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Edition 2, 2019

THE FURROW

Cotton harvest

Coping with the dry

Peter Wanckel

Combining the digital and physical worlds – data at your fingertips.

Making connections – our digital future

The future of agriculture will increasingly rely on the interconnection of machines and the digital world.

By Peter Wanckel, Managing Director of John Deere Australia / New Zealand

Australia and New Zealand hold a special place in John Deere's global innovation network because of the quality of their farming practices.

Our farmers are not only advanced, but also subject to unique demands from climate and water resources. Generally they have less access to government subsides than other parts of the world, which tends to drive greater innovation and an unwavering focus on productivity and efficiency.

From a global perspective, agriculture is challenged to produce more food and fibre to feed and clothe the growing population with increasingly limited resources and more volatile climate.

SMARTER EQUIPMENT

Our focus here is on developing smarter equipment and technology. Quality data sets, when organised and modelled correctly, can provide powerful insights to help farmers produce more, with less.

We are developing sensors that enable the collection of high quality data sets, to seamlessly and securely transfer the data to the Cloud, and then share it with their trusted advisors.

Data is going to play a key role in the future of precision ag but it is about more than just data.

Effective use of data leads to more informed decisions – but once a decision has been made, it needs to be implemented by a machine in the field.

In the late 1990s John Deere invested in the development of its own GPS technology. This was a pivotal decision and is now the foundation of our precision ag equipment.

We have seen development of GPS guidance systems, section control systems, precision seed delivery systems for planting and precision earthmoving systems for water management.

ARTIFICIAL INTELLIGENCE

The next phase of technology development will focus on artificial intelligence technologies that will enable more equipment automation and a new level of precision. This is being driven in part by growing skills shortages and rising labour costs. But there is also the need for the greater accuracy and precision which robotics can provide.

Autonomous equipment will require significant infrastructure to support this. Everything an operator observes and reacts to will need to be replicated using sensors and computers.

Robust connectivity networks will be vital so that multiple machines within a field can communicate with each other to co-ordinate tasks and communicate to a remote manager.

We can do much of this communication today in near real time with a product called In Field Data Sharing. But for autonomous vehicles real time data requirements are higher and current connectivity networks are likely not robust enough.

There is no doubt the future farmer will use autonomous vehicles to manage nutrients and chemicals on a plant-by-plant basis, while at the same time collecting quality spatial data sets about crop health.

This data will be stored securely in the Cloud, so farmers can share and collaborate with other data sources and their trusted advisors who may run data analytics software and provide recommendations on the next action to be undertaken in a crop.

We must continue to innovate and challenge ourselves collectively as an industry. We have moved from delivering a hard-iron product to an era where total solutions are required.

A NEW GENERATION

Most encouraging to me is the young generation of farmers. They are highly educated, have grown up in the information age and are embracing it. They are more inclined than previous generations to utilise digital tools and recognise the power of science and information. For these reasons, as we start to see the merging of the digital and physical worlds in agriculture it's a very exciting future. ■

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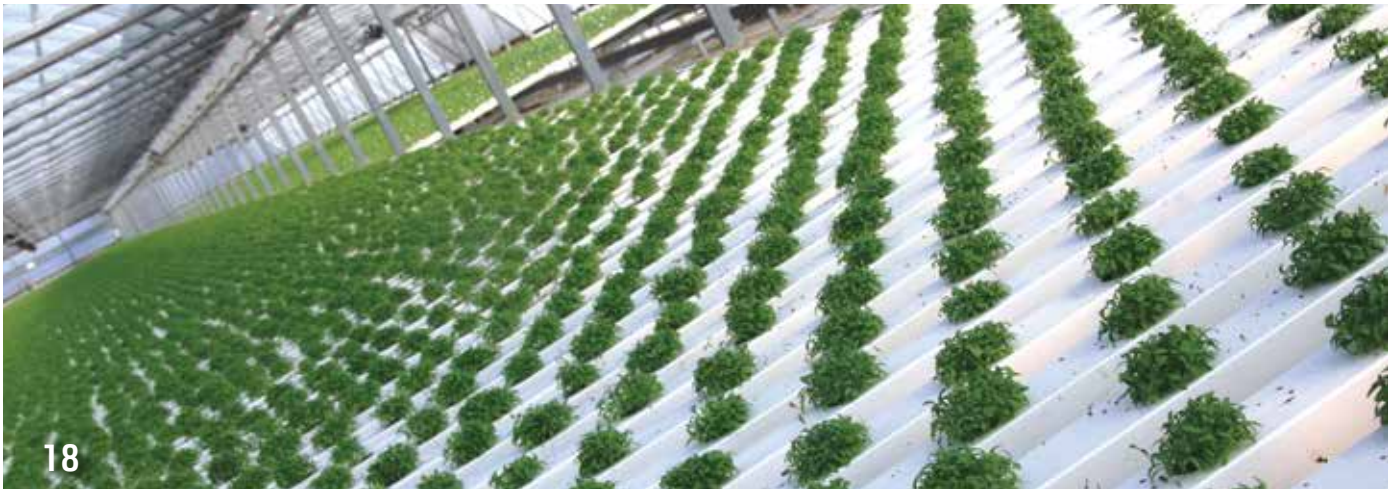

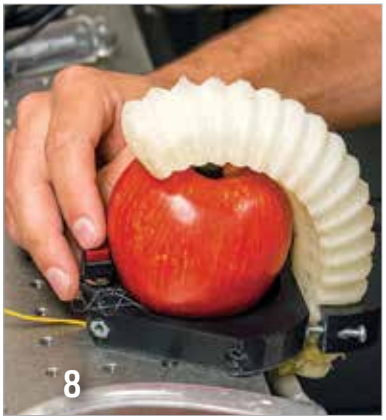

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The Furrow

Australia/New Zealand edition

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The Furrow is an Australia / New Zealand edition of the worldwide farm magazine published in 14 languages by Deere & Company and its subsidiaries. Prices quoted in overseas articles are expressed in the local currency dollar values, unless otherwise noted. Illustrations of products may include some items which are not standard equipment.
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One of Australia's most progressive and entrepreneurial grain growers is turning to old barley varieties to supply a new niche in his diverse, vertically-integrated farming enterprise.

By Liz Harfull

Back to the future

1

Yorke Peninsula grain grower Mark Schilling has a reputation for being a forward-thinking entrepreneur in the agribusiness world, but his latest venture has him looking firmly to the past.

This season a small section of his family's expansive cropping enterprise is devoted to growing varieties of malting barley rarely seen for decades on Australian farms. "We have a time warp in the paddock," Mark says, with a broad grin.

It all began with a question, sparked by Mark's constant quest for vertical integration within what is now a multi-faceted family company that goes way beyond growing grain. How could AG Schilling and Co value-add to the barley they grow and better capitalise on farming in a region known around the world for its ability to produce premium quality malting barley?

The solution they landed on was malting their own barley and selling it to artisan and home brewers, as a premium single-variety, single-origin malt.

The Schilling family has been farming at Cunliffe on northern Yorke Peninsula, in South Australia, for almost a century, starting with Mark's grandparents, Oscar and Augusta, who ran a traditional mixed farming enterprise. By the 1980s, Mark's parents Ashley and Barbara were focussing on sheep and cropping about 240 hectares to mostly cereals.

Under the guidance of Mark and his wife, Merridee, today's enterprise covers more than 2,300 hectares across six properties of owned and leased ground, and land that is share-farmed. The sheep have long gone, and the paddocks are devoted mostly to wheat, barley, oats, lentils, chickpeas and linseed.

» We have a time warp in the paddock. « *Mark Schilling*

1 Mark Schilling in a paddock of Vixen wheat.
2 AG Schilling and Co grain processing and export manager Alan Harris with a straddle carrier used to move shipping containers at Cunliffe.

A GROWING BUSINESS

It is a substantial cropping operation using the latest technology, but it accounts for just 40 percent of AG Schilling and Co, a diverse agribusiness that employs 11 people full-time in interconnected profit centres that include grain storage, handling and export; seed cleaning and retail; mouse bait manufacturing and agricultural equipment dealerships.

"When I left school in 1984 there were high interest rates, we had bought more land and we couldn't afford a workman so I felt that I should come home," Mark explains. "I don't regret one bit of it, but what I learnt was that you have to be diverse. You cannot be mono, you have to be quadraphonic to be sustainable in agriculture."

The diversification began when Mark suggested to his parents that they buy a baler, so he could bring in some extra revenue doing contract baling. "We still do that and I still drive a baler," he says.

STORAGE AND HANDLING

Then came a grain storage and handling enterprise. It started in the mid 1990s, when the Schillings were among the first farmers to grow lentils on Yorke Peninsula, having worked out the potential gross margins per tonne were better than peas. They sowed a paddock of a new improved variety,

3 Merridee and Mark Schilling and their dog Wesley, in a lentil storage shed.
4 Yorke Premium Malbro Mid, the Schillings' first beer made from their own paddock of Banks barley.
5 A sample of malted Banks barley.

Digger, under contract to The Lentil Company.

As more growers in the region came on board, Mark offered to store lentils for the Horsham-based business. "Three seasons into it we had a big year. I still remember the trucks lined up along the laneway to unload. The shed nearly burst," he says.

"We were growing export hay at the time, and had built a large hayshed. So we decided to put in concrete walls and a floor, and that was our first grain shed – 4,000 tonnes. Within two years we built another 4,000-tonne shed, and then another. We built seven sheds in seven years, including two for a neighbour."

DEALING IN DIVERSITY

In 2000, came a cleaning and packing facility, which handles grain for human and animal consumption, both packaged and in bulk. This part of the business managed all the logistical operations to deliver the lentils to overseas customers. "So we learnt how to pack bulk containers, and we started to understand export pathways," Mark says.

The next logical step was to market and export grain in their own right. Now focussed solely on grain either grown or purchased by AG Schilling and Co, this part of the business supplies customers in the Middle East and Asia, including red lentils into Bangladesh and Sri Lanka, and APW milling wheat into Vietnam, China and Malaysia.

In another push to maximise resources, the cleaning plant was also used to clean seed for seed breeding companies. Out of that flowed the opportunity to grow seed crops and start retailing seed lines of cereal, pulse and oilseed varieties.

In 2007, the Schillings added importing agricultural components to their portfolio, after experiencing frustration with the performance of the no-till seeding points trying to cope with stony conditions on their farm. An online search led Mark to a brand of tungsten-tipped seeding points being manufactured in Canada. Having given them a try, he was so impressed he offered to become their Australian dealer.

Then, in 2014, came another sideline, manufacturing zinc phosphide mouse baits. It was driven by farmer demand for cheaper and more readily available baits to kill mice, which at times reach plague proportions on Yorke Peninsula. Again, in searching for a way to reduce input costs, Mark's entrepreneurial mind recognised a business opportunity.

For Mark, the triggers for an idea often come from getting to know a process, and looking for synergies within the business that will make the most of the resources available. "Once I understand the whole chain I will start to look at ways to make it easier, and I'm always looking for ways to reduce costs, supplement income and value add," he says.

The latest venture selling their own malt started with a paddock of Banks barley the Schillings grew in 2017 as a seed crop, to bulk up supplies for a commercial Australian seed breeding company. Still going through evaluation, Banks is a high yielding, mid to late-flowering barley suited to medium to high rainfall areas.

After it was harvested and kept in storage for six months to allow the seed dormancy to break down, the Schillings sent it off to Voyager Craft Malt in New South Wales, for malting and further testing as part of the malt barley accreditation process.

> » The older varieties had distinct, unique flavours which added character to the beers of yesteryear. « *Alan Harris*

VALUE ADDING

Meanwhile, Mark was looking for a way to value-add to his own malting barley. Talking over the challenge with his farm manager Neil Wittwer and grain processing and export manager Alan Harris, they hit on the idea of trying to get back some of the malted Banks and turning it into beer.

After contacting a few breweries, Mark contracted the Clare Valley Brewing Co, which made the first batch of 800 litres in September 2018. A few weeks later the beer was launched as Yorke Peninsula Malbro Mid – a nod to the single paddock in which the Banks was grown.

Schillings have share-farmed the land for more than 25 years in partnership with its Adelaide owners, Brian and Margret Hallo, who trade as Malbro Pty Ltd.

Somewhere along the way, Alan, a keen home-brewer, became aware that one of the specifications brewers look for in malt is its DP, or Diastatic Power, which is the ability of enzymes in the malt to break down starches into fermentable sugars.

"The big commercial brewers use adjuncts like rice to bolster the fermentable sugars, so they need malt with high DP to convert all those starches. But craft brewers want a malt with lower DP because it leaves more non-fermentable sugars in the beer and creates a better mouth feel and more distinctive flavours," Alan explains.

"We've lost a lot of that through the current breeding practices in Australia and their targets, because we have been growing barley for the big end of town. The older varieties had distinct, unique flavours which added character to the beers of yesteryear."

With this knowledge in hand, Alan went to the Australian Grains Genebank at Horsham, looking for old barley varieties with low DP so the Schillings could trial them. He came up with Prior, which was popular in Australia in the 1960s, and Maris Otter, an heirloom English barley bred about the same time and still favoured by craft brewers in the United Kingdom.

After managing to source some seed through Intergrain, he also added Schooner to the list. Bred at Adelaide's Waite Institute in the early 1980s, it was one of Australia's most popular varieties until about 20 years ago, when higher yielding options became available.

"We are growing them and then we will malt them and test the flavours, because that's what craft brewers want," Mark says. If any of the old varieties prove suitable, the next challenge will be finding an economic way of malting small batches of grain so it can be sold at a competitive price.

In the meantime, the Schillings have already begun packaging and selling a premium base malt, made from Banks sown in mid May last year.

They harvested 4.5 tonnes per hectare in mid November and five months later sent it to Coopers Malt House in Adelaide.

PADDOCK TO PLATE

"Paddock to plate is part of my vocabulary now. When we have our weekly meetings as a team, we describe it as a food and beverage business," Mark says.

"We don't make money out of the beer, not directly. It's about marketing. Having the label helps market our other commodities. People can taste our beer, made from our barley, so it showcasing what we do." ■

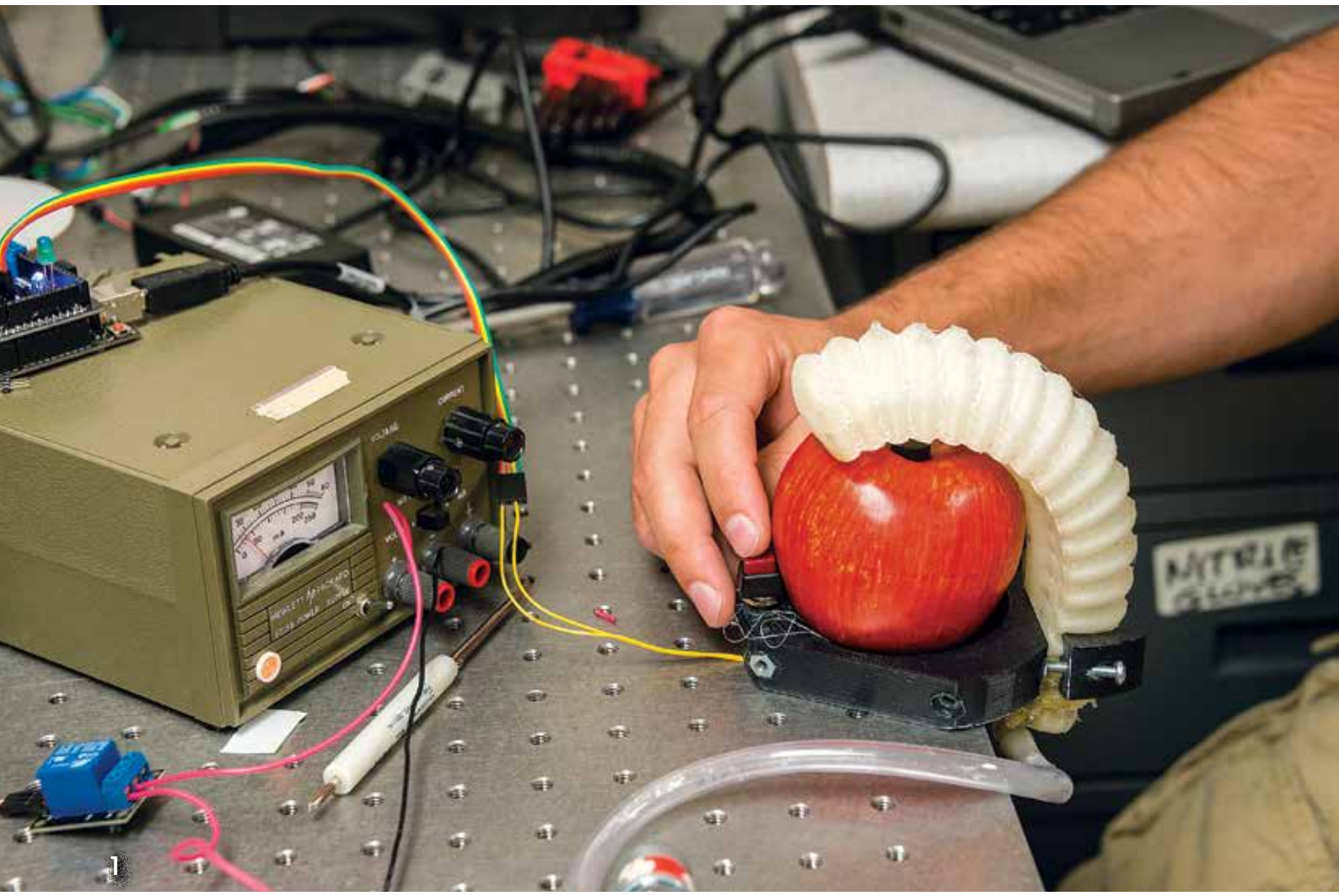
4


5

Electric eyes and helping hands

How robotics are revolutionising farming.

By Steve Werblow



A worker climbs a ladder, spots a ripe apple, and gives it a quick once-over to make sure it's not diseased or damaged. He snakes his arm around a branch, grabs the fruit, and gives it a twist to snap the stem, then gently places the apple into his bag.

Unskilled labour, yes, but robotics expert Manoj Karkee at Washington State University notes how many complex decisions and movements go into that single second of activity. "It's perception and decision-making, then it comes down to moving the hand – manipulation," he says.

Manoj and his team of scientists are reaching across engineering and agricultural disciplines to create robots capable of finding, analysing, and picking fruit or recognising which berry canes to prune or which plants to spray in a growing crop.

Computer processors are cheaper, smaller, and more

powerful than ever. So are batteries, sensors, and GPS systems. Manoj says a few thousand dollars can build a robot that would have cost several times as much at the start of his career in the mid 2000s, with machine learning and analytical capabilities unheard of even five years ago.

Mechanisation of fieldwork isn't just more feasible than ever, it's also more necessary. Farm labour is increasingly expensive and scarce, and many growers have a difficult time managing for peak labour demand.

Manoj's robots – a tree fruit picker, a cane pruner, an autonomous weeder – won't replace an entire crew.

"We're dealing with a lot of variabilities and a lot of complexities," he notes. "If a machine can deal with 85 percent of a job, or 80 percent, that remaining 15 to 20 percent can be done by labour. That could be a permanent pool of labour."

It is taking years to optimise a robotic "hand" capable of the complex motion of picking an apple, as well as the arm and vision system that can guide the hand to a ripe fruit.

CHANGING AGRICULTURE

Agricultural robots will change what it means to be a farmworker. There will still be picking, hoeing, and spraying to do, but many next-generation farm jobs will involve working with robots or maintaining them in the field.

Robots are now capable of learning from skilled operators, streams of data (for instance, thousands of photos of weeds), or from other robots that encounter similar situations or conditions. Farm workers will teach robots to function more effectively while also looking to the machines for cues, much as drivers of autosteer tractors watch their red-and-green light bars.

Robots will change crops, too. Just as modernisation pushed breeders to develop dwarf trees, evenly ripening fruit, and shatter-resistant grain, robotic harvesters will rely on pruning systems and trellises that make it easy for mechanical arms to reach fruit.

Small is big in robotics. "The hypothesis is that small robots working in large teams will be able to accomplish more than just current equipment alone," says Girish Chowdhary at University of Illinois.

> » Labour, technology, and biology all are coming together and creating a ripe situation for automation and robotic technologies to be successful. « *Manoj Karkee*

Manoj Karkee integrates computing and mechanics. His lab's TerraSentia robot – which analyses breeding plots for desirable traits – and AgBot can cruise under the crop canopy, on the prowl for signs of disease, nutrient deficiency, or weeds. Girish notes that their construction and composite body parts – many of them 3-D printed – are modeled on drones, not miniaturised tractors.

"The simplicity of the system is the key to its robustness," Girish says.

Girish and Manoj have worked hard to make the complex simple. Now, prototypes are in the field and commercial bots are just a few years away.

"Labour, technology, and biology all are coming together and creating a ripe situation for automation and robotic technologies to be successful," Manoj points out. ■

1 An engineer tests a 3-D-printed finger for a robotic apple picker.
2 Manoj Karkee of Washington State University integrates computing and mechanics.
3 It is taking years to optimise a robotic "hand" capable of the complex motion of picking an apple, as well as the arm and vision system that can guide the hand to a ripe fruit.


2


3

MANAGE THE FARM DIGITALLY

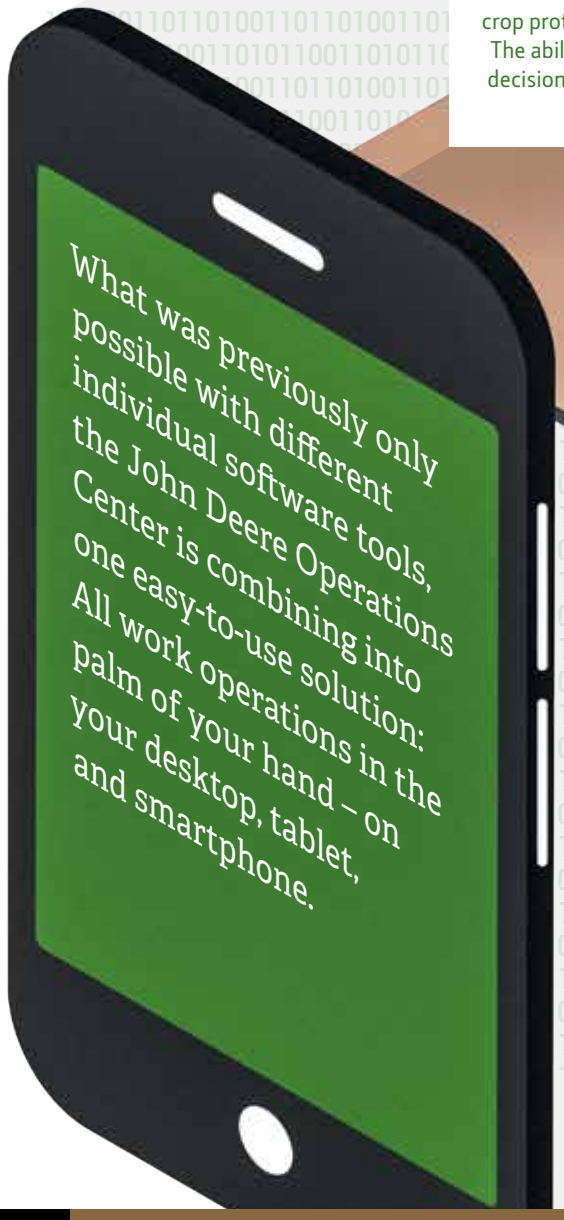
TEXT: STEFFEN BECK
ILLUSTRATION: LINA SCHINDLER, GERNOT WALTER

PLANNING THE CROP ROTATION

Here, the farmer plans their crops for the entire year. The crop rotation plan can be shared digitally, for example with a contractor. Thus they receive an overview of the fields to cultivate and/or harvest.

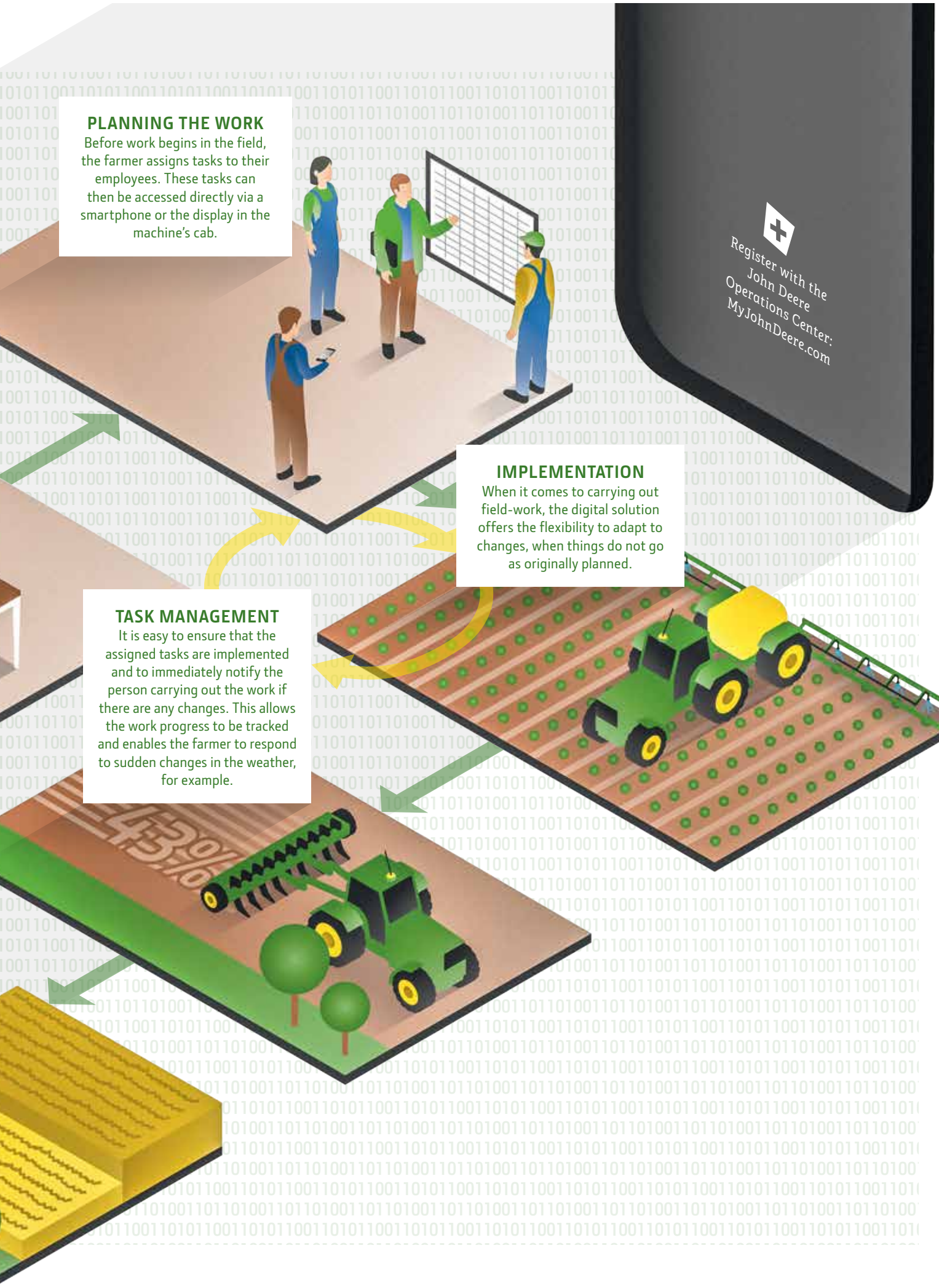
MANAGING THE FARM

By analysing current information, sent to the farmer by monitoring features, they can make decisions relating to forthcoming operations like sowing, fertilising, crop protection and purchasing. The ability to make fact-based decisions offers a big potential for savings.



MONITORING

Here, the farmer analyses agronomic data, such as machine data and varying yields in the field, thus laying the foundation for planning and executing their work based on real information.


PLANNING THE WORK
Before work begins in the field, the farmer assigns tasks to their employees. These tasks can then be accessed directly via a smartphone or the display in the machine's cab.
Register with the John Deere Operations Center: MyJohnDeere.com
IMPLEMENTATION
When it comes to carrying out field-work, the digital solution offers the flexibility to adapt to changes, when things do not go as originally planned.
TASK MANAGEMENT
It is easy to ensure that the assigned tasks are implemented and to immediately notify the person carrying out the work if there are any changes. This allows the work progress to be tracked and enables the farmer to respond to sudden changes in the weather, for example.

1

Southern harvest

Our photo essay of the 2019 NSW Riverina cotton harvest shows the region's farmers continue to produce world-class cotton, despite significantly reduced water allocations.

By Nathan Dyer

It's mid-May on the banks of the Murrumbidgee River in New South Wales and cotton harvesting is in full swing. Nearby, pickers are slowly working up and down paddocks of white, harvesting an estimated 48,000 hectares planted in the Murrumbidgee and Murray Valleys this season.

In the yard of the Southern Cotton gin at Whitton, 40 kilometres south-east of Griffith, giant yellow and pink cotton modules form long, uniform rows, almost as far as the eye can see.

Despite local growers being faced with water allocations of just 7 percent of their entitlement, and a challenging growing season, Southern Cotton general manager Kate O'Callaghan says the 2019 harvest has turned out relatively well.

"Most people sold their cotton for over $600 per bale and their seed for over $450 per tonne, so even though yields were reduced, the income was still good," she says.

Although average Riverina yields were nine bales per hectare this year compared to 11 bales/ha last year, Kate says the grower-owned gin will produce close to 175,000 bales this season.

And she says that result reflects the efficiency of local growers. "Riverina cotton growers use their water really efficiently. If you only have 7 percent allocation it's essential that your management leads to the best yields and income for that limited water."

The Australian Bureau of Agricultural and Resource Economics and Sciences estimates national 2018/19 cotton plantings were 344,000 hectares, down 40 percent on 2017/18, with Australian growers expected to produce 2.1 million bales this year.

Cotton Australia CEO Adam Kay says Australian cotton growers are the best in the world when it comes to water use.

"Australian cotton growers produce yields three-times the world average, making them the most water efficient producers globally," he says. "And the Australian cotton industry has achieved a 50 percent water efficiency gain in the past 15 years, this means more crop per drop of water.

Australia is the world's third largest exporter of cotton, behind the United States and India, and produces about 4 percent of the global cotton supply. ■

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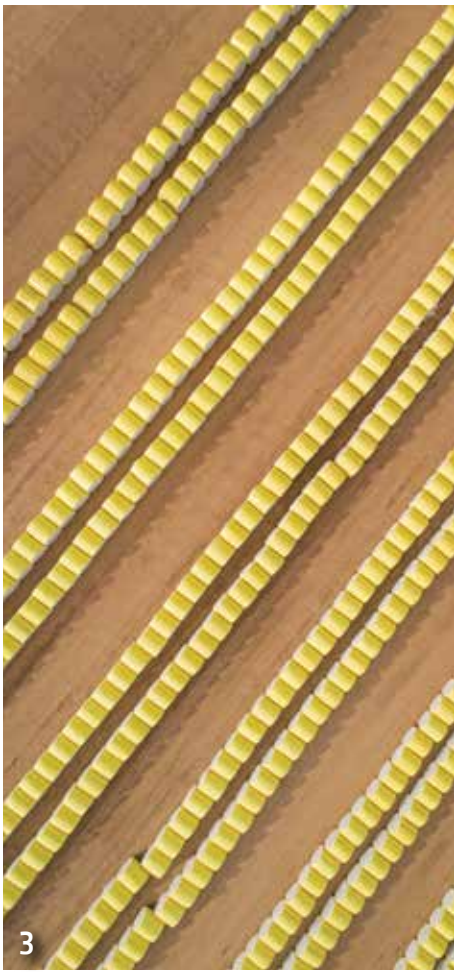

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1 Picker driver Nathan Barnes in front of his machine near Whitton, NSW.
2 Pickers in action during the 2019 Riverina cotton harvest.
3 Yellow cotton modules form long lines at the Southern Cotton gin.
4 Processed cotton bales in storage.

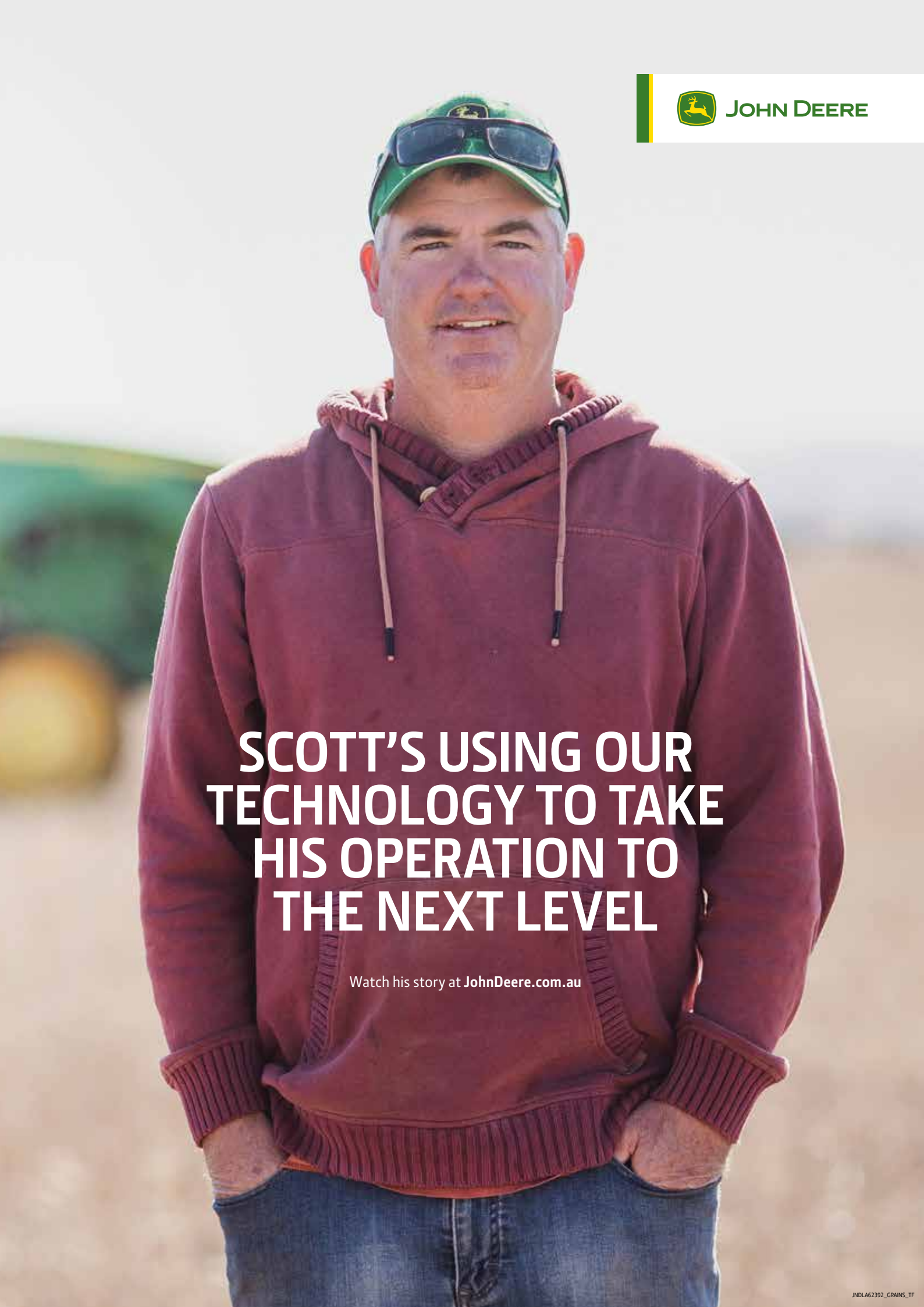
4

5

6

5 Pickers working side-by-side on a Riverina cotton crop.
6 Yellow and pink cotton modules awaiting processing at the Southern Cotton gin.
7 Southern Cotton employees Ben Bagust and Kate O'Callaghan at the company's Whitton gin, NSW.

7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SCOTT'S USING OUR TECHNOLOGY TO TAKE HIS OPERATION TO THE NEXT LEVEL
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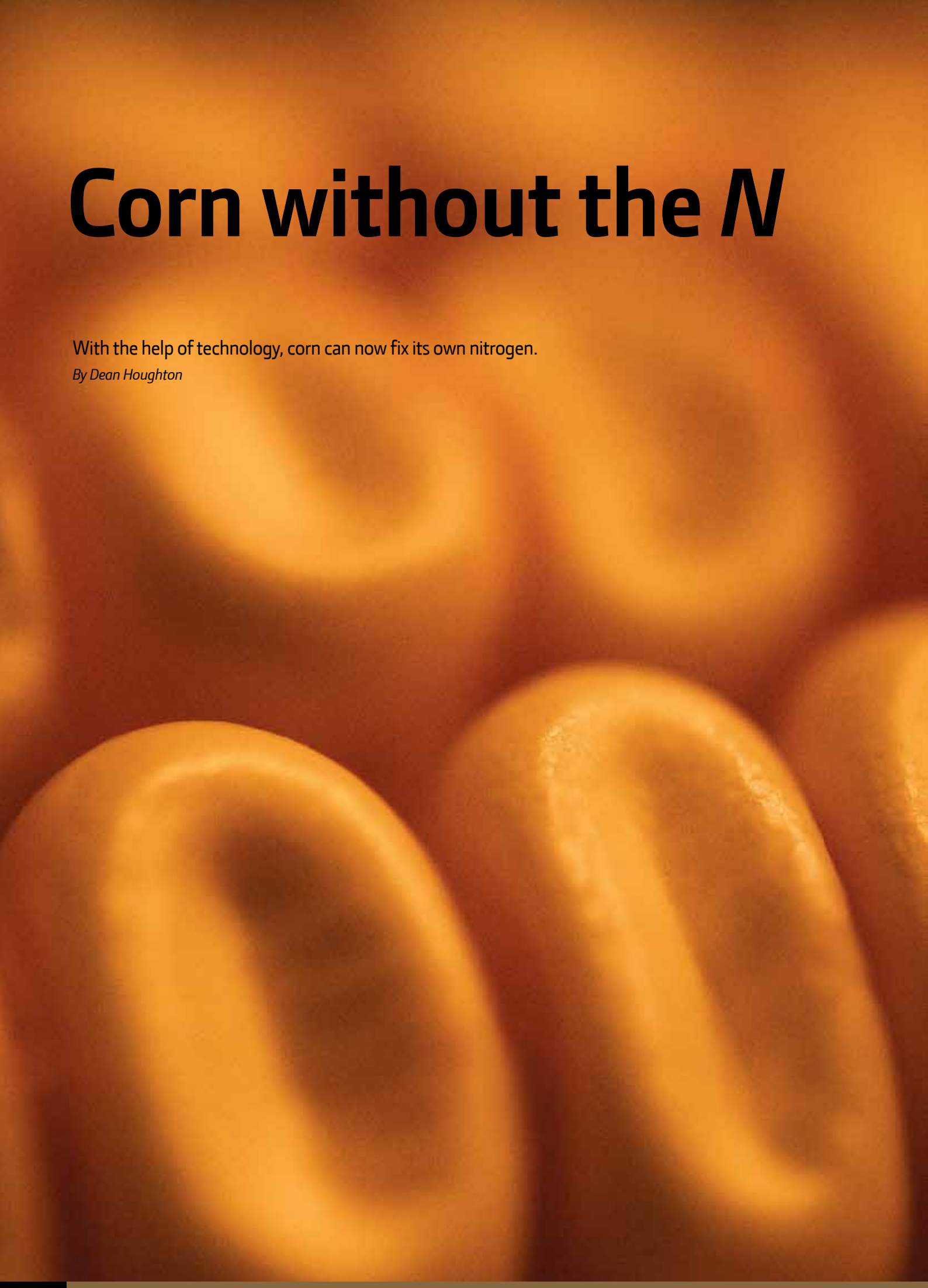
Corn without the *N*

With the help of technology, corn can now fix its own nitrogen.

By Dean Houghton



There's no way to spell corn without the ***n***, but new technologies offer the promise of growing corn with less N – significantly less, in fact.

Soybeans and other legumes can call on a symbiotic relationship with rhizobia bacteria to meet their nitrogen need, but corn and other cereals have not been able to fix their own N – until the 2019 growing season, that is. A couple of products from the burgeoning biologicals sector were introduced on a commercial scale for the 2019 growing season across most of the United States, providing microbes that help corn pull some of its N needs from thin air.

"The world needs to unhook itself from its increasing reliance on synthetic nitrogen fertilisers," says Ted Cocking, a United Kingdom scientist who has devoted his life to the subject as director of the University of Nottingham's Centre for Crop Nitrogen Fixation. "This biological technology is basically a gift from nature."

> » This biological technology is basically a gift from nature. «
> *Ted Cocking*

THE N CONUNDRUM

The Haber-Bosch process, the industrial technique that squeezes nitrogen from atmospheric N, is one of the great agricultural success stories of the past century – and one of its most problematic.

In 1909, German scientist Fritz Haber demonstrated the concept with a table-scale device that produced, drip by drip, 4 fluid ounces of ammonia per hour. Scaled up by engineer Carl Bosch – both Haber and Bosch won Nobel prizes for their work – synthetic nitrogen fertiliser supercharged the world's agriculture.

Billions of pounds of such fertilisers are used in producing the world's food supply. A 2008 study calculated that approximately 50 percent of the nitrogen found in human tissues originated from the Haber-Bosch process. But nitrogen is elusive, with much of it escaping into air or water; even the most optimistic studies calculate only about 50 percent nitrogen-use efficiency in farm crops. The energy intensive process depends on fossil fuel, accounting for up to 5 percent of the world's natural gas use.

As often is the case, farmers are looking to the microbe to improve the efficiency of agriculture's role in the ecosystem.

Cocking and his colleagues worked with nitrogen-fixing Gluconacetobacter diazotrophicus, a unique bacteria discovered in sugarcane. Scientists found that this bacteria could intra-cellularly colonise corn plants as well as several other crops species, including canola, rice and wheat.

Introduced commercially by Azotic in 2019 under the trade name Envita, corn farmers now can introduce this strain of bacteria by applying an in-furrow liquid application. Plans call for a dry version to be available in the future for use as a seed treatment.

Once in contact with the seed, the Envita bacteria colonise the entire plant, from roots to shoots, setting up shop in the cell right next to the chloroplast – the factory for photosynthesis. As a result, these microbial workers provide nitrogen to the plant where it is needed, when it is needed.

YIELD INCREASES

On-farm trials found that corn with the N-fixing bacteria could produce the same yields with less synthetic N. But farmers often reported a yield boost with N-fixing bacteria under full N rates.

Other N-fixing options are available, or on the horizon. For the 2019 growing season, Pivot Bio released its product called ProveN. This biological advance provides microbes that adhere to corn roots and feed off exudates, in turn delivering a constant source of N to the plant.

Further beyond, researchers at the University of Wisconsin-Madison, teaming with the University of California-Davis and Mars, Inc., are studying a tropical corn from Mexico that fixes *N. Mucilage*-coated brace roots host N-fixing bacteria; scientists hope to work the genetic mechanism into commercial corn hybrids. ■

1 Dripping with possibilities, this Mexican corn hosts nitrogen-fixing bacteria in mucilage-coated brace roots.

From backyard business to thriving success, this horticultural enterprise is serving a growing market and generating its own power along the way.

By Liz Harfull

Hydroponic herbs hit the mark

1

Ian Lines is readying himself for a busy spring and summer. As managing director of one of Australia's largest fine herb producers, it's not the season that will be keeping him on his toes.

The family business, Holla-Fresh Pty Ltd, grows hydroponic produce in impressive quantities year-round, thanks to 3.8 hectares of atmosphere-controlled greenhouses and glasshouses on the outskirts of Tantanoola, in South Australia's Limestone Coast region.

Ian's anticipation of an unusually busy end to 2019 is more about the world-first technology now settling into place in a modest steel shed recently built at the heart of the operation.

The shed houses a fully-automated biomass system, which converts wood waste into hot water and electricity. Initial

testing shows that it has the potential to save the business around $300,000 per year in energy costs, while producing valuable horticultural by-products and making Holla-Fresh carbon negative.

Even before it is fully commissioned, hopefully in December, a growing number of people from food production and renewable energy sectors in Australia and overseas have started visiting to inspect the groundbreaking technology.

It's all a long way from the business's humble beginnings almost 30 years ago. The enterprise was inspired by a small hydroponic system Ian's brother, Mark, set up in a suburban backyard in Adelaide.

Keen to become self-employed, he and Ian joined forces in 1991 to establish their first timber-framed glasshouse on the current site, close to where Ian was working on a broadacre cropping and livestock enterprise. "We put in a trial of tomatoes and lettuces, but we soon worked out that everyone was growing those. So we threw a few curly parsley seeds in, and started selling them with their roots on," Ian says.

THE LIVING HERB COMPANY

"No-one else was doing it at the time and Woolworths saw them, thought it was a great idea and promptly put an order in to supply their supermarkets in SA. We became known as the living herb company, and we sold all our herbs with roots on at that stage, under our own brand name."

Within three years, Holla-Fresh was large enough to employ Mark full time. Within another year or so, Ian was working in the business full time too, as demand for fresh herbs grew and the range expanded.

"We were lucky with the timing," Ian says, looking back on the business's trajectory. "We were in at the beginning and we grew with the industry. I'd like to say we had a big crystal ball and knew what we were doing, but we didn't.

> » Most people have no idea how labour intensive growing fresh herbs is. We have tried to automate as much as we can but the harvesting and packing side of it is all done by hand. « *Ian Lines*

"We had to learn by trial and error, because hydroponics in those days was a very secretive industry in Australia and it was only in its early stages too. We would knock on doors looking for advice and people didn't want to know."

Today Holla-Fresh grows more than 20 different herbs, supplying around five million units every year to major supermarket chains and independent stores across Victoria, South Australia and the Northern Territory. "Our target market is high-volume, low-margin supermarkets," Ian says.

Most customers take the same herbs, but they can be packaged in different ways, and the major chains these days prefer their own branding. Holla-Fresh operates two packhouses which pack each herb as many as four different ways to meet these requirements, including punnet and bunched lines, and ensure efficient delivery, given some herbs have a shelf life of only seven days.

1 Holla-Fresh managing director Ian Lines.
2 Packing fresh herbs for a major supermarket chain.

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State-of-the art glasshouses enable year-round production of every herb, with automated systems carefully controlling temperature, humidity, irrigation and fertiliser regimes tailored to suit each variety.

Herbs with a creeping habit, such as oregano and thyme, are grown in a traditional bed system. Crops that last longer and can be harvested multiple times, such as basil, are grown in coir slabs with perlite, similar to those used to grow tomatoes and lettuces.

AUTOMATED LABOUR SAVING

Coriander, watercress, parsley, chives and dill are produced in an automated NFT (Nutrient Film Technique) moving gully system, first developed by the Lines about 15 years ago to reduce labour costs, increase yields and improve product quality.

Their version of a concept originally developed in Europe proved so successful that Mark sold his shares in Holla-Fresh in 2015 to focus on manufacturing moving gully systems and glasshouses for customers across Australia through his own business, Grow Systems Australia, based in nearby Mount Gambier. Two years ago the company began exporting its technology, building systems for horticulture enterprises in China and Hong Kong.

The moving gully system involves growing plants in channels that automatically move along the growing beds, halving the amount of time it takes to transplant and harvest herbs, and significantly reducing crop damage, particularly of the more delicate herbs.

The set-up has also enabled Holla-Fresh to increase the number of plants it can grow in a 92 metre by eight metre bed to about 24,000 compared with about 15,000 in a traditional fixed bench system. Heating, cooling and irrigations costs have also been reduced significantly, because of the increased plant density.

Despite the innovation, labour remains the single biggest cost at Holla-Fresh, which employs up to 60 people year-round. About a third are migrants, mostly Karen and Karenni refugees from Myanmar, formerly known as Burma, who have settled in large numbers in the region.

3 Harvesting basil in one of Holla-Fresh's state-of-the-art glasshouses.
4 Bunches of coriander ready for delivery.
5 One of the coir slabs used to grow lemon thyme.
6 Part of the world-first Echo2 biomass system.

"Most people have no idea how labour intensive growing fresh herbs is. We have tried to automate as much as we can but the harvesting and packing side of it is all done by hand," Ian says. "It takes eight people a couple of days just to harvest one bay of coriander – that's 14,000 plants."

The second biggest cost to the business is energy. The decision to install a biomass system stemmed from a quest to find a more viable alternative to electricity purchased from the grid and a high-maintenance boiler which uses waste oil to heat water. "Our energy sources here were unsustainable," Ian admits.

To help them in their search, Holla-Fresh engaged the South Australian government agency, Green Industries SA, which has a remit to develop the State's green economy. After a lengthy process reviewing various options such as solar, wind and wood-chip boilers, they suggested Holla-Fresh consider installing a modular biomass system under development in Western Australia.

SUSTAINABLE FUEL ALTERNATIVE

Known as Echo2, it is the brainchild of third-generation Kalannie farmer and eucalyptus oil producer Ian Stanley, and Peter Burgess, who spent five decades working in the mining sector. The two men created a company called Rainbow Bee Eater after meeting at the world's first biochar conference 12 years ago.

They aimed to pool their knowledge and resources to develop new technology that would supply low-cost biochar, and provide a renewable and sustainable energy alternative to fossil fuel.

When Holla-Fresh first heard about Echo2, the system was in the final stages of development as part of a 10-year project being undertaken in collaboration with a specialist engineering company, SDA Engineering, supported by the Australian Government, which helped the project secure R&D tax incentive status.

After nine months of due diligence, feasibility studies and negotiation, work began at Tantanoola last year to build the first commercial prototype. The plant produced hot water for the first time in October 2018, and has been going through a gradual commissioning process, with the SDA Engineering team expecting to finish final modifications by Christmas.

Designed to run 24 hours a day, unmanned, the biomass system uses pyrolysis to convert woodchips into syngas, or synthetic gas, which is then used to power a water boiler and a generator housed in the same shed. "Technically, the basic process is nothing new, but normally it produces a dirty gas, full of tars and condensation. These guys have worked out how to clean the gas up in a natural way, without any waste," Ian says.

The process produces two potentially valuable by-products – biochar and a condensate called smoke water or wood vinegar, which can be used in horticulture to increase seed germination and improve plant health.

WIN-WIN BYPRODUCTS

While Ian is still considering options for selling the wood vinegar, the biochar is already going to a Mount Gambier company that produces garden and landscape supplies. As part of what Ian describes as a classic win-win arrangement, the same company, Van Shaik's BioGro, supplies Ian with the woodchips he needs. They are made out of waste timber from Victorian building sites, which previously went to landfill.

While some of the engineering has needed to be modified, Ian is very happy with how the substantial investment has turned out so far. "It's been a longer process than we all wanted but the system works brilliantly," he says. ■

Click goes the technology

A range of new technologies are on the way to help sheep producers better monitor and manage individual animals to boost profitability.

By Liz Harfull

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When Campbells Bridge farmer Scott Nicholson was awarded a Nuffield Scholarship to explore new technology that might improve the profitability of Australian sheep and wool enterprises, he wasn't expecting to find any magic solutions.

But his travels during the past 18 months have convinced him significant benefits lie ahead if producers are given the right tools to monitor individual animals, better harness the information gathered and then use it to tailor how they are managed.

"I would have loved to find something that will increase my bottom line by 20 percent, but the reality is that won't happen. However, there are things in the pipeline that when combined together will help us to build more resilient businesses," he says.

Scott operates Bretton Estate, about 20 kilometres north of Stawell, in western Victoria, with his wife, Laura, and father Robert. Roughly divided evenly between sheep and dryland cropping, the enterprise covers about 2,000 hectares of owned land and another 1,000 hectares of leased country, with an average rainfall of between 450 and 500 mm.

The Nicholsons run about 5,500 Merino ewes, with half

joined to White Suffolk rams for prime lamb production. Scott is also a partner in the Sohnic Merinos stud, based about 50 kilometres further north at Marnoo East. Focussed on breeding dual-purpose rams that deliver maximum profits per hectare in combined wool and meat production, the stud provides the basis of Bretton Estate's commercial Merino flock.

The cropping side of the operation includes wheat, barley, canola and legumes, as well as hay production, with all but the canola used to finish lambs in an on-farm feedlot. Depending on the season and market prices, the aim is to optimise weight gains and carry lambs through until prices start to lift in the autumn.

A FRESH CHALLENGE

Scott decided to apply for a Nuffield Scholarship because he was looking for a fresh challenge. He had been working on the property for almost 15 years, after completing a Bachelor of Business (Agribusiness) degree at Marcus Oldham College in Geelong. His family sold their original farm at Maryborough and moved to Campbells Bridge only a year or so before he came home.

With support from Australian Wool Innovation (AWI), Scott's scholarship took him to the United States, Canada and New Zealand, exploring a wide ranging selection of technologies such as the use of Electronic Identification (EID) in performance recording, automatic handling and drafting equipment, virtual fencing and smart sensors.

Importantly, he decided to look outside his own industry and see if other sectors of agriculture offered concepts that could be adapted. In New Zealand, he explored the latest advances used in the dairy industry to monitor and manage individual animals, including automatic calf feeders, robotic dairies and cow identification systems.

"Most sheep producers are only measuring total output, in terms of lambs produced or wool sales, not what individual animals or different types are doing. But technology already exists in the dairy industry which could really help us monitor individual performance and better manage those animals," Scott says.

» Smart tags and virtual fencing have the potential to be game-changers for the sheep industry – but they are not viable propositions yet. « *Scott Nicholson*

One of the examples that caught his eye was the way EID was used to deliver tailored rations to individual calves via automatic calf feeders in the paddock, and in the bale while cows were being milked. "Dairy farmers can feed their top producers more grain, so they get more milk," he says.

"We feedlot lambs and if we had a better understanding of each animal and what they are converting that would be so valuable. But at the moment we are only working on averages. There is massive potential for us to better understand animal performance and analyse different animals, different genetics and different breeds, so we can fast-track our objectives."

Scott says the introduction of compulsory EID for sheep in Victoria over the past two years meant producers in that state already had in place a key component.

"Now we need to identify how we can potentially use it. There is a lot of software and things like that coming online in the next few years, which could be big for the industry, and they are not things that people will necessarily have to spend

1 Scott Nicholson with a pen of Sohnic Merino rams.
2 A Farmbot remote water monitoring unit with rain gauge, among the technology already being used on Bretton East.
3 An auto drafter and Combi Clamp combination which the Nicholsons use for handling, weighing and treating sheep.

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4 Eleven-month-old lambs, recently introduced to the on-farm feedlot.

big money on," he says. Another important lesson he learnt was that no matter how good the technology, it wasn't going to save a farm business if the basics weren't right first. "In a nutshell, people have to make sure their business fundamentals are OK first," he says.

"Then, if they adopt the right technology it can help them, but there is no silver bullet. There is no single piece of technology out there that I came across, that is going to double your profitability."

INFORMATION GATHERING

It was more a case of achieving a cumulative affect by adopting a range of technology that each offered the potential to improve production or profits by two or three per cent. And in the case of technology that gathered information, it would still come down to the producer being able to interpret it, make the best possible decisions and then implement them.

While Scott believes smart tags and virtual fencing have the potential to be game-changers for the sheep industry, he says they are not viable propositions yet, given the cost of purchasing them for every animal in most commercial-sized flocks.

"But the tags are getting better, and if more people start buying them eventually there will be a critical mass and they will get cheaper," he says.

Meanwhile, Scott is planning to trial a new smart tag being developed by AWI so producers can monitor individual sheep remotely, via a computer, tablet or mobile device. They come in the form of collar tags for temporary use on lambs, and ear tags that will last several years on adult sheep.

"Our interest lies in the feedlot, which is a more controlled environment. If we had smart tags on the lambs, we could start to identify things like how long they spend at the feeder, how long they are ruminating, how long they spend at the water trough, and their behaviour patterns," Scott says.

His scholarship also brought home the increasing issues farmers around the world are experiencing when it comes to keeping their social licence to farm. He is convinced the level of public scrutiny is only going to become more intense for Australian farmers, especially with animal welfare.

"We need to build systems where we do everything we can for our animals. It really matters. We need to do the right thing, and not just when we think people are watching," he says, citing mulesing as a classic example.

Scott decided to stop mulesing last year, despite the Australian Government announcing it had no intention of following New Zealand's lead and banning the controversial flystrike-prevention practice.

Conscious for some time of increasing pressure from overseas consumers and animal welfare lobbyists, Sohnic Merinos and the Nicholsons were already heading in that direction through their breeding program, but after his experiences overseas, Scott decided it was time to draw a line.

CONSUMER PRESSURE

"Before that, naively, I thought that maybe it might go away, but I can tell you for certain it's not," he says. "We can all see where it's headed. Mulesing will end up being banned in Australia, but only after a consumer backlash and the wool buyers start saying they won't take the wool. It would be a far better solution if we stopped before that happens.

"The issues of social licence and sustainability are not going to go away. The level of public scrutiny in other countries is already higher than it is here."

Likewise, he says the Australian red meat industry needs to be prepared for the increasing popularity of fake meat products. "If you had asked me 18 months ago, I would have said they were never going to cut it, but very soon they are going to be in every fast food chain and supermarket, so we have to deal with it." ■

†Conditions apply. Valid on 1 - 4 Series Utility Tractors. 6 year/2000 hours (whichever comes first). See your local John Deere dealer for more information on the Limited Warranty for New John Deere Turf & Utility Equipment.

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Soil under pressure

Soil compaction is a well-known problem, but its impact is often underestimated and difficult to assess. And it is a growing concern for European farmers.

By Jean-Claude Hiron, Adrien Leroy, Marjolein van Woerkom and Olivia Cooper

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At the end of November it is bitterly cold in this corner of the French département Aisne. Frédéric Sabreja, sugar beet grower, inspects the field. The weather is dry – hopefully it will remain so. "Last year we finished harvesting the beets in catastrophic wet conditions," he recalls. "The trailers were buried to their axles in mud. They left such ruts that while ploughing a few days later, the tractor almost bottomed out."

Similar conditions in recent years are a concern to members of the machinery co-operative Cuma (Co-opérative d'utilisation de matériel agricole) of Chalandry, of which Frédéric is president. It affects both the soil structure and crop yields, notes his colleague Nicolas Mallèvre, who accompanies him that day on a tour of their fields. "Even if it's not extreme compaction, we see the yield difference. Wheat after rapeseed yields 8-9 tonnes per hectare, compared to 5 tonnes per hectare after sugar beet. The later sowing after beets does not account for all of that difference."

WHEN TO HARVEST?

Compaction issues are increasingly worrying producers in the North of France, especially with more frequent weather hazards, on naturally sensitive soils and with crops where exceptionally heavy machinery is involved, such as sugar beet and potatoes. However, the problem does not stop at the borders. The Netherlands, Germany, Austria. On a global scale, Europe as a continent has the biggest soil structure problems in the world.

"When 70-tonne machines are working on sandy silt soils in heavy, wet conditions, that scares me," says Nicolas. "A

» The weight of the machine does not necessarily have a negative impact on the soil. « *Louis Claessens*

1 Louis Claessens says that in Europe contractors bear the bulk of the responsibility for compaction.
2 To make their own decision on when and how to harvest, Nicolas Mallèvre (left) and Frédéric Sabreja invested in their own tractor-harvester combination for sugar beet.

sugar beet harvester can compact the soil down to a depth of one metre. Earthworms had better have strong shoulders to unpack that!"

These concerns are shared by other members of the Cuma co-operative, particularly given the end of sugar beet quotas. The 20 percent increase in local sugar refinery production and the resulting extended harvest schedules make it increasingly difficult to control harvesting conditions. So in 2017 the Cuma members decided to invest.

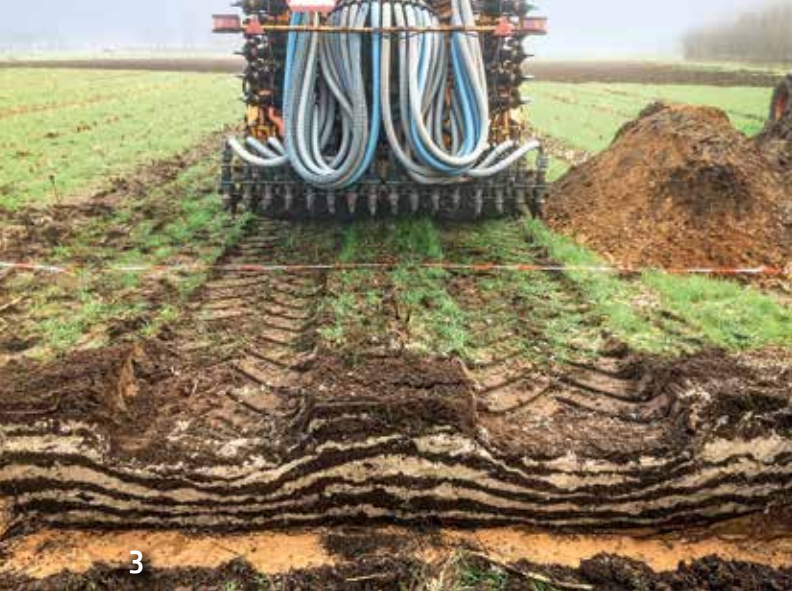
HOW FAR DOES IT GO DOWN?

"We switched from contracting self-propelled beet harvesters on our 130 ha of sugar beet to using a tractor with a front attachment to cut the foliage and a drawn beet harvester," reveals Frédéric. "This allows us both to reduce the weight on the soil and, since we own the equipment, to harvest in the best possible conditions."

The tractor-harvester combination has a net weight of 17 tonnes and Ultraflex tyres are inflated to 1.5 bar (22 psi) to spread the load. Having already adopted precision technologies like auto guidance and section-controlled application, members are now thinking about switching to remote tyre inflation systems.

"The number of axles is directly related to the depth of compaction, so we try to have as many as possible on the machine's chassis," notes Frédéric. In addition, two rows of beets are sacrificed during sowing to allow for wide wheels to pass through.

"We do compact the soil, but try to stay as shallow as possible," says Nicolas, pointing at the beautiful beet field that



3 & 4 At field trials with different chassis configurations there were significant differences in depth of compaction.
5 & 6 For the contractor business Volkerink Heino analysing the soil and advising clients to minimise compaction is an important part of the business strategy.

stretches behind him. Compaction is linked to so many variables that it can't always be avoided. It is therefore more a question of controlling the risk. "If you compact deeper than 30 cm, it's too late. Mechanical action is ineffective – only deep frost, drought, or time will enable the structure to improve again."

Cuma's investment in the new harvesting system was logical – but the co-operative still needs to stay economically viable. The increase in beet production has been accompanied by falling sugar prices, while operating costs keep increasing. "Five years ago, we made €500/tonne," says Frédéric. "Today, we make €350/tonne. There is no room for error– we need to optimise as much as we can, to make the farm operations sustainable."

Fellow farmers are generally well aware of the risks of compaction, he adds. But, for the time being, many do not see avoiding compaction as a way to increase yields. However, Frédéric expects this issue to become more prominent in the years to come. "I think the impact is not yet noticeable enough."

HOW SEVERE IS IT?

Louis Claessens, contractor in the Dutch village of Heino, describes the situation in almost identical terms. "Compaction is not something you see. As contractors, we leave the land nice and flat, which means it is impossible to see tracks that might have developed below the surface. But the soil has actually become so compacted that water cannot escape."

Passionate about agronomy, Louis purchased the contracting business Volkerink Heino in 2009. It was a difficult time to start. The aftermath of the 2008 financial crisis was still being felt, and the risk was significant. Hence the idea of differentiating himself with services focused on soil analysis and preservation. "My strategy is to fully utilise the potential of the clients' production system. When they make money, so do we."

To show his clients how serious the risk of soil compaction is, he recently organised a field demonstration, running 14 tests with different types of machines, chassis and tyres. "I wanted to visually demonstrate the impact that the wheel pressure has on the soil. Here, dairy farms do not care very much about soil quality."

At Volkerink Heino, reducing potential soil compaction drives each investment decision. The Van der Molen eight-wheeled chassis was installed on the 16m^3 slurry tanker as well as on one of the trailers. Tyre pressures are set at one bar (14.5 psi) and the load at the wheel remains below 3 tonnes.

Louis also uses a plough that allows the tractor to remain on the unploughed surface. "In terms of compaction, contractors bear the bulk of the responsibility," he says. "It's up to us to do something."

7

» Use the metal just enough to allow the roots to do the rest of the job.

« *Philip Wright*

One thing is certain – preventing compaction will be more of an issue in the years to come, against a backdrop of increasing machinery weights. "However, the weight of the machine does not necessarily have to have a negative impact," says Louis. "Everything comes down to weight per wheel. It is better to carry 16m^3 on eight wheels than 10m^3 on two."

IDENTIFYING COMPACTION

According to soil expert Philip Wright, farmers should first look for areas where the grass or crop is performing badly – is it lying wet or yellowing under stress?

"Having identified problem areas, dig a hole in a good area of the field to get a feel for what the soil structure should be like, and then dig in the bad areas – you'll be able to feel and see the difference straight away."

Dig a series of holes to at least 1.5-2 spade depths, then prise off some soil on a non-smeared face. It should break away vertically; if it fractures into horizontal slabs that's an indication of compacted layers.

Look at the moisture in the soil profile, he adds. If there is a wet layer over a dry layer, water isn't getting through. Also check the soil colour and smell, presence of worms, and root growth. Are the roots growing right down or reaching a layer and then stopping?

All of this will help to identify the level and depth of compaction, so you can decide how to deal with it.

Crop roots can support and improve soil structure – and dry or frosty weather can offer natural improvement through shrinking and cracking, says Philip. "There is a temptation to go in with a deep subsoiler or plough, but that will cost more in fuel, disrupt the natural soil structure and potentially do more damage. You need to identify the limiting factor in the soil and do just enough to alleviate it – use the metal just enough to allow the roots to do the rest of the job." ■

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7 Members of the Cuma co-operative mainly grow sugar beet, wheat, canola and maize. For all of the members, protecting the soil is an important factor.

8 Altogether, the co-operative cultivates 1,200 ha with machines brought together from all members. Six of them share the beet harvesters.

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Cream of the crop

Vision, grassroots marketing and persistent hard work helped this small family dairy business beat large corporations to win Australia's champion cream award.

By Liz Harfull

Thirty years ago, Giuliano and Rita Lorenzetti made a brave decision. At a time when it was virtually unheard of in Australia, the Adelaide Hills dairy farmers decided to start processing their own milk.

Investing $13,000 in a small, second-hand pasteuriser, they set about converting milk from a handful of cows into a product they could sell direct to boutique cheese and gelati makers.

Earlier this year the family-owned and operated business rewarded the Lorenzettis' vision and hard work when it won the award for champion cream at the 20th annual Australian Grand Dairy Awards, announced in Sydney.

The honour was just the latest in an increasing list of national food and dairy industry awards claimed by their business, Tweedvale Milk, since it won a gold medal in the first attempt in 2003, with its traditional full-cream milk.

Tweedvale is based at Lobethal in the central Adelaide Hills of South Australia. The brand takes its name from the moniker the town was given during the First World War when anti-German sentiment forced settlements of German-origin to change their names.

Giuliano and Rita settled on the outskirts of Lobethal in 1974, with their children, Carlo and Gabriella, after buying a 28-hectare farm, where they milked about 40 cows and ran a Holstein Friesian Stud.

Having grown up on a dairy farm in Italy, Giuliano had first

come to Australia about 20 years before. In the late 1960s, he returned to his home country and married Rita, whose family also had land and milked cows.

The young couple returned to South Australia in 1970 and bought a dairy farm in partnership with Giuliano's brother. They went back to Italy a few years later, hoping that the country's economy might have improved and they could stay closer to their extended family, but it wasn't to be.

Today they are on the same property purchased in 1974, living just over a rise from the processing plant built alongside the original dairy. From the beginning, the focus was on breeding the best possible cows, and giving them and their pastures as much attention as possible so the cows were healthy and stress-free. Their efforts earned them producer awards for milk quality, up against much larger enterprises.

RAPID GROWTH

Then in the late 1980s, they were approached by La Casa Del Formaggio to supply milk for Adelaide's first commercial fresh mozzarella. The new business took off rapidly, going on to employ more than 130 people and sell its products to thousands of supermarkets and speciality food stores across Australia. "In 12 months they became really big and we couldn't supply them enough milk anymore," Rita says.

By this time the dairy industry was changing rapidly, with Australian herd sizes increasing significantly to remain profitable and thousands of farmers leaving the industry. On such a small parcel of land, expanding the herd was not an option for the Lorenzettis. "We sold the cows and decided to do something else but my husband, he is very persistent, so we kept the young ones," Rita explains.

With the farm having won awards for milk quality, Guiliano was convinced they could find another market, and a more profitable option than supplying a large processor. So they bought the pasteuriser in 1988 and he went in search of new customers, while Rita persevered, learning by trial and error

> » I think we were the first in Australia to capture the coffee market with boutique, non-homogenised milk. «
> *Carlo Lorenzetti*

how to use it. "Nobody could tell me how," she says. "The person we bought it from had died and the family didn't know how to use it. I only had a little book and I said to myself well, I will try. If I break it, that's the end of it."

Rita soon mastered the machine and the Lorenzettis began supplying milk to gelati makers, producing Italian ice-cream for Adelaide cafes, as well as one or two boutique cheese and yoghurt makers.

"When we bought the pasteuriser we only had three cows producing milk," admits Rita. "As the customers were growing, we were getting in more cows, and then our cows were not enough, so we had to go to other farmers and buy their milk, and it went from there."

Growing the business was not easy. "We had to sell our milk cheap to get into the market, because we were selling it in bulk," Carlo adds.

"We didn't have a bottling machine at that time, so we were providing it in 10 and 20-litre bags. It wasn't making much money but you could see there was potential."

Confident of the business's future, in 1996 the family built

1 Tweedvale Milk general manager Carlo Lorenzetti with some of the company's range of milks and creams.
2 Filling 4-litre containers of traditional full-cream, non-homogenised milk for the cafe trade.
3 The milk pasteurisation plant.

4 Tanker driver Ashley Carrison delivering milk to Tweedvale.
5 Tweedvale's Pure Double Cream claimed the award for champion cream at this year's 20th annual Australian Grand Dairy Awards.

a new dairy and processing facility, with a cold store and bottling plant capable of handling four, two and one-litre containers. After graduating from university, Carlo joined the business fulltime and took on the task of securing more customers and distributing the milk, while Rita continued to be responsible for the daily processing and Giuliano ran the dairy farm.

Still in his early twenties, Carlo found it tough to win new customers but the cafe scene was taking off in Adelaide, and he made the most of their growing reputation with high-end cafes using their milk to make gelati.

Cleverly, he also offered a solution to a problem that was troubling the city's best baristas. At certain times of the year, they could not get the milk they were using to form a silky, dense foam for their lattes and cappuccinos, no matter how skilfully they tried.

LOCAL AND RELIABLE

Carlo suggested Tweedvale milk would be more reliable and have a better flavour because it was an old-fashion full cream milk, pasteurised but not homogenised. Slowly but steadily, it became the milk of choice for cafes and restaurants in the greater Adelaide area that wanted to support local food producers and prided themselves on excellent coffee. "I think we were the first in Australia to capture the coffee market with boutique, non-homogenised milk, as the main customer base," he says.

Carlo says the ability of the milk to create the perfect foam stems from multiple factors, not just its protein or butterfat levels. Feeding cows the right balance of pasture and specific grains, and avoiding heat stress play a part, with the Adelaide Hills offering a cooler climate than most other parts of the State.

"But it's very complex," he says. "Processing the milk as close as possible to the farm where it is produced also helps, and we don't manipulate the milk as much."

Today the Lorenzettis receive 10,000 litres per day from five dairy farms, four of them within 12 kilometres of the plant, and another about 35 kilometres away, which provides milk on a more ad hoc basis when needed. "We pay a premium for their milk because we have high standards but also because we want their farms to remain viable so that consumers have a choice to buy local in the future," Carlo says.

With the processing side of the business having reached full capacity and Giuliano having retired from milking some years ago now, they no longer run their own herd. As it is, Rita continues to work long days processing the milk, admitting with a smile that it would take more than two people to replace her should she decide to retire.

A larger pasteuriser was installed in 2007, along with a state-of-the art separator that removes the cream from some of the milk, producing a reduced fat milk and a rich, natural cream. A separate pasteuriser able to handle the thick consistency is used three days a week to make both pouring and double cream.

The Tweedvale Pure Double Cream, which took out the trophy for best cream in Sydney, is about 50 percent butterfat, and made without thickeners or preservatives. Rita oversees the making of this too, gently heating the cream to pasteurise it, and working with the rest of factory team to ensure all the machinery and equipment is washed and rinsed thoroughly. "For the cream to taste good, it must not have any taints. Everything has to be very, very clean," she says.

MEETING CONSUMER DEMAND

Faced with a fresh marketing challenge after they started making the cream, Carlo began by selling it to a nearby roadside apple stall, where a local orchardist sells both fresh fruit and home-made baked goods using apples. It was one of the first retail outlets Carlo noticed promoting the concept of food miles, encouraging consumers to buy fresh local produce.

The growing consumer trend has continued to serve Tweedvale well. Both the cream and milk are also now sold in independent supermarkets across Adelaide, as well as selected fruit and vegetable shops.

With the marketplace becoming increasingly competitive, more boutique dairy brands emerging and the rapid growth of veganism, entering annual dairy awards is an important marketing tool for the business. "It reminds people we have a premium product, and it encourages us to strive to do our best," Carlo says. ■

JOHN DEERE

Behind New Zealand Dairy

See the video at JohnDeere.co.nz

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Rosemary pioneers

A plan hatched between two farming friends 20 years ago, Glenelg River Herbs has grown to become one of Australia's largest suppliers of fresh rosemary.

By Nathan Dyer

On a cool morning in August, Anita Watt looks over a field of purple flowering rosemary stretching across a hillside in the red-gum country of western Victoria. An early storm has passed and the buzz of honeybees floats on the crisp winter air.

It's here, near Balmoral, 65 kilometres north west of Hamilton, that Anita and business partner Christina Hindhaugh established an idea 20 years ago that has grown into one of Australia's largest rosemary operations.

Walking amongst scented rows of herbs, Anita explains how the idea came about after Christina, a fellow sheep farmer, and friend, completed a Churchill Fellowship looking at broadacre herb production in the United States, Britain and France.

"She'd started trial growing herbs in about 1996 and came back from her Churchill Fellowship in 1998 with this dream to have fields of rosemary growing at Balmoral, similar to the lavender fields in France," says Anita, grinning.

After agreeing to help write a business plan for the venture, Anita, who at the time was running the family prime lamb farm with husband Danny, and teaching special needs children part time, decided to partner with Christina in what was an unusual business for the prime grazing region.

"There were a lot of people who said, 'They'll never last'," recalls Anita, reflecting on the early years of establishing the business. "And there was an awful lot that we didn't know, but we were both pretty equal partners in our own farms and I think that's what gave us the confidence we could do this

ourselves." Despite neither having horticultural experience, the new partners took their plan to investors in Melbourne who agreed to back the venture. Soon after, in 1999, a company was formed, eight hectares leased across two locations, and rosemary planting commenced.

1 Glenelg River Herbs managing director Anita Watt in a rosemary field near Balmoral, Victoria.
2 Harvested rosemary drying on-site.
3 Mount Zero Pink Lake herb-flavoured salt.
4 The Memory Stick is available at specialist shops across Victoria.

EARLY HURDLES

From the beginning, the challenges of establishing a horticulture business from scratch were evident. "There are lots of things we know now that we didn't consider at the time," Anita says. "For one, we had envisaged it would be bulk dried herbs and oil, so we wouldn't need a lot of staff. But now it's nearly every day of the year we have staff here, because we're picking daily to supply the supermarkets –

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that's where the demand is and that's where the profit is."

Planting and harvesting equipment presented another unique challenge. "There was no such thing as a rosemary harvester," recalls Anita. "But we had an old self-propelled harvester at home, from the 1960s, that we used to harvest phalaris seed, so we set our husbands a challenge and over eight months Danny and Chris cut and welded, and stressed over, what is, as far we know, the world's only rosemary harvester."

Then there was the growing cycle. "Although a rosemary plant lives for 30 years, we learnt very quickly that a rosemary plant will produce suitable product for about five years, and after that you need to replace it," Anita says.

GROWING SUCCESS

Today, Glenelg River Herbs grows more than 20 hectares of rosemary across three Victorian properties, and a fourth at Lucindale, South Australia, with more than 100,000 plants producing about 30 tonnes of the herb each year.

Younger plants are handpicked for the fresh herb market, and older plants machine harvested for dried and oil products. The company employs 10 casual staff.

Sustainability is a key focus. Water is sourced from dams and creeks supplied by Balmoral's average annual rainfall of 600 mm, and applied through sub-surface drip irrigation. Fertiliser is added through the same system. No pesticides are used. "And we try to mow as much as we can, and spray as little as we can for weeds," says Anita.

» We went with purely Mediterranean herbs because that's our environment here. « *Anita Watt*

The company's main customers are hydroponic growers supplying the big supermarkets with fresh rosemary. Secondary customers include poultry company Ingham's which uses fresh rosemary sprigs in some if its pre-packed products, and a Sydney-based food processor which uses fresh and dried herbs in its food products. Dried herbs and essential rosemary oil products are also sold at specialty stores across regional Victoria.

ADDING TO THE MIX

In 2012, with an estimated 47 percent of the domestic fresh rosemary market, the decision was made to add sage, thyme, lemon thyme, oregano and bay leaves to the cropping mix. "We went with purely Mediterranean herbs because that's our environment here," Anita explains.

Although still only a small part of the business – rosemary represents about 70 percent of income – Anita says the other herbs are slowly starting to find their niche as regular markets are established.

"The fresh market for those other herbs is quite unpredictable because there are a lot of growers, but we're

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5 Rosemary in blossom at the Balmoral farm.
6 Assorted dried herb retail packs.
7 Oregano growing at the Balmoral farm.
8 Glenelg River Herbs staff members (left to right) Les Mutch, Heather Howman, Janet Exell, Anita Watt, Alison Brumley and Penny Wells.

finding that demand for dried product is increasing, particularly for thyme."

Like other Australian agricultural companies competing against cheaper imports, Anita says it's vital the business continues to innovate and value add.

Two years ago the company bought a still and began distilling essential oil. One of its latest products is The Memory Stick, a roll-on rosemary essential oil product marketed as a memory aid.

"In the last few years there's been quite a lot of research done in the United Kingdom about rosemary being really good for your memory, and that's been really positive for sales of rosemary oil," says Anita, explaining the drive behind the product positioning. "And they say even Shakespeare knew about this, where Ophelia says in Hamlet, 'There is rosemary, that's for remembrance; pray, love, remember'."

Although still in its infancy, Anita says there are high hopes for The Memory Stick, with strong sales at specialist stores in Melbourne and a recent push into Vietnam showing promise. "It's still at a niche level, but we would love it to grow to a commercial level," she says.

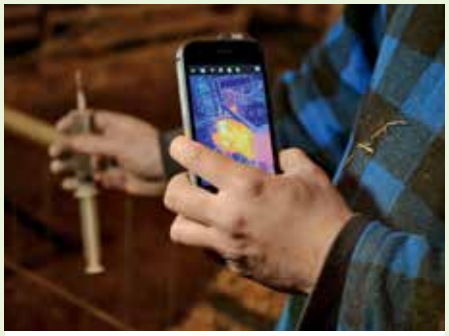
Along with innovation, Anita says it's important for companies like Glenelg River Herbs to work with other like-minded businesses. A case-in-point is a partnership with Mount Zero Olives, which has resulted in a successful herb-flavoured salt, and a soon-to-be-released rosemary-infused olive oil. "They're great marketers, and they have a big social media presence, and they like partnering with us because of the local provenance," Anita says.

A LASTING LEGACY

Sadly, Christina passed away in 2015 after a 10-year battle with breast cancer. Four years on, Anita, who was named *The Weekly Times* Coles 2018 *Farm Magazine* Innovative Farmer of the Year, continues to expand the business they built together.

Anita says she's proud of what she and Christina achieved together. "I suppose when you establish something where there was nothing before, you do look back and think, wow, we did that," she says. "And although the challenges are definitely hard at times, that's what makes the little wins so rewarding." ■

INTERNATIONAL NOTES



UNITED KINGDOM

Thermal imaging – usually associated with high-speed police chases – is finding a new application, on farms. Mixed farmer Robert Hodgkins, from Stevenage, Hertfordshire, has been trialling the technology on his mobile phone, and has found considerable benefits. Robert runs 1,500 ewes and found the thermal imaging very useful during lambing. "It's incredibly useful for seeing things in darkness you wouldn't normally see," he explains. After an incident of night-time dog worrying, he used the imaging to find a lamb which had become separated from its mother and caught in brambles. Robert was able to check its temperature using the thermal imaging, finding it was in the first stages of hypothermia. He was then able to prepare a glucose injection, at the right temperature.
He has since found the system to be incredibly versatile and has discovered multiple other uses, including finding oil leaks and electrical faults on machinery, as well as monitoring soil temperature and identifying fresh droppings for faecal egg counting. He already has plans for it to help find hot spots in grain piles, towards which he can then target his grain store's cooling system. ■

SWEDEN

Teff is an Ethiopian annual grass used for baking special gluten-free bread. So how did that crop end up in Sweden and on Andreas Nypelius's farm in Gotland? Teff is a sun-loving crop, that ideally would like 3,500 sun-hours, while Gotland averages just 2,800 hours.
Andreas admits that the first year growing 2 ha of teff (*Eragrostis teff*) was challenging. "We only got a fraction of the yield we would need, but much of that was due to the extremely harsh weather conditions," he says. "We need a yield between 700 and 1,000 kg/ha for it to be economically viable." Even so, teff is not a very demanding crop, says Andreas. "We are a little concerned about diseases but we´ll start by putting it into our crop rotation."
Crop protection is not available but late seeding makes weed control an easy task.
He plants the crop in late May and harvests it in late September. Fertilising is done as with other crops and Andreas applies 75kg/ha of N, 9kg/ha of P and 12kg/ha of K.
The only drawback is that small seeds make planting a challenge. "We had to take care so the seeds didn't drain out of the seeder since they are so small." ■

DENMARK

Insects are said to be one of the food products of the future, and Jessica Moore Buhl-Nielsen from the company Wholi thinks that the future starts with what we are doing today. "There are over 1,900 species of edible insects that are eaten by more than 2 billion people around the world. Insects are a true super-food, they have a high protein content, fibre, omega-3, vitamin B12, iron, magnesium, calcium and zinc," she says.
In addition, they are arguably more sustainable than other animal products. According to the company, producing 1 kg of insects requires 12 times less feed than 1 kg of beef, and about 1,000 times less water. Wholi was founded in 2016 by Malena Sigurgeirsdóttir and Jessica, with the goal of contributing to a more sustainable world by manufacturing flavourful and nutritious food with insects.
This became the business Dare To Eat, which has developed into Wholi.
"We want to inspire people to eat more insects by informing them of all their benefits, publish inspiring stories about how insects are eaten in the rest of the world and help people on their way through workshops and recipes," she says. ■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Out on a limb

An antimicrobial extract from New Zealand's native tōtara tree is showing potential for use against mastitis in cattle.

By Richard Bentley

About 100 million years ago New Zealand opted out of Gondwanaland and created a substantial moat between itself and the rest of the world. That was a good move – it allowed the development of a flora that is significantly different from most other land masses.

The absence of browsing and chewing mammals meant that to survive, plants did not have to become acidic and therefore unpalatable. Furthermore, the more alkaline flowers, stems and leaves developed compounds that are now finding uses in human and animal health. Methylglyoxal in manuka honey is a prime example.

Another is totarol from the NZ native tōtara tree (*Podocarpus tōtara*). This complex molecule ($C_{20}H_{30}O$) and related compounds give the long-lasting qualities that made tōtara ideal for use by early Māori for canoes and subsequently by European settlers for fence posts, battens and foundation piles.

Entrepreneur Doug Mende, while studying biomedical compounds from NZ native plants in the early 90s, became aware of totarol, which was being extracted from timber using solvents. A scientist at the government research institute Industrial Research Limited had been looking at totarol as a potential alternative to antibiotics but pharmaceutical companies were not interested.

However, Doug saw the possibilities and took it on. In 1999 he formed Mende Biotech Ltd and began to characterise the solvent extract. Subsequently researchers proposed using supercritical fluid extraction with high pressure CO_2 for separating out the active compounds Doug wanted.

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1 New Zealand's native tōtara trees can grow to 30m, yielding reddish durable timber that contains totarol, a potent antibiotic and antioxidant.
2 Doug Mende, founder of Mende Biotech Ltd (centre); Tim Balmer, commercialisation manager (right); and Dave McConnell, director, in front of tōtara offcuts ready for processing.

"At that time no one had ever done either extraction from wood or extraction of a solid using supercritical fluid CO_2 so Industrial Research Limited went down a very complicated path looking at how to use this process safely," says Doug.

"We found that it left no solvent residue in the product and it gave a higher yield of a purer product that could be certified organic, so it was a no-brainer to adopt the new process. We patented it, and now it has been scaled up for use on larger quantities of tōtara wood chip."

The method produces an extract with a unique suite of active components, which Doug registered as Totarol™ in 1999 and set about characterising its antimicrobial and antioxidant properties.

"Working out how to produce and analyse it accurately took about five years but once we achieved that we started working with the cosmetics company L'Oréal," he says.

"They evaluate up to 1000 new compounds each year but only about five get through their toxicology tests and are registered. Totarol™ made it!"

That success gave Mende Biotech and Totarol™ credibility, and the powder is now exported to around 25 countries mainly for use as an ingredient in oral hygiene and skin care products.

ANIMAL HEALTH

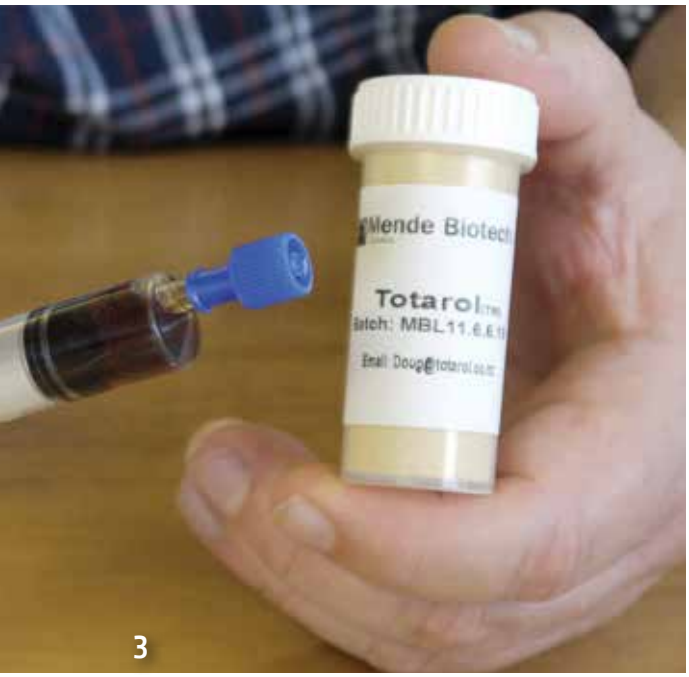
Recently the company has focused more on animal health, particularly mastitis in cattle – a $200 million problem for New Zealand. The looming threat of antimicrobial resistance creates pressure on vets and farmers to manage the use of existing antibiotics very carefully. Alternatives need to be found and Doug is convinced that a Totarol formulation will do the job.

However, new products to be used in food producing animals are subject to strict regulations and complex testing regimes. The company's first task was to find tōtara raw materials that met BioGro New Zealand's organic standards. Initially Doug had used old tōtara fence posts and battens but these were not acceptable so he sourced 'wild harvest' wood – offcuts of heartwood from a sawmiller who removed dead and dying tōtara trees sustainably from a native forest.

The change brought unexpected benefits – Totarol extracted from forest wood proved superior in both quality and quantity.

Another requirement for registration is that the fate of Totarol in cattle be determined – is it cleared from the body after treatment or does it accumulate in milk, meat, fat or organs? Normal rules for registering veterinary medicines are that the active ingredient must be a 99 percent pure single compound.

However, Totarol is a mixture of totarol (~82 percent) and 63 related compounds that work synergistically to produce potent antimicrobial effects. So the question is: Can the company check solely for totarol as the marker for residues



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and still meet registration requirements?

Battling away at this challenge is Totara BioScience's Commercialisation Manager Tim Balmer, a vet with considerable experience in the Animal Health industry including the multinational pharmaceutical company Novartis. "For Totarol™ to be developed as a new active ingredient for the animal health market we had to submit all our toxicology and analytical data for assessment by New Zealand's regulatory authority, the Agricultural Chemicals and Veterinary Medicines group. They have now given us the go-ahead," says Tim.

"This is a major step forward because it is the first time an extract rather than a single compound has been granted clearance for development. First hurdle out of the way!"

However, more hurdles remain. The company has developed several formulations that must now be tested on laboratory cultures of mastitis pathogens, and the best formulation then tested for effectiveness in live cattle. They must then look for possible residues in milk, meat, other body tissues, urine and dung.

"Normally this would be done by putting radioactive markers on the molecules and then tracing what happens in the body, but for all 64 components that would be an astronomical cost," says Tim.

"However, there is one major component – totarol – and we have data from one study showing that the molecule was excreted intact."

"That's not surprising because these compounds are plant derived, the body has never seen them before, so why would it have a metabolism ready to break them down?"

The prospects for a successful outcome are very good. Totarol has proved extremely potent against mastitis bacteria and many other pathogens, including multi-resistant "superbugs", but leaves desirable bacteria intact. Two Totarol formulations tested on yoghurt and cheese starter cultures did not inhibit their activity – reassuring from a milk residue perspective. Furthermore, the comprehensive toxicology testing done for the cosmetics industry in the EU indicates the product's safety.

» Antimicrobial resistance is putting pressure on animal health companies to adopt new antibiotics that are not used on humans. « *Doug Mende*

However, many more tests will need to be done to determine such things as the minimum effective dose, the maximum residue limits, and minimum withholding periods. Worldwide acceptance will require that all work be carried out to international Good Laboratory Practice quality standards. Consequently the cost of developing a mastitis product to the point of registration is eye-watering – around NZ$5 million more according to Tim.

"We have been trying to attract large pharmaceutical companies but they are notoriously risk averse. Even though we have started the registration process they want to see the product developed to an advanced stage, preferably fully registered, and then they will snap it up," he says.

"Unfortunately New Zealand's institutional investors are risk averse too. We are in the best place for developing and testing a mastitis product but probably the worst for raising the capital."

Although the mastitis project is their major preoccupation at present the company is planning other animal health

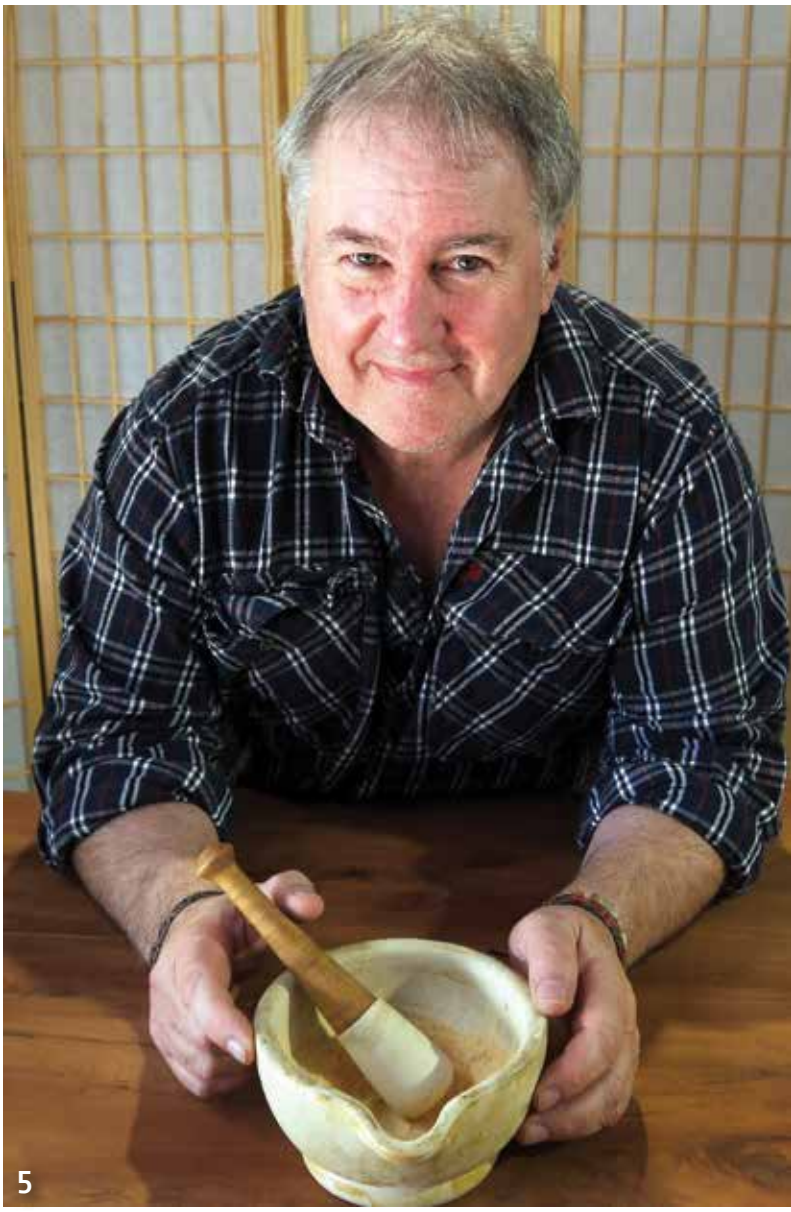
applications for Totarol including dry cow therapy, teat sprays and treatment of endometritis in cattle and pyoderma in dogs.

Doug Mende, who has now been working in this field for 20 years, continues to think long term and sees the outlook for Totarol being very positive.

"Antimicrobial resistance is putting pressure on animal health companies to adopt new antibiotics that are not used on humans. However, we now have large amounts of data showing that Totarol is particularly effective against some of the nastiest resistant superbugs, so there appear to be applications for human health as well." he says.

"For now we are focused on registration for mastitis, which will make Totarol the first natural antimicrobial product available as a prescription medicine and a create new antibacterial class for veterinary use."

"From a Kiwi point of view it is a very good story – home grown research that has resulted in a novel process to turn indigenous, sustainably sourced organic plant material into a potent antimicrobial and antioxidant product with many possible applications." ■



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3 A liquid formulation from Totarol powder for testing on mastitis bacteria.
4 Mastitis prevention and treatment is estimated to cost the NZ dairy industry around $200 million annually in direct costs and lost production.
5 Doug Mende leaning on a tōtara heartwood slab with a bowl of yellow Totarol powder
6 Totarol is obtained from finely chipped tōtara using supercritical fluid extraction with high pressure CO_2. The chip residue is used as mulch in plant nurseries.

AGRICULTURE & RESEARCH

SHARING IS CARING

Counterintuitive as it sounds, planting deep-rooted shrubs next to dryland crops may help West African farmers boost grain yields.

And just like we learned in kindergarten, it all starts with sharing.

Soil scientist Richard Dick of the Ohio State University in the United States found that *guiera senegalensis* pulls water from 30 to 40 feet underground through its deep root system.

The shrub's stomata (pores on the leaves that transpire, or sweat, water during the day) close at night, so excess water leaks into the top few inches of the soil through shallow roots rather than into the air through the leaves.

That creates a shallow reservoir the shrub – or nearby crops – can tap the next day.

The impact can be profound.

Where Richard grew pearl millet and dense stands of Gueria side by side in drought conditions, yields jumped 900 percent and the crop was ready for harvest 15 days earlier. ■

FUN WITH PLAY-DOH

In countless homes during the holidays, children extrude miles of Play-Doh worms.

Scientists at the University of Delaware have been doing much the same thing.

Ivan Hiltpold and Greg Shriver put green Play-Doh worms with orange pins for heads to work in the name of science.

They placed their Play-Doh worms around dispensers of synthetic volatile odour cues that mimic the chemical distress signals plants emit when they are under attack.

Because Play-Doh worms preserve bird pecks, the entomologists could see that birds were more attracted to the worms near the emitters of the distress odours than to those near emitters that only contained organic solvents.

Although conventional thinking is that birds can't smell, the scientists believe they can somehow sense volatile distress signals, then fly down to investigate. ■

RICE ON THE SIDE

Rows of rice could turn out to be an effective biological treatment to reduce pesticide runoff from farm fields.

Matthew Moore, Martin Locke and Robert Callum of the United States Department of Agriculture's national sedimentation laboratory in Oxford, Mississippi, simulated rainstorms on test plots and studied runoff two years in a row.

Rice plots reduced atrazine loads in water leaving the field by an average of 85 percent compared to bare soil that cut atrazine flow by an average of 57 percent.

Rice lowered diazinon levels by an average of 86 percent and trans-permethrin by 97 percent, compared to 62 percent and 67 percent, respectively.

The researchers believe rice planted in drainage ditches could be used to help to clean water on its way to rivers and lakes, or even as constructed wetlands designed to capture and clean runoff. ■

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PRECISION PAYS

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The quinoa option

An age-old grain potentially offers Canadian spring wheat producers a profitable new crop opportunity.

By Lorne McClinton

Eating quinoa (pronounced keen-wah) might be good for your health, but Wayne Groot can testify that it's been great for his bank account. The ancient South American grain has become wildly popular with health-conscious consumers because it contains high levels of protein and fibre, and is gluten-free.

Wayne, a Canadian seed potato, grains, and oilseed grower in Sturgeon County, Alberta, first grew 50 acres of the crop under contract with Northern Quinoa Production Corporation (NorQuin) as an experiment in 2016. He had been told to expect yields between 800 and 1,500 pounds per acre, so he was thrilled when he grew a 2,000-pound crop. The return outpaced all his crops but the seed potatoes.

Despite all its publicity, quinoa is still a small market crop. Global production was still under 200,000 tonnes in 2014. The vast majority is grown in Peru, Bolivia, and Ecuador.

"There is a lot of potential to make money by growing this crop, but there's a lot of risk too," says Derek Flad, NorQuin's breeding research manager.

"When larger growers tell us they want to grow 500 acres or none, we caution them to start with just 50 acres until they get a handle on it. The last thing we want to happen is for a grower to lose his shirt on it."

"We jumped up to 75 acres in 2017," Wayne says. "We hoped to grow a morer in 2018, but were only able to get a contract for 75 acres again."

That turned out to be a good thing, he says. His 2018 yields were disappointing due to a drought.

SENSITIVE CROP

"Others have had zero yields due to insect pressure, too," Derek cautions. "It's a very environmentally sensitive crop. We tell producers to pencil in a 1,000-pound crop for their first year, and hopefully they will do better in subsequent years."

NorQuin, which contracted 35,000 acres in 2017, is by far the largest quinoa production company in Canada. Derek says almost all Canadian production is currently grown on the Prairies. The company has contracted production stretching from the Red River Valley in Manitoba to Northern Alberta.

» It's a fairly high-priced commodity, so we find it beneficial to leave a bit more chaff in than risk throwing any out the back end. « *Wayne Groot*

Other companies have a small acreage in central Canada too. NorQuin only offers total production quinoa contracts. Based in Saskatoon, Saskatchewan, NorQuin supplies every seed and buys back the entire production in the months following harvest.

Wayne planted a golden quinoa variety from NorQuin in 2016 and 2017 but switched to their new composite rainbow blend in 2018. It doesn't take any special equipment to grow.

The seed is similar in size to canola, so he plants it with his air-drill. While the crop can be grown just about anywhere spring wheat and barley can, it's considerably riskier than these stalwarts, Derek says.

The biggest problem is there are no registered herbicide, fungicide, or insecticide options for quinoa production in Canada. So, it can only be grown on the cleanest of fields possible. "We have fairly clean fields thanks to our potato production," Wayne says. "Our biggest weed problems are volunteer crops. We are finding we have to be more aware of insects though."

It is a very tall crop and has similar fertiliser requirements to canola. The crop typically requires between 110 and 120 days to mature, so growers should expect it to be among the last to be harvested. "It's fairly easy to harvest," Wayne says. "We set the front end of the combine the way we would for wheat and the back end for canola and fine-tune from there. It's a fairly high-priced commodity (65 cents a pound in 2018) so we find it beneficial to leave a bit more chaff in than risk throwing any out the back end."

INSECT PESTS

Quinoa is susceptible to common insect pests like cutworms, wireworms, and bertha army worms, Derek says. But it can be devastated by the quinoa stem borer and the goosefoot groundling moth, species that dine on lambsquarters.

"Quinoa is first cousin to the common weed lambsquarters and is affected by the same insects," Derek says. "You can pull up a lambsquarters anywhere on the Prairies and find evidence of stem borer damage. We're currently trying to get minor use registration for products to control them and working with Agriculture Canada entomologists to develop Integrated Pest Management protocols to manage them."

The crop is also so new that it isn't covered by crop insurance programs yet. So, if you want to grow the crop you have to be willing to self-insure. "It's not as easy to grow as wheat or canola," Wayne says. "But I like the challenge; it keeps things interesting." ■

1 Wayne Groot has done very well with quinoa most years.
2 There are no herbicides, fungicides, or insecticides registered for quinoa.
3 The grain is very popular thanks to its high protein and fibre levels.


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You wake up every morning thinking about your bottom line.
So do we.
As dawn breaks, you're ready to grow your operation.
So are we. We work to know you — to understand what you face in the field, and to help you get the most out of what you put in. Along the way, you can count on us for flexible financing — to structure payments and provide terms that fit you, and your business.
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