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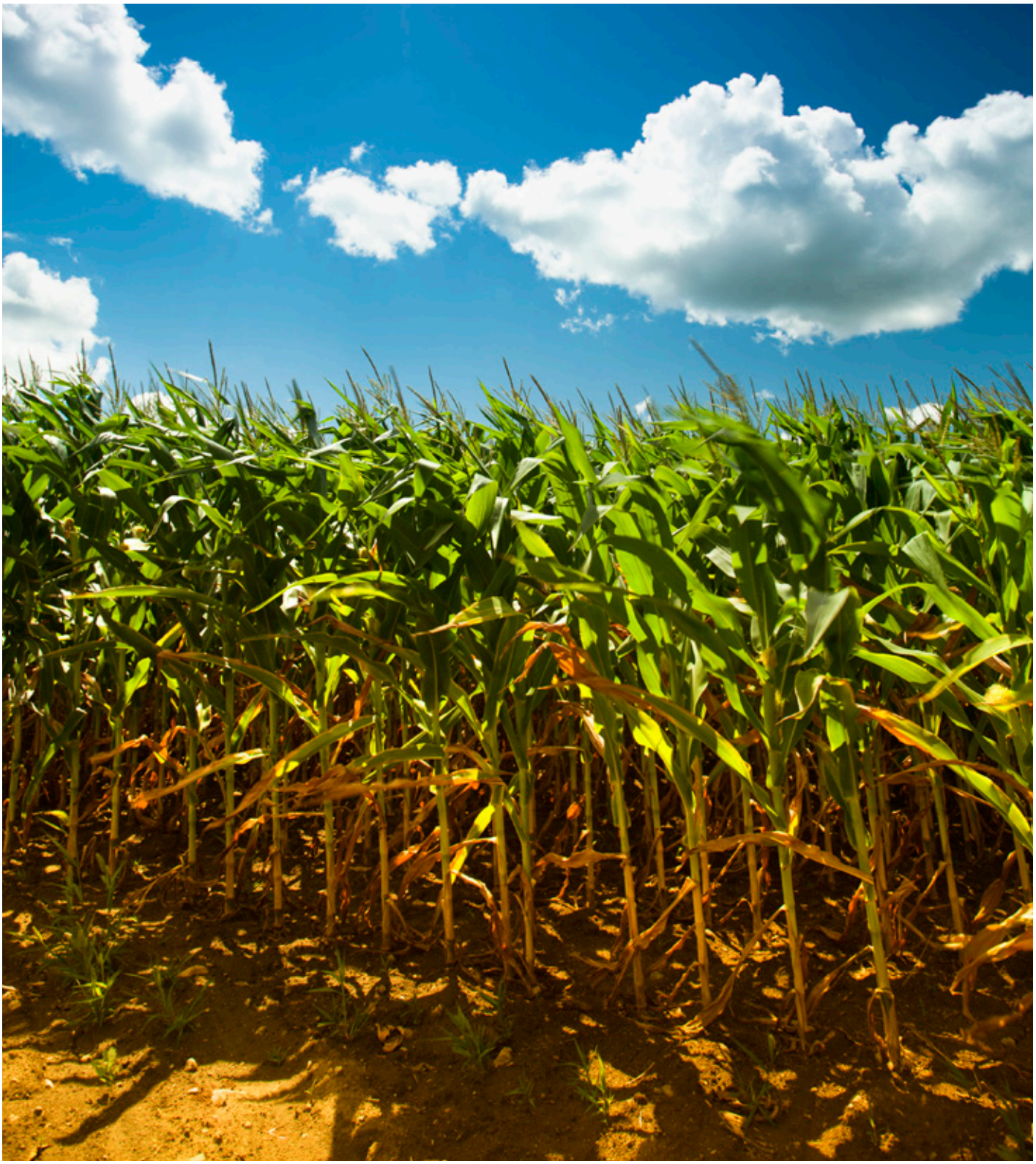
THE AUSTRALIAN AGRONOMIST MAGAZINE

Robotic weeders: Coming to a farm near you?

Wheat disease breakthrough to help feed the world

Ten tactics for success with early-sown canola



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WHEAT DISEASE BREAKTHROUGH TO HELP FEED THE WORLD

IN RECENT YEARS THE RE-EMERGENCE OF A DISEASE THAT CAN KILL WHEAT, WHICH PROVIDES A FIFTH OF HUMANITY'S FOOD, HAS THREATENED THE WORLD'S FOOD SECURITY.

Now, a breakthrough has recently been announced in two companion papers being published in the prestigious journal Science.

Wheat already provides about 20% of humanity's food, and with demand set to skyrocket, it is timely that a collaboration that includes the University of Sydney, the CSIRO, Rothamsted Research in the United Kingdom and the University of Minnesota and USDA in the United States, has seen scientists isolate the very first rust pathogen gene that wheat plants detect to 'switch on' resistance.

In a world first, science has leaped a step ahead of an old foe that has recently re-emerged in some parts of the world, where it has devastated crops because of its ability to evolve, undoing much of the hard work that began in earnest with the Green Revolution – using natural techniques to isolate the first rust pathogen gene that wheat plants detect and use to 'switch on' in-built resistance.

The breakthrough in research targeting the stem rust foe, historically the most dangerous pathogen of wheat, will mean suspect samples could be analysed within hours in an emergency rather than weeks, potentially saving crops from being destroyed.

"For the first time it will be possible to do DNA testing to identify whether a rust in a wheat crop anywhere in the world can overcome a rust-resistance gene, called Sr50, which is being introduced in high-yielding wheat varieties," said Professor Robert Park, corresponding author from the University of Sydney.

"This will indicate whether or not a given wheat crop needs to be sprayed with expensive fungicide quickly to protect against rust, which would otherwise devastate the crop in a matter of weeks," Robert added.

Rust disease epidemics have emerged at times in tandem with carefully refined selective breeding in cereals. The disease is once again extremely damaging in East Africa and is making a comeback in Europe.

The new findings were recently published in one of the world's leading journals, Science.

Mr Jiapeng Chen, a PhD candidate from the University of Sydney who initiated the work by sequencing and analysing the genome of a virulent rust isolate, said this was the first important step in addressing the diagnostic challenges posed by ever-changing fungi, which result in new rust pathogen strains.

Robert explained, "It's like an ongoing arms race. We've got to keep one step ahead of this changing pathogen. The last major epidemic of wheat stem rust in Australia alone, in 1973, caused $AU300 million in damage. Imagine what that would be today."

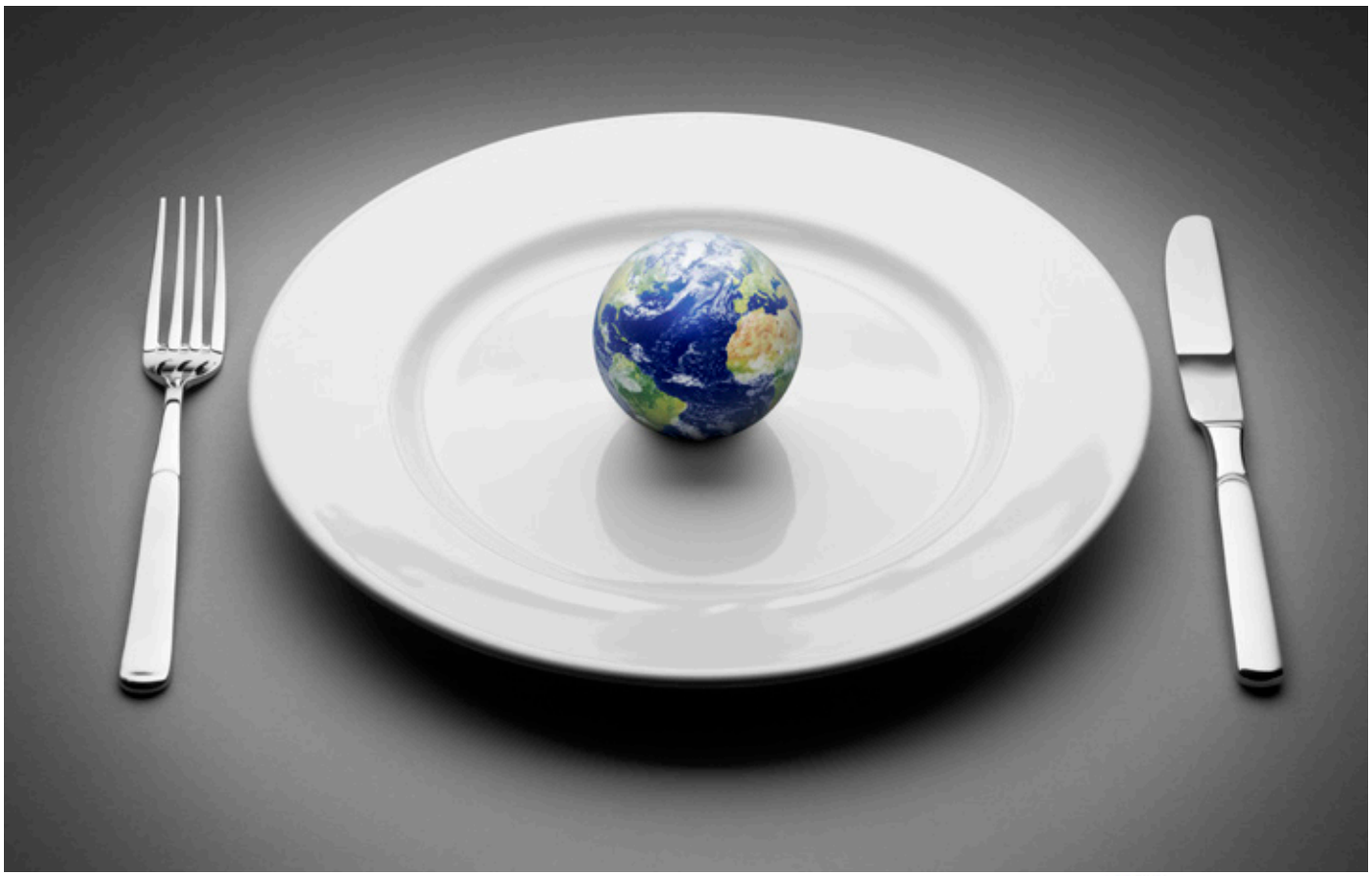
Co-corresponding author, Dr Peter Dodds from the CSIRO's Agriculture and Food team, said demand for wheat in the developing world was expected to jump 60 percent by 2050, and in economic terms alone the ramifications were huge.

"Now that we've identified how stem rust strains are able to overcome Sr50 resistance, by mutation of a gene we've identified called AvrSr50, this information can be used to help prioritise resistance genes for deployment," explained Peter.

"Our results so far show the plant immune system is able to directly recognise the fungal protein. We are gaining a better understanding of the whole process, what's going on at the protein level, at the gene level," he added.

Co-author Dr Kostya Kanyuka from Rothamsted Research, an agricultural science centre in the United Kingdom, said stem rust had been making a comeback in Europe, for example in Sweden as recently as this year, and was threatening Asia and the United States.

"The highly virulent Ug99 race of the stem rust fungus, which emerged in 1998 in Uganda, has become even more potent as it has spread through Africa and the Middle East, with winds threatening to carry it into Asia," Kostya said.



“This will indicate whether or not a given wheat crop needs to be sprayed with expensive fungicide quickly to protect against rust, which would otherwise devastate the crop in a matter of weeks.”

Robert Park

American collaborators Professor Melania Figueroa, Professor Brian Steffenson and Dr Yue Jin were able to extend the results of the study by examining strains of the stem rust pathogen from other parts of the world, including the USA and Africa.

“It is important to look at this gene in worldwide rust strains to gain a picture of where virulence is most likely to evolve,” Melania said.

Robert, who is from the Plant Breeding Institute, part of the University’s Sydney Institute of Agriculture and School of Life and Environmental Sciences, said the results should also lead to a better understanding of how rust pathogens infect wheat, evading detection by the wheat plant, and causing yield losses.

“In addition to the immediate practical benefit regarding the important rust-resistance gene Sr50, our world-first finding could potentially have a longer-term payoff in the 10-15-year horizon,” he concluded.

SPACE AGE PLANT BREEDING LIGHTS THE WAY FOR FUTURE CROPS

NASA experiments to grow wheat in space were the inspiration for University of Queensland (UQ) scientists to develop the world's first 'speed breeding' procedures here on planet Earth.

UQ Queensland Alliance for Agriculture and Food Innovation (QAAFI) Senior Research Fellow Dr Lee Hickey said the NASA experiments involved using continuous light on wheat which triggered early reproduction in the plants.

"We thought we could use the NASA idea to grow plants quickly back on Earth, and in turn, accelerate the genetic gain in our plant breeding programs," Lee said.

Lee was part of the team from the UQ School of Agriculture that began trialling speed breeding techniques to cut the length of plant breeding cycles more than 10 years ago.

"By using speed breeding techniques in specially modified glasshouses we can grow six generations of wheat, chickpea and barley plants, and four generations of canola plants in a single year, as opposed to two or three generations in a regular glasshouse, or a single generation in the field," Lee said.

"Our experiments showed that the quality and yield of the plants grown under controlled climate and extended daylight conditions was as good, or sometimes better, than those grown in regular glasshouses," he added.

Lee said information on how to use speed breeding was increasingly in demand from other researchers and industry.

"There has been a lot of interest globally in this technique due to the fact that the world has to produce 60-80 per cent more food by 2050 to feed its nine billion people," Lee said.

The speed breeding technique has largely been used for research purposes but is now being adopted by industry.

UQ scientists, in partnership with Dow AgroSciences, have used the technique to develop the new 'DS Faraday' wheat variety due for release to industry in 2018.

"DS Faraday is a high protein, milling wheat with tolerance to pre-harvest sprouting," Lee said.

"We introduced genes for grain dormancy so it can better handle wet weather at harvest time, which has been a problem wheat scientists in Australia have been trying to solve for 40 years," Lee said.

"We've finally had a breakthrough in grain dormancy, and speed breeding really helped us to do it," he added.

Lee said the level of interest in speed breeding led to his collaborators at the John Innes Centre and the University of Sydney to write the Nature Plants paper, which outlines all the protocols involved in establishing speed breeding systems and adaptation of regular glasshouse facilities.

UQ PhD student Amy Watson was a co-first author of the paper and conducted some of the key experiments that documented the rapid plant growth and flexibility of the system for multiple crop species.

Lee believes the sky is the limit for the new technology and he is now investigating the integration of speed breeding with other modern crop breeding technologies.

"It could also have some great applications in future vertical farming systems, and some horticultural crops," Lee said in conclusion.

Speed breeding wheat under lights: Dr Lee Hickey inspecting the wheat in the UQ glasshouse.

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NEW MAPS ENRICH LUPIN BREEDING TECHNOLOGIES

Advances in the performance of future lupin varieties are set to take a significant leap forward, with the development of two new molecular maps to aid plant breeding.

The Department of Primary Industries and Regional Development has updated the ultra-high density consensus genetic map, in addition to developing a physical map for narrow-leafed lupins.

The department's research and collaborations, with the support of the Grains Research and Development Corporation, have established Australia as a world leader in lupin molecular genetics.

Department senior research officer Dr Huaan Yang said the two maps would provide plant breeders with greater confidence in the accuracy of the data used to produce new high-performance lupins, tailored to the environment.

"The dense, high quality data in the genetic and physical lupin maps provides the fundamental building blocks from which to develop new higher yielding varieties with greater resistance to pests and diseases," Huaan said.

"This new genetic data will boost future lupin breeding technology, delivering a resource to integrate genomic selection into lupin breeding that is on-par with breeding approaches in other mainstream international food crops," he added.

The latest developments build on an initial draft lupin genome sequence published in 2013 and the comparative genomes of another 18 lupin lines that were re-sequenced in 2015.

The updated ultra-high density consensus genetic map incorporated the department's previous work, as well as research by the University of Western Australia, the CSIRO and from Poland.

Huaan said the ultra-high density genetic map was far more detailed than previous versions, providing plant breeders with greatly enhanced tools to work with genes of breeding interest.

"We have discovered 19,000 new molecular markers across the lupin genome, which, when integrated with data from previous maps, has enabled us to establish a more dense and complex genetic map for lupins, comprising more than 34,500 markers," Huaan said.

"The quality of this map is particularly high, as the DNA sequence for each of those markers has been located on the genome sequence assembly – physically within the chromosomes," he went on to add.

Department researchers, working with scientists at Murdoch University and the Beijing Genome Institute, used the ultra-high genetic map to update the physical map of lupins.

"While the genetic map provides 'signposts' to the molecular markers and the approximate distances between genetic traits, the physical map goes to the next level to provide the actual distance along the DNA sequence for each chromosome," Huaan said.

"The new maps will enable plant breeders to use molecular marker technology to pinpoint the genes that determine key traits with greater applicability and precision – enhancing the potential development of new varieties," he said in conclusion.

LENTILS STILL A GOOD CHOICE FOR GROWERS

Lentils are still a good option for Western Australian growers to consider in future cropping programs on medium to heavy textured soils, with 2017 trials producing seed yields of 1.5t/ha or above.

The Department of Primary Industries and Regional Development trials in Western Australia, with Grains Research and Development Corporation (GRDC) investment, concluded that sowing lentils to achieve 100 to 110 plants per square metre in mid-April resulted in profitable yields.

Department senior research officer Mark Seymour, who will be speaking on legume trial results at the 2018 GRDC Grains Research Updates in February, said ideal seeding rates were 45kg/ha for small seed types such as PBA Hurricane XT , 50kg/ha for medium sized varieties including PBA Bolt and 60kg/ha for PBA Jumbo2 .

Research trials were sown at Dongara, Wittenoom Hills, Kumarl north of Salmon Gums, Grass Patch and Gnowangerup in April and May.

Mark said when comparing all Pulse Breeding Australia (PBA) variety performance, PBA Bolt was a consistent performer across all trial sites.

"PBA Bolt is the most popular lentil variety grown in Western Australia, with alternative options of PBA Hurricane XT and PBA Jumbo2 ," he said.

"The Grass Patch trial sown in mid-April was the highest yielding trial for PBA Bolt at 2.3t/ha, followed by 1.9t/ha at Wittenoom Hills," Mark added.

Mark said in the trials located in areas of southern WA, PBA Hurricane XT was noticeably slower growing than PBA Bolt, and yield was equal to or lower than PBA Bolt.

"PBA Hurricane XT is the best available option if growers are concerned about sulfonylurea residues, or they are planning to use imazethapyr in-crop for increased weed control," he said.

"PBA Jumbo2 has the best disease resistance of the varieties making it of particular interest to southern growers. PBA Jumbo2 produced similar yields to PBA Bolt, however, emergence was uneven, particularly on sodic soil sites. The increased disease resistance may outweigh any variable growth concerns," Mark explained.

Lower yields across all varieties were observed at Kumarl due to frost and at Dongara and Gnowangerup as a result of delayed sowing and emergence.

COASTAL MACADAMIA EXPANDING IN NORTHERN NSW

Macadamia production in the New South Wales Northern Rivers region has expanded by around 25 per cent with new macadamia enterprises developed on floodplains.

NSW Department of Primary Industries (DPI) macadamia development officer Jeremy Bright said approximately 2500 hectares of land on the coastal floodplain has, or is in the process of, being set up for planting macadamia.

"This expansion follows a workshop facilitated by NSW DPI 12 months ago on growing macadamia on the floodplain region of northern New South Wales," Jeremy said.

"The participants involved have been holding monthly planning meetings, facilitated by industry and NSW DPI, relating to the complex of issues encountered when developing sensitive areas. The objective of the workshop and planning has been to give potential and new growers from the Clarence, Richmond or Tweed coastal areas a better understanding of what is involved in developing into productive and successful macadamia farms," Jeremy went on to explain.

"Key to the success of developing this land is the involvement and communication with the relevant shire councils and NSW DPI Fisheries and Department of Industry – Water. Each workshop has been developed as a step-by-step guide to the development of a floodplain macadamia enterprise. In particular, how to work successfully within acid sulphate soil boundaries, grower responsibilities, drainage management, and other best practice techniques," he added.

Over the past year the group has investigated the following topics:

- Selecting suitable land
- Drainage management plans, development applications, using Integrated Orchard Management (IOM) principles and LiDAR mapping
- Orchard design and getting the soils right prior to planting eg. pH, CEC, organic carbon etc
- Working with acid sulphate soils (ASS) and your responsibilities
- Selecting varieties suited to coastal land
- Inter-row and within row spacings
- Young tree management and support options for wind

Although the three catchments have further potential for macadamia production, potential growers should be aware that not all floodplain land is suitable for macadamia production.

2018 OAT VARIETY GUIDE FOR WA NOW AVAILABLE ONLINE

Growers considering sowing milling oats or export hay this year can find all the latest performance data in a recently released variety guide published on-line.

The 2018 Oats Variety Sowing Guide for Western Australia has been produced by the Department of Primary Industries and Regional Development, with support from the Grains Research and Development Corporation (GRDC).

It draws on results from the National Oat Breeding program, the department's agronomy trials from across the grain belt, the GRDC's National Variety Trials, and information from commercial breeders and agronomists.

Department research officer Georgie Troup said the guide was designed to help growers determine which milling oat or export hay variety to grow in their region.

"Each variety has its own strengths, weaknesses and characteristics that determine their suitability for different locations," Georgie said.

"The Oat Variety Guide provides growers with a comparison of grain yield, grain quality, hay yield, hay quality, herbicide tolerance and disease resistance for new and established milling oat and hay varieties. The guide also provides agronomic information for oat varieties that offer growers the best opportunity to meet market requirements," she went on to explain.

The updated variety guide also introduces information on new oat variety, Kowari, which was launched nationally in September 2017.

Kowari is a cross between Mitika and a Western Australian breeding line developed as a Mitika replacement, particularly in South Australia. It was included in the department's oat agronomy trials in 2017 to examine its potential application in Western Australia. Agronomy research results on performance will be available early in 2018.

Kowari will undergo commercial milling evaluation prior to sowing this season and, if endorsed by industry, may be added to the list of varieties accepted for delivery into milling grades OAT1 and OAT2 in 2018/19.

The 2018 Oat Variety Sowing Guide should be read in conjunction with industry information provided in the Grains Industry of Western Australia's (GIWA) Oat Variety and Grade Update available on the GIWA website.

Georgie encouraged growers to refer to the guide when developing their 2018 oat sowing program.

WILD BEES WORTH $22 MILLION TO AUSTRALIA'S LUCERNE CROP

University of Adelaide researchers have calculated that wild bees and other unmanaged insect pollinators contribute, on average, $22 million to the production of dryland seed lucerne annually.

They are now working to 'future proof' these free crop pollination services to help build wild bee and other desirable insect populations.

"Australia's lucerne seed industry is worth about $95 million with as much as 30-40% grown under dryland conditions, although that can drop to 5-10% in very dry years," says project co-leader Dr Katja Hogendoorn, in the University's School of Agriculture, Food and Wine.

"Lucerne seed production depends 100% on insect pollination, but in 2014, Lucerne Australia identified that 66% of dryland lucerne growers did not place hives in their lucerne. That means wild bees and other 'free' insect pollinators are contributing an average annual value of $22 million, possibly as high as $25 million, to lucerne seed production. That is a highly valuable resource that we need to nurture and promote," Katya explained.

The researchers are now investigating what actions growers can undertake to help build secure populations of wild bees and other pollinating insects. About 83% of seed lucerne is grown in South Australia's south east, with the rest in Victoria and New South Wales.

"We will be identifying the wild pollinators, finding out what other food resources can support their presence near lucerne paddocks; and investigating their activity pattern to establish when they need these resources, where they nest, and what they use to build their nests," says project co-leader Professor Andy Lowe, Director of Food Innovation at the University of Adelaide.

"This will enable us to produce guidelines and a web-based planning tool for growers to design plantings of Australian native plants around their crop that provide healthy food and shelter for these wild pollinators," Andy added.

This project is of particular importance because insect pollinators are in decline worldwide, because of pesticide use and habitat destruction.

The creation of habitat for crop pollinators is part of future-proofing pollination services in preparation for a likely Varroa mite incursion, which has decimated populations of feral honey bees worldwide.

STINGLESS BEES LATEST WEAPON IN ARSENAL TO PROTECT AUSSIE CROPS

Researchers are boosting their understanding of native stingless bees as pollinators in a $10M effort to help safeguard Australia's fruit, nut, vegetable and cut flower supply into the future.

Hort Innovation and Western Sydney University (WSU) recently launched a project to investigate stingless bees to ease Australia's dependency on the European Honeybee, a pollinator that is vulnerable to threats, particularly Varroa Mite. While the mite has not yet taken hold in Australia, if it does, scientists expect it may cause the collapse of local honeybee populations.

Hort Innovation R&D general manager David Moore said there is strong industry support behind the initiative, which was made possible through vegetable industry levy funds, funds from the Australian Government, and co-investment from Western Sydney University.

"As an industry, horticulture is keenly aware that it needs to safeguard against any threats to the nation's food crops and ensure the sustainability of Australian farms," David said.

"To help do this, we need to consider alternative pollinators, investigate their performance in different crops, and find better ways to propagate and deploy them," he added.

David said the leading candidates to ease the nation's reliance on European Honeybees are stingless bees, which are easier to manage in that they do not sting, live in large colonies (like honeybees), pollinate a wide variety of plants, and can be kept in managed hives.

Lead researcher at Western Sydney University's Hawkesbury Institute for the Environment, Professor James Cook said there are a growing number of stingless beekeepers, and stingless bees are already used in macadamia farms, where they outperform honeybees.

"This research has the potential to change the way we view pollination in Australia. It is already clear managed stingless bees may have wide but underdeveloped potential for crop pollination," he said.

"Stingless bees are also used in crop pollination in several Asian countries, such as India and Thailand, and there is good scope to exchange knowledge and expertise on bee biology, husbandry and deployment in horticulture," James added.

James said the project would comprise experimental studies on a range of fruit and vegetable crops (both tropical and temperate), testing first if the bees visit the flowers and transport the crop pollen.

"Investigating the effectiveness of stingless bee pollination and its impact on crop set, yield and quality will be the next steps. For the most promising crop and bee combinations, we will then conduct more detailed studies to determine best ways to deploy managed hives within the target crop," he explained.

Researchers will also study the potential of stingless bees to be effective managed pollinators in glasshouse conditions, utilising the newly launched National Vegetable Protected Cropping Centre located at WSU.

Vegetable grower Ed Fagan, who also travelled to India on the study tour, said the importance of pollination could not be overstated.

"Seeing what has happened in India, and seeing some of the data on what happens if your pollination isn't one hundred percent right made me realise how important pollination is. We should not be complacent," Ed said.

The Pollination Fund program is supported by the Hort Frontiers initiative, a new investment model created by Hort Innovation to address critical issues facing the future of Australian horticulture.

RYEGRASS WEED CONTROL BENEFITS PROVEN FOLLOWING FIELD RESEARCH

The most recent product offering from this research program designed to improve crop establishment, early vigour and nutrient uptake SE14 was launched in Australia in 2016. This launch followed an extensive development program to produce a product which is not only compatible but also synergistic with a host of other down the tube seeding liquids including UAN, trace elements, in-furrow fungicides and other crop protection products.

SE14 is an in-furrow moisture retention product designed to increase soil moisture holding capacity around the root zone, reducing plant stress under dry conditions and keeping nutrients and crop protection products solubilised and available for plant uptake

Recommendations of soil moisture products in combination with relatively insoluble pre-emergent herbicides such as prosulfocarb have been made in Europe for a number of years. However, there has been little work done in Australia were lower herbicide usage rates, lower rainfall and lighter soils – result in difficult conditions to get moisture activated pre-emergent herbicides working. The potential for SE14 to improve pre-emergent herbicide activation and resulting weed control was first observed by SACOA in early stage grower demonstration trials in 2015.

Throughout the winters of 2016 and 2017 – SACOA, in collaboration with ADAMA, investigated whether SE14, by changing the soil moisture profile, could not only increase crop plant stand and early vigour, but also improve weed control resulting from a range of commonly used pre-emergent herbicides, including Countdown in cereals and the soon to be released grain legume and canola pre-emergent herbicide C4 from ADAMA.

A number of grower sown and small plot replicated cereal and canola trials were established looking at the interaction of pre-emergent herbicides, boomspray applied at the IBS timing, including Countdown, Sakura, Boxer Gold, Trifluralin & mixtures in cereals and C4, Trifluralin, Butisan, Altiplano and Propyzamide in canola. Seeding treatments were the grower standards of UAN, TE and fungicide rates with and without SE14 3.0L/Ha, liquid injected into the seeding furrow.

Results from these trials over two very different seasons in 2016 and 17, were impressive and indicate the potential for SE14 to assist in the management of difficult weed populations. Crop stand increases in the SE14 treatments of up to 35% over the standard seeding treatment were observed in addition to an early safening effect with some herbicides.

Ryegrass control was increased by up to 40% with some actives, in the SE14 seeding treatments, averaging 30% improvement across all the herbicides tested, versus the standard seeding treatment. Largest increases in ryegrass control were observed with relatively insoluble herbicides such as Trifluralin (44% increase) & Countdown (30% increase) and Trifluralin + Countdown mixtures (40% increase).

Results from this research have been published and presented at the recent GRDC Crop Updates. More work to validate these weed control benefits, evaluate a larger range of herbicides and progress the SACOA pipeline of soil amelioration and seedling establishment products is

ROBOTIC WEEDERS: COMING TO A FARM NEAR YOU?

The future of weeding is here, and it comes in the form of a robot.

The growing popularity of robotic weeders for specialty crops has grown partly out of necessity, said Steven Fennimore, an extension specialist at the University of California, Davis.

Steven defines specialty crops as vegetables like lettuce, broccoli, tomatoes, and onions. They are not mass-produced like corn, canola and wheat.

The need for robotic weeders stems from two issues. One is a lack of herbicides available for use in specialty crops. Another is the fact that hand-weeding has become more and more expensive. Without pesticides, growers have had to hire people to hand-weed vast paddocks. Hand-weeding is slow and increasingly expensive: it can cost US$150-$300 per acre. That motivates some growers to look to robotic weeders.

"I've been working with robotic weeders for about 10 years now, and the technology is really just starting to come into commercial use. It's really an economic incentive to consider them," Steven said.

Steven works with university scientists and companies to engineer and test the weeders. The weeders utilise tiny blades that pop in and out to uproot weeds without damaging crops. He said that although the technology isn't perfect, it's getting better and better.

The weeders are programmed to recognise a pattern and can tell the difference between a plant and the soil. However, they currently have trouble telling the difference between a weed and a crop.

That said, Fennimore explained how some companies are training the machines to tell a lettuce plant from a weed. He's also working with university engineers on a system to tag the crop plant so the weeders will avoid it.

"The problem with the machines right now is that they are version 1.0, and there's tremendous room for improvement. The inability to be able to tell the difference between a weed and a crop requires the grower to be very exact when using them. The rows have to be a little straighter, cleaner, and more consistent because the machines aren't that sophisticated yet. The robots don't like surprises," he explained.

The robotic weeders currently on the market cost between US$120,000 and US$175,000. For some California growers, it is a better long-term option than expensive hand-weeding. Others think it's a lot of money for a new technology, and are waiting for it to get better and cheaper.

Steven believes robotic weeders are the future of weeding in specialty crops. Because of higher labor costs and more incentives to grow organically with fewer pesticides, European growers have been using robotic weeders for some time.

He is focusing his work on physical control of weeds because it offers the best option. He's also started working in crops besides lettuce, such as tomatoes and onions. He adds that each crop will require a different system.

"I believe what makes the robotic weeders better than herbicides is that this electronic-based technology is very flexible and can be updated easily. We all update our phones and computers constantly, which is a sign of a robust and flexible technology," he concluded.

BEST MANAGEMENT PRACTICES IMPROVE PROFITABILITY FOR BANANA FARMS

New research from the Department of Agriculture and Fisheries (DAF) in Queensland shows that banana farmers adopting best management practices can improve their profitability, whilst reducing sediment and nutrient in run off from their farms to help the Great Barrier Reef.

DAF agricultural economics manager, Mark Poggio, said a recent study examined the costs and benefits of banana farmers adopting the best management practices (BMP) advocated by the industry's Banana BMP Program.

"The study investigated a range of management practice changes, including nutrient management, irrigation, tillage and fallow management," Mark said.

"In the case of nutrient management, it was found that by targeting fertiliser application more carefully, farmers can improve nitrogen use efficiency and increase their profitability in the process," he explained.

He added that "Water quality modelling results found that implementing best practice nutrient management was the single most important driver of dissolved inorganic nitrogen abatement on farms."

Mr Poggio explained that the findings are based on a range of modelled scenarios developed in consultation with industry.

"The scenarios represented typical banana growing farms in the Tully and Innisfail regions, with variation in farm sizes, soil types and slopes," he said in conclusion.

CAN THE GRAINS INDUSTRY BE REVOLUTIONISED WITH ROBOTICS?

A leading robotics researcher has highlighted the enormous potential for current robotic technologies to revolutionise grain farming productivity by reducing input costs and aiding decision making.

Mark Calleija from the Australian Centre for Field Robotics (ACFR) was a keynote speaker at a recent Grains Research and Development Corporation (GRDC) Grains Research Update in Wagga Wagga.

He shared some of the cutting edge technologies ACFR is developing in the space of the vegetable, tree crop and livestock industries and explained how these tools could be adapted for grains.

The ACFR is one of the largest field institutes in the world and develops innovative robotics and intelligent software for agricultural and environmental applications.

Mark said the ACFR's experience in many aspects of agriculture has the potential to be adapted to the grains industry.

"Our systems are used to reduce farm input costs such as labour and fertiliser, and aid decision making that enables farmers to increase productivity," he said.

"While we are yet to develop a prototype that is grains industry specific, the ground work has been done and it is unlikely to take a lot of redesign to create a robot with a grains application, such as tweaking the target weeds. There is enormous potential in the tools already available in the prototypes we have developed for other crop types, with functions such as automated crop mapping, weed and pest control," Mark explained.

The 'Ladybird' and 'RIPPA' prototype robots collect data for use in vegetable crop mapping, estimation of crop quality metrics, yield estimation and predicted optimum harvest time.

"Ladybird has numerous sensing systems, including hyperspectral, thermal infrared, panoramic vision, stereo vision with strobe, LIDAR and global positioning. These sensors allow many aspects of the crop to be measured and assessed," Mark said.

"Using RIPPA, farm input costs such as labour and fertiliser can be reduced through crop interaction mechanisms. Systems have been developed for autonomous real time weeding and spraying of weeds, crops or pests. It has the ability to use camera imagery and deep learning detection algorithms to identify weeds and use a steel tine to disrupt the weeds, amongst many other functions," he explained.

"Decision making tools that can be developed using the data that RIPPA collects could be used to increase the marketable yield of crops," Mark added.

In the grazing industry, the 'SwagBot' concept was developed as a multi-purpose robot capable of a range of farm surveillance and physical tasks.

"SwagBot is an all-terrain cattle farming robot and we have successfully demonstrated its ability to navigate farm obstacles such as hilly terrain, water, mud and branches," Mark said.

"It can autonomously navigate predefined farm routes, detect and spray weeds and collect soil samples at predefined locations. Soil samples collected by SwagBot could be sent away to a laboratory for analysis or analysed in-situ to build soil fertility maps for improved pastures," he went on to add.

"Spot spraying of weeds is a particularly labour-intensive task that is a high priority candidate for automation, based on feedback from livestock producers," Mark said in conclusion.

NEW CLOUD-BASED NUTRITIONAL DATA SERVICE EMPOWERS GROWERS AND AG SERVICE PROVIDERS

A cloud-based nutrition data management and imagery service launched late last year, will shortly be empowering growers and ag service providers to see exactly where nutritional inputs are required by identifying areas of variability, supporting targeted sampling, and tracking trends month on month and year on year.

AgTech start-up Decipher is moving ahead in leaps and bounds, with the release of its Decipher Plus and Decipher Pro packages to address real time nutrition issues and boost productivity.

Decipher business manager Wayne Hiller said the cutting edge imagery processing power of the Google Earth Engine processes mass amounts of imagery data in seconds, providing a quick, easy way to hone in on nutritional requirements and inform crop nutrition decisions.

“It can identify issues before you can see them with the naked eye when walking through the paddock, and allows growers to compare trends over time,” Wayne said.

“For instance, a grower may have been using the same units of phosphorous over a number of years, during that time achieving or exceeding yield targets, and thinking everything is okay. But, if he or she can see variability occurring in plant growth over that period, that grower is more likely to take soil samples to investigate what is happening and actively review the nutrient strategy with their agronomist,” he explained.

To get an idea of Decipher’s functionality, a free version is available at decipher.com.au. There’s also a companion mobile application, DecipherGO, for in-paddock activities.

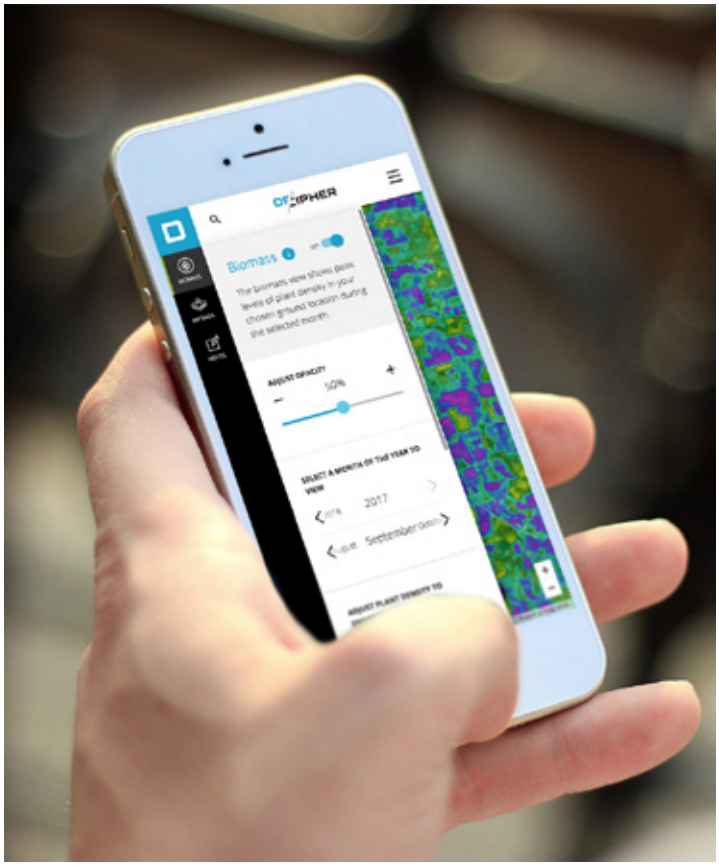
Decipher Plus builds on the entry-level functions providing a much more customised service, including the ability for growers to invite advisors to collaborate and help with decision-making.

“To start, you can set up your farm boundaries by uploading existing maps, or drawing them yourself. This, along with historical 30 metre imagery and 10-metre-high definition imagery, lets growers see what’s happening specific to those areas,” Wayne said.

“Growers can then start to investigate areas of interest by planning sampling and observation jobs. By using the app, they can geo-locate sample and observation sites and apply a barcode for ease of identification at CSBP Soil and Plant Lab, a Decipher partner laboratory. This provides a seamless sampling process and allows growers and those completing sampling in field to come back to the exact area in future years for comparisons and tracking,” he went on to explain.

Wayne said Decipher Pro is aimed specifically at ag service providers, allowing them to manage the data for multiple clients.

“Advisors will be more effective in managing nutrition by having the insights and visibility needed to better service clients, helping to drive productivity improvements that will translate to improved business performance,” he concluded.



BUDGET ROADMAP CHARTS COURSE FOR $100 BILLION IN FARM PRODUCTION BY 2030

THE NATIONAL FARMERS' FEDERATION (NFF) HAS OUTLINED A LIST OF THE KEY INGREDIENTS NEEDED TO TAKE AGRICULTURE TO A $100 BILLION INDUSTRY BY 2030, IN ITS FEDERAL BUDGET ROADMAP.

The NFF's comprehensive Pre-Budget Submission continues the call for: trade liberalisation; significant investments in transport and telecommunications infrastructure; improvements to the tax system; investments to attract the right skills to regional areas; and meaningful cuts to the business compliance burden.

The peak body has also recommended funding to: unleash on-farm technology; better promote Australia's agriculture exports; and educate school students on where their food and fibre comes from.

NFF President Fiona Simson said the NFF's 'bold, but achievable' goal for agriculture to increase its production value by 67% between now and 2030, required a clear roadmap.

"Agriculture is one of Australia's fastest growing sectors. In 2016-2017, production was valued at $63 billion. To turn this into a 12 digit figure – there must be investment across the board," said Fiona.

Fiona said Australian agriculture was a vibrant, innovative and entrepreneurial sector, a significant export earner and a cornerstone of the national economy.

"Investing in agriculture benefits all Australians, in particular regional communities, and this should always be taken into account when assessing the value of measures to support agriculture. Agriculture also adds value in other industries such as manufacturing, by providing opportunities for food processing, transport, storage and logistics," she said.

"Agriculture is key to Australia's future prosperity. Our vision of a $100 billion industry is within reach if we get the economic, social and environmental policy settings right. Australia's next wave of prosperity depends on the Federal Government continuing to back Australian agriculture and our regions with sensible, evidence-based policies," Fiona went on to explain.

The NFF's Pre-Budget Submission centres on seven key themes and makes 60 detailed recommendations. A summary of these recommendations includes:

"Agriculture is one of Australia's fastest growing sectors. In 2016-2017, production was valued at $63 billion. To turn this into a 12 digit figure – there must be investment across the board."

Fiona Simson

1. Accelerated Productivity

Seed funding of at least $250,000 to establish a voluntary Agricultural Data Code of Practice.

The establishment of a Chief Digital Agriculture Officer to assist farmers to best take advantage of new technologies.

$5 million over three years for a Telecommunications Innovation Pilot Project to grow digital literacy and foster technology applications in rural and remote Australia.

2. Connectivity

$180 million ($60 million per round) to Rounds 4, 5 and 6 of the Mobile Blackspots Program, consistent with the funding for previous rounds.

The establishment of a Rural Regional and Remote Telecommunications Research Fund as a long-term outcome of Telecommunications Universal Service Obligation reform.

3. Trade Liberalisation and Market Access

The expansion of the Agricultural Counsellor network as new trade agreements are negotiated.

The establishment of a 'Special Trade Envoy' to provide a farmer's perspective to international trade negotiations, to advocate for trade liberalisation domestically and to build partnerships with other farming groups across the globe.

4. World Class Infrastructure

A minimum of $1 billion dollars to establish an infrastructure fund to improve regional roads and rail in a bid to make export pathways more efficient.

Adequate resources to facilitate consultation with landowners about route selection, land acquisition and construction in regards to the development of the Brisbane to Melbourne Inland Rail.

$5 million for a full feasibility study and a go-to market investment strategy for the Food Precinct to be developed around the Greater Western Sydney Airport.

5. Sustainable Stewardship

A commitment to genuine EPBC Act reform and the exploration of the potential for the greater use of non-regulatory approaches that recognise the contributions farmers make towards meeting biodiversity objectives.

The acceleration of a national system of innovation in biosecurity by committing to Intergovernmental Agreement on Biosecurity recommendations including: a $25 million National Biosecurity Innovation Program and the increasing of funding appropriation for research and development corporations by $2 million annually for a new cross-sectoral biosecurity R&I coordination and investment function for the RDCs.

6. Human Talent

Funding for a comprehensive and regular analysis of the persistent labour shortages in the sector with a view to framing a dedicated agricultural visa which will address those needs.

Investment in a number of initiatives to better educate school children about where their food and fibre comes from, including $100,000 per year for the Primary Industries Education Foundation Australia.

Seed funding to cover the initial year of operation of a Seasonal Worker Program Administration Fund, of which employees could access to fund their travel to Australia. Employers would then deduct periodic amounts from employee's wages to cover the cost of travel and pay these amounts back into the SWP Administration Fund.

7. Flexible Business Tools

A commitment to work with the States and Territories to abolish stamp duties on crop and livestock insurance products.

#SaveTheWriteOff: End the yearly budget uncertainty for small business and extend the current instant asset write off for small businesses in perpetuity. Currently this arrangement expires on 30 June 2018.

The retention of fuel tax credits across all sectors.

Reforms to make farm management deposits more effective: incentives to improve the availability of FMD interest offset facilities; allow FMDs to be held at the business level rather than just the individual level; and permit FMDs to be brought back into a business over time or be taxed at average rates in the event of unexpected cessation or death.

A review of tax zone rebates and remote area fringe benefit tax (FBT) concessions: Investigate whether current arrangements to compensate individuals for the disadvantages of living in remote areas can be made more effective.

TEN TACTICS FOR SUCCESS WITH EARLY-SOWN CANOLA

SOWING CANOLA EARLY IN MOST SOUTHERN AND EASTERN AUSTRALIAN CROPPING REGIONS CAN INCREASE PRODUCTIVITY AND PROFITABILITY BY FOLLOWING 10 KEY TACTICAL GUIDELINES.

The guidelines – relating to location, variety selection, soil moisture management, seed placement and rates, weed, pest and disease management, soil nutrition and croptop/windrow timing – have been established after an extensive three year investigation as part of a Grains Research and Development Corporation (GRDC) collaborative research investment.

Through the Optimised Canola Profitability project, which is a collaboration between the GRDC, CSIRO, New South Wales Department of Primary Industries and the South Australian Research and Development Institute (a division of Primary Industries and Regions SA), 34 field experiments were conducted from 2014 to 2016, looking at the interaction between variety and sowing date.

The experiments were located at 14 sites, from Eyre Peninsula in South Australia and the Wimmera in Victoria through to the central west slopes of New South Wales and the Darling Downs in south eastern Queensland.

One of the project leaders, CSIRO research scientist Dr John Kirkegaard, says the traditional canola sowing window in much of the southern and eastern growing regions has opened in late April, continuing well into late May.

“However, changing rainfall patterns, disciplined summer fallow management and improved no-till seeding systems are enabling growers to capitalise on soil moisture opportunities and reduce production risk by sowing canola earlier in the season,” John said.

“The project was established to quantify potential yield and grain quality benefits from sowing crops in early to mid-April and has focused on tactical agronomic requirements to achieve successful outcomes. We have been looking at varieties that are suitable for earlier sowing and how they should be managed,” he further explained.

The guidelines for early-sown canola, developed with Rohan Brill (NSW DPI) and Andrew Ware (SARDI), have been published in a new electronic Ten Tips to Early-Sown Canola brochure.

The 10 guidelines are:

1. Consider your location – early sowing of canola before mid-April can be successful in most environments of southern and eastern Australia. The main exceptions are South Australia, where low rainfall probabilities in March-April are likely to restrict early sowing to around mid-April, and northern New South Wales, where trials show significant yield variability with early April sowing, meaning late April or early May is preferred.

2. Select a slower developing variety – early sowing amplifies phenology differences between (spring) canola varieties. Sow slower developing varieties early to target the Optimal Start of Flowering period ie: the period when combined frost/heat/water stress is minimised and yield potential maximised. Sowing faster developing varieties early will expose them to greater frost and disease risk at flowering and can reduce yield potential.

3. Manage fallows and residues – management of soil moisture in the fallow period is critical for successful canola establishment. Control fallow weeds when they are small and before they start to use soil moisture. Consider potential residues, particularly from Group B herbicides and Group I herbicides in the previous crop and fallow. Spread residue evenly at harvest and retain until sowing to reduce moisture loss. Consider sowing canola after pulses, brown manure or long fallow to increase residual moisture in lower rainfall areas.

4. Manage seed placement – consider placing seed slightly deeper (25-40 millimetres) for early sowing to account for higher evaporation rates. Reduce to 15-20 mm when dry sowing. If sowing retained open-pollinated (OP) seed, grade to at least 2mm diameter to maximise establishment. Ensure the furrow is closed above the seed but avoid heavy press wheel pressure.

5. Adjust seeding rates – establishment rates are usually lower when early sowing, with typically warmer temperatures and marginal moisture. As a guide, assume 40-50% establishment for early sowing compared with 60-70% for later sowing. Use the higher end of the range for hybrid and large seeded OP seed. Increase seeding rates accordingly.

6. Carefully manage weeds – early sowing usually occurs before annual weeds can germinate on the main autumn break. Select paddocks with a low weed burden and use a robust pre-emergent herbicide strategy. Select the herbicide tolerance package best suited to the weed spectrum and herbicide resistance status of the paddock.

7. Select fertile paddocks – select paddocks high in nitrogen (N) to fully capture the higher yield potential of early sown crops. Aim for 80 kg/ha N per tonne of targeted grain yield. The rate of N is more important than the timing, although early sowing allows more opportunities for topdressing applications. In higher risk, low rainfall areas, sowing canola early with adequate N at seeding or early topdressing is a successful strategy.

8. Consider pests and insects – aphid pressure can increase with early sowing but risks are reduced by controlling host weeds in the fallow period. Early sowing decreases the risk of red legged earth mite. Other pests, including slugs, earwigs and slaters, are more influenced by rotation and residue management than sowing time, although stubble retention is a successful strategy for early sowing.

9. Consider disease pressure – early sowing can reduce the risk of blackleg crown canker in canola as young plants often develop several leaves before the onset of spore showers in autumn. Slow developing varieties sown early will flower at similar times to fast varieties sown later. Pressure from upper canopy blackleg and sclerotinia stem rot will therefore be similar and the same management practices apply. Note: If faster maturing varieties are sown too early in disease-prone areas there is increased risk of upper canopy infection, with significant impacts on yield.

10. Assess croptop/windrow timing – early sown crops will generally branch more, particularly at lower plant densities, so a higher proportion of grain yield will be derived from branches than the main stem. Seed on branches matures slower than on the main stem. When assessing croptop or windrow timing, check seed colour change across the whole plant, not just the main stem.

The Ten Tips to Early-Sown Canola brochure also details Optimal Start of Flowering dates for Victoria, South Australia, central and southern New South Wales, and northern New South Wales and southern Queensland, and includes a table of proposed 'phenology' ratings of canola varieties compared with commercial 'maturity' ratings.

"However, changing rainfall patterns, disciplined summer fallow management and improved no-till seeding systems are enabling growers to capitalise on soil moisture opportunities and reduce production risk by sowing canola earlier in the season."

John Kirkegaard

SHINING A LIGHT ON WOMEN IN AGRICULTURE

Three Victorian women have been recognised for their contributions to regional Victoria, being announced as the 2018 Victorian AgriFutures™ Rural Women's Award finalists.

The award celebrates outstanding leadership and innovation throughout rural and regional Victoria, including its $13.1 billion agriculture sector.

This year's finalists are:

Cara Hadzig, from Murra Warra, who wants to reduce farm work injuries by developing an application that provides farm safety inductions, alerts for maintenance requirements and a platform to log faults and issues around the farm.

Melissa Connors, from Kyneton, who wants to create stronger and more engaged communities by connecting tree changers with established and retired farmers who can pass on their invaluable local knowledge to motivated newcomers.

Jade Miles, from Stanley, who wants to share her learnings from developing a community owned regional food co-operative and build a social enterprise based model that can be rolled out in other regions.

The Victorian winner will be announced at a ceremony on 20 March 2018 at Melbourne Museum and will receive a bursary of $10,000 to implement their project vision.

Each state and territory winner will get the opportunity to attend the Australian Institute of Company Directors (AICD) course prior to the national award ceremony in Canberra held in September.

Agriculture Victoria spokesperson Leesa Sheerin congratulated the winners and all the applicants for taking an invaluable role in shaping their communities.

"The AgriFutures™ Rural Women's Award celebrates these women, their achievements, and the crucial role they are playing in rural and regional industries, businesses and communities," Leesa said.

In addition to the Victorian AgriFutures™ Rural Women's Award, the Victorian Government also supports a number of different initiatives which empower and support rural and regional women.

The Rural Women's Network, re-established on 1 July last year, is supporting rural women to have a more active voice in government and community decision-making. The Invisible Farmer project offers Victorian women in agriculture the chance to share their inspirational stories.

LIVESTOCK PRODUCERS WARNED TO CHECK PADDOCKS FOR TOXIC WEEDS

Western Australian livestock producers have been encouraged to monitor paddocks and livestock over coming months for toxic plants and signs of summer weed poisoning, especially if further rainfall occurs.

The Department of Primary Industries and Regional Development in Western Austrlaia has received reports of lesser loosestrife (Lythrum Hyssopifolia), as well as box poison (Oxylobium parviflorum) in the Great Southern.

Department veterinary officer, Andrew Larkins, said the reports were a good reminder to closely observe paddocks and stock.

"Low levels of feed on offer in some areas, coupled with summer rainfall could easily elevate the risk of toxic plants to livestock this year," Andrew said.

"It is important for producers to inspect paddocks for weeds prior to introducing livestock, as well as nearby bush and scrub areas, rock heaps and wet areas, which all provide suitable microclimates for toxic plants," he added.

Additional plants that could be at risk to livestock include caltrop (Tribulus terrestris), mintweed or goosefoot (Chenopodium pummilio) and native gastrolobium species, as well as some self-sown crop re-growth.

Andrew said most poisonings could be avoided by ensuring stock are not hungry when introduced to a new paddock.

"Feeding livestock hay beforehand, particularly if they have been yarded or transported, ensures they have adequate gut fill to prevent the animals from gorging and also dilutes any potential toxic components from suspect plants," he explained.

Andrew said it was important to continue to monitor stock for signs of summer weed poisoning, such as ill thrift, photosensitisation, weakness and sudden death.

"Livestock affected by toxic plants should be removed from the suspect paddock immediately. Move animals slowly and provide them with access to shade, fresh water and good quality hay," he said.

If producers notice any unusual signs in their stock they are encouraged to contact a department or private veterinarian to determine the cause and limit production losses. The information also aids market access disease freedom evidence.

FIVE NEW AGRONOMY GRADUATES NOW ON THE GROUND

Agriculture Victoria has selected five new graduates to take part in its latest 18 month Agronomist Development Program.

The expanded number of graduates will take up positions at Hamilton, Bendigo, Mildura, Ballarat and Horsham, and will also undertake intensive placements with leading grower groups and agribusiness.

Program leader James Nuttall said the new graduates – Stephen O'Connor, Kate Finger, Rachel Coombes, Mitchell Fromm and Alexander Clancy – were the fourth intake under the program which was established to build grains industry capability.

"This current intake follows three previous cohorts of three graduates that commenced with the program in 2015, 2016 and 2017," James said.

The Agronomist Development Program is part of the Regional Research Agronomists program, co-funded by the Grains Research and Development Corporation (GRDC) and Agriculture Victoria.

James said that to date, the program had targeted grains research and development for the medium and high rainfall zones, however, the recent expansion into low rainfall zone has meant that several of the graduates will be undertaking placements that focus on production systems and networks in the Victorian Mallee.

For three of the five graduates, Stephen O'Connor, Kate Finger and Rachel Coombes, their 18 months will include intensive placements with leading grower groups and agribusiness.

They will gain experience in key areas including seasonal risk management, nutrition and pathology, trial development and management, pest, weeds and disease identification, and crop protection options in a regional context, as well as developing communication packages to support research adoption.

These positions will be based in Hamilton, Bendigo and Mildura.

The remaining two graduate positions are designed to build capability in targeted areas.

For graduate Mitchell Fromm, the program focus will be pulse agronomy in the Mallee with placements at Southern Pulse Agronomy and Moodie Agronomy, working from Horsham and Mildura.

And last but not least, Alexander Clancy will focus on precision agriculture, working with Agriculture Victoria's remote sensing specialists at Bendigo and with agribusiness Precision Agriculture in Ballarat.

SOIL BIOLOGY PROVES RESILIENT TO HERBICIDE INPUTS

Research into the biological activity within soils across Australia as part of a joint New South Wales Department of Primary Industries (NSW DPI) and GRDC investment has found there are limited impacts on soil biology from herbicide residues.

However, there is the potential for herbicide residues to cause crop damage if they are not used correctly.

NSW DPI soil scientist Dr Michael Rose said research conducted at the Wollongbar Primary Industries Institute has found soil biology is generally quite resilient to herbicide inputs.

“The key finding that’s come out of this project is that when herbicides are used at the recommended label rates and directions, they generally have very little impact on soil biological activity,” he said.

“The soil biological functions are what help to break down most of the herbicides, so as long as a soil is healthy, has adequate organic matter, and is at the right temperature and moisture to promote microbial activity, the impact of the herbicide is negligible. There are times when the environmental conditions can slow the rate of herbicide degradation, for example, when there has been a long dry cool period, or low organic matter, or a low or high pH,” Michael went on to explain.

Michael said despite an increase in herbicide applications following the adoption of low or no-till farming, farmer management strategies such as diverse crop rotations, liming, applying organic amendments or correcting nutrient deficiencies helped to maintain healthy soil biological activity.

“We do know that there are two chemical groups that target enzyme pathways found in microorganisms as well as plants. These are glyphosate and the Group B herbicides, e.g. sulfonylureas (SUs) and imidazolinones (IMIs),” he said.

“However, just as weeds evolve herbicide-resistance, so too do the microbes,” Michael added.

“To have any measureable effect on the soil microbial function, the dose of glyphosate that’s needed is more than 10 times the recommended label dose rate and more than five times for the Group B herbicides. At label rates, we haven’t seen changes to the functional biological activity of soil greater than plus or minus 10 per cent,” he went on to explain.

Michael growers need to be aware herbicide residues can directly adversely impact crops, which is more likely to happen after a dry summer or fallow sprays, or if the soil has low biological activity.

The complicating factor is there are more than 50 different active ingredients registered for use in the Australian grains industry.

“Each of these chemicals will behave differently from paddock to paddock depending on the climate, soil type, crop type,” Michael said.

“We are now looking at developing a model which will give growers and consultants an in-field tool to assess the persistence of different herbicides in individual soil types. Growers would input spray rate and timing data as well as data from normal soil tests including soil pH, organic matter and texture. The tool would then geo-locate the paddock to get a reading of rainfall and temperatures since the spray application from the nearest weather station. By combining all those elements, we aim to get a good prediction of how much herbicide is left at a given point in time,” he explained.

“The model framework is in place, we are working on developing this to the next level into a tool for growers to use. We still need further data on what these herbicide residues actually mean for the subsequent crop. While we could tell you what the level of the herbicide residue in the soil may be at any given time, we are not yet at a stage where farmers can interpret that data to inform management decisions,” Michael said in conclusion.

COVER CROPS IN NITROGEN'S CIRCLE OF LIFE

A circle of life - and nitrogen - is playing out on farms across the globe. And researchers from the United States are trying to get the timing right.

Some cover crops, such as hairy vetch or cereal rye, are not grown to be eaten. Instead, they capture nutrients, including nitrogen, from previous crops, the air, and the soil. When cover crops decompose, these nutrients are released. The cash crops planted afterward can use these nutrients to grow and thrive.

But cash crops need different amounts of nutrients at different stages of growth. A new study assesses how quickly nutrients are released from two different cover crops. The goal, according to study co-author Rachel Cook, is to time nutrient release from cover crops to better match the nutrient needs of specific cash crops.

"It's like trying to time a meal to come out of the oven exactly when all the hungry dinner guests arrive," said Rachel, currently a researcher at North Carolina State University.

The researchers focused on nitrogen because it "is typically the most limiting nutrient in crop production, but has the most potential for environmental impact from losses." The two cover crops, hairy vetch and cereal rye, are two of the most commonly planted cover crops in the Midwest.

They found that hairy vetch and cereal rye had significantly different nitrogen release dynamics.

"We now better understand the rate and quantity of nitrogen release from two of the more popular cover crops currently in use," said Rachel.

"This information can help farmers estimate how much nitrogen they might expect to get from their cover crop and when it will be available," she added.

The study showed that hairy vetch released more nitrogen overall compared to cereal rye. Nitrogen release was also quicker from hairy vetch plants whose growth had been halted.

"Hairy vetch releases almost all available nitrogen in the first four weeks after it is terminated," said Rachel.

That's before the major time of nitrogen uptake by corn, which is around week eight after planting. "So, terminating hairy vetch too early could cause losses of nitrogen before the corn crop can get to it," she went on to add.

Cereal rye, on the other hand, released nitrogen slowly over multiple weeks. "This would be beneficial before a cash crop with low nitrogen needs," said Rachel.

The study was carried out in field test sites at the Agricultural Research Center at Carbondale, Illinois. Study plots were planted with either cereal rye or hairy vetch. After terminating the cover crops with herbicide, researchers planted soybean or corn, respectively.

The researchers measured the growth of the two cover crops, how quickly they decomposed once terminated, and the ensuing quantity and rate of nitrogen they released.

Overall, hairy vetch plants released almost three times as much nitrogen compared to cereal rye plants. More than 70% of the total nitrogen released by hairy vetch occurred within the first two weeks after termination. In contrast, nitrogen release from cereal rye occurred later, with almost no net nitrogen release in the first four weeks after termination.

Rachel hopes that more information on how different cover crops release nutrients will help farmers make more informed decisions. "They will be able to choose which cover crop works best for their farm and the specific cash crops they are planting. They will also know when to terminate the cover crop prior to planting the cash crop," she said.

Cover crops also do more than release nutrients after they are terminated. They can help manage soil quality and erosion, for example.

"Long-term studies with cover crops will be really important. These studies can help us understand how cover crops can improve soil properties over time and how that might improve cash crop yields," Rachel said in conclusion.

FUNGICIDE RESISTANCE FOUND IN BARLEY SPOT FORM OF NET BLOTCH

Grain growers are advised to implement integrated disease management strategies for barley crops this season after the discovery of fungicide resistance in the pathogen responsible for spot form of net blotch (SFNB) in Western Australia.

Analysis of 2017 crop samples from several paddocks in Western Australia's Esperance and South Stirling regions detected the resistance in the fungus pathogen *Pyrenophora teres f. maculate* (causing SFNB) to some Group 3 DeMethylation Inhibitors (DMI) fungicides.

These samples were collected by Department of Primary Industries and Regional Development (DPIRD) research officers and screened for fungicide resistance by the Centre for Crop and Disease Management (CCDM), which is a national research centre co-supported by Curtin University and the Grains Research and Development Corporation (GRDC).

CCDM Fungicide Resistance Group leader Fran Lopez-Ruiz said his team also observed reduced sensitivity towards fungicides from Group 3 fungicides in the *Pyrenophora teres f. teres* pathogen, which causes net form of net blotch (NFNB).

He said the level and frequency of resistance likely to occur in barley paddocks this season was uncertain and the focus was now to determine the extent of the potential problem in susceptible areas that may have heavy disease pressure.

Fran said recent concerns about fungicide performance in South Australian barley crops by growers and agronomists had also prompted rapid collection and analysis of SFNB samples from 2017 by the SA Research and Development Institute (SARDI).

"A mutation in the pathogen causing SFNB was found by CCDM and SARDI researchers and it was initially thought this could be associated with resistance to the new generation of Group 7 succinate dehydrogenase inhibitors (SDHI) fungicides," he said.

However, further research found no SFNB pathogen resistance to SDHI fungicides.

Fran said the Group 3 resistance finding in SFNB in Western Australia should act as a reminder to growers and advisers that it is best practice to implement a fungicide application plan as part of integrated disease management strategies for season 2018.

"Collectively we all have a role to play in protecting the longevity of our fungicides by using them responsibly, regardless of whether fungicide resistance is present in our own backyards or not," he said.

For growers with DMI resistance, or suspected resistance, in their paddocks, Fran recommended avoiding the application of two consecutive applications of the same Group 3 fungicide active (either as a foliar or seed dressing) in one season, unless these were used in mixture with a different mode of action.

He said a Group 7 (SDHI) seed dressing could be used as a preventative measure, but advised on strict adherence to recommended label rates and application methods to achieve adequate fungicide coverage.

Fran also provided the following guidelines for fungicide use:

- Choose mixtures with different modes of action if available.
- Alternate fungicides, and never apply the same fungicide twice in a row.
- Avoid applying the same mode of action twice.
- If resistance is present or suspected, avoid or minimise the use of that mode of action as this will only further select for resistance.
- Rotate crop types.
- Grow resistant barley varieties to reduce disease pressure.
- Use label rates to ensure adequate spray coverage.

More research with GRDC investment is being carried out into SFNB fungicide resistance and growers and advisers are encouraged to submit stubble and green plant samples of net blotches from all growing regions across Australia this season.

"This will help us better understand and monitor the extent of the situation and the frequency of the resistance nationally," Fran said.

Sampling is best carried out through local plant pathologists, and for more information, email the CCDM Fungicide Resistance Group directly at frg@curtin.edu.au or visit the CCDM website.

THREE TACTICS FOR COMMON SOWTHISTLE WEED CONTROL

Grain growers could be forgiven for their frustration when dealing with the problematic weed, common sowthistle.

What was once considered a winter problem has become an issue all year round, and is now one of the most widespread, broadleaf weeds in southern Queensland and northern New South Wales.

For the past 18 months the Northern Grower Alliance (NGA), as part of a Grains Research and Development Corporation (GRDC) research investment project, has been investigating the challenges of safe, effective and economical control of common sowthistle or Sonchus oleraceus.

NGA's research manager Lawrie Price said the increasing common sowthistle problem is largely a result of the fact its seed is readily dispersed by wind. Growers are also starting to battle glyphosate resistant populations.

"In recent years, weed control in summer fallow has become an increasingly difficult and expensive component of northern farming systems," Lawrie said.

"This is in part due to a heavy reliance on glyphosate, which has led to the selection of weed biotypes which are glyphosate resistant. So we now need to develop non-glyphosate-based management strategies to effectively, safely and economically control common sowthistle," he added.

GRDC's most recent investment into this weed has seen NGA researching weed management using residual, knock-down and double knock approaches.

1. Residual herbicides (fallow or in-crop)

Products currently registered for residual control of common sowthistle in fallow include Balance® and Terbyne Xtreme®. Balance, Terbyne Xtreme and simazine are all registered for in-crop residual control.

2. Herbicide double knock

Using a double knock of glyphosate followed by paraquat can be an effective tool on small common sowthistle (e.g. 4-8 leaf).

However, the level of control can be variable on larger weeds (rosette) and at more advanced growth stages. Evaluation of alternative first knock candidates indicates that Group I products followed by paraquat are providing improved levels of efficacy compared to glyphosate followed by paraquat on larger rosettes.

Many of these options are used for fleabane control and often provide a level of residual activity for common sowthistle. Screening is also underway for alternative second knock herbicides to paraquat.

3. Knockdown control

Lawrie said there were limited knockdown (single knock) options for common sowthistle.

"Sharpen® (saflufenacil) is registered for use in mixture with glyphosate. This can be an effective tool but needs to be applied on very small weeds for consistent control," he said.

"Basta® is also registered for use in some situations and maybe an option. It can be used in fallow for the control of common sowthistle at the 2-6 leaf stage."

In summary, Lawrie said when it comes to problematic weeds, like common sowthistle, effective management can have an impact on crop profitability so growers need to focus on individual paddocks and adjust rotations to suit environmental conditions and also allow for residual herbicide use in fallow or in-crop.

STRENGTHENING CITRUS FRUIT TO BETTER RESIST CLIMATE CHANGE

Research of the Department of Agricultural Sciences and the Natural World of the Universitat Jaume I (UJI) in Castellón, Spain, has identified the genes within citrus fruit that biotechnology could improve to face climate change.

Work spearheaded by Professor Vicent Arbona is progressing in the understanding of the signaling pathway of a plant hormone that will make plants more resistant to stress by flooding. Conclusions of the research have been published in Plant Molecular Biology.

One of the negative environmental conditions that will worsen with the effects of global warming is the flooding of farmland due to torrential rain.

For this reason, "we have studied in the laboratory a plant hormone, abscisic acid or ABA, which is key to regulating tolerance to adverse environmental conditions by plants, and we have observed that there are specific hormonal and molecular responses to stress due to flooding of the substrate," explained Vicent, a member of the Ecophysiology and Biotechnology Investigation group.

Researchers at the UJI have identified genes associated with the signalling mediated by the aforementioned hormone and cloned them, removing and isolating them from the plants in order to study them more in-depth.

"What was especially relevant from a basic research standpoint was that, for the first time, the descent in levels of a plant hormone compared to control values as an answer to environmental stress could be a physiologically significant response, and data points in this direction," said Vicent.

This plant hormone's response, on a biochemical level, seems to be controlled and specific for this type of stress, as well as being specific to the roots, which are in direct contact with the flooded land. On the other hand, on a molecular level, researchers found that there is a specific response tied to the hormone levels within the tissue, meaning that the plant could tell which type of stress it is being subjected to, and therefore induce the most suitable physiological responses to fight it.

Orange trees with heightened resistance to stress.

The next step in this line of investigation, already in development, is to learn how cellular responses vary, on a molecular level, among roots of flooded plants when the hormone is not present, which would make it possible to create a response model where this signalling path would play a key role.

"It is worth noting that this work is being performed with woody crops such as citric fruits, which are hard to handle in a laboratory, but have the advantage that the results are easily extrapolated to real life conditions," said Vicent.

Furthermore, basic knowledge on how this signalling path is organised and its key role in plant resistance to substrate flooding is the first step towards the biotechnological production of citrus fruits that are more resistant to this type of stress.

Professor Vicent Arbona belongs to the Department of Agricultural Sciences and the Natural World of the Universitat Jaume I and developed his research within the Ecophysiology and Biotechnology Investigation group, managed by Professor Aurelio Gómez Cadenas.

Among the main investigation lines of this group are the responses and resistance mechanisms of citrus fruits and other crops to abiotic stressful situations such as droughts, flooding or salinity, and their hormonal control. They also apply biotechnology techniques such as in-vitro cultivation and measure plants' metabolic changes as a response to stress.

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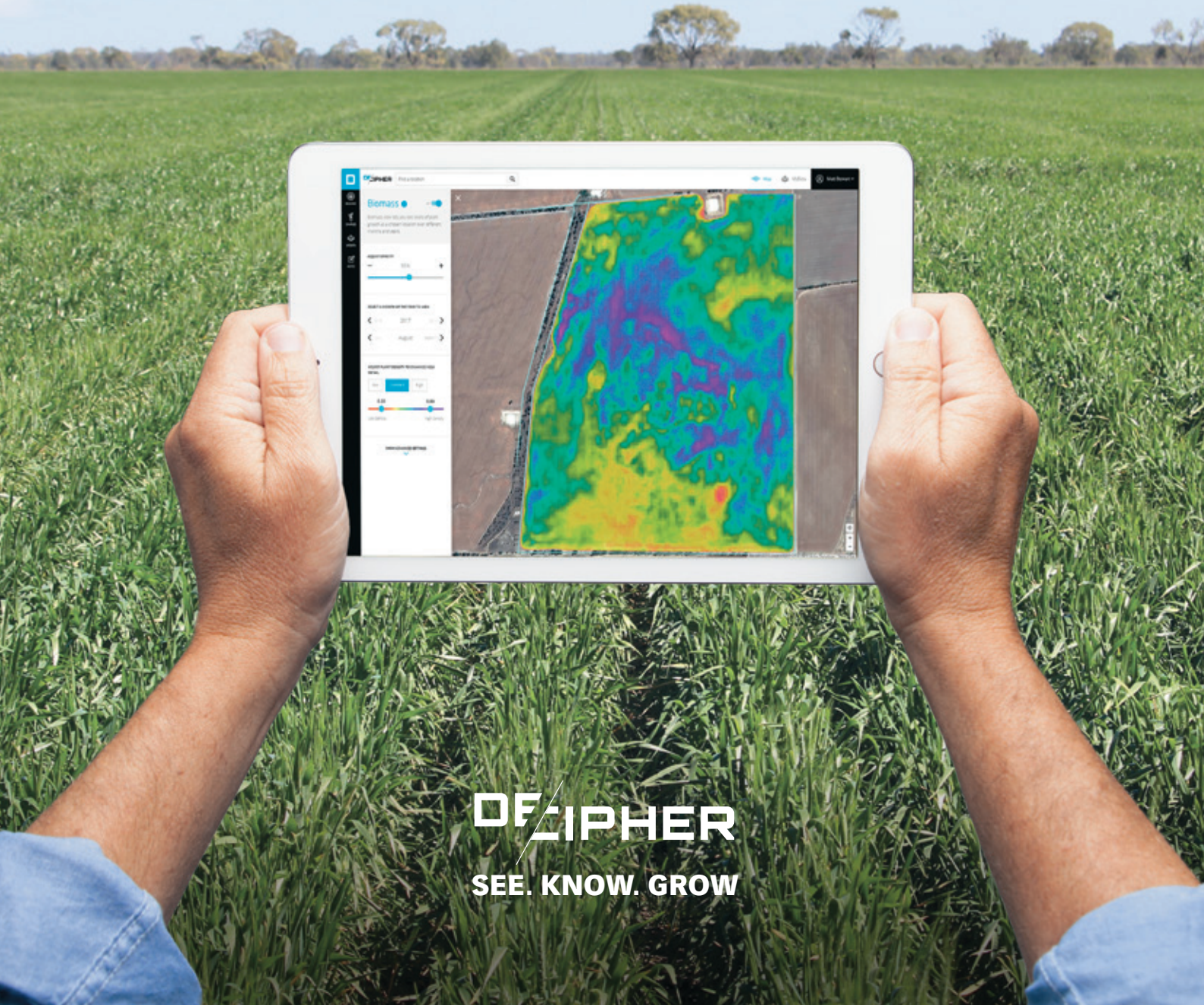

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HOT TOPIC FOR LOCAL VIGNERONS

Vineyard management in heatwaves is the focus of a new project to better understand vine stress during hot conditions.

The New South Wales Department of Primary Industries (DPI), Wine Australia and Riverina Wine Grapes Marketing Board project is exploring the potential of new technology to inform irrigation decisions which could help better manage grapevines in the heat.

NSW DPI viticultural development officer, Adrian Englefield, said new sap flow meters and dendrometers have been installed at two Riverina vineyards, in partnership with Edaphic Scientific.

“We are monitoring vine stress in Shiraz, Cabernet Sauvignon, Merlot and Chardonnay varieties at temperatures of 40 degrees Celsius and higher,” Adrian said.

“This project aims to identify the point where vines could benefit from better informed management decisions. Generally sap flow is highest during the day when plants are actively transpiring and minimal at night when little or no transpiration occurs. We are measuring sap flow trends and comparing them during the growing season. Any reductions in sap flow during extreme weather events, compared with baseline measurements, can indicate vine stress,” Adrian explained.

“Dendrometers measure tiny changes in trunk diameter. A healthy vine has a smooth dendrometer cycle where trunks expand during the day and shrink at night when transpiration has ceased,” he added.

Coupled with soil moisture information, canopy temperature and humidity sensors, the pilot project aims to monitor vine stress under different irrigation schedules during the hot summer months.

As part of Wine Australia’s Regional Program in the Riverina, NSW DPI has also run grower workshops exploring management options and technologies which are available to mitigate extreme heatwave events.

GRAPEVINES ARE MORE DROUGHT TOLERANT THAN THOUGHT

The latest word on the grapevine is promising.

During more than a decade of observation, grapevines in Napa, California in the United States and Bordeaux in France, never reached lethal levels of dehydration from seasonal drought, researchers recently reported online in Science Advances.

Guillaume Charrier, plant ecophysiologist at the French National Institute for Agricultural Research in Paris, and colleagues have determined just how resilient the plants are.

Grapevines lost most of their leaves only when their ability to circulate water and nutrients was reduced by 50 percent, due to lower water pressure in their stems and roots. While field conditions never led to water pressures this low, the team found the threshold for leaf loss in greenhouse tests.

Typically, when plants become extremely dehydrated and water pressure drops, air bubbles can develop in the xylem, tissue that carries water up from the roots. In plants, as in humans, an air bubble — also known as an embolism — can prove fatal because it stops the transport of nutrients and can cause leaves to drop.

The team used a technique similar to a CT scan to “look within the stems of grapevines with X-rays without cutting into them” and see if embolisms formed, Guillaume said.

Grapevines sacrifice peripheral parts, such as leaves, to preserve water pressure and avoid fatal embolisms. Different grapevine varieties, like Syrah and Grenache, were all similarly resilient, the team found.

“Before, we didn’t have an understanding of how far we can push these plants until they die,” said study co-author Paul Skinner, a soil scientist and vineyard consultant in Napa.

Knowing grapevines’ response to dehydration could prove crucial as droughts become more severe with climate change. That could help vineyards conserve water with better irrigation strategies, and give wine connoisseurs something to toast.

RESEARCH ON DEEP TILLAGE DIGS UP INTRIGUING RESULTS

Research on a comprehensive range of deep tillage practices on sandplain soils in Western Australia has demonstrated the yield benefit is worth the investment.

There has been increasing interest across the Grainbelt in the use of deep rippers, mouldboard ploughs, one-way ploughs and clay delvers to manipulate the soil profile to depths of up to 70 centimetres.

Department of Primary Industries and Regional Development scientists, in collaboration with AgVivo consultant Tim Boyes, compared the performance of several strategic deep tillage options in field trials at Meckering and Goomalling, with support from the Grains Research and Development Corporation (GRDC).

The results, to be profiled at the 2018 GRDC Grains Research Update in late February, showed significant wheat yield benefits after one or two seasons.

Department soils researcher Dr Steve Davies said good wheat yield responses were achieved across a range of deep tillage practices.

“Overall yields increased by 26 to 50 per cent in the first year and 5 to 39 per cent in the second year on pale deep sand over gravel soil at Meckering, while at Goomalling yield increases to responsive treatments were 2 to 93 per cent,” Steve said.

“The most profitable treatment at Meckering over two seasons was one-way ploughing, followed by ripping with spading and soil inversion with a mouldboard plough. Only very deep ripping, with or without soil inclusion or with one-way ploughing, were profitable in the first year at Goomalling, which had a more difficult 2017 season with much lower yields,” he went on to explain.

Steve said the research provided a valuable insight into the complexities of the deeper soil profile.

“On the deep sand over gravel soils at Meckering, removing deep soil compaction improved the plant’s root access to potassium, nitrogen and water, which drove improved productivity in the first year,” he said.

“More sustained yield responses in year two were achieved by treatments with additional topsoil and subsoil modification, such as deep mixing with a spader or inversion with a one-way or mouldboard, which effectively removed the topsoil water repellence. At Goomalling, the removal of deep compaction, particularly in the dry season, improved root access to subsoil moisture, subsequently improving yields and the removal of water repellence achieved better crop establishment,” Steve further explained.

The research also included an economic analysis of the investment, which demonstrated cost recovery from most treatments could be achieved within two years, apart from delving which has a higher initial implementation cost.

“Many treatments recover their costs in the first year, although this depends on the site. The economic benefit from a number of other treatments is almost as large as the cost of the treatment, so the break-even point is year two,” Steve said.

Steve said the data from the research would assist the development of more comprehensive agronomic packages and assist consultants and farmers to make more informed decisions to optimise the benefits of soil manipulation at depth.

“We now have a better understanding of the soil profile and the gains to be attained by tapping into moisture and nutrients below 50 centimetres, which could make a substantial difference to crop performance in particular seasons,” he said.

The field trials will continue during the 2018 growing season and complement other soil manipulation trials being conducted by DPIRD with GRDC support across the Grainbelt.

“Understanding how long these treatments continue to provide benefit for is paramount to support grower adoption,” Steve said in conclusion.

SUCCESS WITH INTEGRATED PEST MANAGEMENT IN COTTON

WRITTEN BY JOHN BARBER, MARANOA PEST MANAGEMENT

"This article describes how a group of cotton growers in southern Queensland uses integrated pest management or IPM. Some growers and advisors in other areas appear to be practising IPM to some degree, but many are not, as a quick look at the growers' insecticide usage, variable costs and pesticide failures would prove. There is no doubt that our IPM achievement in southern Queensland is due in large part, but certainly not solely, to our summer cotton monoculture. There is no sorghum or maize in the area.

That is the point. The cotton industry is mostly a monoculture but there is not much IPM. I suggest it is possible to plan and use integrated pest management throughout the cotton industry and in other agricultural enterprises, because all the necessary components for IPM exist everywhere. It would require more diligence from advisors, the application of proven research information, cooperation between neighbours and changes to some machinery but it will be profitable and sustainable."

JOHN BARBER

In the Australian cotton industry, years of research have focused on determining methods for Integrated Pest Management (IPM), particularly since about the mid-1990s when the levels of resistance in Heliothis to pyrethroids reached 80 to 90 % each season. There has been an emphasis on the preservation of beneficial insects, tolerance of some pest damage, and cultivation between seasons to disrupt the pupal phase of the moth's life cycle.

The indeterminate growth habit of cotton, its dominantly irrigated production in Australia and the host of beneficial as well as pest insects which are found in the crop made it ideally suited to the development of a very sound integrated pest management strategy. It is not hard to imagine the irrigated cotton crop acting like a reservoir for a huge range of species and numbers of insects in an otherwise fairly dry environment.

IPM has been continually promoted, particularly since about 1996 when Bollgard was introduced as a single gene product and the high levels of resistance to pyrethroids, carbamates and organophosphate insecticides were widespread.

The knowledge of IPM has developed but its adoption has been very slow. Bollgard has provided the means to control Heliothis which was the dominant pest, and IPM appears to have suffered. In the 2016/17 cotton season there was still widespread use of pyrethroids, dimethoate and fipronil to control early season non larval pests such as aphids, mirids and Rutherglen bugs. There were also larvacides applied to supposedly large egglays in the middle of summer when the natural mortality of eggs easily exceeds 80%. Late season pests such as the silverleaf whitefly (Bemisia) and the mealybug (Pseudococcus solenopsis) were more abundant, particularly on areas where broad spectrum insecticides had been used some three months earlier.

On the other hand, decades of field experience have shown that none of these insects reaches full pest status when broad spectrum insecticides are never used in the season. It is also unlikely that IPM might have worked for so long on just a few farms in the Australian cotton industry. It would work on all farms. Similarly, it is likely that sucking pests like the green peach aphid which is a pest in other agricultural industries and was mentioned in the Autumn 2017 issue of this magazine, and is apparently also a major pest in several countries, could also be managed with a specific IPM compatible insecticide or even without insecticides at all.

The low adoption of IPM is a problem for several reasons. Firstly, history has shown that misuse or overuse of insecticides has caused unnecessary financial hardship to growers. Secondly, even specific insecticides like Pyriproxifen, which is used to control silverleaf whiteflies, will suffer increased resistance when misused.

The cotton industry entomologists have advised that in 2017 the number of sites in the cotton growing areas where resistance to Pyriproxifen was observed increased up to 60%.

The amount of resistance at each site (the resistance factor) increased up to the same amount. It seems that many people considered that it was easier to spray a good insecticide on one afternoon than to conduct IPM all season. Thirdly, and probably the most costly problem, is that time and money are wasted when research priorities are directed towards solving problems which have already been demonstrated by research and practice to either not occur or be easily managed when IPM is practised.

The role of commercial interests in suppressing IPM cannot be ignored.

Research has shown that a neonicatinoid seed dressing which is harmful to beneficial insects might be useful at some sites about one year in five, even less. Yet Cottonseed Distributors, which is the seed company supplying seed to the Australian cotton industry recommends that the dressing, which is supplied by one of its commercial partners, be applied to all seed before sale.

Monsanto has developed a genetically modified trait to control thrips, which has already been delivered to Australian breeders. It will be quite a few years before it is incorporated into an Australian variety but by eliminating that insect the GM trait could easily cause more problems than it solves. The market research is still outstanding.

Commercial relationships are intended to benefit end users. Our IPM group in southern Queensland and farmers elsewhere who have not used the seed dressing for decades get high yields and are far from unprofitable.

It is disappointing to hear claims that full IPM doesn't work, or spray thresholds are too high, or egglays were substantial and have been sprayed with a larvicide.

"There has been an emphasis on the preservation of beneficial insects, tolerance of some pest damage, and cultivation between seasons to disrupt the pupal phase of the moth's life cycle."

John Barber

IPM cannot fail. It does not mean spraying so-called 'soft insecticides' and hoping they work. It means managing the pest population using all the demonstrated non insecticide methods then spraying an insecticide as a last resort. We aim to manage, not control insect pests. Just like the health of animals, the health of plants can often be managed without a medicine or an insecticide and without any loss of profit.

The good news, and it is very good news, is that in the early 21st century the international corporates like Bayer, Dow, Dupont and others, have developed excellent products for pest and disease management in agriculture and each has met very stringent regulations before release. The products have very good activity on and are very specific to the target, yet have very little activity on non-target species and very little effect on the environment. They are well suited to IPM. Farming with broad spectrum insecticides which were released over thirty years ago is just not necessary.

“However for the majority of the season, in all areas, thrips are a beneficial insect. They are predators of spider mite eggs and since mites can also be a pest both early and late we long ago learned to tolerate the thrips.”

John Barber

The progress of the cotton crop is measured at any time by observing retention. This is the number of squares, flowers and bolls retained on the plant as a proportion of the number initiated, usually expressed as a percentage. It is imperative to understand retention in order to practise IPM.

By the end of the season a well grown Bollgard cotton plant will have about 24 mainstem nodes, with vegetative branches developing from the first six or seven nodes, the actual number depending on plant spacing, while the remainder are fruiting branches.

There can be four or five bolls on each fruiting branch between about mainstem nodes 12 to 16 but retention is commonly measured on only the first two bolls on each fruiting branch, or positions, as they are called. About 60% retention is enough to produce a high yielding crop, but more than that is certainly possible when environmental conditions and nutrient supply are optimised. Another way to look at retention is to count the number of bolls on the first two positions of each fruiting branch. It will average between 1.0 and 2.0 so the higher the better.

Fruiting points develop on the vegetative branches from about the mid season onwards. There will be more vegetative branches when there are 6 to 8 plants/m than if there are 12 to 14 plants/m. At lower populations there can be as many bolls on the vegetative branches as on the fruiting branches. High yields are usually associated with a modest plant population with strong vegetative branches on most plants. Bolls on vegetative branches are later than early bolls on the mainstem, so their development usually avoids any early stresses.

Early damage, note cotyledons unaffected

Our in crop IPM starts when we choose seed without any insecticide dressing on the seed. This saves up to $40/ha on the cost of seed. We then aim to establish a plant population of about 8 to 10 plants/m, which can be difficult. The new Bollgard varieties have a very high turnout (percentage lint) but seedlings appear to lack the early vigour of previous lines. In 2017/18 we have planted up to 16 seeds/m on tougher soils, in order to establish 8 to 10.

The plan is to keep the seedling alive, so with reduced vigour this is not as easy as it used to be. We cultivate as early as possible. This is very important because it aerates the soil which increases growth rate and vigour in the seedling, as well as controlling early weeds to reduce selection pressure on Roundup.

The first likely pest in some areas is the cotton thrip, Thrips tabaci, which, as a sucking pest, can further reduce seedling vigour. Thrip damage to the growing tip of the seedling causes it to branch. Its early growth habit becomes more spreading than if not damaged so it fills in gaps quicker. If anything the greater leaf area supports a higher yield potential.

Thrips are more abundant when wheat crops nearby are close to or at harvest because large numbers of thrips will move from the straw to the cotton. The potential for thrip damage is roughly proportional to the amount of cereal crop grown in a region.

However for the majority of the season, in all areas, thrips are a beneficial insect. They are predators of spider mite eggs and since mites can also be a pest both early and late we long ago learned to tolerate the thrips. We have never had spider mites since we stopped using dimethoate and fipronil.

I believe it is a misconception that early damage delays harvest. The accumulation of heat units at that time is slow. There are far more heat units/day in the middle of the season when any stress such as delayed irrigation will certainly cause a delay.

Sucking pests at the beginning of 2016/17 were as bad as anyone could remember, probably coming from the record plantings of wheat and chickpeas as they were harvested. We managed these with only Transform and paraffinic oil.

Transform is a sulfoxamine (Group 4C). It has excellent activity on aphids, mirids and Rutherglen bugs and suppresses whiteflies but has very little activity on thrips. It costs about $26/ha for a spray of 100g/ha, which is usually enough until row closure. Paraffinic oil is an adjuvant which gives excellent control of aphids and good suppression of adult whiteflies, especially after several uses, and costs about $4.50/L. It is not a registered insecticide.

Industry guidelines suggest a maximum of four full width Transform sprays in a season. Therefore, Transform can be used on more than four occasions when it is applied as a band. The highest pressure from sucking pests always occurs early in the season so

by using a ground rig to spray only the plant (band spraying), as distinct from broadacre spraying, we protect early fruiting points at minimum cost. There is no restriction on oil usage.

We spray Transform and paraffinic oil as a mixture at either a quarter band or half band then as required by plane (100% band). The minimum at several sites in 2016/17 was a half band followed by the plane, or 1.5 sprays for the season. The industry average was probably 6 or 8, often several for whiteflies. It is impossible to get actual data. I can only double check verbal reports.

We usually apply our first band of Transform when there are at least 6 to 8 true leaves on the seedling. Band spraying is most conveniently done with another operation, such as in the mix when Roundup is sprayed over Roundup Ready cotton or even when cultivating. Band spraying is essential to minimise cost.

At the conclusion of 2016/17 it was three seasons since our IPM group at St. George has produced Bollgard cotton by spraying it with only these two products for pest management. At the time of writing (February 2018) there is no doubt it will be four seasons.

Oil has been available for more than a decade. Transform is fairly new and before it we used low rates of Steward (indoxacarb) which is very active on mirids. Sometimes we have a few aphids or whiteflies because like most flying pests they can be blown in, but they have never been a problem. By using IPM we have been able to avoid problems which often plague non IPM users. In the future I will be following this proven formula, but still looking to rotate with any new IPM compatible products.

As part of our IPM we also spray the growth regulant, mepiquat chloride, which causes the plant to mature existing squares, flowers and bolls, and to decrease the amount of vegetative growth and late squaring. The treated crop is darker green, its foliage has a leathery feel and without late young growth the crop is less attractive to pests and has a more even finish.

The crops yielded 11 to 14 bales/ha in 2016/17, when the excessive and prolonged heat reduced all yields. In previous years we have had yields up to 18 bales/ha, which are way above district and industry averages. Yield has never been sacrificed by using IPM.

The years in the field have proven that when full IPM is practised the yields and quality of the crop are the highest, the maturity is the earliest and the costs are the lowest.

These results also show that agronomy and pest management are strongly linked. You cannot be a good pest manager without being a good agronomist. After establishment the cotton grower or manager should do everything to keep the plant growing at its maximum rate. Any stress is undesirable.

Sometimes you can be a poor pest manager, overspend on insecticides, get high yields and still be profitable, thanks to the plant breeders and the season, but in a tough season or when insecticide resistance increases or the price of cotton falls that plan doesn't work. In 2016/17 prolonged hot periods caused the industry average yield to fall by over 3 bales/ha while costs would have been above average for non IPM users.

By using Transform and oil we preserved every beneficial insect we could, we also tolerated early damage for as long as we could, saw the benefit of the oil in managing low populations of whiteflies, then finished the job with mepiquat chloride. It is a highly productive, low cost and repeatable system for managing insect pests in Bollgard.

By far the majority of growers, I suspect over 90%, use seed treated with either a neonicatinoid insecticide or add an organophosphate granular insecticide into the furrow when planting. Both insecticides are translocated through the seedling as it grows and are active for two to three weeks controlling wireworm and early season sucking pests, such as thrips.

Early thrip damage

The granular seed treatment gives longer control than the neonicatinoid and is usually, but not always, considered enough to promote growth to the first squaring stage.

Those advisors who consider that the level of control achieved by the pre-planting treatment is insufficient, usually recommend an additional foliar spray of either dimethoate or fipronil. These are by far the cheapest options and can be mixed with an early broadacre Roundup spray. It is a common practice and is at the heart of pest management problems.

Without thrips early mites can follow and these are usually sprayed with avermectin, a cheap miticide. Avermectin is also commonly added to later sprays of Regent and dimethoate targeting mirids, even though mites may not be present, because it is well known that these products suppress thrips and mite invasion usually follows.

I think mites are more common than most people realise. Like whiteflies and mealybugs, they can be common on garden ornamentals and vegetables where I suspect they are usually sprayed with dimethoate or a pyrethroid because these products are cheap and available in small volumes. The resistance of two spotted spider mite to avermectin is now up to 75% and 60% or more strains have some resistance (Cottoninfo fact sheet, November 2016). It is another example of why IPM is so important.

Without the insecticide treatment to cotton seed, thrip damage to seedlings in regions where there are large areas of cereals can be severe. However I am not totally convinced that we do not suffer and tolerate almost the same level of damage at St. George, where some of the photos were taken. I have considered a post emergence spray of Movento, which is used for thrip control in horticulture and suited to IPM. But at $23/ha for a 33% band it could only be justified if there was a very high probability that it would reduce or eliminate some other similar cost. We have to learn to tolerate thrips and promote seedling vigour by cultivation.

Silverleaf whiteflies and the solenopsis mealy bug were significant pests in 2016/17, particularly it seems in the areas where pyrethroids, fipronil and dimethoate were used to control Rutherglen bugs early in the season.

The cost to control whiteflies late in the season is $70 to $120/ha, depending on how many sprays are used. The mealy bug cannot be effectively controlled. A few years ago the whiteflies only reached pest status in the northern hottest cotton growing areas, but they are quickly adapting to cooler regions so have been observed and (pointlessly) sprayed on the Darling Downs in Queensland, in central and southern New South Wales and in Victoria.

In conclusion, there are no secrets to success. Everything we do has been demonstrated by research and repeatedly tested in the field. For successful IPM it is absolutely essential to preserve beneficial insects, and therefore to choose insecticides on the basis of IPM compatibility, not purchase price. There is nothing new about the notion that you get what you pay for.

In areas where thrips can reasonably be expected to reduce seedling establishment and there is not yet confidence in accepting some damage then using either of the two pre sowing insecticides is justified. It is the simplest, least cost, most effective nearest to full IPM solution available. The next objective should be to use cultivation to continue establishment, add paraffinic oil to Roundup sprays and not spray another insecticide until first squares appear and mirids are observed to be causing square losses.

There are so many beneficial insects and spiders in a crop and they are always on the job, if they are allowed to be. There will be different pests and different beneficials in other agricultural industries, but there are many common ones, such as ladybirds and spiders, and principles don't change. Ladybirds are amazing aphid predators. Transform and paraffinic oil are also very good aphicides. They are just two of the very good, well priced, IPM compatible products available for most crops.

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ENGINEERS MAKE WEARABLE SENSORS FOR PLANTS, ENABLING MEASUREMENTS OF WATER USE IN CROPS

PLANT SCIENTIST PATRICK SCHNABLE FROM IOWA STATE UNIVERSITY IN THE UNITED STATES QUICKLY DESCRIBED HOW HE MEASURED THE TIME IT TAKES FOR TWO KINDS OF CORN PLANTS TO MOVE WATER FROM THEIR ROOTS, TO THEIR LOWER LEAVES AND THEN TO THEIR UPPER LEAVES.

This was no technical, precise, poster talk. This was a researcher interested in working with new, low cost, easily produced, graphene-based, sensors-on-tape that can be attached to plants and can provide new kinds of data to researchers and farmers.

“With a tool like this, we can begin to breed plants that are more efficient in using water,” Patrick said.

“That’s exciting. We couldn’t do this before. But, once we can measure something, we can begin to understand it,” he added.

The tool making these water measurements possible is a tiny graphene sensor that can be taped to plants. Researchers have dubbed it a ‘plant tattoo sensor’.

Graphene is a wonder material. It’s a carbon honeycomb just an atom thick, it’s great at conducting electricity and heat, and it’s strong and stable. The graphene-on-tape technology in this study has also been used to produce wearable strain and pressure sensors, including sensors built into a ‘smart glove’ that measures hand movements.

Researchers describe the various sensors and the “simple and versatile method for patterning and transferring graphene-based nanomaterials” to create the flexible sensors in a paper recently featured in the journal Advanced Materials Technologies.

The research has been primarily supported by the Faculty Scholars Program of Iowa State’s Plant Sciences Institute.

Liang Dong, an Iowa State associate professor of electrical and computer engineering, is the lead author of the paper and developer of the technology. Seval Oren, a doctoral student in electrical and computer engineering, is a co-author who helped develop the sensor fabrication technology. Co-authors who helped test applications of the sensors are Patrick Schnable, director of Iowa State’s Plant Sciences Institute, a Charles F. Curtiss Distinguished Professor in Agriculture and Life Sciences, the Iowa Corn Promotion Board Endowed Chair in Genetics and the Baker Scholar of Agricultural Entrepreneurship, and Halil Ceylan, a professor of civil, construction and environmental engineering.

“We’re trying to make sensors that are cheaper and still high performing,” Liang said.

To do that, the researchers have developed a process for fabricating intricate graphene patterns on tape. Liang said the first step is creating indented patterns on the surface of a polymer block, either with a molding process or with 3-D printing. Engineers apply a liquid graphene solution to the block, filling the indented

patterns. They use tape to remove the excess graphene. Then they take another strip of tape to pull away the graphene patterns, creating a sensor on the tape.

The process can produce precise patterns as small as five millionths of a metre wide, just a twentieth of the diameter of the average human hair. Liang said making the patterns so small increases the sensitivity of the sensors.

"This fabrication process is very simple. You just use tape to manufacture these sensors. The cost is just cents," Liang said.

In the case of plant studies, the sensors are made with graphene oxide, a material very sensitive to water vapour. The presence of water vapour changes the conductivity of the material, and that can be quantified to accurately measure transpiration (the release of water vapour) from a leaf.

The plant sensors have been successfully tested in lab and pilot field experiments, Liang said.

A new three-year, US$472,363 grant from the U.S. Department of Agriculture's Agriculture and Food Research Initiative will support more field testing of water transport in corn plants. Michael Castellano, an Iowa State associate professor of agronomy and William T. Frankenberger Professor in Soil Science, will lead the project. Co-investigators include Liang Dong and Patrick Schnable.

The Iowa State University Research Foundation has applied for a patent on the sensor technology. The research foundation has also granted an option to commercialise the technology to EnGeniousAg, an Ames startup company co-founded by Liang Dong, Patrick Schnable, Michael Castellano and James Schnable, an assistant professor of agronomy and horticulture at the University of Nebraska-Lincoln, a collaborator on another Iowa State sensor project that sparked establishment of the company (and Patrick Schnable's son).

"The most exciting application of the tape-based sensors we've tested so far is the plant sensor," Liang said. "The concept of wearable electronic sensors for plants is brand new. And the plant sensors are so tiny they can detect transpiration from plants, but they won't affect plant growth or crop production."

But that's not all the sensors can do. The technology could "open a new route" for a wide variety of applications, the authors wrote in their paper, including sensors for biomedical diagnostics, for checking the structural integrity of buildings, for monitoring the environment and, after appropriate modifications, for testing crops for diseases or pesticides.

"The most exciting application of the tape-based sensors we've tested so far is the plant sensor. The concept of wearable electronic sensors for plants is brand new. And the plant sensors are so tiny they can detect transpiration from plants, but they won't affect plant growth or crop production."

Liang Dong

PAVING THE WAY TO CUTTING MARKET COSTS

Researchers have provided the most detailed map of routes and costings across Australia's entire agricultural supply chain, potentially saving the industry millions of dollars annually.

The CSIRO researchers have applied the logistics tool TraNSIT (Transport Network Strategic Investment Tool) to 98 per cent of agriculture transport across Australia including commodities such as beef, sheep, goats, dairy, pigs, poultry, grains, cotton, rice, sugar, stockfeed, horticultural and even buffalo.

The information was presented in the final TraNSIT agricultural report, released late in 2017.

Transport infrastructure is essential to moving over 80 million tonnes of Australian agricultural and horticultural output between farms, storage, processors and to markets each year and costs close to $6 billion annually.

The TraNSIT tool identifies ways to reduce travel distance and time, save fuel costs, cut down on wear and tear to vehicles, and produce and minimise stress for both truck drivers and livestock.

"Farmers will be saving money on transport as well as being able to deliver food to the market faster and with less damage and disruption," said Dr Andrew Higgins, the CSIRO's TraNSIT project leader.

"We expect these savings will eventually be passed onto the consumers," he added.

In 2013, CSIRO developed TraNSIT to provide a comprehensive view of transport logistics costs and benefits based on infrastructure investments in agriculture supply chains in Australia.

An initiative of the Federal Government's Agricultural Competitiveness White Paper, the tool was originally applied to the beef industry before being extended to all agriculture transport across Australia.

The first project under the $100 million Beef Roads program will be the sealing of 17km of the Clermont to Alpha Road in Central Queensland, which is due to start early next year.

The $8m works will improve road safety and access for oversize vehicles while reducing freight and maintenance costs.

Besides the latest TraNSIT agricultural report focusing on each agricultural commodity, it also features a flood case study and rail to road scenarios.

"Several case studies were identified by industry and government for this final report, representing TraNSIT's diversity of applications across Australia," Andrew said.

Researchers applied TraNSIT to evaluate the impact of road closures and detours on the transport of valuable crops and livestock during flood events, using Forbes in central west New South Wales as an important case study.

From early-September to mid-October 2016 severe rainfall caused extensive road closures throughout New South Wales, with Forbes becoming particularly isolated.

"The Forbes area is a diverse agricultural region of grain production, beef cattle, poultry, dairy and pigs," Andrew said.

"There was about a $2m increase in transport costs created by the short term and long term road closures from this flooding event, and about another 500 vehicle trips that could not occur as there was no alternative routes. The cost would have been even greater if the floods had occurred during harvest season where more cotton and grain are being transported in large volumes on the roads," he explained.

Using TraNSIT, researchers can analyse several ways to reduce the economic impact of floods in country regions and throughout Australia including upgrading or raising particular bridges to reduce the frequency of closures from flooding.

This will in turn reduce the occurrences where cattle or harvested crops cannot reach their market.

The rail to road hypothetical scenario looked at the impact of shifting all agriculture (grains, beef, sugar, cotton) that currently use rail to be road only.

Grains were more expensive ($208m) when transported by road, while cattle (or beef) was much less expensive (about 70 per cent less). These differences were primarily due to rail wagon capacity versus semi-trailer capacity.

TraNSIT is now being applied overseas, particularly in Indonesia, Laos and Vietnam to address supply chain inefficiencies and cross-border bottlenecks.

TAKE CONTROL OF FEED COSTS

Managing cattle through tough seasons can be emotionally and financially challenging.

However, according to Désirée Jackson, deliverer of Meat & Livestock Australia's (MLA) Nutrition EDGE course, there are practical strategies producers can employ to reduce stress, contain costs and improve animal performance.

"During the past six months many parts of northern Australia have experienced dry conditions, with pastures severely damaged by frost or small, ineffective falls of rain," she said.

"Pasture energy and protein may be insufficient to maintain animal body weight and condition score, so producers will need to consider feeding additional forage, providing energy supplements and implementing management strategies to ensure animals remain in saleable and/or breeding condition," Désirée explained.

Tactics such as early weaning, segregating breeders for preferential feeding and reducing stocking rates can all help, but Désirée believes early preparation is crucial in order to get a herd through in the best condition possible.

"If producers know the long-term historical green date for their area and if there's been no significant break beyond that, contingency plans need to be put in place," Désirée said.

"Even if it does rain after the production point date (which is approximately six weeks following the green date), producers should be aware their pastures will not produce the same bulk over the growing season," she added.

Désirée warned that, if cattle have been nutritionally stressed and are in low body condition, they are often at greater risk during the transitional period after rain. This is when the existing dry pasture has been rain-spoiled and new pasture is just emerging.

"Stocking rates need to be assessed and adjusted when carrying out a forage budget. The aim should always be to ensure there is sufficient roughage available going into the wet season," Désirée said.

"A diet quality analysis, best done when grass has gone to seed, is also useful to ascertain the balance between energy and protein so that the correct management, including the most appropriate supplement, can be determined. If energy is deficient and more limiting in the diet than protein, producers are less likely to get a response from urea-based supplements and may need to upgrade to an energy supplement, depending on the severity of the energy deficiency," she went on to add.

Be aware that urea-based supplements (including the energy-based, fortified molasses which contains urea) stimulate appetite, creating a comparative stocking rate increase of about 30%

Two simple strategies to manage feed costs:

1. Bring weaning forward

- Early weaning is an effective strategy for preserving cow body condition and cutting feed costs. Here are Désirée's recommendations for getting it right:
- When cow body condition is very light, wean down to 80kg and segregate weaners into weight groups of 100kg and under, 100–150kg and 150kg plus.
- Weaners under 150kg need quality forage, with adequate levels of energy and protein e.g. cereal hay, while very small weaners may need a grain-based supplement, but feed with caution.
- Weaners under 150kg that are not going forward are at significant risk of poor, long-term post-weaning performance.
- If young weaners are under stress or being fed in small yards, they may need a rumen modifier to prevent coccidiosis.
- The aim is to get small weaners into that next weight group where they are cheaper to feed, but still going ahead.

2. Determine foetal age at pregnancy testing

- According to Désirée, information provided by foetal ageing at pregnancy testing can be used strategically to minimise feed costs. Here's how to manage it:
- Knowing when cows are due to calve means producers can segregate breeders into those calving before the green date and those due to calve after. Costs can be reduced by feeding energy supplements to just the early calvers when it's required.
- Similarly, empty cows should be identified and, if a producer wants to keep them, they have the option of feeding them a cheaper, urea-based supplement (where effective) rather than the more expensive energy-based supplements.
- Maiden heifers should be managed separately, aiming to calve in body condition score of 3.5. This can be achieved by spike-feeding six to eight weeks before the start of calving. This helps minimise their post-partum anoestrous period and improves re-conception rates.

SCIENTISTS FIND EARLIEST EVIDENCE OF HUMANS ALTERING THE ENVIRONMENT

IN A PAPER PUBLISHED IN NATURE SCIENTIFIC REPORTS, RESEARCHERS FROM THE UNIVERSITY OF WOLLONGONG'S (UOW) SCHOOL OF EARTH AND ENVIRONMENTAL SCIENCES HAVE PROVIDED THE EARLIEST UNEQUIVOCAL EVIDENCE IN THE GEOLOGICAL RECORD OF A PROFOUND HUMAN EFFECT ON THE ENVIRONMENT.

The paper shows how soils have responded to natural climate variation over the past 12,000 years, and that human activity around 3,500 years ago disturbed this natural equilibrium.

The paper's lead author, UOW PhD student Mr Leo Rothacker, said soils are key components of ecosystems and vital to human societies, making it important to understand how they evolve through time.

"Soils are one of the most important components of the Earth's ecosystems. In order to sustain future soil resources, we must understand how soils respond to changes in climate and human land-use," Leo said.

"Previous studies have linked the downfall of civilisations to soil diminishment via accelerated erosion, which resulted in poor agricultural yields and might have caused wide-spread starvation. Our study provides the first evidence that this is exactly what happened in ancient Greece and Macedonia 3,200 years ago. Our data indicates that the human impact via agricultural practices was so dramatic that soils were completely stripped from the landscape," he explained.

"This could have contributed to the establishment of the Greek 'Dark Ages', a time where population declined rapidly, agriculture suffered, the metallurgy of bronze and the ability to write were forgotten," he added.

The researchers studied sediments deposited in Lake Dojran, a small lake that today straddles the borders of Greece and The Republic of Macedonia, to see how natural climate change and human activity had affected soils in the region over the past 12,300 years.

The sedimentary record revealed an unprecedented erosion event associated with the development of agriculture in the region between 3,500 and 3,100 years ago, indicating a transition from a natural to an anthropogenic landscape.

"Lakes are excellent archives to unravel the environmental variability in the geological past," co-author Dr Alexander Francke said.

“This could have contributed to the establishment of the Greek ‘Dark Ages’, a time where population declined rapidly, agriculture suffered, the metallurgy of bronze and the ability to write were forgotten.”

Leo Rothacker

Alexander said that in particular relatively small and shallow lakes such as Dojran are highly sensitive to environmental variability.

“Lake Dojran further benefits from the fact its catchment area is small, which provides a more direct connection between hillslope erosion and sediment deposition in the basin, and the local paleo-climatic conditions have already been extensively studied. This allows us to directly link erosion to climate and thus to unravel natural and human causes of accelerated hillslope erosion,” he said.

“Our evidences for dramatic erosion 3,200 years ago coincides with the first occurrence of cultivate plant taxa in the pollen record. This supports that humans removed trees at that time, to replace them by cultivated plants,” Alexander added.

He went on to explain that “climate variability cannot be invoked to explain these changes since no significant change in climatic conditions is known for this time interval, and we show that before 3,200 years ago, the response of soil erosion and development to climate change is very different to that what is observed at 3,200 years.”

Co-author and team leader Associate Professor Anthony Dosseto said the study provides evidence that the Anthropocene, a proposed geological period dating from the commencement of significant human impact on the Earth’s geology and ecosystems, began much earlier than its most commonly given starting point at the beginning of the Industrial Revolution. “Several propositions have been made for the onset of the Anthropocene,” Anthony said.

“Some have proposed that it started as early as the emergence of agriculture during the Neolithic Revolution around 12,000 years ago, however, supporting observations are scarce. Our study shows clear evidences that as early as 3,200 years ago humans modified their landscape so deeply that it is recorded in the lake sediment archives. This supports that the Anthropocene, and thus a deep human impact on the environment, started as early as a few thousand years ago,” he explained.

The research team is undertaking a similar study at nearby Lake Ohrid, with early results showing similar patterns to those seen at Lake Dojran. Anthony said the team would also study other sites around the world.

“We are applying the novel tools presented in our study to various locations around the world, including Australia and New Zealand. This will provide unprecedented insights on how soil resources respond to climate change, and how early humans have impacted their environment,” Andrew said in conclusion.

SOUTH AMERICA TO REAP BENEFITS FROM AUSTRALIAN BRED DURUM WHEAT

BY ANDREW SPENCE

THE FIRST COMMERCIAL CROP OF AN AUSTRALIAN DURUM WHEAT VARIETY THAT WAS UNSUCCESSFUL IN ITS HOME COUNTRY WILL BE HARVESTED IN CHILE IN FEBRUARY.

The licensing of the Yawa variety was finalised in a deal between the University of Adelaide and Chilean seed company Isopro in late 2016.

The Yawa variety of durum wheat, which is mainly used to make pasta, was first bred by the late Professor Tony Rathjen and Dr David Cooper at the University of Adelaide's Waite Campus. They worked in conjunction with co-investment partners Grains Research and Development Corporation and the New South Wales Department of Primary Industries. Yawa was released in Australia on September 4, 2012.

However, its small grain size in dry years meant it was not suitable to the often harsh southern Australian conditions, and it has since all but vanished from the market. A 50 gram sample of Yawa seed was sent to Chilean researchers at Isopro and the University of Talca under a material transfer agreement in 2012.

Plentiful water from the Andes and slightly cooler growing conditions allowed Yawa to thrive under irrigation in Chile, outperforming local varieties by up to 40 per cent in trials. The Chilean trials over four years have achieved yields of up to 11.6 metric tonnes per hectare, 1000 grain weight (TGW) of up to 53, Color b* consistently between 30-32 and protein levels up to 12.2 per cent.

Isopro founders Stuart Thomas and Sergio Rojas said Yawa had consistently out yielded all other varieties in the trials, on some occasions by up to 40 per cent. Stuart said it had also proved far superior to local varieties for black point resistance and in overall quality.

"We are absolutely thrilled with Yawa and the excellent yields it manages to achieve over here. With Yawa, our ultimate goal is to increase the area under durum production and destine that production to other South American countries, either as grain or semolina," Stuart added.

Durum wheat breeder Associate Professor Jason Able from the University of Adelaide's School of Agriculture, Food & Wine has built the relationship with Isopro since 2012. He said conservative business projections showed royalties, paid at the rate of AU$4.50 per metric tonne of grain, could reach $500,000 a year within seven years.

The university sent one tonne of pure seed to Isopro in 2016, which produced 32 tonnes of seed in February 2017. That seed was all sold to growers who are expected to harvest about 1200 tonnes in the coming months.

"Of this, about 800 tones will be sold to local mills and 400 tonnes kept back for seed with a potential to produce a lot more the following year. Where Isopro want to get to is they want to be able to export into Peru and Colombia because they are big buyers of durum from Canada or Mexico. Those pasta companies there have had discussions with Isopro and are quite excited by what they've seen with Yawa," Jason said.

Jason said there were strict rules around the Yawa licence, which meant the durum could only be grown in Chile and the grain or semolina sold in South America. "We didn't want to see competition against Australian growers in a situation where if it really took off and they wanted to export it to Italy then that would be directly competing with our growers, which is not on," Jason explained.

Chile has only become a self-sufficient durum producer in recent years and reaps about 145,000 tonnes a year. Isopro is hoping the

“Our ultimate goal is to increase the area under durum production and destine that production to other South American countries, either as grain or semolina.”

Stuart Thomas

yield and quality benefits will quickly convince existing growers to switch to Yawa and also lure new growers into the industry. Outside of Chile there is very little durum grown in South America with the bulk of pasta made from grain imported from Canada or Mexico. Peru imports about 300,000 tonnes of durum, Colombia 150,000 tonnes and Bolivia and Equador some 50,000 tonnes each year.

“There’s this golden opportunity for Isopro to really take a step up and dominate some of the market share if they can get a substantial number of growers to produce enough grain to be milled and distributed around these other South American countries,” Jason said. He has visited Chile to conduct an audit of Yawa plantings and speak with growers about farming techniques to maximise protein levels in the durum.

Global durum production is typically between 30 and 40 million metric tonnes a year. Australia exports a little over half of the 500,000 – 600,000 tonnes of durum wheat it grows a year. But it is the high quality of the grain, including protein levels consistently greater than 12 per cent that has Australian durum in demand globally.

The durum breeding program at the University of Adelaide has ongoing support from many industry stakeholders with major co-investors including the Grains Research and Development Corporation (GRDC), South Australian Grain Industry Trust (SAGIT), pasta company San Remo, Southern Australia Durum Growers Association (SADGA) and the NSW Department of Primary Industries.

The university has bred many varieties in recent years including DBA-Aurora in 2014, which has been a step-change variety and one in which has been hailed as a ‘turning point’, particularly in the southern region of Australia. When compared to older varieties, Aurora has led to significantly increased yield potential in more non-traditional areas, greater resilience to disease and cemented Australia’s durum among the highest quality in the world.

AT LAST, A NEW PERENNIAL RYEGRASS THAT DELIVERS MOST OF ITS IMPROVED FORAGE YIELD IN THE AUTUMN AND WINTER.

What happens when some of the world's best plant breeders, entomologists and pathologists work together for multiple years to improve perennial ryegrass varieties to best suit the needs of Australian conditions, producers and livestock? They 'hit the spot' with a strongly performing, high yielding new variety, that's what. One that delivers its improved forage yield just when its needed most.

The culmination of a decade of breeding, development and regional screening in Australia, the introduction of SF HustleAR1 from Seed Force offers Australian farmers a new generation perennial ryegrass that clearly differentiates itself from what is currently available.

In fact, SF Hustle AR1 has proven to perform at the highest level in both internal Seed Force and independent PTN trials to be released via the PTN website, and is to be included in the Dairy Australia Forage Value Index.

The SF Hustle AR1 story is an interesting one, with several 'chapters' leading to its recent commercial release.

Seed Force was established in 2006 to enable access to genetics from RAGT, one of Europe's leading plant breeding companies. Under the joint venture, Seed Force has imported new breeders' lines and commercial varieties for testing in Australia.

Whilst many of the varieties of some species imported by Seed Force have shown industry best performance, all early perennial ryegrass material lacked winter activity so important to Australian livestock producers.

They did, however, show best pasture quality through their growing season, and good persistence in the absence of endophyte.

This spawned a dedicated breeding program where the best performing varieties from Australia and New Zealand were sent to France where they were monitored closely in nurseries, and then introduced into some crosses with the best French material. This enabled access to the high-technology capacity of RAGT's breeders, entomologists and pathologists, who were all involved in the screening and development of the program.

Those crosses were then evaluated in Europe, Australia and New Zealand and some combinations of the best crosses were made. During the process the AR1 endophyte was bred into those combinations which became new breeder's lines.

Of the resultant lines, the first to be released is SF Hustle after undergoing rigorous trialling in Australia.

It was initially included in the internal Seed Force trial at Warrnambool sown in 2014, then in a trial managed by AgriResults at Penshurst sown in 2015, four independent PTN trials sown at Howlong, Ballarat, Terang and Cressy Tasmania in 2014, and further PTN trials sown in 2015, 2016 and 2017.

What the results show is that SF Hustle offers Australian livestock producers a high yielding perennial ryegrass with the safe grazing AR1 endophyte proven to deliver higher milk production than some other endophyte types.

What's more, AR1 is the only novel endophyte safe for grazing by horses.

Importantly, SF Hustle's forage yields and persistence are better than all other AR1 varieties and similar to the best varieties with any endophyte combination.

Its real advantage, however, is the fact it delivers most of its improved forage yield in the autumn and winter, the two most critical seasons for perennial ryegrass in Australia.

It is a diploid perennial ryegrass with mid-late maturity, flowering some 10 days later than Nui.

Seed Force shareholder and pasture seed industry icon David Gould is excited about the potential of this new variety.

"I have waited 12 years from the inception of Seed Force to have a perennial ryegrass variety that I can have confidence in to deliver significant benefits into the southern perennial ryegrass market. I have watched this line through its development, and internal trialling and am pleased that the independent trials have now confirmed its performance as one of the industry's best," David said.

"Every time I have taken people across our internal trials sown and managed by Eurofins, they all comment on the plots of Hustle," he added.

Seed Force will have limited quantities of SF Hustle in 2018 through its specialist retail seed agents.

IT'S TIME FOR EVERYONE TO LIFT THEIR GAME AROUND SPRAY DRIFT IN COTTON

It is said that good fences make good neighbours. If only life were that simple in the farming game. Cotton growers in New South Wales certainly wished that was the case over the recent summer holidays.

Collaboratively, damage from a single spray drift incident on Christmas Day, is estimated to have cost growers millions.

The even more disturbing aspect to this story, particularly to those who are unaware of the phenomenon of spray drift, is the fact that the offending chemical is thought to have travelled over 70kms before settling and doing its work.

Sadly, this is not the only spray drift story for the 2018 crop. Reports have now been received in most of Australia's cotton growing valleys.

All of this is despite the best efforts in advertising, advocacy and information sharing by Cotton Australia, CRDC, CCA, researchers and media. Why is this still a problem?

The bigger picture is that we all need to keep in mind however that spray drift does not only affect cotton, nor is it only 2, 4-D that will drift. Other crops, grazing land, communities, waterways and of course bees can all potentially be impacted by both on and off target spraying, no matter what the active ingredient or purpose of the spray.

Anyone in the farming game is responsible - ethically, financially and environmentally - to ensure that they are adopting best practice in their planning and execution of spray application of all chemicals. This is an issue that has the potential to do major damage to reputation and 'social licence to operate' of all involved in Australian agriculture.

With all of the science and understanding that we now have around inversions, and the brilliant online mapping tools available to us such as CottonMap and BeeConnected, how is that spray drift continues to make headlines? Is it apathy? Is it ignorance? Or, is it just a stubborn reluctance to accept the science and continue with age old routines of spraying at night and in the early morning when it is 'still and safe'?

In the not so distant past, it would have been difficult to accept, let along prove, that spraying a field on Christmas day could impact a crop 70 kms away. As long as your neighbours were happy, you had a safe and successful spray. This however, could be a big part of issue.

While it may seem to many of us that this is an old and tired issue, spray drift (particularly that related to cotton damage) is in fact and evolving and shifting one.

With more and more cotton being grown in traditional sorghum cropping areas, operators who may have been 'getting away' with less than best practice, and didn't consider that the spray drift message was relevant to them, are now finding themselves in hot water.

Additionally, as our understanding of suitable spray conditions increases, operators are having to spray their required hectares within a much shorter safe window. For many who are still using older spray rig technology, this is simply not achievable and will require significant financial outlay to upgrade.

As an industry, we need to combine to continue to share the message of safe spray practices, and ensure that it is not just cotton that we keep front of mind in this discussion.

Constructive and positive discussions about best practice need to continue, particularly in public forums such as social media, to ensure the broader public is clear that the issue is being addressed in a proactive manner by industry.

The message is pretty clear:

- Don't spray Group 1 herbicides at night (or early morning)
- Don't use LVE in summer
- Don't go 'off – label'

There is so much valuable information out there. Perhaps we still need to challenge some old thinking in order to get the message out to those who are just not listening, or just haven't had to listen in the past.

For more information visit cottonaustralia.com.au/cotton-growers/phenoxy-protection for CottonMap and best practice guides, and beeaware.org.au/pollination/beeconnected for Bee mapping.

AUSVEG JOINS THE NFF HORTICULTURE COUNCIL

Peak industry body AUSVEG has applauded the formation of a united Horticulture Council to ensure that the interests of the Australian horticulture industry are effectively aligned with the National Farmers' Federation (NFF).

The Council will work with the NFF to ensure that the issues that are affecting Australia's horticulture growers are seriously considered as part of the national agricultural advocacy agenda and to better articulate industry concerns so that the NFF can support a more horticulture-focused message to government.

The Council will be represented by horticultural commodity groups AUSVEG, the Australian Blueberry Growers' Association, Apple and Pear Australia Ltd, Dried Fruits Australia, Voice of Horticulture (representing its 21 members) and Summer fruits Australia Limited. The Victorian Farmers Federation, NSW Farmers and Growcom will also be represented on the policy forum.

AUSVEG CEO James Whiteside said that while AUSVEG will continue to advocate independently on a range of issues, having a mechanism for unified advocacy for all Australian agriculture, including horticulture, will increase the effectiveness of representation on cross-industry issues.

"Commodity groups in Australian horticulture do not exist in isolation. What affects vegetable growers also affects apple growers, blueberry growers and all other horticulture producers," said James.

"Yet despite there being a significant number of common issues, the horticulture industry has traditionally been highly fragmented. This has been reflected in its advocacy efforts, and has meant the industry has not been as effective as it could be when representing growers. By working with the NFF to establish a unified voice, we'll be able to speak louder and be heard more clearly in Canberra. This will help us support our growers in tackling the major issues that weigh on our sector, like access to reliable sources of labour and water," explained James.

"Through the collection of horticultural members on the Council, the NFF will also develop a deeper understanding of the priority issues that affect horticulture growers to ensure effective representation. The Council will be committed to providing robust and constructive feedback on the NFF's advocacy efforts so that our growers can get the best possible representation," he added.

Organisations that have joined the NFF Horticulture Council have signed an official Memorandum of Understanding agreeing that the forum was established to 'strive for more efficient, effective, cohesive horticulture policy and advocacy that affects all Agriculture at the national level'.

Coinciding with this recent announcement, AUSVEG is also significantly increasing its advocacy activities by appointing Tyson Cattle to the role of National Manager – Public Affairs. Mr Cattle, who until recently was the editor of the Fairfax publication Stock and Land, will focus on building strong, fact-based cases that AUSVEG will take to government and other stakeholders to advance the issues that are impeding the growth and prosperity of growers.

FUNDING TO HELP VICTORIAN FOOD BUSINESSES INNOVATE

Businesses in Victoria's agriculture and food sector can now apply for funding to access the know-how they need to take new products to market.

The new Food Innovation Voucher Program is part of the Victorian Government's Boost Your Business initiative, aimed at helping businesses innovate, diversify, improve productivity and employ more people.

Agriculture Victoria Program Manager, Will Dalton, said these vouchers prioritised businesses in the food supply chain and made up to $10,000 available for early stage feasibility and testing of ideas, and up to $50,000 for research and development, process innovation, product development, market positioning and labelling.

"For example, a food manufacturer might want to align their products with national nutrition guidelines so they can be sold in vending machines in venues such as hospitals and sport centres," Will said.

"The company knows that because of the long shelf-life needed to sell food in vending machines, very few products meet health food requirements. They could apply for a Food Innovation Voucher to find and work with a food technologist to help them develop an innovative dip and cracker product which meets these health food requirements and can be dispensed from a vending machine," he went on to explain.

Will said the vouchers could also be used to access facilities, services and advice from Registered Service Providers such as the CSIRO, universities and industry facilities.

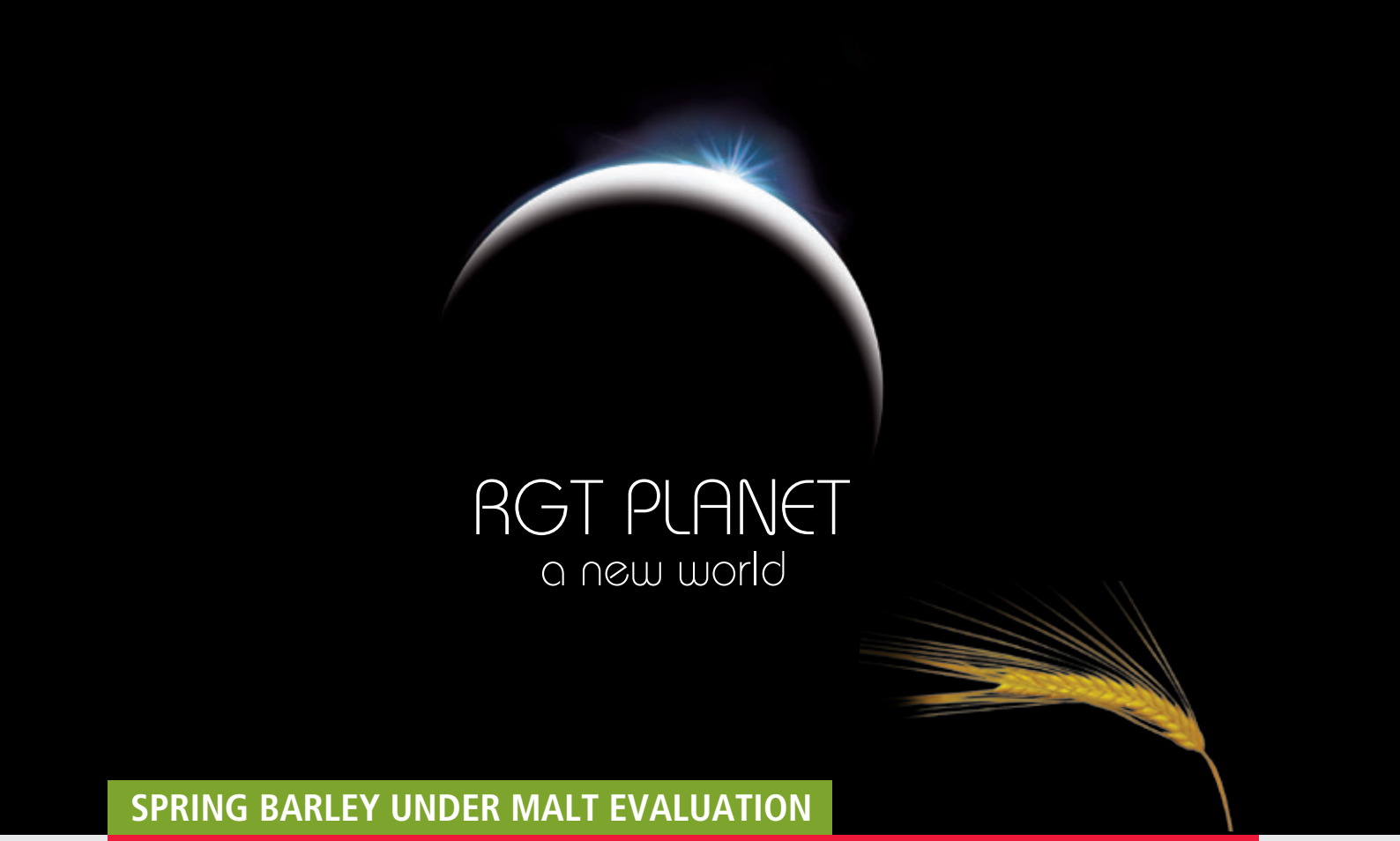
"The Victorian Government is confident this initiative will help local businesses find ways to add value to their products, boost production levels and better meet consumer needs," he added.

Will said there are also three other vouchers available; Advancing Victorian Manufacturing, Social Enterprise Capability, and The Asia Gateway stream.

The voucher program is open to small to medium sized enterprises in the agriculture and food value chain with an operating presence in Victoria. Upon application, businesses will also be registered as members of the Food Innovation Network, an online network linking industry with innovation services and capabilities, to drive innovation and problem-solving.

The first round of the voucher program closes on 2 March and interested business should speak to a registered service provider before starting the application process.

To view the list of service providers and program guidelines, or to apply, visit business.vic.gov.au/foodinnovation or call 13 22 15.



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ARYLEX™
ACTIVE

NEW Pixxaro Herbicide with Arylex active is registered and available for the control of marshmallow, thistles and other hard to kill weeds.

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