organism.

The most commonly used gene editing technology is the CRISPR-Cas system, a natural bacterial process that has been adapted for use as a genome editing tool in other organisms. Emmanuelle Charpentier and Jennifer Doudna, the scientists who developed the method, were awarded the Nobel Prize in Chemistry in 2020 for this discovery. Over the past decade, scientists around the world have been learning how to use the technique and fine-tune it in their organism of choice.

Gene editing is currently classified as genetic modification in New Zealand, but many countries are passing new regulations specifically for gene edited crops. Scientists around the world are now finding answers to the five questions that need to be addressed in creating a gene edited plant for commercial use.

1 What trait do we want to change?

Scientists interested in altering a trait in a plant look at many different varieties of that plant to see what natural variation exists. Plant breeders maintain large germplasm collections – libraries of individuals representing the variety of genetic differences found in nature – to ensure access to the full diversity of the species.

If a trait, like blue flowers or star-shaped fruit, exists in a species naturally, you're likely to be able to create it through gene editing, potentially much faster than if you used a traditional breeding approach. Gene editing allows scientists to make very simple changes to the existing DNA sequence of an organism to create a new version of an existing gene. This may result in a very different version of the trait to that of the original individual, but mirrors a change that could occur through natural mutation. The main advantage is the ability to bring one specific trait into an otherwise elite plant without many rounds of traditional breeding to remove unwanted changes.

Disease resistance in plants is sometimes conferred by a particular version of a single gene. The resistant version may exist in the wild relative but was not needed when breeding the cultivated crop, perhaps because of a lack of disease pressure in the growing region. A cross with the wild relative would introduce the resistant gene into some of the offspring, but would also mix in many thousands of unknown and unwanted versions of genes as well. It might take six or more rounds of breeding to get an elite cultivar back again. In perennial fruit crops, each round of breeding might take five or more years, making this a very slow process. With gene editing, this could be reduced to a single round by changing the gene from the susceptible to the resistant version directly in the elite cultivar.

2 Do we know the gene(s) for that trait?

To be able to use gene editing to alter a trait, you need to know a great deal about how it is controlled at the genetic level. Some traits are controlled by a single gene, others by a network of genes and by influences from the environment.

For example, human height is controlled by a combination of more than 700 genes, with some influence from environmental factors like nutrition.

Gene editing involves programming the CRISPR-Cas system to seek out and make a change to a specific gene that controls the trait of interest. That means scientists need to have a deep understanding of the trait, the gene they wish to edit, its DNA sequence, how it is controlled and how it interacts with other genes in the plant. Only with all this information can scientists

programme the CRISPR-Cas to target a specific DNA sequence within the gene and, with any certainty, alter only that gene and the associated trait.

3 Is there freedom to operate?

Scientific organisations have been patenting genes and DNA sequences since the 1970s, although some countries, like the USA, have changed their rules for gene patenting in recent years. Holding the patent on a gene means that no one else can work with it to create a commercial product without your permission for around 20 years (depending on the rules of the country where it's been patented).

Therefore scientists may be limited to working with genes that they or their organisation have already patented, that haven't been patented by anyone yet, that are already in the public domain, or where they can obtain permission from the patent holder.

There are also limitations on using CRISPR-Cas because of its ownership. Scientists can use the CRISPR-Cas technology for research purposes if they have a research licence, but their results can't be commercialised without an additional, often costly, commercial licence. The terms of these agreements are negotiated with the patent holders, who can decide who to issue licences to, for what purposes, in which regions, and at what cost.

4 Do we know how to edit the plant?

Most of the time, scientists need every cell of the adult plant to contain the edited version of the gene to cause the desired trait change. This involves taking a single cell from an elite donor plant; getting the CRISPR-Cas machinery into that cell so it can edit the DNA sequence; growing the single edited cell up into a full plant; and checking the plant has the required edit and that no other unwanted changes have occurred during the process.

Plant cells are harder to edit than animal cells. Because of the structure of plant cells, the CRISPR-Cas machinery currently has to be introduced into the cell via genetic modification: scientists are looking for a way around this gene-modification step, as it usually leaves DNA from the CRISPR-Cas machinery in the plant cell.

Creating a whole plant from a single cell is also a challenge. A plant cell can be grown into a full plant using tissue culture, but there isn't a one-size-fits-all process. Different plants, and in some species different varieties, require different tissue culture regimes, and it may take many years of experimentation to find one that works.

5 Does the edited plant perform well agronomically?

Even with all the information available to them, scientists can't guarantee that a plant taken out of the lab will perform well in the field or orchard. Plants are very sensitive to their environment and changing one gene – whether through natural mutation or through gene editing – can have an impact on how a plant behaves in a production setting.

If a gene-edited plant were to be selected as a potential commercial variety, it would then need to enter the pipeline of growing trials used for all new varieties to ensure it had all the characteristics required for commercial success.

The need for regulation & stewardship

Genetic technologies offer benefits for food production, particularly in allowing scientists to deliver at a faster rate the new varieties that address some of the agrifood sector's most pressing issues, such as climate change adaptation and resistance to new pests and diseases. However, there is still a requirement for ensuring the technologies are used appropriately, and that the varieties offer the same, or better, outcomes for consumers and producers.

Across the world, regulations are changing and it's important that altered regulations support both scientific advancement and consumer safety. Regulation based on the outcome of breeding programmes, regardless of the technologies used, is likely to offer both. However, there are also social, cultural and economic factors to be considered in introducing any new technology. It is important that all aspects of the debate are considered, to ensure that the deployment of gene technologies in a commercial setting delivers positive impacts for society.





Science & wine

Blending innovation & craft

BY MATT PHILP

First we domesticated animals and gave up our nomadic ways. And then? Eight thousand years ago, after building the first permanent settlements, what did we humans do next? We made wine.

Viticulture and winemaking are older than Methuselah. Yet even as it pays homage to tradition, the wine industry is steadily adopting cutting-edge technology and innovative practices. From automation in the vineyard to forensic ‘fingerprinting’ of vintages, the industry isn’t standing still in the face of its challenges. In New Zealand, potentially dial-shifting initiatives include finding new methods to identify grapevine diseases, the application of augmented reality (AR) to tasks such as pruning, and the launch of an Experimental Future Vineyard to accelerate the science needed for the New Zealand industry to prosper.

Plant & Food Research’s Science Group Leader for Viticulture and Oenology, Dr Damian Martin, says one of the main factors driving change is pressure on the wine

industry to become more sustainable. At the boutique end, organic and biodynamic wine has been a growing trend for 30 years. But the mainstream is now feeling the heat from younger consumers who want to know that the wine they’re drinking is made with at least some level of commitment to sustainability.

“One of the things the industry is very concerned about, especially in Europe, is that the viticulture sector contributes to a significant proportion of agri-chemical use. There are a bunch of chemicals already being phased out there, and the trend to use fewer inputs will grow,” says Martin. “That creates challenges. The key diseases and pathogens that vineyards come up against aren’t going away. In fact, under climate change and more environmental stress and extreme weather events, both biotic and abiotic pressures are increasing. So that’s among the things pushing the industry to innovate and change the way that things are done.”

If chemical pesticides are out, how do you prevent disease? Martin says the industry is taking two approaches. The first is to build more resilient natural systems to make vineyards less susceptible to pathogens and pests. It’s a back to the future strategy, abandoning the modern monocultural vineyard for a biodynamic or permaculture system.

“In Europe, people are even getting into multi-variety planting within a vineyard block, because they feel that generates more resilience than a single clone of a single variety mass planted,” he says, adding that one potential complication of boosting biodiversity on old world vineyards – which were traditionally established on less fertile sites – is that you create competition for scarce resources and hurt productivity.

The alternative approach, he says, is to innovate, “be that with clonal selection, root stock selection or improved grapevine breeding technologies to try to introduce more disease tolerance and resilience in plants.”

There’s also a concerted push by the industry to identify vineyard diseases earlier, often through the use of leading-edge technologies. In the United States, for example, researchers are testing whether an imaging spectrometer could be used to identify signs of a particular disease from the air. Developed by NASA’s Jet Propulsion Laboratory and originally used to measure and monitor hazards such as wildfires, the technology records the interaction of sunlight with chemical bonds. In the case of sick plants, which might not exhibit infection symptoms for up to a year, it was hoped that the instrument could detect stress at the cellular level, enabling much earlier intervention.

And early tests on Californian vineyards have been heartening, with researchers able to differentiate non-infected and infected vines both before and after they became symptomatic at up to 87% accuracy.

In New Zealand, meanwhile, scientists from Plant & Food Research have developed a machine learning algorithm that could help in early detection of grapevine leafroll disease (GLD), a significant threat to the country’s \$2.4 billion wine export industry. Called VinEye and operating as a mobile app that instantly analyses photos of vines for GLD infection, it has proved promising on vineyards there and in California and will now be tested in other overseas wine regions. Ultimately, the idea is that the tech will be deployed on robots to offer real-time monitoring that is faster, more accurate and more cost-effective than manual detection.

The prospect of driverless units running up and down vineyard rows scouting for disease and collecting other data is not far off, then. But what about getting a read on conditions below ground? Martin points to the aforementioned Experimental Future Vineyard, which will be based at the New Zealand Wine Centre – Te Pokapū Wāina o Aotearoa in Marlborough and operated by Plant & Food Research.

“Viticulture around the world has been extensively studied for 150 years, but because grapevines are a deeply rooted plant, often grown in soils that are very difficult to sample, what happens below ground is still a bit of a black box,” he says. “At the Centre, we’ll core different soils and vines with intact root systems to study in detail what’s happening in terms of water and nutrient



TOP: Plant & Food Research’s Science Group Leader for Viticulture and Oenology, Dr Damian Martin, says there is pressure on the wine industry to become more sustainable.

BOTTOM: Scientists have developed an algorithm, known as VinEye, which has learnt how to instantly analyse photographs of grapevines and identify vines infected with grapevine leafroll disease.

fluxes, pesticide movements, soil carbon cycling at depth, and so on. We want to understand more about how we can build resilience in the viticultural system by treating the below-ground environment better.”

Looking ahead, he predicts the wine industry is going to look significantly different in ten years. “All over the world there are challenges around the availability of labour and costs of production, and that’s going to drive the need for more automated systems, which in turn will drive what vineyards are going to need to look like. It will be a big area of development.”

There’s already plenty happening in the automation space. In New Zealand, the University of Auckland-led MaaraTech programme is focused on developing robots and AI technologies for use in horticulture and viticulture. One of its more promising developments is the application of AR for pruning vines.

“The wine industry told us that its problem is not just the quantity of labour but the quality of the work that people are doing,” says MaaraTech Programme leader, Professor Bruce MacDonald. “We developed this to help people do a better job, and to automate tasks.”

How does the innovation work? Initially, a robot scans vines. The imaging data is then used to create a 3D digital model, to which machine learning is applied. “You can calculate the things that people use when they are pruning like the diameter of the cane, distance between nodes, and so on. We estimate all of those metrics then apply the particular pruning rules the vineyard owner wants,” he says. “Imagine vineyard workers wearing

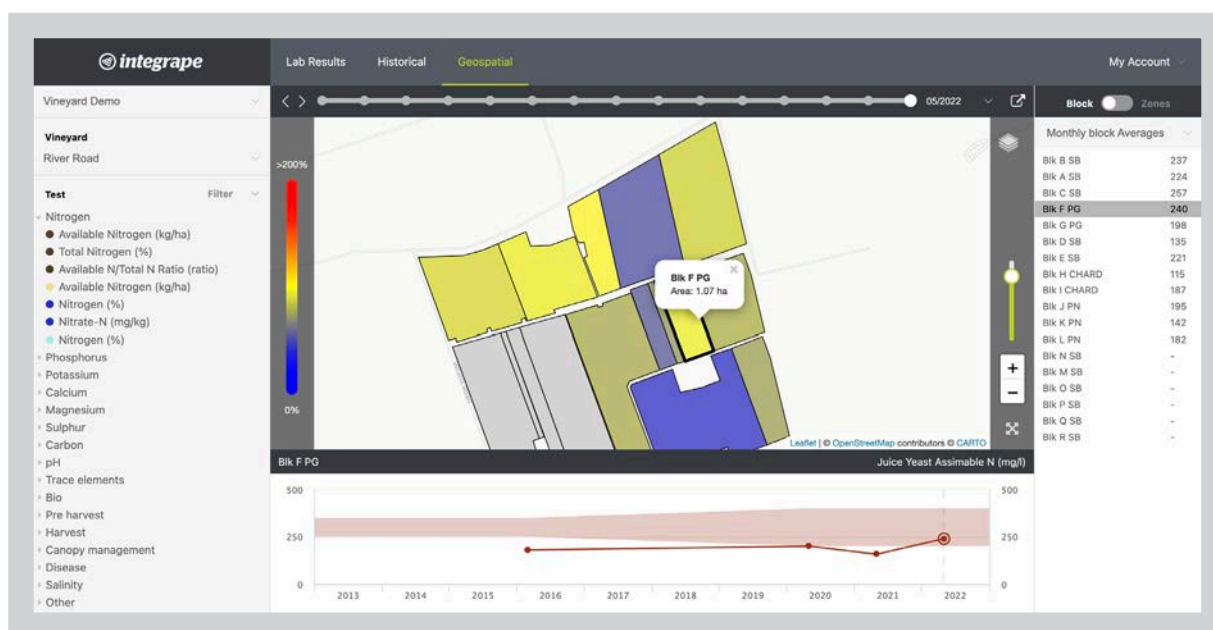
AR headsets, and the graphics they’re seeing are pointing them to exactly where they should prune.”

The same technology could be deployed on robots armed with secateurs, says MacDonald, adding that the programme team has also developed a virtual reality computer game-style product that can help trainees learn to prune before they get near a vine. That innovation is already at a stage where it could be commercialised – there’s plenty of industry interest, he says – but the AR technology requires more testing.

Meanwhile, the tools of precision agriculture are being adopted by innovative wine companies. One example: more than a third of New Zealand vineyards now use Integrape, which brings together all of a vineyard operation’s salient data, from tracking disease to fertiliser application to yield estimates.

Integrape Managing Director, Joris Besamusca, says the home-grown platform was created as a decision support tool and solves the problem of information being collected in diverse formats – PDFs, written reports, winery software and so on – and stored in multiple locations. “With Integrape, they can log in and see everything in the one place,” says Besamusca, explaining that the platform allows growers to get a better handle on historical trends, variability and problem areas.

Complementing Integrape, the company also offers its clients an app called Vure that allows workers in the field to digitally collect observations used to estimate yield and monitor diseases and pests. As opposed to manual recordings, “this is streamlined, with less room for error



Integrape brings together all of a vineyard operation’s data, allowing growers to monitor trends and variations across the vineyard.

and people can react faster because they get to see the results coming in live,” he says, adding that it’s all time-stamped and geo-referenced. “You can see exactly who the sampler was and where they were in a block.”

He’s talking essentially about traceability, a word that’s increasingly relevant at the other end of the winemaking process, when the Sauvignon blanc or Chardonnay is in the bottle and on store shelves. Here, too, New Zealand wine companies are embracing the cutting edge. Recently, North Canterbury’s iconic Pyramid Valley label partnered with Dunedin-headquartered forensic science and data firm Oritain on a world-first method to verify the origin and provenance of its Botanicals Collection of fine wines.

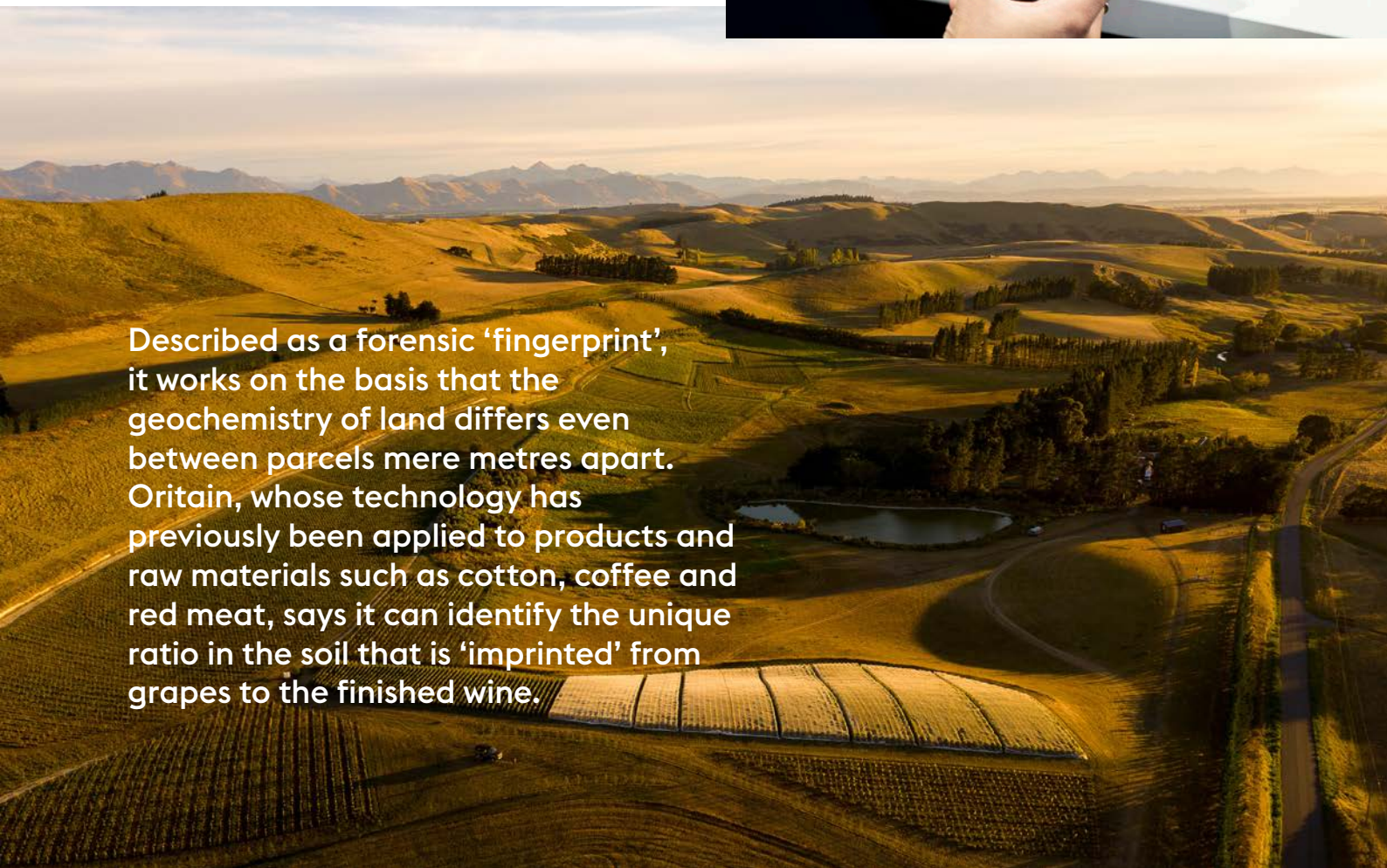
Described as a forensic ‘fingerprint’, it works on the basis that the geochemistry of land differs even between parcels mere metres apart. Oritain, whose technology has previously been applied to products and raw materials such as cotton, coffee and red meat, says it can identify the unique ratio in the soil that is ‘imprinted’ from grapes to the finished wine.

New Zealand wine maker, Pyramid Valley Vineyards, has partnered with tech company Oritain to offer its customers origin-verified wines.

“We were looking for a way to provide two guarantees to our valuable customers. Firstly, that the wines are 100% of the place we say they come from, and secondly, providing verification of their provenance at any time in the life of a wine,” says Steve Smith, Managing Director of Aotearoa New Zealand Fine Wine Estates, Pyramid Valley’s owner. “This fingerprint represents a scientific identifier that links the land, the vine and the specific attributes of the wine. It’s a gamechanger.” ●



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High alert

— the stink bug threat

BY SALLY BLUNDELL

They are accidental tourists with a voracious appetite and aggravating living habits.

Disturbed or squashed, the brown marmorated stink bug (BMSB), *Halyomorpha halys*, emits a horrible smell.

Left alone, it feasts on a broad diet of over 300 edible or ornamental crops, sucking out the juice through a straw-like mouthpiece (in France they're called the devil's thumbtack) that causes necrotic spots, bruising, deformation or fruit fall.

In winter, they'll hunker down en masse in dry, dark corners of homes, factories or warehouses where they can become sleepy stowaways in outward-bound cargo and personal belongings, ready to wreak havoc in their next destination.

"It is absolutely something we do not want," says Biosecurity New Zealand readiness manager, Dr Cath Duthie, who sports a larger-than-life-size tattoo of the bug on her arm. "Either the fruit will be damaged to the point where it is cosmetically unsaleable or we

are going to have to use the type of chemical controls which means we breach our residue limits and therefore can't sell that fruit. Either way, it is going to damage particularly those high-value international markets that rely on perfect fruit with low residue limits."

Growing to about 12–17 millimetres, BMSB originated in east Asia. But since the late 1990s, its high reproductive rate, broad diet and resistance to many insecticides has seen populations explode around the world. In the USA, it took just a decade to become an agricultural pest. By 2010, farmers were reporting up to 90% losses of peach and nectarine crops and 50% apples and pears. The bug has since been detected in 46 states.

In Italy, BMSB was identified in the northern Trentino region in 2016. Despite a rapid roll out of pesticides and netting – restricted to non-tourist pathways – the pest inflicted €150 million of damage on growers' incomes in just one season and nearly wiped out Italy's €300 million pear industry.

Its footprint now includes China, Japan, Korea, North America, Europe and one country in the Southern Hemisphere, Chile.

Not Australia, not Aotearoa, not yet.

A BMSB infestation would devastate New Zealand's fruit, vegetable and wine export industries. According to an NZIER report in 2017, it could wipe between \$1.8 billion and \$3.6 billion from the country's GDP. Home-owners would face thousands of bugs coming into their homes. Some native plants, says Duthie, could be a food source, although it is unlikely it would damage the plant's ability to reproduce. It could compete with native stink bugs, although generally, she says, our most vulnerable natives are in different habitats. "But all bets are off until we know for sure."

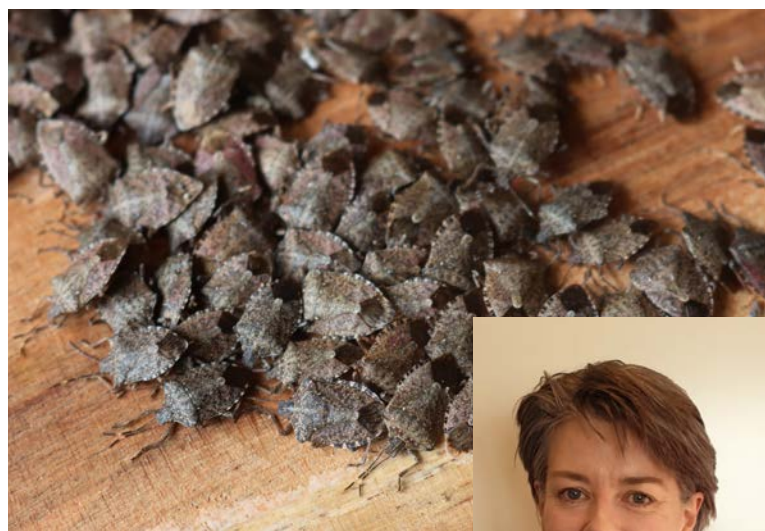
The bug was first intercepted at our border in 2005. In the 2017/18 stink bug season (September to April), about 2,500 bugs were intercepted; four infected car carriers from Japan were turned away; 26 live bugs turned up in a box of imported shoes in Oamaru.

There was some comfort in the fact that BMSB populations were confined to the northern hemisphere. To reach the southern hemisphere, says Plant & Food Research entomologist, Dr Lloyd Stringer, it would probably arrive as an overwintering and unmated adult. "So they'd need to emerge out of diapause, find food, find a mate, mate, then go through a whole generation before winter hits." It seemed a high bar but the discovery of BMSB in Chile in 2017, where the pest is now spreading, "shows it's possible."

The growth in global trade and climate change are increasing its chances. Recent research by Washington State University entomologist, Javier Gutierrez Illan, found BMSB habitats in the US could increase by 70% by 2080. Part of this spread is due to people inadvertently transporting stink bugs in vehicles or farm equipment to areas that would otherwise be hard for them to reach by flying but, according to the study, a warmer, wetter climate is the most important driver of BMSB abundance. In some countries, says Professor Claudio Ioriatti, a world-renowned expert on BMSB at the Fondazione Edmund Mach (FEM) research centre in northern Italy, climate change could speed up the bug's life cycle, going from one generation a year to two.

So far, no country has eradicated BMSB, but the insect's inability to establish a foothold in New Zealand to date has given scientists, industry and government time to collaborate on strategies to mitigate the economic, social, cultural and environmental risks of a BMSB incursion.

New Zealand has been working with Australia to develop offshore treatment and auditing programmes. Under current Import Health Standards, vehicles, machinery and parts from 38 identified BMSB-risk countries, and all sea containers from Italy, must undergo approved treatment before being shipped to New Zealand during the BMSB-risk season (the list does not include China, one of the BSMB's native zones – according to Duthie, China's BSMB population is kept in check by natural predators and imports from China are not reflected in border interceptions, for now at least).



TOP: In just one season, BMSB nearly wiped out Italy's €300 million pear industry.

BOTTOM: There are no natural predators for BSMB in New Zealand. If the pest became established, some home-owners would face thousands of bugs coming into their homes says Dr Cath Duthie (INSET).

Currently such treatments include heat, methyl bromide or sulfuryl fluoride. But some commodities are damaged by heat; methyl bromide depletes the ozone layer; and sulfuryl fluoride is a greenhouse gas. Ethyl formate, neither a greenhouse gas nor an ozone depleter (although it is more flammable than methyl bromide), has been approved in this country but, according to a Ministry of Primary Industries (MPI) spokesperson, “not yet for biosecurity purposes.”

At the border, air passengers from high-risk flights are given information on BMSB; two BMSB-trained detector dogs are on call; breakbulk (uncontainerised) cargo from at-risk countries and sea containers – an expected 5000 this year – are checked.

These biosecurity measures seem to be working. There were 57 interceptions of live bugs during the 2019/20 season, nearly three-quarters lower than the previous season. After a small spike in 2021/22, this figure fell last season to 44, mostly associated with cargo but showing an uptick in passenger pathway interceptions.

Within the border, MPI, the multi-organisation science collaboration Better Border Biosecurity (B3) and the horticulture industry and government backed BMSB Council have supported a range of preparedness projects, including an annual campaign to raise local BMSB awareness amongst gardeners, homeowners and travellers, and research projects in the areas of risk assessment, pathway risk management, surveillance and eradication. With no resident BMSB population in New Zealand, much of this science is undertaken in collaboration with overseas researchers.

As part of a B3 project, Rachael Horner, a Research Associate at Plant & Food Research, has been trialling a more effective alternative to the traditional A4 sticky panel trap used to detect BMSB. The aerodynamic tunnel trap uses an aggregation pheromone to attract nymphs and adults via a rotating wind vane, to ensure a more concentrated pheromone plume, undiluted by cross winds. The traps do kill the insect, says Horner, but



Scientists have been undertaking trials on orchards in Italy, where BMSB is established, with the aim of developing traps such as The Nazgûl, pictured here, as tools for managing the pest.

their main purpose is early detection and monitoring, giving growers better insight into insect populations and how to improve spray timing.

Italian scientists are working on a trap that combines aggregation pheromone with synthesised mating calls, or vibrations, through the relatively new science of biotremology. This ‘pied piper’ technology lures bugs in from a distance with the pheromone then uses the vibration to get them into the trap. Plant & Food Research Honorary Fellow, Professor Max Suckling, visited the FEM research centre in Italy where he worked on The Nazgûl (named for the Black Riders of Tolkien’s Middle Earth), a pheromone-baited coat hanger covered with dark, insecticide-treated mesh. The trap was found to catch over three times more nymphs and adults than the baited sticky panel.

Suckling also evaluated the potential for a sterile male release programme, in which sterilised insects are dropped by drone into a wild population. This technique was used to tackle codling moth in Hawke’s Bay, but BMSB would require a large, local population which, while sterilised, could still devastate crops, and there is the risk, he says, that the imported BMSB might carry a plant pathogen. “So it’s not a silver bullet, but an option.”

Another measure already being used by countries where BMSB has become established is biological control, and in particular the pin-head sized samurai wasp, *Trissolcus japonicus*. This parasitoid, which does not sting humans, lays eggs inside stink bug eggs. When the larvae hatch, they eat the developing stink bugs before chewing their way out of the eggs.

In trial orchards in northern Italy close to natural areas, says Ioriatti, the wasp has reduced the hatching rate of BMSB eggs to less than 30 percent. This decline could be influenced by climate and more informed use of chemicals but the wasp, he says, is an important strategy to control the bug and reduce pesticide requirements. “Some treatment will be needed in the future, but in this region we have reduced by 50% the pesticides applied.”

Trissolcus japonicus has been approved – subject to controls – by the Environmental Protection Authority for release in New Zealand should it be needed. “This is a world-first and marks the before and after for biocontrol preparedness and pre-emptive biocontrol in New Zealand and worldwide” says Plant & Food Research senior entomologist, Dr Gonzalo Avila. Wasps would most likely be sourced from US laboratories, although recent funding from the government’s Endeavour Fund is being used by a team of international experts, led by Avila, to develop a world-first ‘artificial egg’ prototype that mimics BMSB egg, providing a novel way to mass-rear the wasps. “The successful development of our technology will provide a cost-effective and sustainable means for mass producing egg parasitoids to use against BMSB,” says Avila.



The samurai wasp (*Trissolcus japonicus*) is about the size of a sesame seed and could be deployed to help combat a brown marmorated stink bug incursion in New Zealand.

***Trissolcus japonicus* has been approved — subject to controls — by the Environmental Protection Authority for release in New Zealand should it be needed.**

Most scientists agree it is a matter of when, not if, a BMSB population establishes here. Duthie is not so sure. Interceptions, she says, are tracking down. This could be due to microclimatic factors, delays in shipments stranding the bug offshore, or biosecurity measures, “but I am more confident now about our ability to keep it from coming in and establishing.”

Still, the successful deterrence or population management of the BMSB, says Ioriatti, requires rapid response and integrated strategies to address the bug at egg, nymph and adult stages. This in turn requires on-going vigilance, research and collaboration. “International collaboration is of paramount importance. Thinking about what would be the best strategies and if possible eradicate the pest or at least be ready to react. We need to learn how to manage the pest so growers know what chemicals to use and what time, as well as biological control. We need to learn a lot before the pest arrives, learn from colleagues who first experience the problems, be ready to react.” ●

GLOBAL FOOD LEADERS

An interview with Jennifer Boggiss, Heilala Vanilla

Segment talks to Jennifer Boggiss, co-founder and chief executive of renowned humanitarian vanilla brand, Heilala Vanilla.

Heilala Vanilla began as an aid project in Tonga in 2002 in the aftermath of Cyclone Waka; fast forward two decades and the company has built successful partnerships with vanilla growers in Tonga, providing employment and infrastructure across several communities. Its products are featured on the menus of some of the world's best restaurants.

You've talked before about how food technology and innovation are key for your business, why is that important?

Right from the beginning, we just didn't want to be another vanilla brand. If we're going to really take a brand from Tonga and New Zealand to the world, we have to have a point of difference. So our branding and packaging is important in setting us apart. We also have a zero waste process, which is unique in the industry. Food and ingredient formulation is another key component – we do seasonal flavours, we've done alcohol free vanilla and we've gone beyond food products too. We worked with Plant & Food Research on developing a cosmetic grade bioactive ingredient that we are now supplying to a cosmetic company.

Going forward we'll continue to build on research we're doing on the supply chain side of the business in Tonga as well product research here in New Zealand, including around extraction and processing.

What do you think it takes to be a humanitarian and sustainable business and what advice do you have for other companies wanting to take a similar approach?

I think you need a really strong 'why' and a strong purpose to really keep you on that course, because there's going to be many challenging times where it'd be easy just to say, "this is all too hard, let's just go and buy all our vanilla from somewhere else." But it's our purpose, and our 'why'

that keeps driving us. We're also really fortunate to have a team of shareholders and a board of directors that are also really aligned around that purpose.

How is the approach you're taking different to other vanilla companies?

About 80% of the world's vanilla comes out of Madagascar, the other big players are Papua New Guinea, Indonesia, and Uganda. Tonga is unique, we're never going to be large scale like Madagascar, but on the other hand we can really focus on provenance, traceability, and quality. Following being the world's first and only B Corp certified vanilla company I have aspirations to be the world's first carbon positive vanilla brand.

In large vanilla growing nations where the product is treated as a commodity, prices for farmers can be very volatile. Depending on what's happening with yields and demand, you get these big price fluctuations and that can result in farmers having to find other means of income when the price goes low. In Tonga we aim to take those risks away for our farmers. We pay above the global market price and keep prices steady so that farmers have security around vanilla.

What does partnership look like for your company? How has it contributed to Heilala Vanilla's success?

I feel fortunate to be close to our farming families and partners in Tonga, to some extent they feel like extended family and we treat each other in a similar sort of way, with a

lot of respect. There are obviously a lot of cultural nuances between Tonga and New Zealand, there's a lot of things in their culture that I really like – they don't take life too seriously, laughter seems to come very easily and they're really resilient through all their natural and environmental challenges.

We have staff across both New Zealand and Tonga and so one way we build connection and understanding is by running a type of exchange programme with our staff where someone from New Zealand goes to Tonga each year, and someone from Tonga comes to New Zealand.

We know that climate change is a major concern for South Pacific nations, how do you see science supporting the response to this?

I see science supporting the industry to build more resilience. We're working on a project exploring how to make vanilla plant material more robust and disease resistant. We also want to build more resilience into rural communities by exploring different crops farmers can grow alongside vanilla.

Your vanilla products can be found in supermarkets and restaurants in many major markets around the world, how are you reaching new consumers?

I really enjoy connecting with chefs around the world who really endorse what we're doing, why we're doing it and the quality of our product. I was just in the US recently and met with chefs in New York that use Heilala Vanilla. Since that trip, the 2023 Michelin Awards have been announced and a number of those chefs received three stars, two stars or one star. So those sort of things are really a personal highlight, because they really validate what we're doing and the journey that we've been on.

What consumer trends do you think will be important in the future?

I think a business' sustainability credentials, their carbon footprint, that whole side of things is important going forward, especially in food. The other area is balancing quality and affordability. People want sustainable, traceable, quality food, but you've got to balance that with making it affordable to a wider group of consumers.

What was the last new food you tried that you felt excited about?

On a trip to Tonga in 2023, I tried dragon fruit for the first time. A lot of people have heard about it but I haven't really come across it in the markets in Tonga before. One of our partners in Tonga is the not for profit group, MORDI Tonga, which supports rural development and innovation. They've established a demonstration farm for growers interested in exploring dragon fruit as a potential crop. At the demonstration farm I pulled a dragon fruit off the tree and tried it, and it was just so delicious.



Tonga is unique, we're never going to be large scale like Madagascar, but on the other hand we can really focus on provenance, traceability, and quality.



Breaking new ground

Peanuts prove promising for New Zealand

PHOTOGRAPHY BEN LAWRENCE, WARA BULLÔT,
PIC'S PEANUT BUTTER & NORTHLAND INC

A three-year project is exploring if Northland could be a new home to commercially-grown peanuts. It's hoped the work could lead to a new industry in New Zealand and help boost the local Northland economy.

If successful, peanut farming has the potential to unlock new job opportunities in Northland both on and off farm, pumping funds into the local economy and supporting investment opportunities. Trial sites stretch from western Kaipara to Kaitiaki in the Far North, allowing scientists to monitor how the crop performs in different parts of the region.

The 2023–2024 planting season marked year three of the trials, with an estimated five hectares of peanuts planted across six sites, all of which were previously planted in pasture. Sites are on active farms where the landowners have a range of businesses including dairy, pastoral and kumara growing. Three sites are on iwi land.

Three different peanut varieties have been planted in the 2023–2024 season, all of which are Hi Oleic peanut varieties. Oleic acid is a monounsaturated fatty acid, known as a good fat. Hi Oleic peanuts are widely used in confectionary and snacks, as well as peanut butter production.

The project is led by Northland Inc with funding provided by the Ministry for Primary Industries' Sustainable Fibre Futures fund, Pic's Peanut Butter, Northland Inc, and expertise from Plant & Food Research and Manaaki Whenua – Landcare Research.





Northland Inc project manager, Greg Hall, checks soil conditions at one of the six peanut growing sites for the Northland trials.

Peanut plants do best in free draining soils. They need soil temperatures above 18 degrees Celsius, otherwise they germinate poorly. Northland reaches those soil temperatures as early as October and into the summer months, which is the key growing period for the crop.

IMAGE BY BEN LAWRENCE

As peanut farming has never been done on a commercial scale in New Zealand, the project has involved making tweaks to farm machinery – this tractor is pulling a drill typically used for planting maize, but has been busy planting thousands of peanut seeds. To ensure peanuts reach maturity, sowing should occur no later than mid November.

IMAGE BY NORTHLAND INC





On some trial sites irrigation is being used while on others it isn't to allow for comparison of how the crop performs. To grow a commercial peanut crop around 600 millimeters of water is needed – Northland, on average, gets 400 millimeters of rainfall over the season.

IMAGES ON THIS SPREAD
BY BEN LAWRENCE



Peanuts are a type of legume like peas and beans. The peanut plant isn't a tree that produces a crop, instead it's a small bush, which can grow up to 50 centimeters high. Peanut plants add nitrogen and restore soil, making them a great rotational crop for farmers.



Peanut roots start to form nodules during the growing process – when active, these nodules provide nitrogen to the plant. If the nodules are a deep red, it shows they're fixing nitrogen from the air in the soil. All legume plants have these nodules.



Peanuts have yellow flowers that bloom above ground but their seeds develop at the end of live shoots called "pegs," which grow into the ground. Over time the pod containing the 'nuts' develops at the tip of the peg. As part of the Northland project, scientists monitor to see how long this pod takes to reach maturity.

Research Associate at Plant & Food Research, Josh van der Weyden, checks in on the crop. Peanut plants have branches that extend from a central point. By counting these branches scientists can monitor plant health and growth. Counts are being done monthly, with designated sampling areas across each site meaning the same plant will be checked more than six times over the season.



Mature peanut plants. To determine whether it's time to harvest the crop, a selection of plants are dug up and the colour of the pods is assessed. Depending on maturity, the pods vary from being a whiteish yellow to very dark brown or charcoal black.

IMAGE BY NORTHLAND INC



Harvesting peanuts is a two-step process – firstly, harvesters skim the ground to dig up the pods from the soil and invert them so the pods are facing up and the plant's green top is facing down. The crop is then left to dry for around seven days, before a peanut thresher shakes the pods off the plants into bins. In small plot trials during the first year of the project yields of up to five tonnes per hectare were achieved. This is similar to yields in Australia, where a commercial industry is established.

IMAGE BY PIC'S PEANUT BUTTER

Pic's Peanut Butter COO, Stuart Macintosh (left), and company founder, Pic Picot, examine the crop. Pic Picot says the project would allow his company to make an iconic New Zealand product with home grown ingredients. The trials also have the potential to make a real difference to the carbon footprint of Pic's Peanut Butter and redirect the nearly \$10 million spent on imported nuts to Northland.

IMAGE BY PIC'S PEANUT BUTTER



The art of making peanut butter. Pic's Peanut Butter staff Sue Beaton (left) and Terrence Barbero (right) are responsible for ensuring each batch of peanut butter is consistently delicious. Roasted and rested peanuts are fed through the grinders and come out as perfect peanut butter – once it has passed quality control, the freshly made peanut butter is then pumped down to the bottling line where it's pumped into glass jars.

IMAGE BY WARA BULLÔT



Pic's Peanut Butter currently uses about 2500 tonnes of imported peanuts a year. Harvest of year one of the peanut trials saw a sample of 18 kilograms of peanuts sent to the Pic's Peanut Butter factory in Nelson, where cultivars were processed into peanut butter. In some cases, the nutritional values of the Northland-grown cultivars were higher than the peanuts that Pic's Peanut Butter imports from other countries, indicating the potential of locally grown produce.

IMAGE BY WARA BULLÔT



Perfect peas

Peas are an important vegetable grown in Aotearoa New Zealand. In 2023 more than 58,000 tonnes of frozen peas with an export value of \$140 million were sent to overseas markets including Asia and Australia.

Key growing regions for the crop include Canterbury and Hawke's Bay. As the crop approaches the correct maturity it is constantly monitored for tenderness and sweetness before being harvested. Almost all peas grown in New Zealand are deep frozen to extend availability. They are a vegetable that can be used in a wide range of meals and taste good after freezing.

Peas are one of the oldest known vegetables. For many centuries only dried peas were used in dishes such as pea and ham soup. In the 1500s, new varieties of peas with better flavour were developed and people started eating them fresh.

Breeding perfect peas

Pea growers want plant varieties that are high yielding, resistant or tolerant to diseases and produce peas that taste delicious. Plant & Food Research has been conducting pea breeding programmes in Canterbury for over 40 years – supporting both the processed and pea seed sectors. In general pea plants, which include commercial crops, do not have a robust root system, so they don't tolerate extremes of heat or any period of waterlogging, conditions which are occurring more frequently due to climate change. A key aspect of the breeding programme is to support the sector to build climate resilience, with scientists looking to develop pea varieties that are adaptable to various environmental conditions, while also offering improved quality and maintaining high yields.

Extending the season

Extending the growing season also has the potential to boost the value of New Zealand's pea industry. At the moment, sowing pea crops earlier in winter months can impact yields by 10–15%. To help the pea industry address this challenge, expert staff at Plant & Food Research's Lincoln site are conducting research for Process Vegetables New Zealand exploring the potential use of cold-tolerating rhizobia. Rhizobia are a group of nitrogen-fixing bacteria that form symbiotic relationships with leguminous plants, including peas, helping them to fix atmospheric nitrogen into a form that the plants can use for their growth. Cold-tolerating rhizobia would support crop growth and yields in colder temperatures. The research is also investigating the contribution pea plant residue plays in providing an organic, slow-release form of nitrogen to subsequent crops, such as cereals, that would otherwise require artificial fertiliser forms of nitrogen.





A Lighter Touch

A Lighter Touch is a seven-year programme, co-funded by industry and the Ministry for Primary Industries. It began in 2020, with the goal of supporting New Zealand growers to move to producing plant-based food with a lighter environmental touch. Its role is to find tools and techniques to enable growers to move away from agrichemical reliance to agroecological crop protection – sustainable farming that works with nature. The programme arose from a number of issues affecting growers, including the relatively small number of crop protection products coming into New Zealand specifically registered for use on vegetable crops. New Zealand's relatively small size makes it a lower priority market for crop protection companies due to low return on investment for trialing and registration. In addition, many overseas markets are establishing stricter limits on maximum residue levels (MRLs) in the crop. Often, again due to the market size, they do not set MRLs based on research but simply set limits at the lowest level of detection, effectively banning the product. This means less chemistry is available to the pea and other key vegetable crop sectors in New Zealand.

Major diseases that concern pea and bean growers include fusarium root rot and sclerotinia white mould, both of which have the potential to reduce crop yields substantially. To provide growers with soft alternative options for managing these diseases, the A Lighter Touch project, co-developed by Plant & Food Research, Process Vegetables New Zealand and Kraft-Heinz, is exploring different treatment options in a series of field trials.

In the second year of the project, more than 100 trial plots will be planted in Canterbury to determine the efficacy of 23 agro-microbial (biofungicide) and synthetic products against the two diseases. Plots will be monitored and analysed for potential efficacy by Plant & Food Research scientists. The long-term aim is to improve crop performance and yield, allowing the industry to continue to grow, while also supporting soil health and maintaining access to very important export markets.

Pea protein

A potential emerging opportunity for growers is the pea protein market – with the sports nutrition, plant-based meat, alternative milk, pet food and infant formula sectors increasingly utilising the ingredient. A 2022 PWC report prepared for Off-Piste Provisions, a plant-based meat alternative company, and the Foundation for Arable Research in New Zealand, noted the market for pea and fava bean protein is growing globally and is showing no signs of slowing. The report said current barriers include the lack of processing facilities in New Zealand to support pea-protein production, and the need for there to be financial incentives for growers.



Good for you, good for the planet.



From farm to fork, the food choices we make have a significant impact on both our well-being and the health of the planet. Opting for foods that are good for both people and the planet contributes to a more sustainable food system.

Here are six healthy sustainable foods to add to your diet:

For more information on the nutrient content of these foods and over 2700 commonly prepared and eaten foods in New Zealand, visit New Zealand Food Composition Data at foodcomposition.co.nz

Seaweed

Seaweed is a nutrient-rich food packed with essential vitamins and minerals, plus an array of other bioactive components, offering a wide range of health benefits, from supporting thyroid function to promoting heart health. It also includes omega-3 fatty acids crucial for brain health and overall well-being. Seaweed absorbs carbon dioxide, reducing ocean acidification and enabling microorganisms and sea life to flourish. Cultivating seaweed requires minimal freshwater and land, reducing global land-use pressures and making seaweed a sustainable food source with the potential to play a significant role in providing food security worldwide.



Mussels

Mussels contain more protein than many meat and plant crops and have high concentrations of omega-3 fatty acids and micronutrients, like iron, zinc, and magnesium. They are so nutrient-dense that they are one of the best ways to feed a growing global population. Aquaculture takes pressure off wild fish stocks, and mussels are the most sustainable farmed species. Like all bivalves, mussels feed by filtering water and thrive on microscopic organic matter, so their cultivation transforms waste into carbon storage and delicious food.





Beans & pulses

Pulses, including lentils, chickpeas, peas, and beans, are packed with protein, low in fat, rich in soluble dietary fibre and have been found to help reduce the risk of chronic diseases such as diabetes, obesity, and heart disease. Beans and pulses play a vital role in sustainable agriculture. They demonstrate exceptional water efficiency and contribute to soil regeneration, enhancing formation and biodiversity while promoting increased soil carbon sequestration. Their nitrogen-fixing capability reduces dependency on synthetic fertilisers, making them valuable assets in environmentally conscious farming practices.

Mushrooms

Mushrooms are a nutritional powerhouse, rich in B vitamins, and are a low-calorie source of fibre, protein, and the minerals potassium and selenium. Mushrooms play a crucial role in ecosystem health, aiding in nutrient cycling, soil regeneration, and even carbon sequestration. As sustainable food sources, mushrooms grow quickly on a year-round cycle, minimising resource consumption. Their unique vertical shelf or tray growing method maximises efficiency and yields impressive results per square metre of land.



Wild venison

Wild venison is naturally low in fat, high in protein, rich in vitamins and minerals (especially iron, selenium and zinc), and free of additives or chemicals. With no natural predators in New Zealand, harvesting wild venison helps manage deer populations, protecting Aotearoa's unique biodiversity and supporting native forests to combat climate change by sequestering carbon.

Leafy greens

Leafy greens like kale, spinach, and rocket are packed with healthful vitamins like A, C, E and K, minerals, and dietary fibre. They support overall well-being by aiding in weight management, reducing the risk of chronic diseases, and supporting a healthy immune system. Leafy greens are fast-growing, can be cultivated year-round in some regions, and have very low carbon emissions during their growing and harvesting processes.



Quick facts

Wake® raspberries

Raspberries with family in the USA and New Zealand

The Wake® family of raspberries are developed by passionate raspberry enthusiasts. The Wake® story began in Lynden, Washington with raspberry growers in pursuit of a better berry. That journey led the Northwest Plant Company to a partnership with Plant & Food Research and the development of a joint breeding programme, and the joint venture Pacific Berries, to deliver better berries.

The Wake® family includes Wake®Field ('Wakefield') bred by Plant & Food Research in New Zealand and Wake®Haven ('NN08002') bred in the USA.

Using traditional breeding techniques, the Wake® breeding programme focuses on developing new varieties with the qualities important to growers, processors and consumers. Potential new raspberry varieties go through a rigorous evaluation process before they can reach the status of a Wake® variety.

Good for growers

Wake® raspberries are tolerant to raspberry bushy dwarf virus and Wake®Field is also tolerant to root rot caused by *Phytophthora*. Wake® varieties are high yielding and have the perfect characteristics for machine harvesting, which is more efficient for growers.

Wake® raspberries account for more than 50% of raspberry plant sales in Washington State, the centre of the USA's frozen raspberry sector. Wake® raspberries are also grown in New Zealand, Australia, South America and Europe.

Great for consumers

Wake® raspberries are full of flavour and have high concentrations of compounds known to be good for health, like anthocyanins, vitamin C, dietary fibre and folate. They're also perfect for Individually Quick Frozen processing, holding their shape in the freezer for year-round eating.

An ancient past

Wake® raspberries are varieties of European red raspberry. European red raspberries are indigenous to Asia Minor. Their Latin name, *Rubus idaeus*, is linked to the mythological tale of a raspberry bush appearing on Mount Ida in Turkey (then Troy), and they were said to be a favourite of the gods of Olympus, particularly Zeus. Raspberry seeds were spread by the ancient Romans across the Roman Empire.

Another species of red raspberry, *Rubus strigosus*, also exists, found in northern regions of North America and northeast Asia.

Raspberry leaves were traditionally used to prepare women for childbirth, aiding in delivery and breastfeeding. They were also used as a remedy for common ailments, such as stomach and throat problems.



INSIDE SLICE

**At Plant & Food Research,
we believe science can
create a better future.**

By finding smarter, greener options today,
we're helping secure the world we want to
live in tomorrow. With our partners, we use
world-leading science to improve the way
they grow, fish, harvest and share food.

A smart green future. Together.

A smart green future. Together.

Every day we have around 1000 people working across Aotearoa New Zealand and the world to help deliver healthy foods from the world's most sustainable systems. Here's what innovation they think is needed to create a smart green future together.



Our mission is to support the development of the most sustainable food systems, so we need science innovations that make use of all our cropping bioresources, that are not wasteful, that consider the environmental impact of production, are circular and target human nutrition first – we need to start producing foods that are good for people and good for the planet.

JOCELYN EASON

General Manager Science, Food Innovation



Creating a smart green future is about conversations and planning to figure out how we can help Aotearoa get there. This needs to be an ongoing process between the fantastic scientists at Plant & Food Research and the people who can take our work and run with it. When we give the next users of our work exactly what they need to take the next step, then we can help create more impact, faster.

STEWART GRAHAM

Evaluator, Impacts Evaluation



To deliver a smart green future, we can't just grow more food. Our science innovations must use the whole bioresource wisely, to create new desirable, healthy products that are economically and environmentally sustainable. Our aspiration is to create economic returns while leaving our environment in better state than when we started.

MATHEW CUMMING

Science Team Leader, Marine Biopolymer Science



A smart green future doesn't hinge on a single scientific breakthrough. Instead, to me, the key lies in optimising collaboration across fields, perspectives, and methodologies. Big data and machine learning will be important, but we can't ignore other perspectives. An inclusive and collaborative approach is crucial for surpassing current cutting-edge solutions and ensuring sustainable, climate-friendly food production.

JULIE BLOMMAERT

Post-doctoral Scientist, Seafood Production



A smart green future involves collaborative efforts to achieve sustainability through various scientific innovations. While it's difficult to single out one innovation, I believe gene editing and precision agriculture have the potential to play pivotal roles in reducing the environmental impact of food production and ensuring global food security.

MEI MEIYALAGHAN

Scientist, Premium Crops & Technology



'A smart green future together' means a vision of a future where science, technology and sustainable environmental practices are integrated to create a more eco-friendly and efficient world. This vision encompasses various aspects, such as smart cities with energy-efficient infrastructure, renewable energy sources, sustainable transportation, and environmentally conscious lifestyles. It is about the use of technology and science to reduce carbon emissions, conserve resources, and promote a cleaner and more sustainable environment for everyone on this planet.

CYNTHIA LUND

Vice President, North America, Business Development



Climate change, the transition away from fossil fuels to become carbon neutral, natural resource scarcity and the increasing cost of production are important emerging challenges for New Zealand's horticultural sectors. To address these challenges, our science will need to help create new food production systems, plant cultivars and management technologies that collectively improve sector productivity, sustainability and resilience into the future.

BEN VAN HOOIJDONK

Scientist, Fruit Crops Physiology

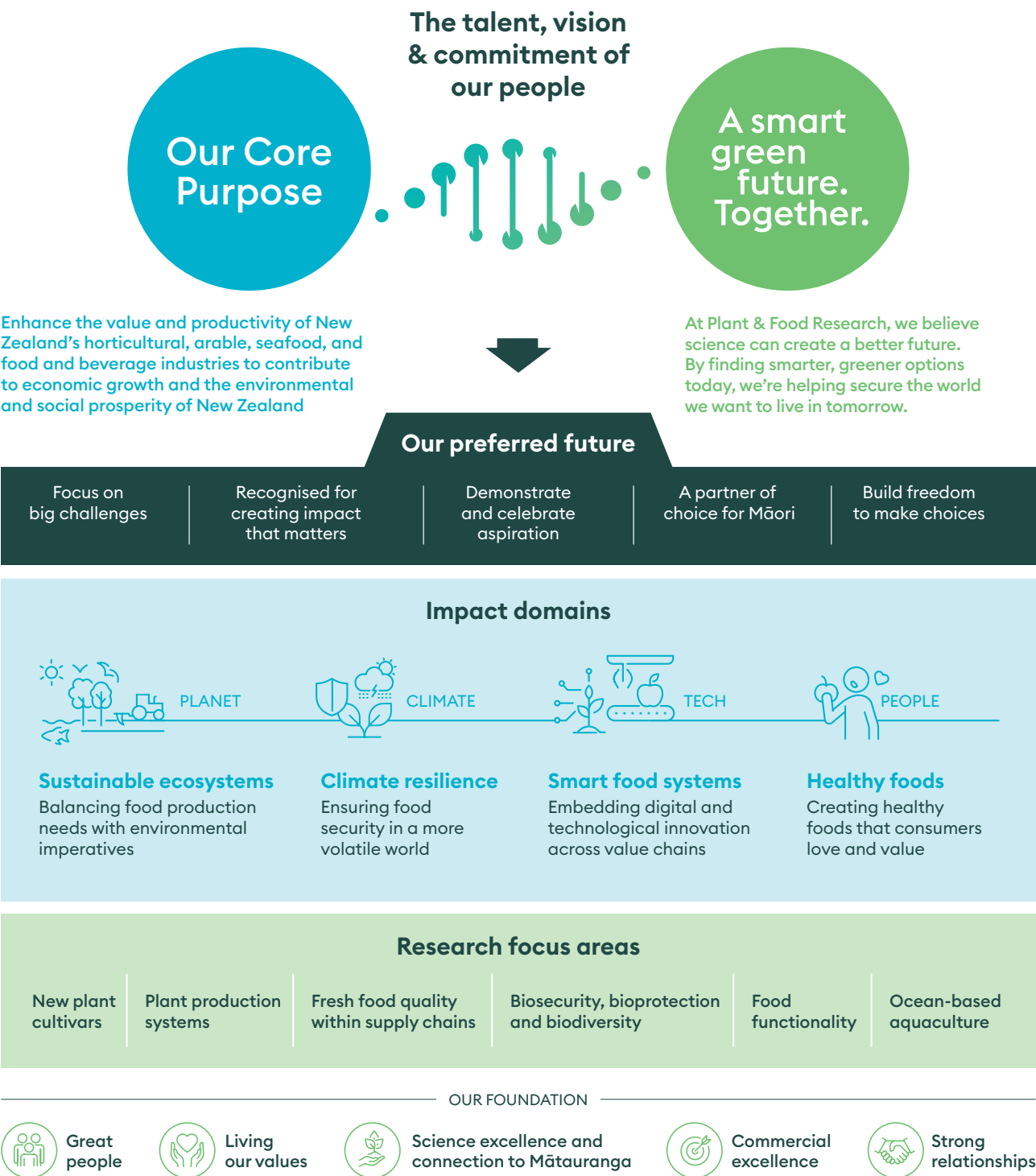


For me, a smart green future means using our research and scientific knowledge to tackle climate change and other global challenges and address a wide range of critical food production challenges that matter to our sectors, partners and stakeholders. It is about Aotearoa's transition to a regenerative biocircular economy where natural systems (taiao) are improved, human well-being (hauora) is enhanced, and a prosperous economy (ōhanga) is sustained.

IRENA OBADOVIC

Research Economist, Impacts Evaluation

Our Strategy



THE NUMBERS 2022/23



975

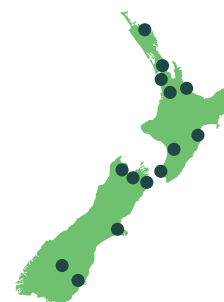
Total staff

14

New Zealand sites
(plus representatives
in Australia & the USA)

421

Hectares
research farms

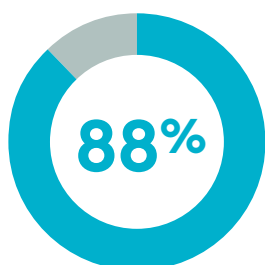


Science publications



277

Peer-reviewed
publications



Publications co-authored
with collaborators

Received in the past 5 years



4

Commercialisation awards

24

Industry awards

33

Research awards

Intellectual assets



9

Patents
granted

3

Plant Variety Rights
granted – New Zealand

8

Plant Variety Rights
granted – International

Revenue

\$184.8M

Total revenue

Our activities are funded through direct commercial research for our customers, the reinvestment of royalties and the New Zealand Government's investment in science.

Royalties
\$63.6M

Commercial
\$58.2M

Other
\$6.2M

Strategic funding
\$43.2M

Contestable
\$13.6M

Strategic funding
Government investment
allocated directly to
each CRI

Contestable
Government investment
allocated through
competitive bidding

Royalties
Commercial return from
plant varieties and IP

Commercial
Direct investment by
customers

Other
All other income sources

Recognising achievements in science

Royal Society Te Apārangi fellowships

Dr Kevin Davies has been elected as a Fellow to the Academy of the Royal Society Te Apārangi in recognition of more than 35 years researching the function and genetic regulation of plant specialised metabolism, an area for which he is an internationally recognised expert.

Professor Andrew Allan was also recently recognised with a Fellowship to the Academy, acknowledging more than thirty years researching plant genetics. Andrew is a Principal Scientist at Plant & Food Research with a joint appointment as Professor at the University of Auckland.

Science New Zealand Awards

The 2023 Science New Zealand Awards honoured several Plant & Food Research scientists and teams. Dr David Teulon was presented with the Lifetime Achievement Award for three decades of work in entomology and biosecurity. The Cyclone Gabrielle Response Team, comprising over 50 research and support staff across 13 different science teams, received the Team Award for their response to the severe impact of the event on the horticulture industry. Dr Brendon Malcolm received the Early Career Researcher Award for his work developing tools that lead to better environmental outcomes and improved profitability for farmers.

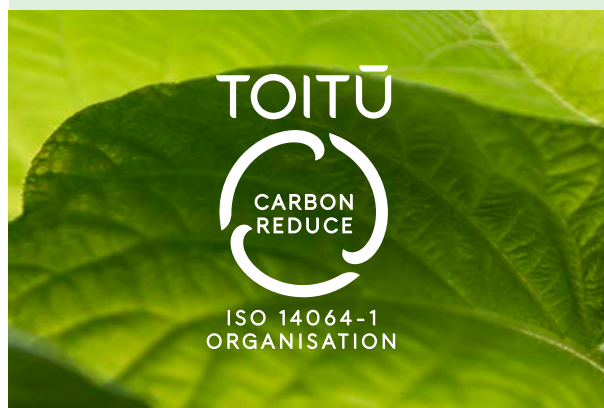


Dr David Teulon, accomplished scientist and biosecurity leader, achieved the Lifetime Achievement Award.

Carbonreduce certification

Plant & Food Research has achieved certification under the Toitū Envirocare carbonreduce programme, demonstrating the organisation's commitment to environmental sustainability. Through the programme, Plant & Food Research works with Toitū Envirocare to identify the best methods to measure greenhouse gas emissions and set goals to reduce emissions. Certification is maintained through an annual audit to sustain continual reduction. "Sustainability is at the heart of Plant & Food Research," says Dr Roger Robson-Williams, Chief Sustainability Officer. "As an organisation supporting others in improving their sustainability, it was really important to us that we understand our own emissions and find practical ways to reduce our environmental impact. The Toitū methodology will help us on our pathway to improved environmental sustainability."

Toitū carbonreduce certification is in accordance with international standards.



Growing opportunity

In partnership with Proximity Designs (a Myanmar-based social enterprise), as part of a New Zealand Ministry of Foreign Affairs and Trade funded project, Plant & Food Research are sharing knowledge from New Zealand's horticulture industry to help develop the growth of Myanmar's vegetable sector. Myanmar's local supply chains currently face several challenges – including inefficient production practices, low availability of irrigation technology and costly postharvest losses. Through this development project, 40,000 smallholder farms are receiving assistance to help them adopt more efficient and resilient production technologies and practices. This will significantly increase the income for these households.

Celebrating 2023 Diversity Awards NZ

Plant & Food Research is on a journey towards building stronger partnerships with Māori, a commitment recognised at the 2023 Diversity Awards NZ. On behalf of Plant & Food Research, Stacey Whitiora, Te Toihau Māori – Group General Manager, accepted the Diversity Awards NZ Leadership category award for their TONO strategy along with highly commended recognition in the Ngā Āhuatanga o te Tiriti Tohu Award category for the Te Rito Pathways programme. “As we mark the fourth year of our decade-long journey, we reflect on our commitment to working alongside Māori as a trusted science partner to help achieve their research and innovation aspirations. We are still in the early phases of the journey, recognising investment into Māori research, science, and innovation will continue to evolve,” says Whitiora.

Plant & Food Research acknowledges all of our Māori partners and wider whānau of kaimahi who have contributed to the success of bringing our TONO strategy and our Te Rito Pathway programme to life.

“We hope to play a positive role in helping to shape Aotearoa New Zealand’s science and innovation system founded upon Te Tiriti o Waitangi partnership. Nāu te rourou, nāku te rourou, ka ora ai te iwi – With your basket and my basket, we will sustain everyone,” says Whitiora.



Almonds a potential new crop for Hawke's Bay

Funded primarily by the Ministry for Primary Industries' (MPI's) Sustainable Food and Fibre Futures fund (SFF Futures), economic analysis, land use and climate suitability modelling and consumer research have examined growing almonds locally. The research showed that consumers would be interested in trying homegrown almonds and would potentially pay a premium for a New Zealand-grown product.

Pic Picot from nut butter company Pic's Peanut Butter says they pride themselves on sourcing the best quality ingredients with known provenance, and homegrown is often a focus for consumers. “We’ve become increasingly focused on the provenance of our ingredients in recent years and are working with Plant & Food Research, MPI, and regional agencies to investigate the viability of growing peanuts and now almonds in the North Island. The possibility of producing an entirely New Zealand-sourced almond nut butter that offers good returns to growers and makes a delicious, healthy product is exciting. I know these products would receive a positive reception from both local and international customers.”



New Zealand nutrition data in new global health app

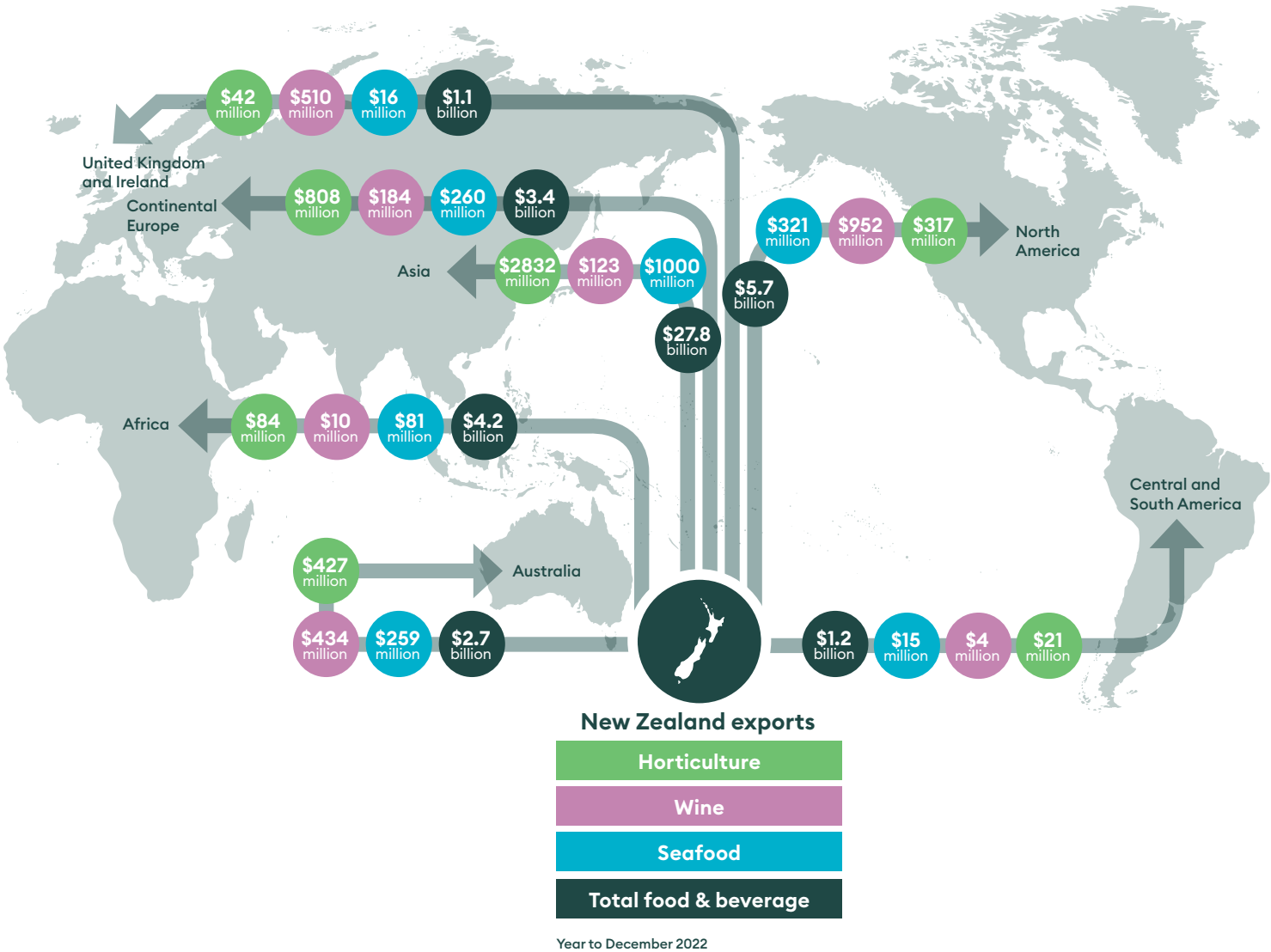
The New Zealand Food Composition Database (NZFCD) has gained recognition as a key data source for the innovative health and wellness app, My-Nutri-Diary. Developed in Germany, this app, designed to support users in achieving nutrition and fitness goals, has marked the NZFCD dataset with a prestigious golden star, emphasising its scientifically validated nature. Users can now access information about their food choices using the NZFCD's comprehensive dataset, a crucial step in ensuring reliable nutritional information.

“It’s vital that anyone looking to understand their nutritional intake is able to access reliable information. We’re excited to know that the New Zealand Food Composition Database is providing this service, both directly through our own website and as a data source for others’ applications,” says Plant & Food Principal Scientist, Dr Carolyn Lister.

The NZFCD is the most comprehensive collection of nutrition data for over 2,700 commonly consumed New Zealand foods and provides reliable data on macronutrients and micronutrients. The NZFCD is a collaborative effort managed by Plant & Food Research and jointly owned with the New Zealand Ministry of Health, its major funder.

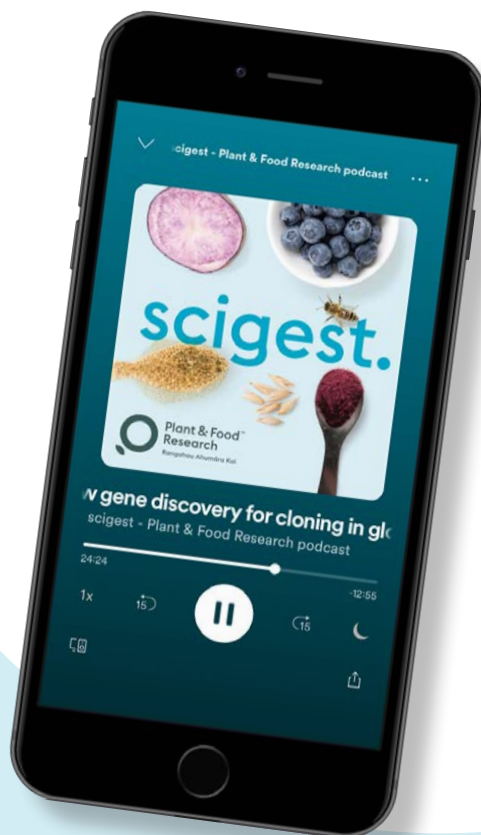
Our sectors

In 2022, New Zealand exported more than \$46 billion of food and beverage products, 67% of the country’s total exports. Plant & Food Research works with partners across the food sector to create new knowledge and technologies. These support development of the most sustainable food production systems in the world, delivering products that meet the demands of the most discerning global consumers.



Statistics source: Ministry for Primary Industries.

Scigest



Discover the world
of science with
the award-winning
Scigest podcast.

Hosted by Plant & Food Research scientists, Scigest explores our diverse research and the incredible stories of the people behind the science, from food innovation to biosecurity and new technologies to sustainable agriculture.

**Listen on our website plantandfood.com
or wherever you get your podcasts.**

A smart
green
future.
Together.