AUSTRALIAN GRAIN

www.ausgrain.com.au
January–February 2019

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Published by Berekua Pty. Ltd.,
40 Creek Street, Brisbane
Registered by Australia Post Publication No. PP100002295. ISSN 1449–2970.

Published bi–monthly.
Grain Yearbook published in April

FRONT COVER

The main limiting factor in the production of crops in northern Kazakhstan is moisture. The average yield of cereals is around 1.2 tonnes per hectare. Similar moisture limitations and yield variations exist in Australia. But some R&D and machinery from Australia is creating great interest among Kazakh farmers. Pictured is co-author Medina Brimzhanova.

Contents

Focus Sections

Southern Australia Focus

Covering cropping systems of Southern NSW, Victoria, South Australia, Western Australia and Tasmania

Northern Focus

Covering Northern NSW and Queensland

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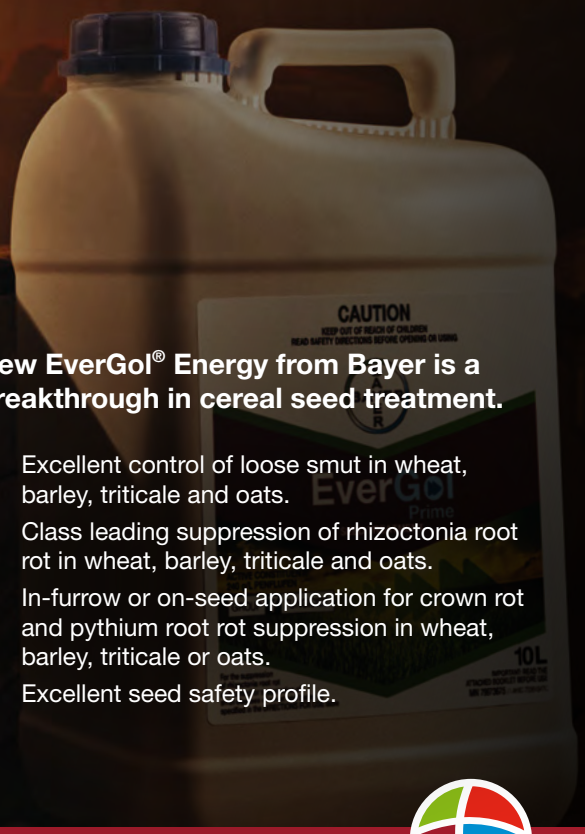

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UPL

Editorial... Lloyd O'Connell

THE world's commercial grain producers first had widespread access to synthetic pesticides during the 1940s and 50s – the beginning of the 'pesticide era.' Today, around 80 per cent of the synthetic pesticides used on-farm around the world are herbicides aimed at weed control. Almost 50 years ago Roundup (glyphosate herbicide) hit the scene. And if you were to run 'pub tests' in any grain-belt community around the world, chances are that most farmers would view glyphosate as the best and most valuable herbicide they have ever had. They'd love to keep it that way – but glyphosate is under attack from a number of flanks.

On-farm, resistance levels are rising but this is very much a winnable battle for farmers by way of smart and responsible herbicide application strategies. It's the on-going attacks being launched from off-farm which are more difficult to counter. In Europe in 2017, the EU regulatory authorities – after intense pressure from a number of activist and environmental groups to ban the product outright – approved the use of glyphosate until 2022 when its on-farm use will again be reviewed. In the highly litigious US, the headline catcher has been the ongoing DeWayne Johnson vs Monsanto case where a jury found in favour of the school groundsman and awarded him $US289 million in damages for terminal cancer he claimed was caused by glyphosate. Apparently, there are hundreds of anti-glyphosate cases waiting to be heard by juries throughout the US.

A decision by the *Health Canada* authority released in January probably gives some much-needed perspective to the glyphosate question. *Health Canada* has completed a review of eight objections which had been lodged against their 2017 decision to approve continued use of glyphosate in Canada. After a thorough and rigourous scientific review, *Health Canada* concluded that the concerns for human health and the environment raised by the objectors could not be scientifically supported. And to get to the real nub of it, *Health Canada* stated that: "No pesticide regulatory authority in the world currently considers glyphosate to be a cancer risk to humans at the levels at which humans are currently exposed."

Agriculture worldwide is very much in the era of pesticides. But we are also in an age where everyone has a soapbox for the production and consumption of information – a lot of which makes its way into the public domain with little or no credible basis or scientific rigour. For farmers to continue to do what they do best – produce affordable and sustainable food and fibre for the world – the techniques and inputs they use on-farm must meet measurable scientific and environmental standards and not the demands of the ill-informed.

I'll keep North Queenslanders out of this wish, but here's hoping some much needed rain makes its way to you soon.

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In this issue...

JOHN DEERE

PRECISION HARVESTING.

DOES IT HAVE THE INTELLIGENCE TO MAINTAIN OPTIMAL SETTINGS AS CONDITIONS CHANGE?

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ASK AN EXPERT – HOW CAN I MANAGE SUMMER WEEDS WITHOUT SPRAYING AT NIGHT?

■ With Mary O'Brien, private consultant

THE recent changes to 2,4–D label instructions have re-focussed attention on the need to avoid night spraying, particularly after 10 pm through to after sunrise. Concerns are being raised about the practical implications of this for summer weed control programs.

Mary O'Brien, a private consultant with extensive experience in managing spray drift, is keen to see growers fully adopt spray application practices that maximise herbicide efficacy and minimise off-target drift.

"The bottom line is that allowing spray to drift is like burning money," she says. "Any product that doesn't hit the target is wasted and the efficacy of the spray job is reduced, mildly resistant biotypes may survive as a result of low dose application and there is potential damage to sensitive crops and the environment."

"The difficulty is that many growers want to spray at night to cover more ground when conditions are cooler and potentially weeds are less stressed. Having a restriction on night spraying does restrict the time available to cover the areas required."

Having heard these concerns from growers across the country Mary keeps coming back to the fact that if there was a limitation to capacity at planting or at harvest, growers would scale up to get the job done in a timely manner.

"Buying another spray rig or employing a contractor is an additional cost, especially after a couple of tough seasons, but I really think this is insignificant against the cost of losing key products and the resultant escalation in herbicide resistance to the remaining herbicides," says Mary. "This problem is not confined to 2,4–D or even to herbicides. I recently spoke to a stone fruit grower who was forced to dump his whole crop after a positive MRL return for a fungicide he had never even heard of, let alone used."

What about just slowing down and lowering the boom during night spraying?

Short answer: This, coupled with a good nozzle, will reduce drift but it will never eliminate it.

Longer answer: The correct ground speed and boom height will have a large effect on the amount of product that remains in the air. The problem is that it only takes one per cent of the product remaining in the air to cause off-target damage.

Once there are a few operators putting just one per cent of their product in the air at the same time, the amount of product quickly accumulates and can potentially be very damaging. Mary calls this 'community drift'.

Isn't it better to spray weeds at night when it's cooler?

Short answer: Not really.

Longer answer: Research by Bill Gordon showed that even if you keep everything else the same, night spraying can

Mary O'Brien says the 'community drift' that can occur when a number of applicators are each putting a small amount of product in the air at the same time, can have very damaging effects on off-target sites.

Temperature inversion conditions are more common at night and in the early morning. These conditions generate a laminar flow of air across the landscape, allowing small droplets to travel many kilometres away from the target site before coming to ground.

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The smoke moving parallel to the ground indicating inversion conditions.

put at least three times more product in the air than daytime application, even if weather conditions are similar and there is no temperature inversion in place. The main difference between day and night is how the wind is moving across the landscape, rather than the wind speed.

Under inversion conditions, the air moves parallel to the ground surface and this means that the product can move significant distances away from the target before coming to the ground.

To achieve the best results through daytime spraying, applicators should focus on treating small, actively growing weeds. When there is good soil moisture, weeds are unlikely to be stressed even when the temperature is quite high.

Can I use other products at night and just avoid using 2,4–D?

Short answer: The current changes to 2,4–D labels has drawn a lot of attention but the problem is the same for all crop protection sprays – herbicides, fungicides and insecticides.

Longer answer: Different products have different properties and some may work better at night but the problem is the sensitivity of some crops to certain products, such as 2,4–D. All products are tested for their efficacy and the label provides detailed information about the required spray quality and spray application conditions. Many products have explicit label instructions regarding wind speed, temperature inversions (or laminar flow) and night spraying.

Given the high risk of drift at night, applicators need to be very confident that there is no inversion present, and weather conditions should be measured at least every 15 minutes to ensure wind speed remains above 11 kilometres per hour. An on-board weather station is the best way to monitor conditions.

What can I do to improve spray efficacy and avoid spray drift?

Short answer: If you do just one thing – change your nozzle.

Longer answer: All the factors that increase drift also reduce efficacy. To improve efficacy and reduce drift, use a better nozzle (larger spray quality) and appropriate water rates (matched to spray quality and stubble load), slow down and keep the boom low. Wind is required to push product downward and onto the target, and remember that the 3–15 km per hour wind speed is for day time conditions only, this does not apply at night. ■

HOW TO ASK A WEEDSMART QUESTION

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A new target-site mutation for glyphosate resistance discovered

By Cindy Benjamin

IN 2016, *Tridax procumbens* became the 13th species to be placed on the Australian list of glyphosate-resistant plants. The resistant population was collected from a sandalwood plantation in the Ord Irrigation Area of Western Australia where a bare earth herbicide program, based on routine and regular glyphosate use, had been practised for many years.

Anyone researching herbicide resistance mechanisms knows that glyphosate target-site resistance is most commonly associated with the EPSPS (5-enolpyruvylshikimate-3-phosphate synthase) Pro-106 site mutation. Recent research out of AHRI has demonstrated that resistance can be endowed through a variation at the Thr-102 site, without any variation at the Pro-106 site.

AHRI's principal research fellow, Dr Qin Yu (pictured), in collaboration with other international researchers, has demonstrated that in Tridax daisy, glyphosate resistance is associated with the Thr-102 site mutation alone. In contrast to earlier investigations with goosegrass – where both the Pro-106 and Thr-102 sites (TIPS) mutation endowed glyphosate resistance – this study has demonstrated that selection for a mutation at Thr-102 alone can lead to moderate level glyphosate resistance in the field.

Known as coat buttons or Tridax daisy, *T. procumbens* is native to the Americas and is a common weed in the tropical to subtropical regions of Queensland, the Northern Territory and Western Australia where it invades pastures, crops, bushland and my lawn!

Like many other species that are regarded as 'hard-to-kill' with glyphosate, Tridax daisy is naturally quite susceptible to glyphosate when it is in the small seedling growth stage. Once the plant matures and the taproot establishes, this species is known to be hard to control in the field.

This natural tolerance at the later growth stages is assisted by the lower efficacy of glyphosate when applied in tropical summer conditions of northern Australia.

A nice photo of a not so nice weed (*Tridax procumbens*).

AHRI's principal research fellow Dr Qin Yu.

Gene sequencing revelations

Now that gene sequencing is relatively cheap, researchers are able to analyse much larger sequences and compare the genetic codes for susceptible and resistant biotypes. With more than 1500 base pairs in the EPSPS gene sequence, researchers generally expect to find the genetic difference between the susceptible and resistant populations at the amino acid position 106. In this resistant Tridax population, sequencing revealed a point mutation (ACC to TCC) at amino acid position 102, resulting in a rare Thr-102-Ser substitution.

This Thr-102-Ser substitution weakly decreased EPSPS affinity to glyphosate, but sharply increased EPSPS affinity to the natural substrate, PEP (phosphoenolpyruvate).

The resistant Tridax takes advantage of these dual mechanisms of reducing glyphosate binding and favouring PEP binding to EPSPS, rendering the herbicide ineffective.

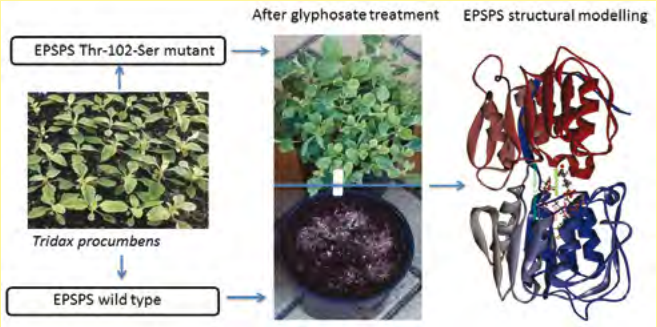
Does low-level mean no worries?

The glyphosate-resistant (R) *Tridax procumbens* population was collected from tropical Kununurra, Western Australia, in 2014, and the susceptible (S) population was collected from Queensland in 2016 from an area with no previous exposure to glyphosate.

Tridax daisy can be both self or cross-pollinated, so with continued glyphosate use, a population of this weed could potentially accumulate multiple glyphosate-resistance mechanisms – a phenomenon that has been documented in other weed species.

At the two- to four-leaf stage, the resistant and susceptible Tridax seedlings were treated with various rates of glyphosate and plant mortality was determined three weeks after treatment.

FIGURE 1: Comparing the genetic codes for susceptible and resistant Tridax seedlings



Plants that produced no new growth after treatment were recorded as dead.

At a field application rate of 450 grams per hectare glyphosate, the S population was well controlled with no survivors.

In contrast, 95 per cent of the plants from the R population survived this glyphosate rate and were only controlled at a rate of 1620 grams or greater per hectare.

On the basis of the glyphosate LD50 ratios in the R versus S populations, the resistance level is estimated to be a moderate 3.2-fold (lethal dose).

Although only a moderate level of resistance is endowed via selection for Thr-102-Ser substitution, there appears to be no associated fitness penalty. This means that simply removing glyphosate from the herbicide program will have little effect on the survival of this biotype. In some other resistance scenarios, even high-level resistance can be associated with a strong fitness penalty, making the population more susceptible to crop competition in the absence of the herbicide in question.

So what's the problem – why not just up the rate?

The problem is because the R and S individuals look exactly the same, the only hint that there is selection for resistance is the incremental increase in survival. Often the response to this is to ignore it for a while and then to start stepping up the herbicide rate. Incremental increases to the rate are very unlikely to provide 100 per cent control so the result is further selection for resistance until the highest legal rate is no longer effective.

How to beat a resistant weed population

Although resistance to glyphosate at the two- to the four-leaf stage was confirmed in this population from Kununurra, the plants were still susceptible to another six commonly used herbicides when tested at the recommended field rates.

As always, diversity is the answer! The sandalwood plantation owner still has the option to use any of these six modes of action – metribuzin, atrazine, diuron, paraquat, bromoxynil + pyrasulfotole and 2,4–D – to control this glyphosate-resistant population of Tridax.

This rare Thr-102-Ser substitution would not likely have achieved dominance in the population if a more diverse herbicide program had been implemented.

This international research was funded by the China Scholarship Council (CSC, No. 201508430078), the National Natural Science Foundation of China (NNSFC, No. 31501661), and the Australian Grains Research & Development Corporation. It is the result of research conducted by Jingbo Li, Qiong Peng, Heping Han, Alex Nyporko, Tymofii Kulynych, Qin Yu and Stephen Powles.

This research was published in the *Journal of Agricultural and Food Chemistry*. ■

Global strategies to combat antibiotic and pesticide resistance

By Kate Langford, CSIRO

RESISTANCE to antibiotics and pesticides (known collectively as biocides) is rising at alarming rates. Doctors are seeing more patients with untreatable infections and in some areas, farmers are unable to kill off weeds and insects that reduce their crop yields. Despite this, there is no global framework to track the threat to human health and crops.

To start addressing this gap, a group of researchers across the globe, including our Senior Principal Research Scientist Dr Sharon Downes, have worked out the estimated antibiotic and pesticide 'planetary boundaries.' If resistance to antibiotics and pesticides goes beyond these boundaries, societies risk large-scale health and agricultural crises.

When it comes to antibiotic resistance, alarmingly, the study found that one group of bacteria: Gram-negative bacteria – which includes well-known pathogens such as Salmonella, Klebsiella pneumoniae, and E. coli – are already beyond the 'planetary boundary', as some species are already resistant to all or most antibiotics tested.

Lead author of the study, Søgaard Jørgensen, from the Royal Swedish Academy of Sciences and Stockholm Resilience Centre believes it is unlikely we will be able to reverse the spread of resistance.

Crop that

Sharon Downes' work in this study focussed on pesticide resistance in broadacre cropping. For several years, Sharon has been working with the cotton industry in Australia to better manage the key insect pests which reduce yields. The majority of cotton varieties now grown in Australia (known as Bt cotton) have in-built protection against their major nemesis, the cotton bollworm.

While this has greatly reduced pesticide use (by at least 85 per cent) and its associated detrimental impacts on beneficial animals such as pollinators, it has given rise to new concerns.

Sharon and her international colleagues have found that in some regions of the world, there is already widespread resistance to the Bt toxins that have been bred into current cotton varieties. However, despite detecting relatively high starting levels of resistance in the insects in Australia to two of the three toxins that are in the current types of Bt cotton, the resistance hasn't spread to-date.

Resistance to cotton bollworm (*Helicoverpa armigera*) is being controlled in Australia through world-leading strategies.

Sharon Downes, Principal Research Scientist at CSIRO, has been tracking resistance by cotton bollworm to Bt cotton in Australia for over 15 years.

Sharon attributes this to the robust strategies that she developed with colleagues and industry stakeholders which obliged Australian cotton growers to steward Bt cotton since it was introduced in the mid-1990s.

The strong communication and social networks across the Australian cotton industry are also critical for enacting good stewardship and thwarting resistance.

The Australian industry has in place strategies for Bt cotton that are considered world-leading in reducing the risk of the spread of resistance.

Stop resisting

One of the strategies is getting cotton growers to set aside areas among their crops where they grow cotton plants that don't have in-built toxins. In these areas, susceptible insects, i.e. those that are not affected when they eat the toxins, are able to thrive. This strategy has a muting effect on resistance because the resistant insects interbreed with susceptible insects.

The impact of preserving susceptibility to Bt cotton is that there is almost no need to apply insecticide sprays to control the cotton bollworm in this crop. This has the flow on effect of also preserving beneficial insects, like spiders and parasitoids (insects whose larvae kill their hosts), which can further help to control the bollworm and a range of other crop pests.

Fight bacteria with bacteria

Attempts to wipe out all bacteria and pests will not help with the problem of resistance. These approaches undermine the benefits we receive from nature.

In our fight against resistance we actually need to build up the number of bacteria and insects that are susceptible to pesticides and antibiotics in the same way that Sharon and her team have been recommending for Australian cotton farming.

Global movement and trade is creating a world where increasingly everyone is fighting the same biota using the same methods and selecting for the same global resistances. This means that to be truly effective, strategies to preserve susceptibility need to be used everywhere.

It's no longer enough to be good stewards of technology only in our own backyard. ■

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Field day frivolity

By Ian M. Johnston

A few weeks ago I drove over the hills to that magnificent city of Orange. Its elevation results in oft chilly weather, which to an old Scotsman raised in Fife, actually has a certain appeal. But it is not just the attraction of the climate which lures me to Orange. It is the anticipation of visiting Australia's longest running annual agricultural field event – The Orange Field Days. This magnificent spectacle is truly a shop window featuring the latest and greatest variety of every conceivable item for folk on the land, ranging from giant high-tech tractors to horse rugs and everything in between.

I confess to having fond memories of the field days. During the second half of the 1950s, during my period as the Factory Field Representative employed by Lanz Australia, I was a regular exhibitor at the Borenore site. It was often stated that when I fired up a Lanz Bulldog, its thumping could be heard all around the ground and the resulting smoke, belching from its semi diesel two stroke single cylinder engine, for a while blotted out the sun. Well, that's what the Fordson guys said anyway. I guess they might have felt a bit peeved, owing to the fact that farmers often kept walking past the Fordson stand on their way to stare goggle eyed at the unconventional Bulldogs.

The frightfully decent chap

Back in the 1950s the site was actually a short distance from its present location. Tractor exhibitors were encouraged to enter their machines in side by side tractor ploughing demonstrations. Thankfully this was actually a test of the tractors, rather than the ability of the operators to plough a geometrically perfect furrow. Plus the tractors involved were all similarly powered, averaging 50 hp and typical of the volume selling examples of the era.

I lined up one of the recently introduced Model H Bulldogs in preparation for the commencement of the ploughing. On one side was a David Brown Cropmaster being driven by a senior executive type, who was the epitome of a frightfully 'decent' posh English chap, attired as if he was on his way to a cocktail party at Buckingham Palace. Apparently the demonstrator had

I demonstrate the Model H to a farmer at Porters Retreat, before the tractor was transported to Orange. Despite being rated at 24 hp, owing to the amazing torque characteristics of the single cylinder two stroke semi diesel engine, its draw bar pull excelled that of any other tractor rated up to 50 hp.

The photo which appeared in *Country Life* of me holding the award certificate.

failed to materialise and he had no alternative but to drive the Cropmaster.

I noted he was furiously perusing the operator manual. Probably endeavouring to comprehend the intricacies of firstly starting the engine and then the perplexities of how to coax the tractor into proceeding.

It occurred to me he possibly spent most of his time in a glitzy office (and likely had the key to the executive toilet and partook of luncheon in the executive dining room) but had never had to soil his immaculate Armani suit by actually sitting on an actual tractor. (Okay, so I was being a bit bitchy)!

To give him his due, despite his shaking hands and sweat pouring from his upper class brow, he successfully started the engine. But when the official waved his flag, indicating the demonstration should begin, the David Brown Cropmaster shot off in reverse, causing a group of observing farmers to flee for their lives!

A fraud?

Predictably to me, but probably no one else, the Lanz with its three furrow Harvey plough, trounced the other dozen or so tractors by being an easy winner back to the finishing line. This was particularly surprising and upsetting for the Ferguson team and at the conclusion of the demonstration, was no doubt responsible for the mass exodus of their senior sales types in the direction of the refreshment tent, in order to comfort their bruised egos.

A while later, back at the Lanz stand, I was summoned to report immediately to the official administration tent. Crikey, what on earth had I done? Had the firm overlooked paying the fee for our site? Had I behaved improperly to the curvaceous young thing at the John Deere stand? Had the smoke emitting from the exhaust stack of the Model H exceeded the standards of The Clean Air Act? I was about to find out!

But no. None of these. Instead I was warmly greeted by the Field Day president and hustled towards a microphone set up on a dais. There I was introduced to The Honourable Edgar Graham, MLA, Minister for Agriculture, who shook my hand and congratulated me on being that year's recipient of the Award of Merit. Bulbs flashed from the sea of unwieldy Speed Graphic

Being presented with The Award of Merit by The Honourable Edgar Graham, MLA, Minister for Agriculture.

cameras pointing at me by enthusiastic press reporters from *The Land, Country Life* and local newspapers.

They obviously had the wrong bloke. They were making a monumental mistake! My feeble protests were silenced by the Minister, who announced over the microphone that Mr (always very formal in these days) Ian M. Johnston had been chosen by a panel of judges to have won the award on account of the innovative design of his Lanz Bulldog Model H.

"Bbbbut," I tried to explain that I only sold the thing on behalf of Lanz Australia Pty Ltd and if an award was to be presented then it should go the design team back at the Mannheim factory in Germany. No one paid any attention to my protests. So I decided the best policy was to simply shut up and gracefully accept the certificate. Which I did. But my conscience bothered me and to be honest, I felt a fraud.

The JCB

Fast forward to 1966. I was again exhibiting at Orange, but this time in my capacity as Sales Manager for Lough Equipment Pty Ltd. The Artarmon based firm had recently been appointed as Australian importers of the highly desirable JCB extensive range of loader/backhoes and excavators, which were returning previously unheard of sales figures throughout many countries of the world.

Joseph Cyril Bamford was an entrepreneur extraordinaire and in 1966 was well on his way to creating the world's richest private manufacturing company. When the JCB dealership was offered to Eric Lough, he found the opportunity too attractive to overlook, even although it meant having to relinquish his firm's long established association with the Whitlock range of earthmovers.

So there I was again at Orange, but this time with a range of JCB machines and a team of enthusiastic sales and technical personnel – including a brilliant but slightly ebullient Irish demonstrator named Bill O'Conner.

On the second day, a rather objectionable and indeed belligerent unshaven fellow approached a few of us, who were engaged in discussing the merits of a JCB 3C with an interested Shire engineer. The fellow somewhat rudely elbowed his way into the conversation and smirked as he stated he "had heard" the JCB hydraulics were "pretty weak".

Bill reacted as if he personally had been defamed. "Yeah! Well just you watch this," he retorted, mercifully keeping his fists under control.

Bill O'Conner does his circus act with the JCB 3C loader/ backhoe. Note the Morris Mini Moke below the tractor.

Without any comment to the rest of us, he swung round to the slandered 3C, scrambled on board and fired up its BMC diesel engine. With bucket inverted and positioned on the ground, the front of the lengthy machine was raised by the loader arm hydraulics. This was followed by the backhoe bucket placed solidly on the ground and the rear portion of the 3C being raised aloft using the power of the boom and dipper rams.

Within seconds the loader backhoe appeared practically airborne, with sufficient clearance for a vehicle to be driven underneath the tractor. And that is exactly what occurred. With the engine stopped, from his lofty height Bill beckoned to a chap on a neighbouring BMC stand to drive and park a Morris Mini Moke under the JCB. Rather daringly (but foolishly I thought) the chap did just that!

The whole reckless exercise took only a couple of minutes and the rest of us just stood and gaped. In all my years of involvement with tractors and earthmoving equipment, I had never seen the like! Here was a four tonne machine high in the sky, totally dependant upon the integrity of its hydraulics to prevent it from crashing to the ground and on its way squashing a poor little innocent car into oblivion.

Bill glared down from his lofty height and yelled at the unshaven (and probably unwashed) fellow "Now what do you reckon about the hydraulics?" The malodorous individual promptly disappeared into the crowd.

A short while later, a Boy Scout messenger approached and handed me a written note. It was a request from the Field Day administration office for he who is responsible for the Lough Equipment stand to kindly report to the office.

I could not believe it! What – another Award of Merit! So with a spring in my step I fronted up at the office, only to be greeted by a very large safety officer, who castigated me for what he termed the irresponsible and dangerous episode with the JCB, "which must never be repeated."

Thoroughly chastened, I followed the example of the Ferguson characters all these years ago, and headed for the refreshment stand. ■

IAN'S MYSTERY TRACTOR QUIZ

Question: Okay – what is it?

Clue: Note the location of the radiator (probably doesn't help).

Degree of difficulty: This is a real stinker!

Answer: See page 48.

Got a pest problem? Try napalm

By David Dowling – *Greenmount Travel*

THE farmers at Pandamatenga in Botswana are faced with many unusual pest problems – herds of elephants flattening crops, various antelopes eating the crops and lions taking any unattended cattle. But their worst problem is a small finch-like bird – the Quelea.

By themselves, the Quelea are kind of cute, but unfortunately they travel and eat in flocks so thick they look like clouds and they can wipe out a sorghum crop in a couple of days. Various original control measures are used, such as petrol bombs (napalm) in bird-roosting trees and workers constantly walking through fields, cracking whips to move the birds along.

But more of Pandamatenga later...

By the start of the 2018 *Greenmount Travel* farm study tour of southern Africa, I was looking forward to a little rest and relaxation and a smoothly run but exciting three weeks – and that was exactly what I got.

A 3-tour odyssey – tremendous in triplicate!

My 2018 odyssey of three successive study tours had started back in Sri Lanka several weeks before. A wonderful tour of Sri Lanka and India hadn't quite prepared me for the 'surprises' that were to come on the third leg of my journey – the Silk Road tour which started in Xinjiang province of far western China, through Kazakhstan and into Russia.

During our previous Silk Road tour in 2016, Xinjiang had been a challenging but overwhelmingly positive experience with beautiful scenery, great people and a rich and diverse culture.

But by 2018, the central government in Beijing had placed its foot firmly on the throat of the local population – mainly ethnic Uyghers. The region is also a melting pot of other central Asian cultures such as Mongols, Kazakhs and Kyrgs.

Chinese whispers

Whispered conversations with some of the locals suggested that around 10 per cent of the Uygher population of around 12 million had been sent to 're-education camps.' People are disappearing – sometimes for no apparent reason, but usually for saying or doing something critical of the regime. Every shop or business has to employ a uniformed guard and spies and informers are everywhere.

Interaction with foreigners creates an automatic suspicion that someone may be collaborating with corrupting influences from overseas, so people were wary about being seen talking to us. Most visits to farms had to be done at very short notice because any arrangements for a visit by foreigners would create immediate suspicion.

Hotels were discouraged and often banned from allowing foreign visitors, and any visit involved such masses of paperwork

SO WHERE TO NEXT?

If this overview of some of our tours in 2018 sounds like something you would be interested in, the good news is that we are taking another study tour to Africa this year – and following a very similar path to that of 2018.

Go to the *Greenmount Travel* website (www.greenmounttravel.com.au) for the details and to express your interest or make a booking.

But please don't delay too long – many of the best game parks and destinations in Africa have limited capacity and book out well in advance. As a result, the Africa tour is limited to 20 people. As at the end of January there were some spots still available, but we would need to hear from you as soon as possible.

Other *Greenmount Travel* tours on offer for 2019 are:

- The UK and Ireland;
- Cuba, Mexico & Central America
- The Netherlands, France, Portugal & Spain; and,
- Japan.

All of these tours have attracted a lot of interest, particularly our first ever venture into Portugal. As with all destinations into the northern hemisphere summer, accommodation and other travel services are in high demand. If you are keen to join a unique adventure, please get in touch as soon as possible.

See the *Greenmount Travel* website for further information.

During the second hour of negotiations to visit a cattle market in Xinjiang.

The scenery in Xinjiang is remarkable but the politics impossible.

Looks comfortable, doesn't it?

and red tape that most hotels were reluctant to accept foreigners.

Our bus was stopped at checkpoints about three times a day on average – often for up to an hour as the Chinese soldiers laboriously checked our passports and quizzed our guides about our travel plans. There were many places we just could not go, and even worse, it often took a long time to get a decision on whether we could go there or not.

On one farcical day near Urumqi, we set out to visit a livestock market in a nearby town – a visit for which we had already received permission. After our second highway checkpoint, we were diverted to the local police station where we waited for an hour while they found someone who could make a decision.

A miracle – the person making the decision said that we were welcome guests and organised a police escort, front and back, to the livestock market. We got within 500 metres of the market when a phone call came through that someone a bit higher up was reviewing the situation. After another hour's wait, we were told that we could park on the road outside the livestock market, but no photos of any trucks entering or leaving the market.

In many ways it was a wasted day, but it gave a great insight into the way a totalitarian state works.

It was a difficult few days for our group, but our real sympathies went out to the people who have to endure this every day of their lives. And when we did get a chance for impromptu interactions with the locals, they proved to be, as always, very friendly, sociable and fascinated by their unusual Australian guests.

Such a shame. But it was a great relief to get into the comparative freedom and openness of Kazakhstan and Russia.

Insects have no chance against the tongue of this chameleon in the desert of Namibia.

Xinjiang is an amazing place to visit but we have reluctantly taken it off our *Greenmount Travel* destination list for the time being.

Back to Africa

Which brings us back to Africa: Swapping Chinese police for man-eating lions, charging elephants and dangerous hippos – I'll take the animals any day. Our trip was a wonderful mixture of the best that southern Africa can offer in terms of farming and touring. For most people, the animals are the stars of the show of course.

What better way to start the tour than in the magnificent Okavango Delta in Botswana. For three days we made our home in a traditional tented safari camp – a real 'Out of Africa' safari, but definitely not roughing it. Our passionate local guides introduced us to the amazing natural and cultural world of the Okavango Delta.

One thing you notice about Africa is that much of the bush looks like Australia – but instead of roos hopping around, you'll find a giraffe sticking his long neck above the trees, or an elephant wandering through camp in the middle of the night.

The waterhole comes alive as a pod of hippos comes to the surface – they look incredible, but don't go swimming with them. Of course, everyone's favourites are the big cats – the lions, leopards and cheetahs. They can be seen too, although they can take a bit of finding, often as they munch on a freshly killed antelope.

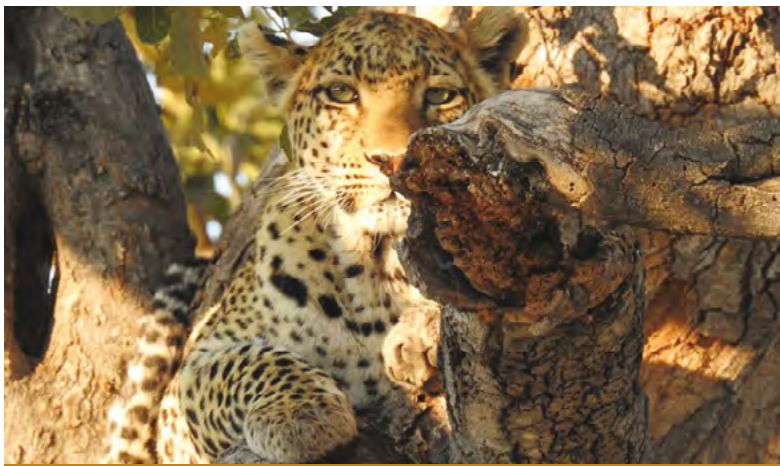
Unfortunately, rhinos are much harder to spot in the wild outside of managed game parks as poaching continues to be a major problem.

From the Okavango, we travelled to a town in eastern Botswana called Pandamatenga. This is where a joint Botswanan Government and private enterprise initiative is producing food crops on around 40,000 elephant-fenced and cultivated hectares. The farms within the project area are run by (mainly) disaffected white farmers from neighbouring countries.

The introduction of modern farm machinery, new varieties and better techniques – much of this from Australia – is not only providing a major food source for the Botswanan people, the local farmers (both black and white) are learning how to become much more productive.

The hospitality of the Pandamatenga locals was incredible and we spent a couple of days visiting their operations and talking to the farmers about their crops and their particular problems. Their very unique problems include elephants pushing through the high electrified fence which goes all around the farming area, and the previously mentioned Queleas.

From Pandamatenga, we crossed the border into Zimbabwe



Leopards can blend in very well.

One of the enterprising young farmers in the beautiful farming country of the Western Cape.

for more animal viewing and then Victoria Falls from every angle, including a swim in the Devil's Pool at the top of the falls for a brave few.

We also visited farms on the Zambian side of the border. Here we met the most resilient people who survived being kicked out of Zimbabwe with nothing, then rebuilt wonderful farming operations in a new country.

But in Africa, there are no long term guarantees.

After an extra unplanned night in Victoria Falls – courtesy of Kenya Airways – we finally arrived in Cape Town, South Africa, and the beautiful farming land of the western Cape.

The Golden Triangle

This is an area so different to the rest of South Africa that you could be in another country.

The farming areas are highly productive, from the vineyards of Stellenbosch to the beautiful Golden Triangle country around Caledon. We met some wonderful enterprising farmers before heading off on the final leg of our journey to Namibia.

Namibia, like Botswana, is a country that seems to be getting along pretty well, as opposed to most of its African neighbours. There is still poverty here, but the colours seem to mix a lot better and there seems to be more mutual respect between the groups.

From a tourist point of view, the west coast of the country is one of the most starkly beautiful places on earth with expanses of red sand dunes stopping only as they meet the rolling waves of the southern Atlantic. It almost never rains here and plants survive on moisture from the fog and mist which is common as the cold ocean currents react with the heat of the desert.

Namibia was also our last chance to catch up on a few of the African animals we had missed previously. The Erindi managed game park gave us the chance to see black rhinos, African wild dogs and cheetahs – often while having dinner in the lodge overlooking the waterhole. ■

The end of the road for the group at the Cape of Good Hope.

Emotional connection + facts = practice change on-farm

WHEN it comes to changing grain growers' perceptions and motivating practice change on-farm United States agricultural academic Drew Lyon believes it doesn't matter where in the world you are, the challenges are strikingly similar.

Professor Lyon is Endowed Chair of Small Grains Extension and Research, Weed Science in the Department of Crop and Soil Sciences at Washington State University and was in Toowoomba recently to compare strategies with Grains Research and Development Corporation (GRDC) extension officers and key weed researchers.

While he said the weeds change from country-to-country, the process of getting growers to change how they perceive and then tackle the problem of weed management remains a universal challenge for those working in research and extension.

"What we have found is that the facts are not enough anymore when communicating messages. For information to be received positively there needs to be an emotional connection between the grower and the message or the message deliverer," Drew said.

The US academic was in Australia on a six-week Nancy Roma Paech Visiting Professorship in Agriculture from the University of Sydney.

New South Wales-based researcher Michael Walsh, who is the Director of Weed Research for the University of Sydney, played tour guide during Drew's trip, which included visits to northern NSW and southern Queensland research facilities and grain properties.

Washington State University Professor Drew Lyon was in Toowoomba recently to compare weed management strategies with Australian researchers and share ideas on the best way to get research information to grain growers. (PHOTO: GRDC)

Michael agrees with his international colleague that an 'emotional connection to complement facts' is critical when it comes to grower practice change and he has firsthand experience of the combination working in Australia.

First hand experience

"I spent five years explaining to growers in Western Australia the benefits of harvest weed seed control, but it wasn't until a few growers who were early adopters, started 'doing the talking' that the concept gained a foothold and led to on-farm practice change," he said.

The example comes as no surprise to Drew.

"We have found not even 'overwhelming research evidence' is enough to shift growers' perceptions, instead they want to hear information and the shared learnings of their fellow growers before they make a change," he said.

"It is about the credibility of the message and the messenger and the emotional connection they have with their audience. Growers are also often more confident to make a change once their peers have trialled something and potentially helped iron out any of the initial issues."

In the US, Drew's work is focused on integrated weed management with a 70 per cent extension component aimed at delivering research information directly to grain growers and crop consultants and 30 per cent research into weed control in dryland grain production systems.

He said there were distinct similarities between the challenges facing growers, researchers and extension officers in both the US and Australia.

"Herbicide resistance is a major concern for US growers and my research and extension is heavily focused on the development and adoption of integrated weed management strategies to counteract this issue," he said.

"We are investigating the use of herbicides in conjunction with cultural practices such as crop rotation, plant population, row spacing, and fertility as well as tillage when necessary to overcome the challenges of herbicide resistant weeds.

When it came to delivering research information to growers he said his Extension Dryland Cropping Systems Team had had success with one of their major projects: The development of the Wheat and Small Grains website *http://smallgrains.wsu.edu/.*

"This is a website where growers and consultants can find all the information and decision tools that Washington State University Extension has related to wheat and small grains production and marketing," Drew said.

The WSU Wheat Academy

"I have also developed an academy program – the WSU Wheat Academy – targeting progressive growers and crop consultants. These short academy programs have been developed to give growers a deeper understanding of the science behind management decisions and researcher recommendations.

"It is an intimate class with scientists and growers. The first year we did this, we had some growers walking out of a (soil chemistry) class just shaking their heads and saying, 'Wow, that was pretty deep, but I loved it.'"

He said the program offered courses in topics such as, entomology, disease, soil fertility, nutrient management, marketing strategy, pulse production, integrated weed management systems, and drones in agriculture. The courses are 90 minutes each as part of a two-day program.

"There's always something to be worried about if you're a grower and always something to do if you're a researcher, always some problem to look into," Drew said.

"An important part of our role is to listen to grower concerns, facilitate research addressing those concerns, and then deliver the results of that work back to growers to help them make sound management decisions on-farm."

He said the key learnings from his Australian trip has stemmed from our position as a global leader in herbicide resistance management, and our use of social media tools like Twitter polls and surveys to collect information on grower practice.

"Australian research and extension differs from the US, in that our extension is linked to universities. The concept, which I think works quite well, is that extension should be a direct link to research conducted at the university, both informing research and translating that research back to growers.

"I really like this model because it allows me to interact closely with growers to discern their issues, conduct applied research to address those concerns, and very rapidly transfer what I learn to them. I am also closely connected to my research colleagues and can pull them into projects where their expertise is of value."

When it comes to furthering knowledge Drew is a staunch advocate of international travel and the sharing of innovation.

"Tours like this one of mine to Australia, are about broadening our understanding of how other grain growing countries are handling research and extension and what works, what doesn't, and how we can all do a better job for agriculture." ■

What are the four personality types of Australian farmers?

PEOPLE tend to see farmers as one large group of food and fibre producers, but have you ever thought about what different individuals they are? How would you encourage these independent, self-sufficient people to adopt change or innovate?

Agronomist Cam Nicholson is passionate about providing advice to boost farmers' profitability and productivity, and one of the keys tools he uses is determining the personality types of his clients.

Cam was a recent guest on the GRDC podcast series, which has been developed to keep growers and other industry stakeholders informed on-farm.

The series features some of the grains sector's most pre-eminent researchers, growers, advisers and industry stakeholders sharing everything from the latest seasonal issues, to ground-breaking research and trial results with on-farm application.

People learn and respond differently

Cam said research shows everybody learns and responds differently and over the past 15 years he has developed his own assessment guide to farmers based on the temperament typing of the Myers Briggs Type Indicators (MBTI) and the work of Queensland psychologist and beef producer Rod Strahan.

In this engaging podcast he shares his insights into how farmers can be categorised and why it helps to understand their learning preferences and personality types if you are working with them, particularly as an agronomist, farm adviser or stock and station agent.

Cam initially presented his information about the value of understanding how the people you are working with 'work' at the GRDC Grains Research Update to help improve agronomists and farm advisers understanding, interaction and engagement with their clients.

He said farmers can be divided broadly into four types:

- **The dependables:** Who love what they do, are very reliable and methodical and need a good reason to change.
- **The doers:** Who are a bit like the dependables, but they work at a more frantic pace and tend to not quite finish off jobs.
- **The pioneers:** Who are the first to try something, adopt new technology quickly, love to think strategically about big picture, take risks.
- **The team builders:** They farm with intergenerational change and the environment in mind, and both males and females contribute equally.

"About 80 per cent of farmers fall in to the first two categories with about 55 per cent being dependables and 25 per cent being doers. In comparison, within the general Australian population, the dependables make up 40 per cent and the doers account for 15 per cent," Cam said.

"The balance are the pioneers and the team builders, who together make up about 20 per cent of farmers. In the Australian population there are only 15 per cent of these types."

Agronomist Cam Nicholson has spent the past 15 years studying the behaviour of his farmer clients to develop a better understanding of how personality types affect learning and business operation. He shares his insights in a new GRDC podcast. (PHOTO): GRDC

Assessing temperament

When it came to providing on-farm advice Cam said the trick was to assess your clients' temperament type by asking questions, assessing their answers and observing how their farm operates.

"This approach really works both ways. Farmers should also know their own personality types through simple testing online, so that they know their strengths and how they'll respond to pressure or making decisions," he said.

"Then they need to identify complementary personality types within the business, or bring someone with the necessary skills in.

"In many cases adding women to the decision-making mix is also positive, as that helps to balance out the way in which decisions are made and information gathered."

Cam said it was difficult to change the personality type you were born with, but you can choose to work in different ways and build your skills in areas that you aren't naturally strong in, as well as be prepared to consciously change the way you work.

"There's a bit of conjecture over the actual split, but I believe that the influence on temperament types is 40 per cent genetic, 40 per cent what you learn in the formative years aged 12–15, and about 20 per cent the crowd you hang with," he said.

"And funnily enough, there's not a lot of difference between the average Australian farmer in his/her 50s and 60s, and the younger digital natives coming through – they're young, but they're inherently conservative."

While it took him 15 years to learn this, Cam says he's spent the following 15 years sharing his knowledge with others and becoming a more effective advisor.

To listen to Cam's podcast, go to *https://grdc.com.au/podcasts* ■

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CLAAS Harvest Centre

Unravelling the workings of the world's major honey bee pest

By Dennis O'Brien, Agricultural Research Service – USDA

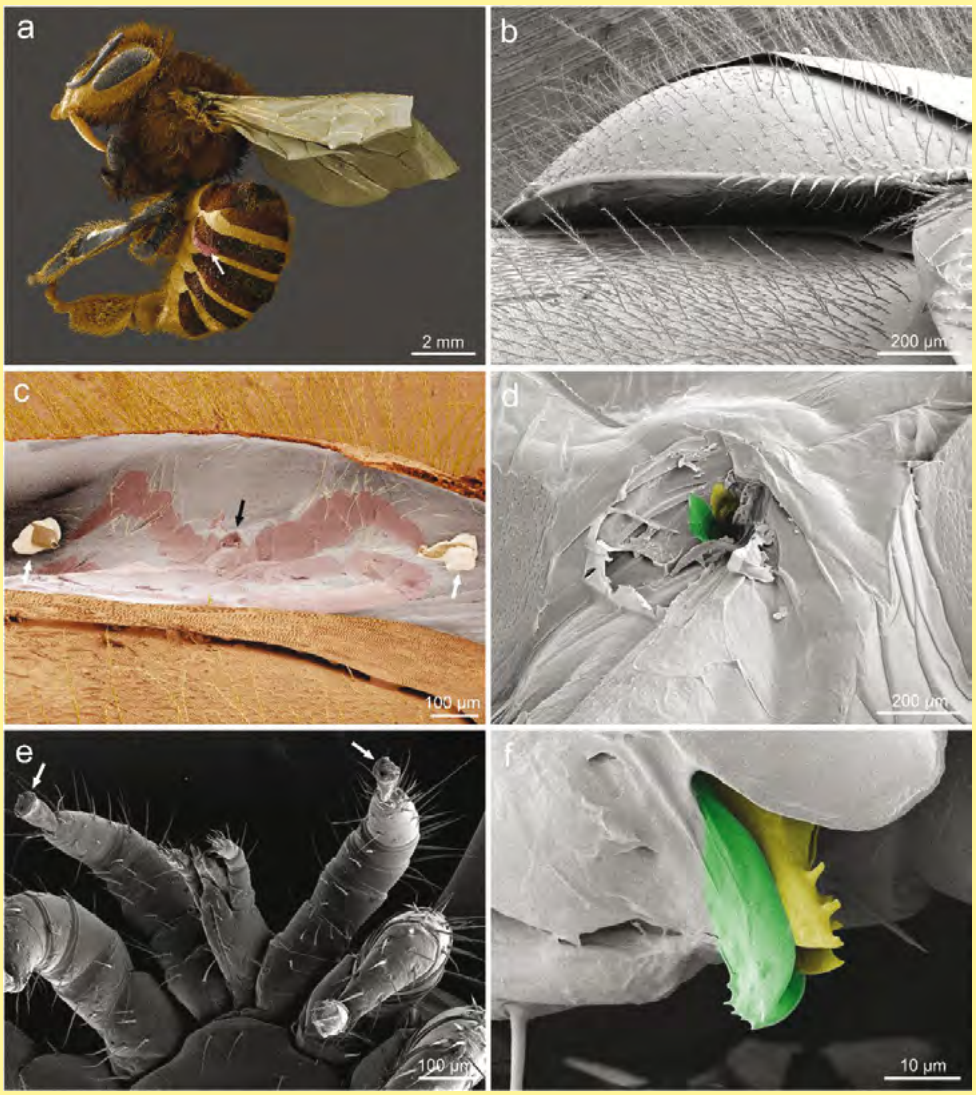
RESEARCH by scientists at the Agricultural Research Service (ARS) and the University of Maryland released in late January sheds new light – and reverses decades of scientific dogma – regarding a honey bee pest (*Varroa destructor*) that is considered the greatest single driver of the global honey bee colony losses. Managed honey bee colonies add many billions of dollars to the value of worldwide agriculture each year through increased yields and superior quality harvests.

The microscopy images are part of a major study showing that the Varroa mite (*Varroa destructor*) feeds on the honey bee's fat body tissue (an organ similar to the human liver) rather than on its 'blood,' (or hemolymph). This discovery holds broad implications for controlling the pest in honey bee colonies.

Varroa mites have been widely thought to feed on the hemolymph, of honey bees (*Apis mellifera*) because of studies conducted in the 1970s which used outdated technology.

But this collaborative study, by University of Maryland and ARS researchers at the ARS Electron and Confocal Microscopy Unit, offers proof of the mite's true feeding behavior. Through the use of electron microscopy, the researchers were able to locate feeding wounds on the bee caused by the mites, which were located directly above the bee's fat body tissue (Figure 1).

FIGURE 1: Feeding site of Varroa on adult honey bee



Feeding site of Varroa on adult honey bee imaged via low-temperature scanning electron microscopy. Images representative of 10 worker bees with attached mites prepared for imaging of which all 10 showed a wound in the intersegmental membrane. (a) Location of the mite shown with white arrow; (b) The mite is wedged beneath the third tergite of the metasoma; (c) When removed, a detailed impression of the mite can be observed in the intersegmental membrane in addition to a wound where the mouthparts of the mite would be (black arrow); (d & e) Note the foot pads of the mite (white arrows) remained attached to the membrane when the mite was extracted; and, (f) Higher magnification of the wound reveals distinct grooves in the wound matching the modified chelicera of the mouthparts of the mite, colourised for clarity.

First direct evidence

The images represent the first direct evidence that Varroa mites feed on adult bees, not just the larvae and pupae.

In addition, University of Maryland researchers conducted feeding studies and found that Varroa mites that were fed a diet of fat body tissue survived significantly longer and produced more eggs than mites fed hemolymph. The results show, mites fed a hemolymph-only diet were comparable to those that were starved. Thus, proving conclusively that the Varroa mite feeds primarily on the fat body consumed from bees.

The results are expected to help scientists develop more effective pesticides and other treatments to help bees cope with a mite known to spread at least five viruses.

They also help explain why Varroa mites have such detrimental effects on honey bees, weakening their immune systems, and making it harder for them to store protein from pollen and survive through the winter.

The study was part of the Ph.D. thesis of Samuel D. Ramsey from the University of Maryland and was conducted in collaboration with ARS researchers and study co-authors Gary Bauchan, Connor Gulbronson, Joseph Mowery, and Ronald Ochoa.

The study was published in the January 2019 print edition of the *Proceedings of the National Academy of Sciences*.

The Agricultural Research Service is the US Department of Agriculture's chief scientific in-house research agency. ■

NORTHERN FOCUS
COVERING NORTHERN NSW AND QUEENSLAND

Creating stiff competition against summer weeds

EVIDENCE is mounting that summer crops really can be an effective weapon in the war on herbicide resistant weeds. With soil moisture at a premium, there is nothing spare to waste on summer growing weeds.

With all four of the most difficult to control summer weeds – feathertop Rhodes grass (FTR), awnless barnyard grass, common sowthistle and flaxleaf fleabane – now with confirmed cases of glyphosate resistance, the pressure is on to find effective non-herbicide control tactics. These weeds can produce 40,000, 42,000, 25,000 and 110,000 seeds per plant respectively. Other studies have found these numbers could be even higher, so every effort to reduce seed production is worthwhile.

Various trials in mungbean, soybean and sorghum crops have consistently found that planting these summer crops in competitive configurations can reduce weed biomass and seed production while maintaining or increasing crop yield.

The change in row configuration may involve set up costs to modify planting equipment but does not require an increase in seeding rate as the effect has been demonstrated using the same established populations for mungbean and soybean. For sorghum, the competitive edge comes through increased plant population rather than narrower rows.

Dr Michael Widderick, is the lead DAF researcher in the mungbean and sorghum crop trials to better understand the agronomic factors that increase the crop's competitive advantage over feathertop Rhodes grass and awnless barnyard grass.

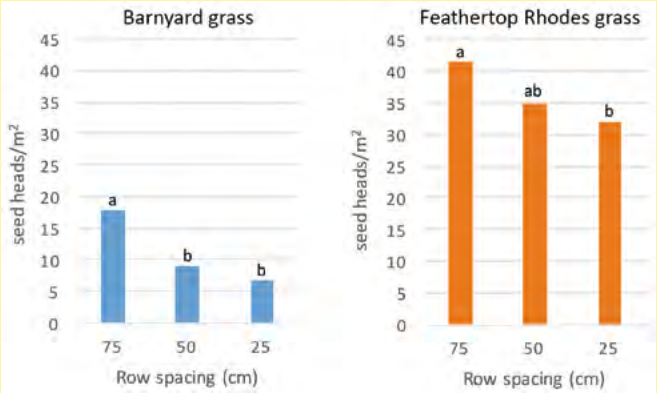
Narrow row spacing and early control

Along with narrowing the row spacing in mungbean and soybean, there are also benefits in early weed control. Keeping crops weed-free for the first three to six weeks seems to be a valuable rule of thumb to give crops the head start required to drive down weed numbers. Weeds that germinate in-crop after the three to six week mark are fewer in number and individual plants also produce less seed.

As a non-herbicide control tactic, crop competition is very important in any integrated weed management program.

With investment from the GRDC, researchers from NSW Department of Primary Industries, University of Sydney and Queensland Department of Agriculture and Fisheries are conducting trials to identify ways to increase the competitiveness of sorghum and summer pulses.

FIGURE 1: Effect of mungbean row spacing of weed seed head production



NOTE: This represents one year of data only.

In the 2017–18 summer, sorghum was sown in trials using three row spacings (50, 75, 100 cm) and two crop densities (5 and 10 plants per m^2). In a separate trial, mungbean plots were established using three row spacings (25, 50 and 75 cm) and two crop densities (20 and 35 plants per m^2).

Seed of feathertop Rhodes grass and awnless barnyard grass was spread at planting and the plots were irrigated to ensure optimal crop and weed emergence.

Early and encouraging trial results

With only one year of data from this trial so far it is difficult to make recommendations. Average seed head production in non-crop treatments was 1745 heads per m^2 for feathertop Rhodes and 1525 heads per m^2 for awnless barnyard grass. Growing either crop more than halved the number of weed seed heads produced, even in the least competitive configuration for the two crops.

Row spacing in **mungbean** had a clear impact on weed seedhead production for both weed species. This effect has been demonstrated many times in a range of agronomic trials with mungbean. Narrowing row spacing to 25 cm reduced feathertop Rhodes grass seed head numbers to 32 per m^2. For awnless barnyard grass, narrowing row spacing to 50 cm or less reduced seed heads to less than 10 per m^2.

For **sorghum** it seems increased plant population had the best effect, significantly reducing weed seed head numbers for both weed species. Unlike mungbeans and soybeans, sorghum yields were reduced in plots with narrower row spacing configurations. At each row spacing, the higher plant density (10 plants per m^2) treatment yielded more than the lower density plant population.

In a separate trial, University of Queensland researchers confirmed that row spacing, not plant population, is the key driver to reducing weed growth in **soybean** crops. In soybeans, weed biomass was reduced by 89 per cent under narrow rows (25 cm) and 75 per cent under wider rows (75 cm) when the crop was kept weed-free for the first three weeks after planting. If weeds were controlled for the first six weeks, then weed biomass was reduced by 98 per cent under narrow rows and 88 per cent under wider rows.

In weed-free plots there was a 20 per cent yield benefit in changing from 75 cm row spacing to 25 cm. This yield difference was 65 per cent in plots where weeds were introduced six weeks after planting and a huge 121 per cent higher when the weed infestation occurred three weeks after planting.

Similarly, if a **mungbean** crop is kept weed-free for the first three weeks after planting, then the narrower row spacings of 25 and 50 cm saw a reduction in weed biomass. In both the 2015 and 2016 summers, the combination of keeping the crop weed-free for at least the first three weeks and planting on the narrower rows (25 or 50 cm rather than 75 cm) generated a yield increase of 159–197 per cent in 2015 and 198–223 per cent in 2016.

To sum up

Summer crops are an integral part of many farming systems and play an important role in an integrated weed management program. Many summer weeds only remain viable on the soil surface for a period of around 12 months so if a competitive summer crop is followed with a competitive winter crop and harvest weed seed control, it is possible to have a real and lasting impact on the weed seed bank.

For more information about growing competitive summer crops, visit the Weedsmart website: *www.weedsmart.org.au* ■

In these plots, mungbean was sown on row spacing 25 cm at low crop density (20 plants per m^2) competing strongly with both awnless barnyard grass (left) and feathertop Rhodes grass (right).

In these plots, mungbean was sown on row spacing 75 cm at low crop density (20 plants per m^2). The plot on the left was kept weed free while the centre plot shows limited suppression of feathertop Rhodes grass. Being a low growing weed, the level of infestation of awnless barnyard grass (right) is difficult to see in this photo.

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BAYER

Using harvest weed seed control methods in sorghum

By Gulshan Mahajan[1], Michael Walsh[2] and Bhagirath S. Chauhan[1]

AT A GLANCE…

- Unintentional harvesting of weed seeds along with crops causing the spread of weeds to large areas is serious, particularly when the weeds are herbicide resistant.
- In harvest weed seed control (HWSC) tactics, various cultural and mechanical management practices are combined for decreasing weed seeds amount replenishing the soil seed bank.
- Our study suggests that in a sorghum crop, HWSC can be successfully utilised for the destruction of seeds of feathertop Rhodes grass (FTR), and partially for awnless barnyard grass (ABYG). Windmill grass (WMG) seeds may not be captured using HWSC methods.

IN Australia, FTR, WMG and ABYG have evolved resistance to glyphosate, and the concurrent maturation of crops with these weeds results in unintentional harvesting of weed seeds and subsequent redistribution of these seeds across the paddock during crop harvest. The collection of weed seeds during harvest has led to the development of a range of harvest weed seed control (HWSC) tactics aimed at targeted collected weed seeds to prevent them returning to the paddock and into the seed bank.

Crop-weed competition depends upon many ecological factors such as time of weed emergence relative to the crop, weed density, duration of competition and the type of weeds present in the field. For example, some weeds have an extended period of seedling emergence, which can continue late into the growing season of the crop.

Some weeds have a great ability for competition even at a low density and some weeds, when emerged late in the crop season, may not be able to provide competition to the crop and unable to produce enough seeds that could increase the weed seed bank in the soil. High fecundity and seed dormancy in weeds ensure carryover to subsequent year(s).

Seed retention levels for FTR, WMG and ABYG in sorghum fields in the northern grain region of Australia have not been investigated and therefore, the potential efficacy of HWSC systems on these weeds is unknown.

This study was conducted at Gatton to determine the percentage of FTR, WMG and ABYG seed production that was retained on the weed plants at sorghum maturity/harvest.

How the research was done

The experiment included three weed species (FTR, WMG and ABYG) and four planting times of weeds (zero, two, four, and six weeks after crop emergence) with three replications.

The sorghum crop was planted on November 29, 2017 at a row spacing of 100 cm with a density of seven plants per

QAAFI researcher, Gulshan Mahajan.


Infestation of feathertop Rhodes grass in sorghum.

metre. The weed species were planted in trays and kept in a shadehouse.

At the two-leaf stage, five plants of each weeds species were transplanted at zero, two, four, and six weeks after sorghum emergence (WAE) in between two rows (1.0 m length each) of the crop. The crop was irrigated twice a week,as required depending upon rainfall and harvested on March 26, 2018.

Seeds of FTR and WMG are wind-blown; therefore, seed numbers were estimated by counting the lobes in each seed head and rachilla segments (pedicel base) in each lobe. It was observed that each rachilla segment in the lobe had one seed. Total numbers of seed heads and seed heads above a low sorghum harvest height of 15 cm were counted.

For estimating seed production per head, two intact seed heads were chosen randomly from above and below 15 cm height of the weed plants. For total number of seeds, each rachilla segment (pedicel base) was counted and then, averaged for seeds per head.

The seeds that were still attached to the rachilla segment at harvest time were counted separately for estimating the shattering percentage. Weed biomass at maturity was determined for each weed species at each planting time.

Data were subjected to an analysis of variance (ANOVA) in a randomised complete block design (RCBD) and means for significant effects were separated using least significant difference (LSD) at the five per cent level of significance.

What we found

Feathertop Rhodes grass: Biomass was highest (28.7 g per plant) when FTR emerged with the crop and reduced significantly (17.0–0.51 g per plant) for the cohorts emerging at 2 to 6 WAE (Table 1). Seed production was 2180 seeds per plant for the first two cohorts. The third cohort (i.e. 4 WAE) produced only 121 seeds per plant while no seeds were produced by the last cohort. Above a 15 cm height, FTR retained 77 and 82 per cent of the total seeds for cohorts emerging at 0 and 2 WAE, respectively. These results suggest that HWCS could provide upto 77–82 per cent control of FTR seeds in a sorghum crop.

Windmill grass: Biomass was highest (5.3 g per plant) for WMG emerging with the crop (i.e. 0 WAE) and reduced

TABLE 1: Aboveground biomass, total seed production and seed retention (%) of FTR in the sorghum

Treatment	Aboveground biomass (g per plant)	Total seed production (number per plant)	Seed retention above 15 cm height (number per plant)	Per cent seed retention above 15 cm height (%)
0 WAE	28.7	2179	1678	77
2 WAE	17.0	2184	1791	82
4 WAE	2.63	121	103	85
6 WAE	0.51	0	0	0
LSD (0.05)	17.1	1532	—	—

WAE: Week after sorghum emergence.

TABLE 2: Aboveground biomass, total seed production and seed retention (%) of WMG in the sorghum

Treatment	Aboveground biomass (g per plant)	Total seed production (number per plant)	Seed retention above 15 cm height (number per plant)	Per cent seed retention above 15 cm height (%)
0 WAE	5.33	4086	82	2
2 WAE	3.91	2835	85	3
4 WAE	0.20	30	1	3
6 WAE	0.14	0	0	0.0
LSD (0.05)	2.0	1339	—	—

WAE: Week after sorghum emergence.

TABLE 3: Aboveground biomass, total seed production and seed retention (%) of ABYG in the sorghum

Treatment	Aboveground biomass (g per plant)	Total seed production (number per plant)	Seed retention above 15 cm height (number per plant)	Per cent seed retention above 15 cm height (%)
0 WAE	19.6	2998	1140	40
2 WAE	6.3	883	407	46
4 WAE	0.55	62	36	58
6 WAE	0.36	51	35	68
LSD (0.05)	5.7	1195	—	—

WAE: Week after sorghum emergence.

significantly (3.9–0.14 g per plant) for cohorts emerging later in the crop (Table 2). WMG produced around 4100 seeds per plant at 0 WAE and numbers reduced to 2835 and 30 seeds per plant for the cohorts emerging at 2 and 4 WAE, respectively. Plants from the last cohort did not produce any seed. Above the 15 cm height of the sorghum plants, WMG retained only two to three per cent seeds for the plants emerging at 0 to 2 WAE.

These results suggest that HWCS may not be feasible for the control of WMG seeds in sorghum.

Awnless barnyard grass: Biomass was highest (19.6 g per plant) for the ABYG plants emerging at 0 WAE and it declined significantly (6.3–0.36 g per plant) for the plants emerging at later stages of the crop (i.e. 2–6 WAE) (Table 3). Approximately 3000 seeds per plant were produced by plants emerging with the crop (i.e. 0 WAE) and the numbers reduced to 883, 62 and 51 seeds per plant for the 2, 4 and 6 WAE treatments, respectively. Above the 15 cm height, ABYG produced 40, 46, 58 and 68 per cent seeds in the 0, 2, 4 and 6 WAE treatments, respectively.

Our study shows that 40–46 per cent of ABYG seeds produced by early cohorts (0 and 2 WAE) can be captured using HWSC methods and high planting densities will suppress later emerging cohorts of ABYG.

The results suggest that there would be a reduced impact of HWSC systems during sorghum crop harvest to target ABYG seed production. ABYG produced a significant amount of seeds in the first two flushes with more than 50 per cent of this seed already shed before sorghum harvest.

To sum up

This study suggests that HWSC can be utilised for the destruction of FTR seeds. There would be some benefit of using HWSC for ABYG. But HWSC probably may not be utilised for the destruction of seeds of WMG as most seed is below a 15 cm harvest height.

Late emerging cohorts of all three weed species (i.e. 6 WAE) failed to produce enough biomass and seeds due to shading effects by the crop canopy and high crop competition. The growth duration of WMG and ABYG (about 50–60 days) is shorter than the sorghum crop (about 115 days); therefore, the majority of the weed seeds already shed when the sorghum crop was ready to harvest.

The scope of HWCS for ABYG and WMG might be explored in short duration crops like mungbeans.

The authors would like to thank the Grains Research and Development Corporation (GRDC) for investing in this research under Project US00084.

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Russian wheat aphid: 'Be alert, not alarmed'

NORTHERN region grain growers and their advisers have been advised to 'be alert, not alarmed' by the probability that Russian wheat aphid (RWA) will be found in cereal crops this season.

Speaking at a RWA information session in Toowoomba on January 21, research entomologist Maarten van Helden from the South Australian Research and Development Institute (SARDI), said it was inevitable Australia's latest broadacre crop pest would soon be found in other northern cropping regions including those in Queensland.

"Last year, RWA was confirmed on the Liverpool Plains in northern NSW and we believe it will continue to spread into the cereal growing regions of Queensland," Maarten said.

RWA was first detected in Australia in 2016 and is now present in cropping areas of South Australia, Victoria, Tasmania and southern New South Wales.

RWA is manageable

"While RWA is a high priority pest, it is manageable and the best thing growers and advisers can do is regularly monitor crops for signs of the pest," Maarten said.

"There are very distinct plant symptoms associated with RWA and early detection will give growers time to make informed, timely, cost-effective decisions about the appropriate management strategy for their situation."

Maarten said it was critical suspected insect samples be sent to the Queensland Department of Agriculture and Fisheries (DAF) in Toowoomba for formal identification. Confirmation of the presence of RWA would then enable state-based chemical permits to be enacted.

The southern-based researcher was in Toowoomba in January on a surveillance survey stretching through northern NSW and into southern Queensland. The survey is part of a broader project encompassing Tasmania, Victoria, SA and southern NSW.

The survey represents a major investment by the GRDC into understanding RWA. It is part of a collaborative investment, *'Russian wheat aphid risk assessment and economic threshold'*, led by SARDI in partnership with sustainable agriculture research organisation cesar.

This two-year-research project will investigate the role green bridge plays in supporting RWA populations over the summer, and work to determine the regional production risks posed by RWA and the economic thresholds that will guide growers in effective management of RWA, taking into account growing regions, crop varieties and climatic conditions.

Despite collecting more than 120 samples from roadsides and farms in Queensland and northern NSW as part of the current survey, Maarten said RWA had yet to be found.

"This survey included the key cereal growing regions in the northern region, so the Liverpool Plains, Tamworth, Narrabri, Moree, North Star, Garah, Boomi, Goondiwindi, Brookstead, Bongeen, Toowoomba and Dalby," he said.

"We collected samples in Queensland from 10 sites and failed to detect any RWA.

"But growers and advisers need to remain vigilant and monitor paddocks regularly, because we are positive these pests will arrive in Queensland and early detection will give growers time to determine the appropriate action for specific crops."

Research entomologist Maarten van Helden said it was almost inevitable Russian wheat aphid would soon be found in Queensland. (PHOTO: GRDC)

Follow the FITE

Maarten recommends growers and advisers follow the FITE (find, identify, threshold approach and enact) strategy which has been developed as a simple guide to RWA management. It involves:

- **Find –** Look for aphids and the characteristic plant symptoms of infection including leaf streaking or leaf rolling on cereal crops and grasses;
- **Identify –** Positively identify RWA by consulting with an industry specialist;
- **Threshold approach –** Before deciding on your plan of attack consider thresholds for control, the presence of natural aphid enemies in the crop, crop growth stage and potential yield losses; and,
- **Enact –** Take appropriate action: Manage your next steps including encouraging beneficial insects and protecting honeybees before implementing control options.

Weeds and volunteer cereals harbouring aphids may not necessarily show symptoms of infestation, so growers are advised to closely inspect grasses by unfurling leaves and checking inside partially emerged heads, paying particular attention to annual weedy barley grass.

While RWA is a high priority pest, it is manageable and the best thing growers and advisers can do is regularly monitor crops for signs of infestation. (PHOTO: GRDC)

Seed treatments

Maarten said neonicotinoid seed treatments may provide effective early season control of RWA. Preliminary evidence indicated the length of protection was expected to be equivalent to that observed for other cereal aphid species.

But prophylactic use of neonicotinoid seed treatments is discouraged and should be targeted at those situations deemed to be of higher risk (early sowing, especially early sown barley crops; or areas where volunteer cereals and/or live aphids are identified prior to sowing).

Crop monitoring

Maarten said crops should be monitored regularly throughout the season.

- Crops can be infested under warmer conditions in autumn, during the early stages of establishment, from wingless aphids walking off nearby senescing hosts.
- Intensive monitoring of early-sown crops, including cereals sown as pasture, should occur for the first four to eight weeks after sowing.
- Populations frequently start to increase as temperatures warm in spring or typically from tillering onwards.
- Stressed areas of the paddock are often the first to be infested and hence monitoring may specifically target these areas first.

Management

"Growers are advised to adopt a threshold-based management strategy. Chemical control is warranted if infestations exceed thresholds of 20 per cent of seedlings infested up to the start of tillering and 10 per cent of tillers infested thereafter," Maarten said.

"Yield loss may be minimised through protection of the top three (major yield contributing) leaves. Current research investments by the GRDC will allow us to develop more regionally specific thresholds as our understanding of potential RWA impact on regional production improves."

He said growers should be reassured that the summer growing cereals were not under threat from the pest.

He said growers and advisers should consider the following measures:

- If spraying is warranted, use softer chemistry (e.g. pirimicarb) where possible to encourage natural predators and beneficial insects, especially early in the season.
- Avoid prophylactic insecticide applications.
- If infestation warrants chemical control, growers and advisers should refer to the Australian Pesticides and Veterinary Medicines Authority (APVMA) website for the most recent products under registration or permit. Good spray coverage and consideration of weather conditions (temperature, rainfall) in the 24 hours prior and shortly after chemical application are important.

For information on RWA management go to the Tactics for Future Control publication, available at *https://grdc.com.au/rwa-tacticsfuturecontrol* as well as I SPY, a comprehensive crop insect identification manual, which can be viewed at *https://grdc.com.au/I-SPY*.

GRDC also has an online RWA resource with key information for growers and advisors at *https://grdc.com.au/russian-wheat-aphid*

Growers and advisers are encouraged to report occurrences of RWA to the Exotic Plant Pest Hotline on 1800 084 881. These reports will aid in improving understanding of RWA range and rate of spread.

For formal identification of RWA, Queensland growers and advisers can send samples to Melina Miles, DAF, PO Box 2282, Toowoomba, Queensland. For more details about sample collection contact Melina.Miles@daf.qld.gov.au.

In northern NSW samples can be sent to entomologist Zorica Duric, NSW DPI, Tamworth Agricultural Institute, 4 Marsden Park Road, Calala, New South Wales 2340. For more details about sample collection contact Zorica.Duric@dpi.nsw.gov.au ■

Winter crop variety selection

PLANNING for the upcoming winter season has just become easier for Queensland growers following the release of the first GRDC variety sowing guide to include wheat, barley and chickpeas.

The *2019 Winter Crop Variety Sowing Guide* for Queensland is a collation of data from the GRDC's National Variety Trials (NVT) investment, which benchmarks the performance of crop varieties to develop individual disease and agronomic ratings, varietal information and recommendations on planting windows.

GRDC NVT officer Laurie Fitzgerald. (PHOTO: GRDC)

GRDC NVT Officer North Laurie Fitzgerald said the comprehensive guide had been developed to allow growers to drill down into specific crops, as well as variety characteristics such as yield performance and disease ratings to ensure selected varieties were ideally suited to their local production conditions.

He said the NVT work also involved collecting the most relevant varieties for each region and testing them alongside the elite lines from industry breeding programs.

Making informed choices

"This guide then combines NVT data with expert advice with the aim of providing growers with the necessary data to make informed choices about what winter crop variety to plant this season," Laurie said.

"Only varieties deemed suitable for Queensland conditions have been included in the guide.

"If a variety is not mentioned, there is either no commercial seed available or there is concern that it may not carry robust resistances and may compromise the industry."

The development of a comprehensive guide covering wheat, barley and chickpeas represents an important investment for industry according to GRDC Grower Relations Manager North Richard Holzknecht, as it enables growers to keep up-to-date with the performance of new and existing varieties.

"Being able to make an informed decision about selecting the right variety can mean the difference between a profitable and unprofitable crop," Richard said.

"Variety selection is a critical management decision that impacts everything from sowing time to disease management, fertiliser requirements and herbicide use."

The 2019 guide includes three new wheat varieties available for sowing:

- Sunprime (PBR) a quick maturing Australian Prime Hard (APH) variety
- LongReach Kittyhawk (PBR) a slow maturing APH variety
- LongReach Oryx (PBR) a SOFT1 variety.

There are also two wheat classification changes with Kennedy changed to a feed wheat, while Strzelecki (PBR) has been changed to Australian Hard (AH).

There is only one new chickpea variety available for planting this season and that is PBA Drummond (PBR) an early season variety developed for Central Queensland.

For all the information on the released wheat, barley and chickpea varieties in the NVT trials conducted in Queensland, visit the website *www.nvtonline.com.au* ■

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Australian researchers turn up the heat on sclerotinia

DUAL research projects from the Centre for Crop and Disease Management (CCDM) are shedding new light on ways to combat the damaging disease Sclerotinia stem rot. Researchers from the CCDM – a national research centre co-supported by Curtin University (WA) and the GRDC – have released new findings from key projects focusing on sclerotinia.

It is hoped the results will lead to the development of Australian canola varieties with resistance to sclerotinia, and increase understanding of environmental conditions that cause basal infection, where the disease infects the plant from the bottom of the stem.

With no Australian canola varieties showing field resistance to the damaging fungus *Sclerotinia sclerotiorum*, that causes sclerotinia, CCDM researchers have sourced diverse canola genotypes from around the globe in a bid to discover germplasm with better genetic resistance.

Working with researchers from Agriculture and Agri-Food Canada (AAFC), the CCDM team tested how canola plants – that had already shown high levels of resistance to sclerotinia in Canadian tests – would cope if infected with highly aggressive sclerotinia isolates from Western Australia.

CCDM researchers collected 71 isolates from around WA, sorted them into genetically diverse groups and selected three highly aggressive isolates to take to the next stage of research.

The aggressive isolates were inoculated on a range of plants sourced globally by AAFC from a variety of countries including South Korea, Japan and Pakistan. These plants had already been tested by AAFC's Lone Buchwaldt, who found they were partially resistant to Canadian sclerotinia isolates.

"We wanted to know if the Canadian-tested lines would stand up against the most aggressive WA isolates we could find and the great news is that they did," said researcher Matthew Denton-Giles, formerly with CCDM.

"The Australian trials closely mirrored the results from previous Canadian trials and this is positive news given the aggressive nature of the Australian sclerotinia isolates.

"Canadian researchers are already using the results of their studies to work towards more effective breeding of sclerotinia-resistant canola lines and there is the potential for Australian breeders to learn from the Canadian experience."

Developing resistant Australian lines

CCDM co-director, Professor Mark Gibberd, said the research would help develop sclerotinia-resistant canola in Australia.

"The next step is to collaborate with both AAFC and Australian breeding teams to develop canola populations that contain this resistance," Mark said.

The research is outlined in the paper – *Partial stem resistance in Brassica napus to highly aggressive and genetically diverse Sclerotinia sclerotiorum isolates from Australia* – that has just been published in the *Canadian Journal of Plant Pathology* and is available at *http://bit.ly/2Nng9ky.*

CCDM researchers have also investigated environmental factors leading to basal infection of canola.

To determine which growing conditions will increase the risk of basal infection, former CCDM honours student David Lane carried out laboratory-based tests on hundreds of sclerotia (hard, black irregular shaped and rounded bodies from advanced sclerotinia infections) from WA.

Results showed that sclerotia subjected to dry and hot conditions (37°C), and then exposed to moist conditions, were more likely to germinate and produce hyphae (filaments of a fungus) that could infect plant tissue.

According to Matthew, who supervised the research, these conditions mirror the climate conditions faced by most growers in Australia's western and southern cropping regions – with hot and dry summer conditions followed by autumn rains.

Researcher Matthew Denton-Giles says recent research indicates there is potential for Australian canola breeders to develop canola lines with levels of resistance to sclerotinia. (PHOTO: CCDM)

"This latest research provides scientific confirmation of what many of us have long suspected about growing conditions that favour basal infection of canola plants," Matthew said.

"The next important stage of the research will be to try to mirror the conditions in field trials so we can then look to test the effectiveness of fungicides to help control this kind of infection."

This research – *Heat-Dried sclerotia of Sclerotinia sclerotiorum myceliogenically germinate in water and are able to infect Brassica napus* – has been published in *Crop & Pasture Science*, with the full paper available at *http://bit.ly/2MPorMS* ■

New canola program to help growers manage rainfall risk

TO help growers manage risk in their canola crops, Monsanto Australia Pty Ltd has announced the DecilePro program, which will be available for Australian canola growers in 2019.

DecilePro will provide Roundup Ready canola growers with an alternate way to pay for their technology fee and will be linked to growing season rainfall.

"Growing season rainfall is a key factor in determining overall yield and profitability of canola crops," said Don Benn, Rowcrop Product and Stewardship Manager for Bayer.

"DecilePro will assist in sharing the risk of low rainfall by waiving the entire Roundup Ready canola technology fee when the grower receives rainfall that is decile 3 or lower."

Don said that when growers purchase their Roundup Ready canola seed, they now have the choice of paying a technology fee of $8.30 per kilogram (ex GST) upfront or opting-in to the DecilePro program and not having to pay their technology fee until after harvest.

"If growers chose to opt-in to the DecilePro program, their Technology Service Provider (TSP) simply provides GPS points for the fields they wish to include. The GPS points assign a field to one of the Bureau of Metrology's (BOM) five square kilometre grids. This means rainfall deciles will be unique to every field and will take into account any variation between regions.

"Under the DecilePro program, Roundup Ready canola fields that receive decile 4 rainfall or above will be invoiced at $15 per kg (ex GST) at the end of the season, which will help growers manage cash-flow by providing payment terms that extend past harvest."

Don said growers will have no technology fee to pay for fields in the DecilePro program that receive decile 3 rainfall or below.

"We know growers understand the benefits of the Roundup Ready canola system, especially the weed control and the higher yield potential of hybrids," Don said.

"But some have been reluctant to grow Roundup Ready canola hybrids because of the upfront investment.

"DecilePro not only provides canola growers with payment choices and extended terms for their Roundup Ready technology fee but importantly, it shares the risk by waiving the technology fee in low rainfall years.

"This means when growers opt-in to DecilePro, they will only pay for the benefits of Roundup Ready canola in higher rainfall, and therefore in higher yielding years."

For more information on the DecilePro program, visit *www.roundupreadycanola.com.au*

(Left) Don Benn, Bayer's Rowcrop Product and Stewardship Manager with farmer George Burdett of Lake Bolac, Victoria. Don said that the new DecilePro program offers growers a way to manage rainfall risk in their Roundup Ready canola crops.

THE MAIN POINTS OF THE DECILEPRO PROGRAM

- To be eligible for participation in the DecilePro program, growers must purchase Roundup Ready canola and opt-in to the program before April 15 and provide GPS points of each eligible field.
- Grower must opt-in to the DecilePro program at least one day before taking delivery of their canola seed from a Technology Service Provider (TSP).
- Grower must have a valid 2019 License and Stewardship Agreement (LSA).
- Deciles are calculated using the Bureau of Meteorology five square km grid data.
- Growing season rainfall is for the period between May 1 and October 31 of the relevant growing season.
- If the grower receives a decile 4 rainfall or above, grower agrees to pay technology fee of $15/kg (ex GST).
- This offer is valid on all Roundup Ready canola sales in 2019.
- Program is valid for technology fee only and does not include seed cost or any other input costs.
- Please see full terms and conditions for further information.

Ryegrass seed set control in canola – timing is everything

By Peter Newman

MICHAEL Whitney was an opportunist. He just happened to be playing county cricket in England when all of the Australian bowlers went down with an injury during the 1981 Ashes tour. He got the call-up to fill in and play for Australia and he grabbed that opportunity with both hands, turning it into an Australian international cricket career. Talk about timing!

Stopping ryegrass seed set pre-harvest in canola is all about timing. Sometimes the timing window lines up, other times it does not. Glen Riethmuller, DPIRD Merredin has a knack for choosing the most difficult, most labour intensive research trials to undertake. Between 2010 and 2013 he, along with Abul Hashem and Catherine Borger investigated ryegrass seed set control pre-harvest in canola.

They investigated the practice of spraying under the swather as canola is windrowed for harvest compared to crop topping (desiccation) spraying over the top of the canola. At the time glyphosate was not registered for this practice and this research contributed to this registration.

For this reason, these research results were not made available until after the registration process was complete.

The researchers found that glyphosate can be effective either as a spray swath or crop topping treatment and that the other registered herbicide, diquat (Reglone) is sometimes effective when the ryegrass is at the right stage – but results were variable. Sometimes all of the ryegrass seed set control treatments work, sometimes none of them work. Timing is everything.

Spray swathing trials

Spraying under the swather as the canola is windrowed for harvest has become a common practice in Australia to stop seed-set of ryegrass and other weeds. This has become particularly important to help control late emerging weeds. Pictured bottom left is the spray swathing set up that was used for this research. It is a MacDon 3020 PTO swather with 7.6 metre cut and Brando Hill spray kit attached with Spraying Systems Floodjet TK-.75 nozzles 50 cm apart working at 1.0 bar giving 340 mL per minute, 75 L per hectare water at 5.4 km per hour.

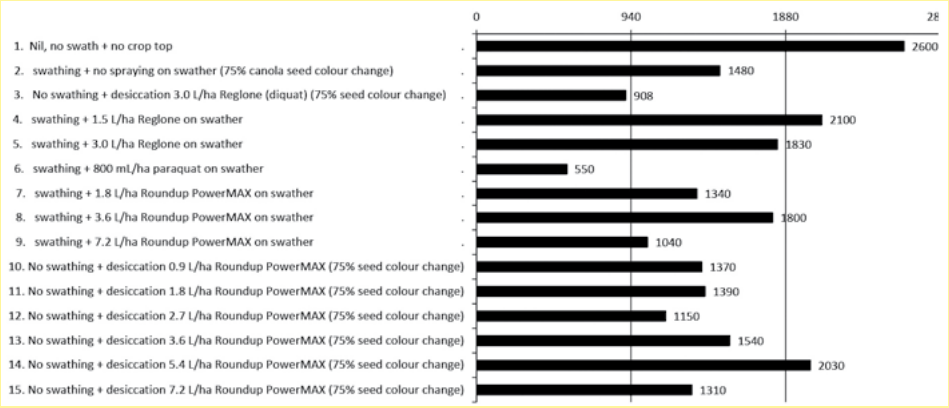
A MacDon 7.6 metre swather and Brando Hill spray kit.

Mount Barker 2010

As with crop topping, timing is everything with spray swathing. The results of this trial (Figure 1) were not particularly exciting with roughly 50 per cent ryegrass seed set control achieved with many of the treatments. What it does show is that spray swathing and crop topping (desiccation) can be equally effective as one another.

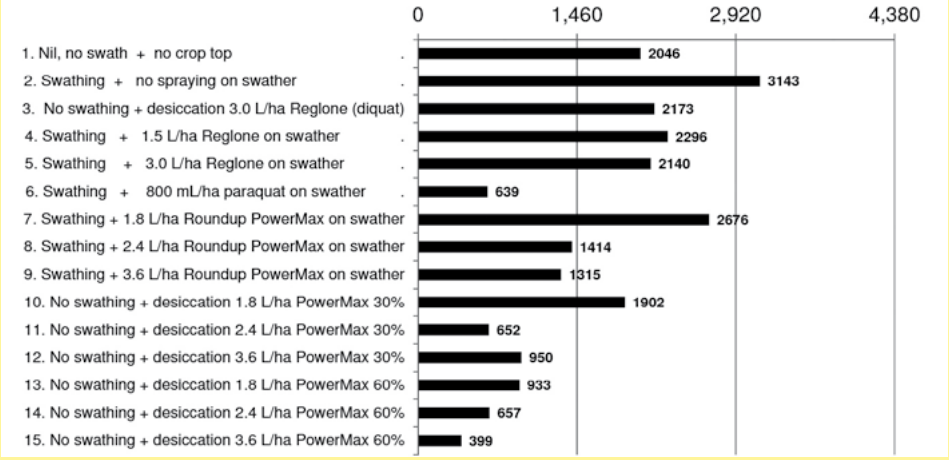
Desiccation with diquat was quite effective in this trial, reducing viable ryegrass seed production by 65 per cent but diquat under the swath was less effective. Swathing alone gave about 43 per cent ryegrass seed set control, similar to the level of control achieved with the glyphosate treatments.

FIGURE 1: 2010 Mt Barker results – viable ryegrass (seed/m^2) after various treatments



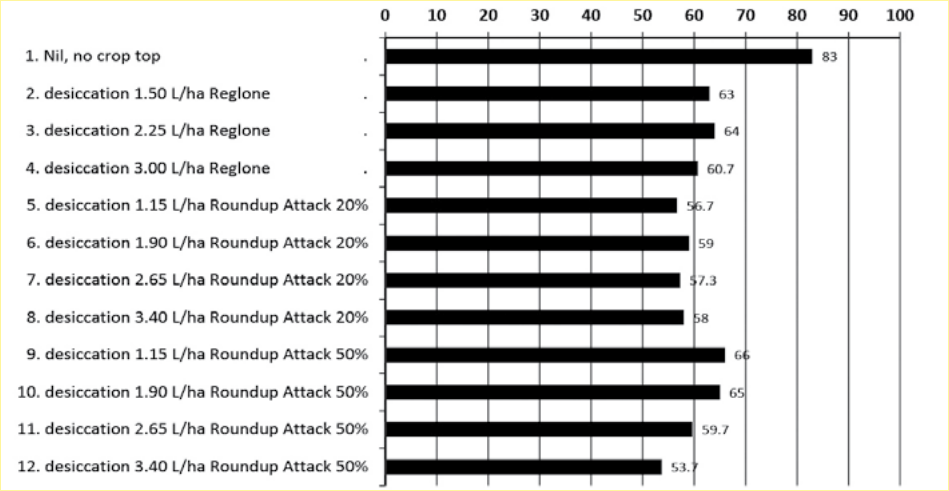
All treatments applied at 75 per cent colour change of the canola on November 23, 2010. PowerMAX refers to Roundup PowerMAX (glyphosate 540 g/L). Reglone = diquat 200 g/L. l.s.d. = 940 (p<0.05)

FIGURE 2: 2011 Mt Barker results – viable ryegrass (seed/m^2) after various treatments



Desiccation treatments: 3.0 L/ha Reglone + 0.16 per cent BS1000, 1.8, 2.4 and 3.6 L/ha of Roundup PowerMAX at 11 km/h with eight Lechler IDK120-02 air inducted nozzles, 50 cm apart, 2.5 bar, 730 mL/min = 80 L/ha. Desiccation and swathing treatments applied on November 28, 2011 at 80 per cent colour change of the canola. l.s.d. = 1460 (p<0.05)

FIGURE 3: 2012 Katanning results – viable ryegrass (seed/m^2) after various treatments



Reglone (diquat) desiccation treatments applied at 80 per cent colour change of the canola. Roundup Attack treatments applied at either 20 or 50 per cent colour change. l.s.d. = not significant (p<0.05)

Mount Barker 2011

The 2011 trial at Mt Barker (Figure 2) showed that glyphosate applied as a desiccant at high rates late was generally more effective than the spray swathing treatments.

On average, spraying under the swather with glyphosate reduced viable ryegrass seed production by 43 per cent whereas the best desiccation treatment with glyphosate achieved 80 per cent ryegrass seed set control.

Paraquat under the swath

Paraquat is not registered for pre-harvest weed control in canola and is not an option. Research has shown that paraquat residues above the maximum residue limit (MRL) of 0.01 ppm have been found in canola grain when paraquat was applied as a spray under the swath.

Crop topping/desiccation – timing is everything

Several years ago I was visiting farms in spring giving recommendations to grain growers about crop topping of lupins for ryegrass control. Some paddocks were good to go with milky dough ryegrass and lupins at the right stage, and other paddocks just down the road were not. The ryegrass was past the ideal timing. The same is true for crop topping of canola. Sometimes the timing window opens up and other times it does not.

Desiccation trials

In 2012 nothing worked. The Katanning trial had low ryegrass numbers and the researchers commented that the ryegrass appeared too advanced at the time of spraying for crop topping treatments to be effective. Figure 3 shows that all treatments were ineffective.

In 2013 everything worked

The ryegrass was at the ideal timing as the canola seed changed colour in this trial and everything worked, even Reglone! This trial also included some different water rates which had no effect on efficacy.

The 2013 Katanning trial (Figure 4) included three water rates of 40, 80 or 120 L/ha applied at either 20 per cent or 50 per cent colour change of the canola. Reglone treatments applied at 80 per cent colour change of the canola.

Glyphosate registration

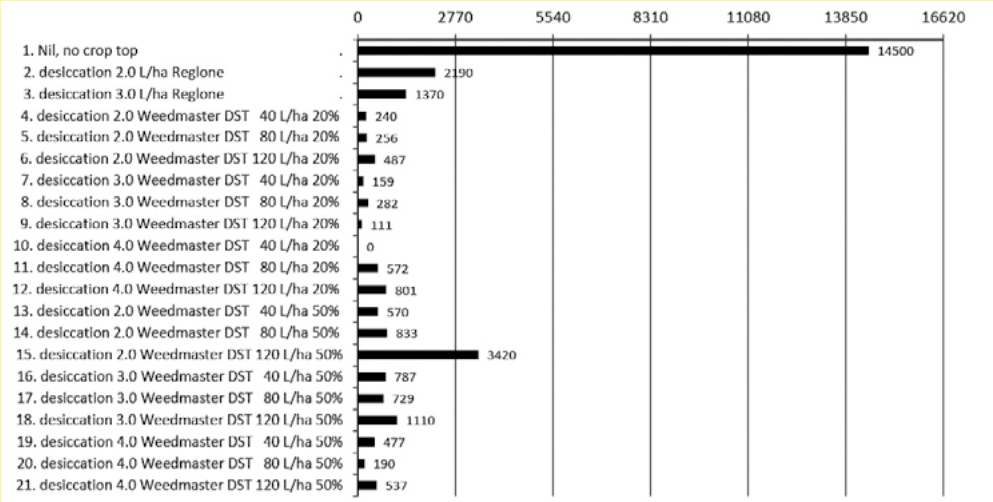
There are two glyphosate products registered at the pre-harvest timing in canola – Weedmaster DST from NuFarm and Roundup UltraMAX from Monsanto (now Bayer). You will notice in the results shown in Figure 3 that Roundup Attack was used in the trials. Roundup Attack is now sold as Roundup UltraMAX. Roundup PowerMAX was also used in this research but is not registered for this practice.

Canola Combo

Paraquat is not registered in canola, and diquat is often ineffective at this late timing. If the ryegrass is flowering to water ripe, diquat may be an option, but more often than not it seems that glyphosate will be the product of choice for pre-harvest weed seed set control in canola.

Clearly, this represents significant selection pressure for glyphosate resistance, which is why Greg Condon has coined the term the *Canola Combo*. That is the double knock of glyphosate applied as a crop topping or spray swathing treatment followed by harvest weed seed control.

FIGURE 4: 2013 Katanning results – viable ryegrass (seed/m^2) after various treatments



l.s.d. = 940

To sum up

Sometimes the crop topping or spray swathing timing lines up perfectly and the weeds are at a vulnerable stage when the crop is ready to be sprayed and/or swathed. In this situation it almost doesn't matter what you do, almost everything works.

But in other situations, the weeds are very advanced when the crop is ready and nothing works particularly well. Crop topping (desiccation) and spray swathing of canola are excellent practices when the timing window is open.

Timing is everything. ■

Farmers' perspective vital for adoption of new, better practices

A STUDY published by scientists from The University of Western Australia jointly with farmers is one of the first to address the role of temperate perennial grass pastures in contributing to soil organic carbon in south-western Australia.

Intensive sampling was conducted on a trial site near Wagin consisting of a mix of temperate perennial and annual grasses that had been sown over a ten-year period. The results demonstrated the potential of perennial pastures for short-term gain in soil organic carbon stocks.

Emeritus Professor Lynette Abbott from UWA's School of Agriculture and Environment and Institute of Agriculture said temperate perennial grass pastures are currently an uncommon choice in this region but have the potential for future development.

"This farming system is unusual and novel for the region, and land managers Caroline and Rob Rex are acknowledged as early adopters and innovators," Lynette said.

"They are engaged in a constant process of experimentation and adaptive management to trial practices that will improve perennial pasture production and soil health."

She said although officially credited carbon farming projects have had limited adoption in Australia, there are likely to be many innovative farmers engaged in farming practices that actively sequester carbon, not captured by national carbon accounting frameworks.

More important drivers

"For individual farmers, the co-benefits of 'carbon farming' such as improved soil health and improved pasture production are likely to be more important drivers of new practices than financial compensation for carbon credits," Lynette said.

"For information on soil organic carbon to be used by farmers, it must be salient to farming goals which are unlikely to centre on carbon, but rather on the farming system, soil health, or co-benefits of soil carbon."

Co-author Dr Natasha Pauli from UWA's School of Agriculture and Environment and Institute of Agriculture said understanding farmers' views, perspectives, and questions surrounding the role of carbon in agriculture is vital for the long term and sound implementation of land management practices incorporating the role of carbon farming.

"At the end of the day, at the farm level farmers will take on almost the entire responsibility for climate change mitigation and adaptation in agriculture, and the adoption of new innovations exposes them to significant risk," Natasha said.

"Taking into account farmers' needs for experimenting with management practices and their detailed local knowledge of why certain locations respond in different ways is paramount for developing longer term and larger scale approaches to improve soil health through novel agricultural practices."

The research was funded by the Australian Government Department of Agriculture and Water Resources through Action on the Ground. Action on the Ground provided funding to assist farmers and landholders (often in partnership with research, industry, NGOs, government, or grower groups), to develop on-farm trials and demonstrations.

The paper – *A farmer-scientist investigation of soil carbon sequestration potential in a chronosequence of perennial pastures* – was published in Land Degradation and Development. ■

Wagin (WA) district farmers Rob and Caroline Rex are engaged in a constant process of experimentation and adaptive management for better farm productivity.

Unearthing information on microscopic pest

INCREASING grain growers' understanding about the impact that root lesion nematodes (RLN) have in their farming systems – and how they can effectively deal with them – is the aim of a new research project.

The GRDC invested in the work after members of its WA Regional Cropping Solutions Network (RCSN) initiative identified RLN as an issue of significant concern for growers, especially in the Albany port zone and western areas of the Kwinana port zone.

GRDC grower relations manager – west, Curtis Liebeck, said the microscopic pests could significantly reduce crop yields by feeding on root tissues, reducing water and nutrient uptake and compromising plant growth.

"Nematodes survive over summer in a dehydrated form and continue their life cycle when the soil conditions become favourable.

"Once established, they can be managed but not eradicated. If they are not managed, populations can increase and may limit crop production."

The project, to be led by farm consultancy Farmanco, will complement significant existing research, conducted largely by the Department of Primary Industries and Regional Development (DPIRD), as part of the National Nematology Project.

DPIRD has conducted research into RLN distribution, host range among crop species, variety resistance within crop species, interaction with acid soils and yield impacts on crops.

Root lesion nematodes are microscopic, worm-like parasites that inhabit the soil and feed on plant roots. (PHOTO: GRDC)

RLN surveys and sampling points

Curtis said the new project aimed to add to the industry's understanding of nematode levels in the grainbelt by conducting surveys over two years to enhance information about RLN distribution in the Albany port zone and western areas of the Kwinana port zone.

"This project will also aim to determine whether targeted sampling points are more effective than random sampling across a paddock, and provide approaches for growers to manage RLN on their properties," he said.

"A broad-scale trial, which aims to establish the impact of different rotations and management strategies on RLN numbers, will be established in each port zone and workshops will be conducted to inform growers of project findings."

The GRDC has recently produced a video and podcast about RLN in WA, featuring DPIRD nematologist, Sarah Collins. To view the video, go to *http://bit.ly/2PSvhXH*. To listen to the new GRDC podcasts, direct links to iTunes or Soundcloud are available from *https://grdc.com.au/podcasts*, or use this URL to listen from your desktop. ■

A cunning new hard wheat variety released in bushranger country

THE 2018 performance across the eastern seaboard of InterGrain's newest Australian Hard (AH) wheat – Vixen – has proven its capacity to withstand very challenging seasonal conditions.

Released at the Baker Seed Co Field Day in Rutherglen, Victoria last year, Vixen again, performed exceptionally well in the 2018 National Variety Trials (NVT) program as well as InterGrain trials. Similarly, seed 'bulk-up' areas achieved very pleasing yields despite trying seasonal conditions.

Extensive trials by InterGrain (past six years) and the NVT program continue to demonstrate that Vixen is the highest yielding, early-mid maturing AH wheat in the southern and south-eastern classification zones, covering South Australia, Victoria and southern New South Wales.

Long-term NVT MET data shows Vixen is estimated to have a 5 to 6 per cent yield advantage over Condo in southern NSW and a 7 to 8 per cent edge over Corack and Mace in Victoria. In 2018 NVT results it averaged a 3 per cent higher yield than Scepter nationally. This was a great performance in a tough season.

Allan Rattey at the Baker Seed Co launch of Vixen.

An alternative for mid-May sowing onwards

Vixen's earlier maturity makes it a very attractive alternative for growers, providing a new varietal option for sowing in mid-May onwards.

The 2018 season also demonstrated Vixen's broad adaptation, as it performed well in the drier conditions in the east whilst still performing exceptionally well in the shorter, high yielding growing season experienced in Western Australia.

In officially launching the new variety at Rutherglen, InterGrain wheat breeder Dr Allan Rattey told growers it was apt that Vixen was released in an area renowned for the cunning activities of outlaw bushranger Ned Kelly.

"Growers at the launch saw first-hand, in the paddock, Vixen's potential in very tough seasons – such as that thrown-up in the dry conditions of winter and spring last year."

Allan says the InterGrain team has seen Vixen show excellent yield stability across multiple years and locations in the southern and south-eastern regions and this is a key trait that makes it a 'stand-out' from other hard wheats.

Disease resistance

He says not only is Vixen the highest yielding early maturing AH wheat now available to growers throughout South Australia, Victoria and southern NSW, it offers a very solid disease resistance package with good yellow leaf spot, stripe rust and stem rust resistance.

"It is rated moderately resistant to moderately susceptible (MRMS) for all three of these common and costly wheat diseases," he says. "Vixen is an exciting new line to come to the market for growers seeking a high yielding wheat option for mid-May sowing.

"Vixen's overall high yield, coupled with its early-mid maturity and high-end yield potential provides seasonal flexibility by handling tough seasonal conditions whilst maximising yield in favourable seasons.

"It also has the agronomic advantage of a medium plant height, similar to Mace, which helps to reduce stubble loads in high yielding environments.

"Vixen will be a useful tool for disease control programs in wheat–on–wheat rotations, especially where cereal cyst nematode (CCN) is effectively managed.

"But it is worth noting that Vixen is rated moderately susceptible to susceptible (MSS) for CCN and this will need to be managed through rotation planning and by using CCN resistant crops and varieties, such as Spartacus CL, within the crop sequence," Allan cautions.

Vixen has a good grain size and comparable hectolitre weight to other commonly grown varieties.

"Our breeding program is very focused on combining high yield with elite quality, enabling delivery of varieties with AH or greater classification and with good physical grain characteristics.

"Vixen is available for planting in 2019," Allan says. "But seed supplies are limited, so it is recommended interested growers place seed orders as soon as possible with local Seedclub members and/or resellers."

For more information about Vixen, refer to:
https://www.intergrain.com/variety/vixen/

■

It's hot! Damn hot! Real hot!

■ By Peter McMeekin, Grain Brokers Australia

EXTREME heat wave conditions were experienced across many parts of south eastern Australia in late January with temperature records tumbling in many regions. South Australia appears to have been the worst affected with 17 official temperature records broken across the state on January 24.


Peter McMeekin.

Adelaide posted a new record of 46.6°C compared to 46.1°C set on January 12, 1939 – more than 80 years ago. In Port Augusta, the thermometer peaked at a scorching 49.5°C (121.1 °F in the old money) which was terribly close to the highest official temperature ever recorded in Australia. This is 50.7°C (123.3 °F), and it was logged at Oodnadatta (also in South Australia) on January 2, 1960.

The sweltering temperatures extended east into most parts of Victoria and inland regions of New South Wales. The neighbouring regions of the Mallee in northern Victoria and the Riverina in south western New South Wales were the hardest hit.

In Queensland, the temperatures were above average but certainly not as extreme as those experienced further south.

But it is the extreme dry that is the biggest challenge.

Impact on summer crops

The combination of hotter than normal temperatures and well below average summer rainfall is starting to have an impact on the state's sorghum production. This year's harvest is going to be a drawn-out affair as seeding in southern Queensland began in early September and planters were still active in late December on some parts of the inner Darling Downs.

Harvest of the crops that were sown in early spring has commenced. Initial quality reports are mixed with screenings issues starting to surface, particularly on the Western Downs. It is far too early to make a call on crop quality and the influence on production, but the unseasonable weather pattern is definitely going to have an impact, particularly if it continues.

If that impact manifests itself in a higher than usual percentage of sorghum 2, then the market has a challenge. It has to try and find a home for the downgraded product. Grower selling has reportedly slowed to a trickle due to the quality uncertainty. They are frantically trying to get sorghum 2 options on their sales to cover the downgrade risk.

But most stockfeed consumers have traditionally been very reluctant to buy sorghum 2. Some take it, but many don't. If they do, it is only in relatively small quantities and at a significant discount. The focus for many these days has turned to a consistent ration aimed at maximising daily weight gain as opposed to chasing the cheapest grains available.

The Darling Downs market closed last week pretty close to where it started. Stockfeed quality wheat was trading at around $450 per tonne delivered. Feed barley was around $50 cheaper at $400 delivered, and sorghum was a further $40 discount at $360 delivered. Discounts being applied to sorghum 2 reportedly range from $20 to as high as $35.

All market participants will be keeping a keen eye on the quality trend as harvest ramps up. If test weights are lower than usual and downgrading becomes an issue, then the current discount structure will have to change.

The sorghum balance sheet

At the current price spread to white grains, domestic sorghum demand could be as high as 1.6 million tonnes (mt). But with much of Central Queensland still to plant (window closing quickly) and northern NSW's production well below average, total production is probably going to be less than 2.0 mt. It could easily be as low as 1.8 mt already.

If there are further production issues the sorghum balance sheet begins to tighten. And that is without any demand from China. The market will have to react. Firstly, if downgrading increases to such an extent that supply of sorghum 2 outstrips demand, then the sorghum 2 discount will widen as a reflection of the oversupply.

Secondly, if production decreases, and/or China enters the market, to such an extent that supply has to be rationed then the sorghum 1 discount to wheat and barley will be pressured to narrow. This, in turn, will encourage consumers to decrease their sorghum demand by increasing white grain inclusion in their ration at the expense of sorghum.

I guess the next question is will that have an impact on white grain prices delivered to the consumer? The quick answer is unlikely, unless there is movement in international values or a politically motivated change in demand for Australian wheat or barley.

The prices quoted above are a reflection of full execution from Western Australia. There is an exportable surplus of both wheat and barley in that state, and both grains are seeing export interest at current values. But a decrease in domestic sorghum production on the east coast will mean that exports of white grains from WA to the east coast will have to increase to fill the void. This will be at the expense of wheat and barley available for international sales.

Trade eyes will be firmly fixed on sorghum production and quality as the harvest ramps up over the next month. If the hotter and drier than normal conditions continue, then the northern feed grains market is in for some increased volatility.

The latest Bureau of Meteorology three month (February to April) outlook doesn't provide much solace. The chances of a warmer three months are higher than 80 per cent over large parts of western and eastern Australia.

It reminds me of the 1987 American war comedy *Good Morning Vietnam*. When US Armed Forces radio DJ Adrian Cronauer (played by Robin Williams) asks a soldier on the front line "What's the weather like out there?" the response was an emphatic "It's hot! Damn hot! Real hot!"

Peter McMeekin is a consultant to Grain Brokers Australia. Call 1300 946 544 to discuss your grain marketing needs. Report submitted January 29. ■

Trying to forget the politics for a moment...

IN late January a lack of adequate snow cover to protect the winter crop against cold weather was raising some concerns in parts of the northern hemisphere. The snow cover acts as an insulation layer for the hibernating wheat and barley crops. If this is not present the exposed crop becomes susceptible to damage, and even death, from freezing winter temperatures.

The areas of adequate snow cover are confined to eastern Europe and the Balkans. This leaves the crop in the central and western regions susceptible to the sub-zero temperatures that are forecast for most of Europe over the next few weeks. Rainfall will alleviate the immediate issue in isolated regions, but an exposed crop remains very susceptible to a cold snap.

No such issues exist in Russia or their Former Soviet Union (FSU) neighbours where the snow cover is reported to be excellent and the winter crop in good shape. The snow cover is so thick it has actually been playing havoc with the movement of wheat and barley to the Black Sea ports for export.

Across the Atlantic, it has been bitterly cold in the northern parts of the US. The market has been finding support on worries that recent snowfalls and the forecast snowstorms may not be extensive enough to protect the winter crop adequately. Freezing temperatures are forecast for much of the Plains and Midwest through to the end of January. The snowstorms are expected to be less severe in the Southern Plains, but so too are the temperatures, reducing the potential weather and production risk in those counties.

US wheat futures closed out in mid January in positive territory on the back of firmer Black Sea export values. There appears to be a renewed feeling that the market and price will ensure Russian domestic requirements are met by restricting exports enough to negate the need for government intervention.

Rumours also abound of fresh US export wheat business being concluded along with reports of optional origin sales being switched to US execution. US hard red winter wheat is now around US$3 to $5 cheaper than both Russian and EU origin wheat. But all of this remains anecdotal as long as the government shut down continues and the key USDA market data is not being collated.

US corn is currently the cheapest in the world.

The window for the US and EU to gain wheat export traction before new crop grain is available gets smaller with every unsuccessful Egyptian tender, not that they are the only option.

The market is also expecting vastly improved supplies in 2019 as global cereal production rebounds from drought reduced production in many jurisdictions this season.

European Union wheat production, for example, is forecast to be 147 million tonnes (mt), an increase of 16 per cent on this season's production of 127 mt. With a return to more normal seasonal conditions, both Australian and Russian production could easily be up at least six mt. That will bring production in the major exporting countries back to around 400 mt, up from 364 mt this season.

The global corn market

Weakness in corn futures values in mid-January bought out some buyers with South Korean importers booking around 260,000 tonnes in snap tenders.

The export interest, and the ongoing weather concerns in South America, pushed corn futures higher as January progressed. US corn exported from the Gulf of Mexico is now cheaper than Ukraine origin corn delivered into many Mediterranean destinations. Pacific North West (PNW) export prices are also competitive trading on a par with Argentinian values into the Korean Peninsula.

Total precipitation in the Brazilian state of Mato Grosso this summer crop season is running around 35 per cent below last year. The state produces almost 40 per cent of Brazil's safrinha corn crop. The first corn crop only makes up about a third of Brazil's total corn production with the second crop (safrinha) making up the balance. This crop is planted immediately after the soybean crop is harvested early in the new year and is the major contributor to their export program.

In China, African swine fever is still a significant concern with 916,000 pigs culled after around 100 outbreaks of the disease had been recorded in 24 provinces since August last year. While that seems a high number, it is small relative to the total pig population of around 430 million head. China slaughtered almost 700 million pigs in 2017.

With US corn prices now competitive internationally, downside from current price levels appears limited. US corn is currently the cheapest in the world and will most likely remain so until the new crop South American harvest comes on stream in the second quarter of the year. Here again, the shutdown means we have no idea if the US is gaining traction in global markets.

The recent political issues have been a massive distraction in global grain markets. The dearth of crucial information and statistics has created a market that is merely treading water, with no direction and no rudder. As a result, the trade focus has now turned to the weather extremes being experienced across the world and the possible global supply ramifications. But that is only one side of the critical supply and demand equation.

Submitted by Peter McMeekin, consultant to Grain Brokers Australia. Call 1300 946 544 to discuss your grain marketing needs. Report submitted January 22.■

Bringing science to the pub and to the plate

In 2016 the CSIRO-developed Kebari barley was used by the German brewing company Radeberger to brew and launch Pionier, the world's first gluten-free beer.

PALE ale loving hipsters of the world rejoice – a new Edith Cowan University, WA research team is bringing cutting edge technology to the world of brewing to make your beer taste better.

Professor Michelle Colgrave and her team are hoping to look deep into the process of brewing with equipment more commonly used in medical and pharmaceutical research.

They'll be using cutting-edge mass spectrometry to figure out how to improve the taste of beer by looking at proteins produced or altered in the brewing process.

Mass spectrometers measure the individual proteins and their fragments in a food sample, allowing Michelle and her team to analyse the different types and amounts of proteins in each sample.

Huge scope for the technology

Michelle said the explosion of the craft beer market had introduced more experimentation in the production process.

"Brewers are bringing in different types of hops, yeast and barley and other ingredients and finding different ways to combine them," she said.

"They're looking to differentiate a product and that's where our expertise in understanding how the proteins in beer affect flavour and other attributes is really important.

"There's huge scope for this technology to be utilised in the craft market and to bring science to that process."

Michelle has joined ECU to expand her research in proteomics (the study of proteins) in grain and other areas of agriculture and food science.

Professor Michelle Colgrave is the 18th appointment under the Professorial Research Project scheme, an ambitious project to recruit more than 20 professors from around the world to rapidly increase research activity and impact.

Improving food safety

The other focus of Michelle's team will be developing better tests for food safety, particularly for food allergies and intolerances.

"We're interested in coeliac disease and gluten intolerance and how we can use these advanced techniques to potentially improve the accuracy of tests for gluten in gluten-free products," she said.

Coeliac disease affects about one per cent of the population but about 10 per cent suffer from non-coeliac gluten sensitivity which is a related but different illness.

There's no accurate test for gluten in heavily processed food products according to Michelle.

Because of how gluten changes during the chemical processes such as in brewing or baking bread it's difficult for traditional tests to pick it up.

"We'll been using mass spectrometry and advanced techniques to find out whether that gluten has in fact been removed," she said.

Michelle also works at CSIRO where she was involved in the development of Kebari – an ultra low gluten content barley. Gluten content in Kebari has been reduced to below 5 parts per million (ppm) and well below 20 ppm, the level recommended by the World Health Organization for classification as gluten-free.

At ECU Michelle will also be leveraging the University's existing expertise in brewing, nutrition and dietetics to utilise mass spectrometry to answer questions that are important to the industry. ■

Kazakhstan farmers adapt Australian farming technology

By Vladimir Astafiev[1], Alexander Kurach[2], Evgeniy Pigarev[3] and Madina Brimzhanova[4]

AT A GLANCE…

This article describes the results of research into the direct sowing of agricultural crops using narrow tynes in northern and western Kazakhstan compared with a traditional way of sowing using wide tynes.

Note that northern Kazakhstan has a short growing season. They plant wheat in late May and grow the crop through their summer for harvest before the first frosts of autumn.

THE main limiting factor in the production of crops in northern Kazakhstan is moisture. The average yield of cereals in recent years is 1.2 tonnes per hectare, with a range from 0.3 to 0.5 tonnes per hectare in dry years, to 1.7 to 2.0 tonnes per hectare in wet years.

To help overcome this yield variation, Kazakhstan farmers and researchers have focused on new moisture-saving technologies such as zero till and minimal till. In particular, they have looked at zero till technology with a reduced seeding rate in the wheat belt of Australia, where moisture is also the limiting factor in many years. For moisture-saving technologies, the most important factor is the choice of the method of sowing and openers/tynes for its implementation.

From 2012–15, we made production tests of the 'Australian' technology of direct crop sowing in the stubble of the previous crops, which involves seeding with an anchor tyne/narrow spike and sowing rates reduced by 30–50 per cent. The planter used was an Australian Rogro planter, using a 1.6 cm tyne opener and a row spacing of 30–40 cm.

This was compared with sowing with conventional sweep/shovel belt planters on a row spacing of 23–25 cm and a seeding depth of 7–8 cm. The Rogro planter makes it possible to set the depth of the sowing in the furrow up to 20 cm down from the surface but with a seed depth only of 3–6 cm.

In arid conditions, this allowed sowing to be carried out in a deeper and more moist soil as the top layer had dried out.

Co-author Madina Brimzhanova (left) and a research colleague measure a well grown wheat crop in northern Kazakhstan.

In the experiments, the width of the row spacing, the seeding rate and the timing of sowing were varied. The size of production plots was from 100 to 400 hectares on three farms located in different soil and climatic zones:

- Zhanakhai farm has an average annual rainfall of 360 mm. Soils are represented by ordinary chernozems, mostly of heavy clay composition.
- LLP 'Ramazan-K' has an average annual precipitation of 250–280 mm. Soil cover of most fields is represented by southern chernozems, and the soil type is heavy loam.
- LLP 'Kumkudyk' is located 150 km west of the second farm and has an annual precipitation of about 200–220 mm on chestnut, loamy soils.

The 2012 season turned out to be extremely dry. At the time of sowing, soil moisture was at a depth of more than 10 cm, and during the growing period (from May 20 to August 1), no more than 20 mm of rain fell. The high temperatures meant that this rain had virtually no effect on plant development.

The 2013 and 2014 seasons were also dry for LLP 'Kumkudyk'. The climatic conditions at the farms for each season are presented in Table 1. The climatic conditions across years and farms were very different, and they underline the risky conditions of farming in northern and western Kazakhstan.

What we found

2012 season

The results of the research in 2012 at Zhanakhai farm are presented in Table 2. In the drought conditions of 2012, it was very useful to set the depth of the shank of the Rogro planter down to 20 cm. This allowed us to 'seek the moisture' below drying surface layers and to sow the seeds in the moist soil layer. Shoots after sowing with the Rogro were very uniform and

TABLE 1: Climatic conditions for production trials

Name of the company	May	June	July–August
Year 2012			
KH Zhanakhai	Air drought	Air and soil drought	July – drought, August – rain
Year 2013			
KH Zhanakhai	Dry	Air and soil drought	Rain
LLP Kumkudyk	Air drought	Air and soil drought	Air and soil drought
Year 2014			
KH Zhanakhai	Wet	Wet	Rain
LLP Kumkudyk	Air drought	Air and soil drought	Air and soil drought
Year 2015			
LLP Ramazan	Wet	Air and soil drought	July – drought, August – rain

protected from dry winds, as they were in the groove/furrow formed by the narrow tyne.

In the extremely arid conditions of 2012, the use of direct sowing with narrow tynes with increased row spacing – and reduction in the seeding rate – provided a significant increase in the yield of wheat, flax, rapeseed (canola), sunflower and soybean. And direct costs of sowing were reduced in wheat, sunflower and soybean crops due to lower fuel and seed costs.

2013 season

The results of 2013 research on the farms Zhanakhai and Kumkudyk LLP are given in Table 3.

It should be noted that the wheat crops seeded at the beginning of the sowing season on May 22 in the Zhanakhai farm experienced severe stress from the June drought.

The combination of wide row spacing, lower seeding rate, and narrow tyne as compared to the sweep, allowed the wheat to be less stressed as tillering was increased by 1.6 times and the density of the wheat was increased. There was also a small increase in yield of 0.04 tonnes per hectare, which was not significant, and a small saving of direct seeding costs.

The later seeded wheat (May 29 to June 1) at farm Zhanakhai endured the June drought better than the earlier seeded wheat. July rains improved the crop, especially the plots that were

TABLE 2: Influence of the method of sowing on the costs and yields of wheat, rapeseed (canola), flax, sunflower and soybean in the Zhanakhai Farm (2012)

Seeder	Conventional sweep 5CTC-2	Direct Rogro narrow tyne	Conventional sweep Case ATX	Direct Rogro narrow tyne	Conventional sweep 5CTC-2	Direct Rogro narrow tyne	Conventional sweep 5CTC-2	Direct Rogro narrow tyne	Conventional sweep 5CTC-2	Direct Rogro narrow tyne
Crops	**Durum**		**Rapeseed**		**Flax**		**Sunflower**		**Soybean**	
Space between rows, cm	22.8	40.0	25.4	40.0	22.8	40.0	69	60.0	22.8	30.0
Seeding rate, kg/ha	195	65	8.0	3.0	40	20	8.0	3.0	110	70.0
Yield, tonnes/ha	0.3	0.7	0.2	0.68	0.2	0.8	0.39	0.52	0.30	0.65
Difference in yield, tonnes/ha		+0.4*		+0.48*		+0.60*		+0.13*		+0.35*
Financial impact, $AUD/ha#		+69		+121		+182		+41		+148

*= Significant difference # Converted to Australian dollars from Kazakhstan Tenge

seeded with sweeps. But the obtained yield increase when sown with sweep was not significant. Although the yield was higher when sowing with the sweep, the Rogro produced 40 per cent more tillers, the 1000 kernel weight increased by 2 grams, and the density increased by 21 g/l.

In more arid conditions at Kumdudyk LLP there was also no significant difference in yield due to seeding methods in 2013. At the same time, direct sowing with the Rogro with a reduced seeding rate increased 1000 kernel weight by 4 grams, increased grain density of 16 g/l and tillers increased by 6 per cent.

2014 season

On ordinary chernozems at the Zhanakhai farm in wet conditions in 2014, sowing with the Case ATX-700 with sweeps and a row spacing of 25.4 cm was compared to direct sowing with the Versatile Noble–2000 with narrow tynes and a row spacing of 20.3 cm (see Table 4).

In the wet conditions of 2014, the reduced seeding rate with narrow tynes increased tillering by 20 per cent, and increased the wheat density by 12 g/l as compared to the crop seeded with a sweep at a regular seeding rate.

In the conditions of a very severe spring and summer drought in 2014 at LLP Kumkudyk, direct sowing with the Rogro increased tillering by 20 per cent and gave a significant yield increase of 0.24 tonnes per hectare in comparison with a conventional planter with a sweep shovel.

2015 season

The results of comparing the methods of sowing in 2015 at Ramazan farm are presented in Table 5.

Under conditions of sufficient moisture in the spring and the second half of summer, with the June air drought, direct seeding with 40 cm and 30 cm row spacing with narrow tyne and a 30 per cent reduction in the seeding rate produced a yield increase of 35–78 per cent over the conventional planter. Tillering increased significantly and the 1000 kernel weight also increased by 3–4 grams.

To sum up

In wet spring-summer conditions, the use of conventional seeders with sweeps with a zonal seeding rate may provide an equal or slightly higher yield of wheat compared to the use of seeders with narrow tynes and a reduced seeding rate. But this increase in yield is not statistically significant.

TABLE 3: Influence of the date and method of sowing on the plant stand, tillering, yield and costs of wheat at Zhanakhai Farm and Kumkudyk LLP (2013)

	Zhanakhai Farm				Kumkudyk LLP	
	Early plant May 22		Later plant June 2			
	Case ATX 700	Rogro	Case ATX 700	Rogro	Flexi-Coil 5000	Rogro
Seeder	Belt 4 cm (sweep shovel)	Direct with narrow tyne	Belt 4 cm (sweep shovel)	Direct with narrow tyne	Belt 4 cm (sweep shovel)	Direct with narrow tyne
Crop	Hard wheat		Hard wheat		Soft wheat	
Space between rows, cm	25.4	40.0	25.4	40.0	30.5	40.0
Seeding rate, kg/ha	91	65	100	55	85	51
Plants per square metre by harvest time	203.7	101.9	209.0	119.4	154.6	123.8
Average productive tillering	1.45	2.36	1.64	2.30	1.40	1.49
Yield, tonnes/ha	1.59	1.63	2.35	2.05	1.09	1.11
Difference in yield, tonnes/ha		+0.04^		–0.3^		+0.02^
^ Not significant						

TABLE 4: The effect of sowing method and seeding rate of wheat on wheat production and cost of wheat production at farm Zhanakhai and Kumkudyk LLP in 2014

	Zhanakhai farm		Kumkudyk LLP	
	Seeder			
	Case ATX 700	Versatile Noble 2000	Flexi-Coil 5000	Rogro
Method of sowing	Belt 4 cm (sweep shovel)	Direct with narrow tyne	Belt 4 cm (sweep shovel)	Direct with narrow tyne
Crop	Soft wheat			
Space between rows, cm	25.4	20.3	30.5	34.0
Seeding rate, kg/ha	150	100	100	60
Plants per square metre by harvest time	169.0	194.6	74.2	84.9
Productive tillering	2.00	2.40	1.22	1.48
Weight of 1000 grains	34.1	34.2	30.1	33.5
Weight per 1 litre, gr/l	781	793	800	810
Yield, tonnes/ha	2.23	2.68	0.24	0.48
Difference in yield, tonnes/ha		+0.45^		+0.24*
Financial impact, $AUD/ha#		+16		+41

*= Significant difference ^ Not significant # Converted to Australian dollars from Kazakhstan Tenge

FIGURE 1: Comparison of wheat plants with different methods of sowing in a dry year

Right: A traditional sowing with sweeps.
Left: Sowing with narrow spike in accordance with adapted Australian technology.

But reducing the row spacing of the narrow tyne planter in wet years can more than compensate for this (see Table 4, farm Zhanakhai).

The Australian direct seeding technology really comes into its own in dry seasons.

In conditions of spring and summer air and soil drought, direct seeding with narrow tynes with a row spacing of 30 cm on wheat and a row spacing of 40 cm on rapeseed (canola) and flax with a 30–50 per cent reduction in seeding rates ensures a reliable increase in yield. In wheat this was around 2 to 2.3 times, in sunflower by 1.3 times (at a row spacing of 60–70 cm), in flax and rapeseed (canola) by 3 to 4 times compared to conventional sowing (Table 2).

TABLE 5: Influence of the sowing method on the costs and productivity of wheat at Ramazan-K LLP (2015)

Indicators	Seeder		
	Horsch ATD 11.35	Rogro	Rogro
Method of sowing	Belt 4 cm (sweep shovel)	Direct with narrow tyne	Direct with narrow tyne
Crop	**Soft wheat**		
Date of sowing	23/05/15	23/05/15	26/05/15
Background, previous crop	Stubble after wheat	Stubble after wheat	Stubble after wheat
Space between rows, cm	33.0	30.0	40.0
Seeding depth, cm	7.9	7.7	7.5
Seeding rate, kg/ha	120	80	80
Plants per square metre at harvest	165.0	174.4	128.8
Productive tillering	1.20	1.81	1.62
Weight of 1000 grains, gr	28.4	31.5	32.3
Yield, tonnes/ha	0.81	1.44	1.09
Difference in the yield, tonnes/ha		+0.63*	+0.28*
Financial impact $AUD/ha#	—	+89	+43

*= Significant difference # Converted to Australian dollars from Kazakhstan Tenge

Kazakhstan growers have been impressed with the results of the "Australian" technology.

In arid spring-summer conditions when sowing rapeseed and flax, the row spacing is justified up to 40 cm, and 30 cm in soybean when sowing with narrow tynes.

In conditions of sufficient moisture in the spring and the second half of summer – but a dry June and the first half of July – a decrease in the row spacing from 40 to 30 cm when sowing wheat with narrow tynes can increase yields up to 30 per cent with equal seeding rates (see Table 5, Ramazan-K LLP, 2015).

For all years of observation, the direct drilling technology increased wheat tillering by 20 to 60 per cent, gave two to four grams more weight of 1000 grains and the weight of the grain per litre was 12–36 g/l higher.

One of the main impediments to lower seeding rates has been that weed competition can be more severe. But there is now a sufficient selection of effective herbicides to overcome this.

Another drawback is that the growing period may be extended in crops with lower plant populations. This is particularly important in areas with a short growing season such as northern Kazakhstan. And it can become a real problem in seasons with low summer temperatures and/or early autumn frosts.

- When switching to reduced seeding rates, firstly, measures must be taken to clear the field of weeds.
- Secondly, reduced seeding rates should be used when soil moisture reserves are low, and planting should take place at the beginning of the optimal planting window – that is, in the second half of May.
- Care must also be taken to ensure high quality seed and seed treatments for uniform germination. With the right approach to this innovative technology, farmers can reduce costs for seed purchase and transportation, storing seeds, seed treatment and halve the time it takes to load the seeders.

The application of direct seeding in the conditions of northern and western Kazakhstan using adapted Australian technology makes it possible to guarantee the increase of crop yields in arid conditions and to at least maintain yields equal to sowing with conventional sweep/shovel planters in wet years.

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Conducting an investment analysis on header fronts

By John Francis – Holmes Sackett

AT A GLANCE…

- The most cost-effective means of increasing standing residue and improving harvest efficiency is increasing harvest height with existing machinery.
- Stripper fronts are an economic inclusion to harvest machinery where they replace draper fronts.
- Improved harvest efficiency drives adequate cost reductions to generate good returns on investment in stripper fronts.
- The addition of any benefits achieved from additional income during a wet harvest by reducing the extent of quality downgrading adds further weight to an investment case.
- The projected returns in this analysis are sensitive to business scale. Reductions in scale lead to reductions in returns on investment.
- The assumptions are based on limited stripper front experience thus ground-truthing with more data will be required to draw conclusions specific to circumstance.
- The inclusion of a systems' specific benefits and reductions in the cost of wet weather at harvest will further improve the investment case for change.

THIS article is written from an economic rather than an agronomic perspective. The intent is to deliver a case study at a pre-determined business scale to demonstrate the process for conducting investment analysis on header fronts. An economic analysis is presented of the costs and benefits of the inclusion of stripper fronts to disc seeding systems.

Crop residue management

One of the intentional benefits of moving from a tyne to a disc seeding system is the benefit of retained crop residue resulting in improved soil moisture retention and improved soil structural characteristics. Plant residues provide physical benefits by protecting the soil surface as well as several biological and soil structural benefits resulting in greater water holding capacity of the soil.

Stripper fronts leave more standing stubble.

John Francis has developed a process for assessing the investment into draper versus stripper header fronts.

The minimal disturbance of soil in disc seeding systems is proposed to add further benefit by resulting in less soil disturbance. This reduces the chance of soil moisture losses at sowing and results in a lower volume of soil being disturbed thereby reducing depletion of soil structure.

Plant residue management and retention is an important component of a system intent on conserving moisture for subsequent crop growth. The management of plant residues is an important component of the system adopted.

The height that cereal crops are harvested can impact on subsequent seeding practices. Conventional harvest height (30–40 cm) can result in a significant proportion of the standing crop moving through the header and being redistributed over the paddock. This redistribution can lead to problems at sowing in disc seeding systems due to the redistributed straw being bent (hair pinning) and pushed into the furrow. This prevents soil to seed contact and reduces even crop emergence.

To overcome this issue some managers have adopted alternative harvest management tactics.

One of these tactics is to increase harvest height while another is to move from the use of a conventional header front to the use of a stripper header front.

TABLE 1: Draper versus stripper front analysis assumptions

Assumptions	
Total crop area	3000
Implement width (m)	12
Fuel cost ($/L)	$1.40
Harvest labour cost ($/hr)	$42
Harvesting hours per day	12
Servicing hours per day	2
Distance travelled per hectare (km)	0.8

An explanation outlining how stripper fronts work relative to conventional harvest fronts and highlighting some of the advantages and disadvantages follows. (This information is extracted from a paper by Broster, Rayner, Ruttledge and Walsh, 2018.)

Stripper fronts use rows of fingers on a spinning rotor to pluck grain heads and pods from mature crop plants. Compared to cutting and collecting the grain-bearing plant sections like conventional header fronts, stripper fronts leave more stubble standing.

By reducing the quantity of material being processed by the harvester, stripper fronts increase the speed and efficiency of harvesting. Anecdotal evidence suggests that stripper fronts are particularly effective in harvesting lodged and fallen crops, as the fingers can lift and remove the heads without the need for collecting large amounts of crop material.

The use of stripper fronts does have some disadvantages.

Tall standing stubble carries increased fire risk and requires sowing equipment which can clear the stubble.

Harvester settings need to be changed due to the decreased volume being processed, which requires some expertise and experience.

A faster harvest rate can have logistical implications – for example: more grain trucks may be required to keep up with the harvester.

Stripper versus draper front

An analysis of the marginal costs and benefits of a harvest system with a stripper front relative to a harvest system with a draper front has been conducted. Trial data from the flexible stubble management project (Swan *et al.* 2018) has been used for some analysis assumptions. Only the harvester and front costs and benefits have been considered in this analysis.

The comparison of the stripper front harvesting at a height of approximately 60 cm (stripper high) has been made with a draper front harvesting at conventional height of approximately 40 cm (draper low) and with a draper front harvesting at approximately 60 cm (draper high) to maintain as much plant residue standing as is practical with a draper front.

An identified constraint with harvesting high using a draper front is that it is improbable that the whole crop will be harvested at a height of 60 cm. The reason for this is that a proportion of the crop usually presents harvest feeding difficulties. This has been dealt with in this analysis by assuming that 80 per cent of the total cereal area can be harvested high while the remaining 20 per cent must be harvested at conventional heights and speeds.

Draper front harvesting was analysed at 40 and 60 cm cutting heights over 20 and 80 per cent respectively, of the harvest area.

One of the key advantages of raising harvest height is the ability to increase the speed of harvest. This improves harvest efficiency by increasing the number of tonnes per hour harvested. This occurs because the reduced residue requires less threshing thus more crop can be harvested at the higher speed.

This advantage expresses itself in cost savings by:

- Reducing depreciation. Fewer hours harvesting for the same harvested area results in additional ownership tenure with little marginal loss of machinery value.
- Reducing repairs and maintenance with the reduction in the amount of crop residue moving through the header.
- Reducing fuel costs. Fuel costs are reduced per unit of production and per unit of area due to the decreased horsepower requirements for threshing and due to the increased crop tonnage harvested per hour.
- Reducing labour costs. Typically, labour is charged on a rate per unit of time. Any increase in efficiency resulting in fewer hours for the same job results in a labour cost saving.

Analysis assumptions are provided in Tables 1, 2 and 3. Limited experience with stripper fronts in broadacre dryland crops forms the basis of some of these assumptions. Further experience will result in better quantification and greater confidence around the relative operational differences between header-front use.

The use of a draper front at high harvest heights reduces header hours by 10 per cent and header costs by 8 per cent when compared to the use of a draper front at low (conventional) harvest heights.

Given there is no capital cost to this change and significant benefit this should be the first step in improving standing plant residue levels.

The use of a stripper front at high harvest heights reduces

TABLE 2: Comparative harvest equipment capital and depreciation costs

		Header	Pick up front	Windrower	Header front	Header front trailer	Total
Draper conventional (40 cm)	Start value	$500,000	$43,500	$180,000	$105,000	$18,000	$846,500
	Years	4	12	10	12	10	
	End value	$300,000	$30,000	$108,000	$30,000	$16,000	$484,000
	Depreciation	$50,000	$1,125	$7,200	$6,250	$200	$64,775
Draper high (40 cm/60 cm)	Start value	$500,000	$43,500	$180,000	$105,000	$18,000	$846,500
	Years	5	12	10	12	10	
	End value	$300,000	$30,000	$108,000	$30,000	$16,000	$484,000
	Depreciation	$40,000	$1,125	$7,200	$6,250	$200	$54,775
Stripper high (60 cm)	Start value	$500,000	$43,500	$180,000	$110,000	$18,000	$851,500
	Years	6	12	10	12	10	
	End value	$300,000	$30,000	$108,000	$30,000	$16,000	$484,000
	Depreciation	$33,333	$1,125	$7,200	$6,667	$200	$48,525

TABLE 3: Variation in header performance at different harvest heights and fronts

	Draper 40 cm			Draper 20% of time at 40 cm & 80% at 60 cm				Stripper 60 cm		
Rotation crop	**Canola**	**Cereal low**	**Total/av**	**Canola**	**Cereal low**	**Cereal high**	**Total/av**	**Canola**	**Cereal**	**Total/av**
Speed (km/hr)	6.5	8.7	—	6.5	8.7	10.8	—	6.5	14.1	—
Harvest efficiency (t/hr)	19.5	40	—	19.5	40	50	—	19.5	65	—
Yield (t/ha)	2.5	3.85	—	2.5	3.85	3.85	—	2.5	3.85	—
Harvest efficiency (ha/hr)	7.8	10.4	—	7.8	10.4	13.0	—	7.8	16.9	—
Fuel use (L/ha)	6.4	7.5	7.1	6.4	7.5	6.6	6.7	6.4	4	4.8
Fuel use (L/hr)	50	78	66.8	50	78	85.7	68.9	50	68	58.4
Fuel use (L/t)	2.56	1.95	—	2.56	1.95	1.71	—	2.56	1.04	—
Grain loss (kg/ha)	50	50	—	50	50	50	—	50	50	—
Grain value ($/t)	$500	$249	—	$500	$249	$250	—	$500	$250	—
Harvest loss ($/ha)	$25	$12	—	$25	$12	$13	—	$25	$13	—
Area (ha)	1000	2000	3000	1000	400	1600	3000	1000	2000	3000
Crop area (% total)	33%	67%	—	33%	13%	53%	—	33%	67%	—
Harvest days	11	16	27	11	3	10	24	11	10	21
Rotor hours	128	192	321	128	38	123	290	128	118	247
Downtime	20%	20%	—	25%	25%	31%	—	30%	30%	—
Engine hours	160	241	401	160	48	162	370	160	167	327
Downtime hours	32	48	80	32	10	39	80	32	48	80

header hours by 23 per cent and header costs by 21 per cent when compared to the use of a draper front at low (conventional) harvest heights.

The economic comparison should not be based on the change from the draper front at conventional height to stripper front rather the change from the draper front at increased height as this option should be progressed first.

The bottom line

Given that there are large efficiencies to be achieved by moving from a draper front at conventional height to 60 cm, and that there is little to no associated capital cost, this should be the first step in increasing standing residue retention.

Based on the assumptions in this analysis the marginal investment in a stripper front, assuming that it replaces a draper front, is $5000. The annual benefit has been calculated by assessing the difference in costs between using a stripper front and using a draper front high. The marginal value of the increased operating efficiency over a 3000 hectares canola wheat rotation is $5.54 per hectare equating to $16,600 assuming the labour component is not a sunk cost.

This generates a return on marginal investment of over 300 per cent and suggests that the operating efficiencies alone are adequate to present a very good business case for investment.

Where the draper front is retained and a stripper front acquired in addition, then the marginal investment increases from $5000 to $123,000 with the same stream of annual benefits. This reduces the return on investment to six per cent which is just above the cost of debt funding.

This suggests that there is no business case for retaining a high value draper front if a stripper front has been purchased. The exception is where the marginal harvest efficiency results in quantifiable benefits during a wet harvest or where the stripper front brings quantifiable and unique systems' benefits. Additional investment of a magnitude of $80,000 with no additional operating costs results in the rate of return falling to 15 per cent.

This suggests that there is scope for the purchase of a lower cost draper front – or additional out-loading capacity – provided 15 per cent is still an acceptable rate of return.

Wet weather benefits

Increasing height and improving harvest efficiency may also lead to reductions in the cost of weather damage when it occurs.

FIGURE 1: Large time and cost efficiencies are achieved by increasing harvest height regardless of front choice

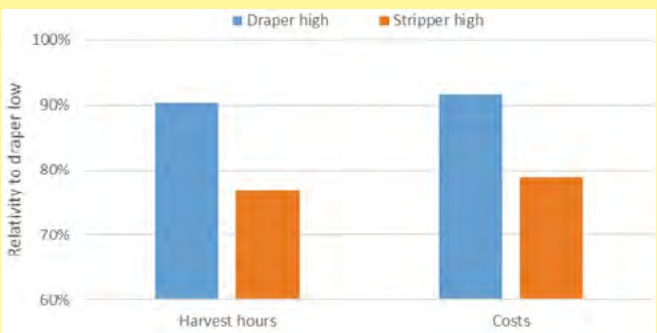
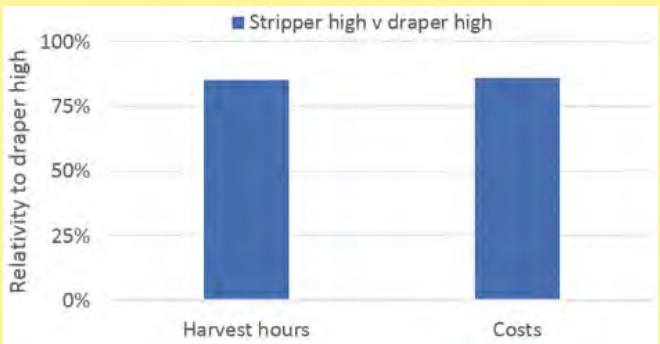


FIGURE 2: The marginal benefit of moving from a draper to a stripper front is 15 per cent in time saved and 12 per cent in cost savings



The value of these marginal benefits has not been included in this analysis.

For harvest efficiency to generate value by reducing the quantity of downgraded quality in wet harvests, management can't stop at the header front. The improved harvest efficiency only generates value in wet weather if the outloading machinery is matched to the increased header capacity.

In other words, there is no benefit in the header doing less hours if, from a weather damage perspective, it is consistently stopping and waiting to be unloaded.

In some cases, this will mean that additional investment must also be made in chaser bins, mother bins and trucks. The extent of the required investment will depend on:

- The capacity of the existing machinery;
- The marginal increase in capacity from the change in harvest height; and,
- The components of the outloading machinery that are owned by the operator.

Systems' benefits of harvest height

A systems-related benefit which is difficult to allocate specifically to the stripper front, is the contribution, over time, of additional standing residue to increased surface soil moisture. This, in theory, could generate more timely sowing opportunities with less emergence problems than systems retaining less standing residue.

Other costs

One study found that grain losses where stripper fronts were used were far higher than those where draper fronts were used for harvest. User experience suggests that improving understanding of how the losses were occurring and investing time in better machinery setup prior to starting can minimise losses regardless of front.

This is a management issue so the cost of grain losses has been assumed to be no different regardless of the header front used.

To sum up

The most cost-effective means of increasing standing residue and improving harvest efficiency is increasing harvest height with existing machinery.

Stripper fronts can generate solid economic returns on investment where they replace draper fronts and where scale is adequate. But they must be set up efficiently to achieve these benefits.

The outcomes of this analysis are specific to this case study, but the process can be followed to establish investment returns where assumptions from this case study vary.

This paper complements the analysis of the costs and benefits of disc versus tyne seeding equipment which is provided in the paper Swan et al. (2018) titled *'Flexible stubble management – how to reap returns to the bottom line'*.

Acknowledgements:
The conclusions delivered from the analyses are based on discussions and assumptions drawn from the following sources:

- **Trial data generated in the flexible stubble management project (Swan et al. 2018).**
- **Experiences of farm business managers with a range in farming systems, scale and farm machinery.**
- **The observations of agronomists working with farm business managers.**
- **Agronomist; Greg Condon, Grassroots Agronomy and farm business managers; Daniel Fox, John Stevenson, Warwick Holding have been instrumental in providing on-farm machinery data and improving the author's understanding of some of the issues. Their contributions are gratefully acknowledged.**

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Crops hold onto harmful mutations reducing productivity

By Kim Kaplan, Agricultural Research Service – USDA

LIMITS on improving yield and other critical traits in maize are probably due to rare harmful mutations genetically linked to a beneficial gene combination that were selected for during domestication and breeding, according to a study published in March 2018 in the journal *Nature*. The same problem is likely to be true not only in maize but in all crops.

These so-called deleterious genetic mutations result from errors in the DNA that occur randomly every generation and accumulate from ancient mutations right up through the breeding of today's best varieties.

"The next generation of enhanced varieties is likely to come by fixing these kinds of rare mutations, which could lead to improved crop yields, more efficient high-performing plants and being able to grow crops on less area," said Karl Kremling, lead author of the paper.

Karl is a graduate student of geneticist Edward Buckler with the Agricultural Research Service's (ARS) Plant, Soil and Nutrition Research Laboratory in Ithaca, New York. Edward is the paper's senior author and an adjunct professor of plant breeding and genetics at Cornell University.

To evaluate the impact of deleterious mutations, the researchers created one of the largest public data sets of gene expression in plants. Deleterious mutations can lead to gene expression that is too high or too low, causing lower productivity.

In humans, like plants, deleterious mutations – including those that dysregulate expression (suboptimal gene expression) – can lead to subpar performance and diseases.

The data set includes nearly 300 lines of maize varieties and nearly 80 million observations of gene expression. With it, breeders will be able to link a phenotype – an observable or physically expressed trait – to differences in gene expression. Even subtle correlations between a phenotype and gene expression can be teased out for many physiological, disease or nutritional traits with this data base.

In this study, the data set allowed the researchers to link deleterious mutations in maize to certain abnormal phenotypes.

They also showed that some of these rare mutations were made more abundant during the process of domestication and adaptation to local environments.

"We were able to show that a substantial portion of the variation in productivity in maize is coming from dysregulation," said Edward Buckler. "The data set is a community resource that will allow maize and other crop researchers to address numerous questions," he added.

The study was funded by the ARS, the National Science Foundation, Cornell University's Plant Breeding and Genetics Section, and the Taiwanese Ministry of Science and Technology. ■

Limits on improving maize and other crops likely are due to harmful mutations genetically linked to beneficial gene combination that were selected for during domestication and breeding. (PHOTO: Keith Weller)

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Nuffield International CEO receives leadership award

THE chief executive officer of Nuffield International Jim Geltch has taken out the 2018 Rabobank Leadership Award, recognising the 'fundamentally important' role he has played developing upcoming leadership in the Australian and New Zealand food, beverage and agribusiness sectors.

AACo chief operating officer Anna Speer took out the 2018 Rabobank Emerging Leader award, recognising developing leaders in the sector.

Presenting the awards, Rabobank Australia & New Zealand Group managing director Peter Knoblanche said in his work leading Nuffield, Jim was making one of the most fundamentally important contributions to leadership in the food and agribusiness sector.

Jim Geltch.

Unsung hero

"Jim is one of the great unsung heroes of the sector, whose enormous contribution to agriculture and the food and agribusiness industries is truly deserving of recognition. Not only is he an extremely accomplished leader in his own right, he has had a huge impact on the sector and done great good by fostering and developing leadership in others," Peter said.

"Through his own leadership of the Nuffield organisation, Jim has played, and continues to play, an invaluable role in the future growth and prosperity of the sector, by facilitating the development and engagement of the talented young people in our agricultural and agribusiness industries."

Peter said, as a capacity-building program, Nuffield farming scholarships provide innovative and progressive young farmers and agriculturalists in Australia and New Zealand – and in a number of other countries – with the opportunity to travel the world to learn best practice and gain a global view on agriculture. "And this plays an enormously valuable role in helping them manage and drive their businesses, and our sector, into the future," he said.

"Indeed, in leading Nuffield Australia and now Nuffield International for almost a decade and a half, Jim is quite likely responsible for mentoring more agricultural leaders than any other individual in the sector in Australia today.

"Nuffield Scholars who have completed the program during Jim's tenure have gone on to become federal and state members of parliament, to sit on numerous industry boards, to become community and business leaders and to develop and demonstrate best farming practice. And indeed, in some cases, to go on to develop entirely new agricultural industries, like Australian chia industry pioneer John Foss."

Peter said it was notable that two recent past Rabobank Emerging Leaders were Nuffield Scholars – leading organics farmer Nathan Free and executive director of Australian Fresh Leaf Herbs, Jan Vydra.

During Jim Geltch's time as CEO of Nuffield Australia, from 2005 to 2016, Peter said, he had been instrumental in guiding the program through a significant growth period, with the number of scholarships – awarded in partnership with industry and the public sector – growing from 10 to 25 per year.

"It was recognition of his successful stewardship at the helm of Nuffield Australia that Jim was chosen in 2016 to become the first-ever CEO of Nuffield International, the global body encompassing all Nuffield Farming Scholarship organisations around the world, including Australia, New Zealand, Canada, France, Ireland, the Netherlands, the United Kingdom and Zimbabwe as well as associate countries Brazil and the US," he said. "And in this role, it is Jim's mission to continue to expand the scholarship program into a growing number of countries."

In a testament to his own leadership style, Peter said, Jim Geltch had demonstrated enormous generosity in mentoring emerging young agricultural leaders in his own time, providing guidance and encouragement to help them succeed. "And for this and his impressive contribution to Nuffield, Jim is highly regarded and widely respected within the agricultural sector – in Australia and around the world," he said.

Peter said it was particularly impressive that Jim – a farmer himself, based in Moama in the New South Wales Riverina – had contributed so much to developing others in the sector, while simultaneously operating, with his family, an operation growing 30,000 tonnes annually of processing tomatoes.

Also a Nuffield Scholar in his own right, Jim was awarded his scholarship in 1986 to explore farmer education, advances in irrigation technology and computer-based crop modelling in Europe and Israel.

In 2001, he was awarded the Order of Australia for service to primary industry in the field of irrigated agriculture and promotion of agricultural research and education.

Accepting his award by video, Jim said one of the most rewarding aspects of his role heading Nuffield was witnessing the growth and development of the young people coming through the scholarship program, and the impact it was making.

Travel is the best educator

"I've always said travel is the best educator you can have. And one of the great pleasures of managing the Nuffield program has been seeing the growth of, in some respects, naïve young men and women who come through the selection process and come back in two years' time after undertaking their scholarships – seeing the self-confidence they've developed and the global view they've built about agriculture," he said.

"When you get out of bed in the morning, if you're enjoying the job, when you get up you'll do some constructive things. But to actually see that on a day-to-day basis is just one of the greatest pleasures I get out of being involved in Nuffield."

Jim said he believed good leadership was about building relationships. "The key is about having empathy and relating to people who you're dealing with. That manifests itself in many different ways, but I think that you need to be able to have people's trust so that when you're working with them, they don't see you as a leader as such, but that they understand the direction that you are taking is the right direction and they're willing to follow you," he said. ■
















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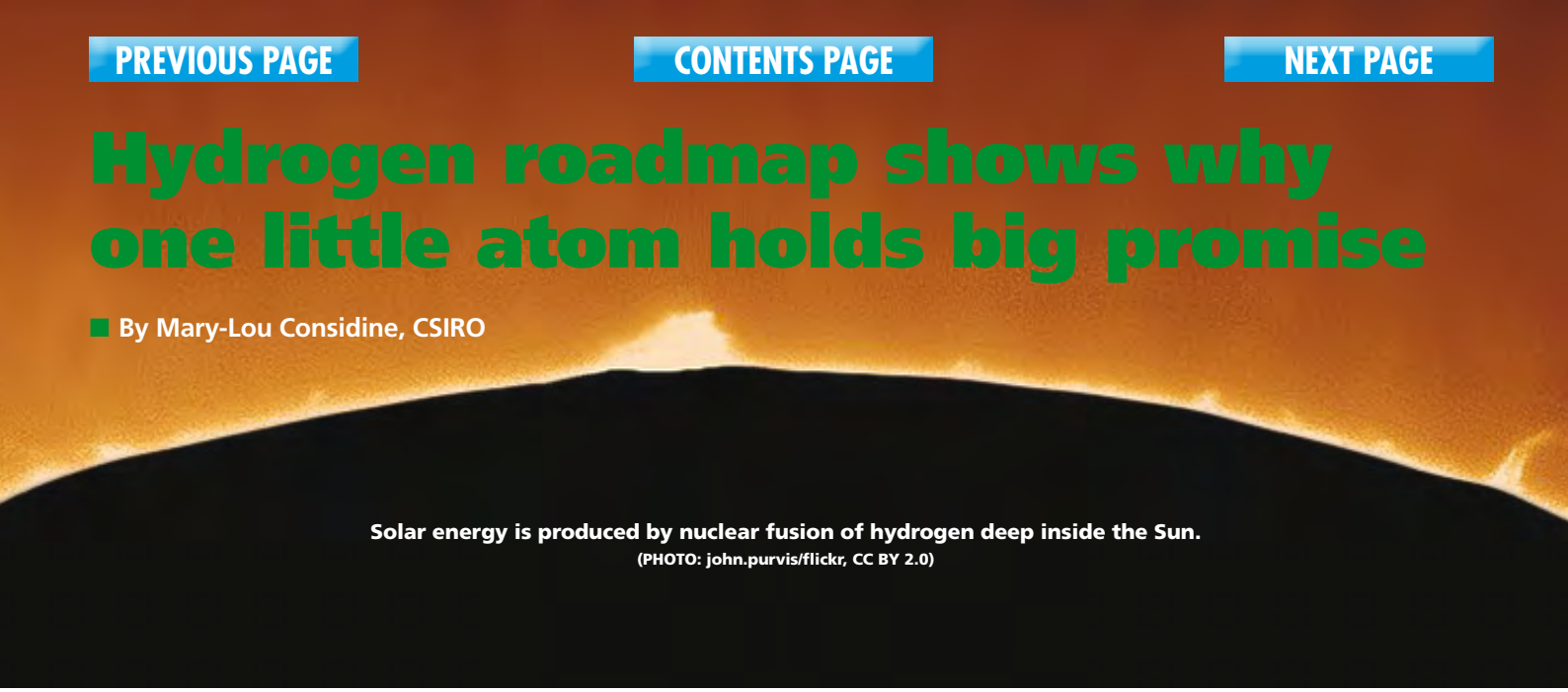
Hydrogen roadmap shows why one little atom holds big promise

By Mary-Lou Considine, CSIRO



Solar energy is produced by nuclear fusion of hydrogen deep inside the Sun.
(PHOTO: john.purvis/flickr, CC BY 2.0)

IT'S the most abundant element in the universe and fuels the powerful fusion reaction that transforms matter into energy in the sun.

Yet, hydrogen – the smallest chemical element, with one proton and electron – has, until now, been sidelined in the world's global energy debate. In a sense, hydrogen is hidden from plain sight. It doesn't occur naturally on its own, but is bound to other elements, such as oxygen in water (H_2O) – the largest pool of hydrogen on Earth – and in carbon-based compounds such as methane (CH_4).

This means that commercial hydrogen needs to be synthesised, largely via a process called steam reforming, in which methane-rich natural gas is heated, causing hydrogen atoms to separate from carbon. Most of this synthetic hydrogen is used as an industrial feedstock, for making products like ammonia, fertiliser, plastics, metals, glass, and some foods like margarine and oils.

Germany has been developing a fuel cell train, while China, the US and other countries are working on fuel-cell tramcars, trucks and even bicycles. (PHOTO: FelixM, CC0)

While reforming is relatively cheap, it also brings with it a large carbon footprint. The alternative conventional way of making hydrogen – splitting hydrogen from oxygen in water via electrolysis – is more expensive and can also create emissions, as the electricity is mostly derived from fossil fuels.

Hydrogen as a clean energy carrier

But hydrogen's status quo is set to change, as countries around the world race to gain a foothold in a new hydrogen economy – based on hydrogen's potential not just as a clean fuel source, but as a clean energy carrier.

Proponents say hydrogen's real value is that it provides the basis for a scalable, infinitely rechargeable 'battery' that can store and transport energy – a gas that can be made using water and renewable electricity, compressed into a liquid for transport and storage, then discharged wherever it's needed, using oxygen from air and with water as the only by-product.

As Australia navigates a path to a cleaner energy future, hydrogen could benefit our domestic energy supply by overcoming intermittency and transportability problems linked to energy from the sun or wind, as well as 'firming' fluctuations in the national grid and decarbonising our fossil fuel mix.

At the same time, clean hydrogen brings the prospect of a new and lucrative export industry. Countries like Japan, Korea and Singapore, which lack the natural resources for producing hydrogen at scale, have already signalled their commitment to hydrogen for decarbonising their economies.

CSIRO, in consultation with industry and government, has just launched a National Hydrogen Roadmap as a 'blueprint for the development of a hydrogen industry in Australia'.

We spoke to report co-author and Director of CSIRO's Hydrogen Energy Systems Future Science Platform, Patrick Hartley, to find out more.

Why the need for a roadmap?

Hydrogen gas is a versatile energy carrier and feedstock. At the moment, it is mostly used in industrial settings. But if it were to be produced using low or zero emissions sources, clean hydrogen could enable deep decarbonisation across the energy and industrial sectors. Clean hydrogen is the focus of the CSIRO roadmap.

Hydrogen is already used in low-emission fuel-cell cars, trucks and trains. We could also mix it with natural gas – using existing gas infrastructure and appliances – to decarbonise Australia's domestic and industrial gas consumption. This has real potential for decarbonising our energy supply. It's feasible to supplement the natural gas piped to our homes with 10 to 15 per cent hydrogen, without the need to make changes to gas infrastructure and appliances.

Germany has been developing a fuel cell train, while China, the US and other countries are working on fuel-cell tramcars, trucks and even bicycles.

Australia could use hydrogen to store and carry energy, supporting the national grid and balancing loads. Remote area power stations could run off solar or wind power with hydrogen storage, replacing diesel generators.

The future export opportunity for liquid hydrogen is significant, with the potential to generate revenue and jobs for Australia, similar to the existing LNG industry. Many countries have been quantifying the economic opportunities associated with hydrogen.

The aim of the CSIRO roadmap is to 'activate the market' here by informing stakeholder groups – industry, government and researchers – about research and investment opportunities so that they can continue to develop the industry in a coordinated way.

Hydrogen and the renewable energy sector

Australia has a huge solar and wind resource that's yet to be fully harnessed. One of the challenges is generating and storing the energy for use when and where it is needed. This intermittency issue has been driving new technology around storage, such as batteries.

But hydrogen is also a good storage option. You can take electricity from any source – renewables are ideal, as they are low-carbon sources – and use that to split water into hydrogen and oxygen via electrolysis. You can actually store the energy from that reaction in the hydrogen and use it later, or transport that hydrogen domestically or overseas.

At the moment, compared to large-scale battery installations, hydrogen storage is much more scalable, in terms of infrastructure requirements.

You can make hydrogen from many different sources. As long as they're either renewable or low-emission, you have a viable pathway to decarbonising energy consumption.

If you make hydrogen from fossil fuels, you do get CO_2 emissions. But, as long as you can abate those – for example, using carbon capture and storage (CCS) – you're actually making progress in decarbonising.

The Victorian Government is working with Japan's Kawasaki Heavy Industries on a hydrogen energy supply chain (HESC) project in the Latrobe Valley that includes a pilot plant to gasify brown coal and produce hydrogen for export to Japan in liquefied form. The pilot plant is located near a well-characterised CO_2 storage reservoir in the Gippsland Basin.

The prize for Australia is that we could develop the basis of an entirely new export industry for low-emissions energy based on hydrogen. The HESC project enables the development of a large-scale hydrogen production and export infrastructure that can be utilised as more hydrogen from renewables comes online.

Japan and the hydrogen economy

Japan has committed to becoming a 'hydrogen society' under a 2017 government strategy. In fact, the 2020 Tokyo Olympics has been dubbed the 'Hydrogen Olympics'. Japan

The Toyota Mirai fuel cell vehicle, ready to be fuelled with CSIRO-produced hydrogen.

has led the development of hydrogen cars (Toyota, Hyundai and Honda), and is rolling out hydrogen refuelling stations across the country, as well as looking at hydrogen for power generation.

As yet, there are no large-scale exporters supplying Japan, although the US, Norway and the Middle East are sizing up the market. This is a significant opportunity for Australia.

Some Australian applications

The Moreland City Council in Victoria has a trial of hydrogen-powered garbage trucks with a hydrogen refuelling station at the depot.

South Australia has set up a project involving new PEM (proton exchange membrane) polymer-membrane electrolysis technology.

The PEM electrolyser will use excess electricity from the grid with recycled water to produce hydrogen for injection into the natural gas network. The state will also host a 50MW hydrogen 'superhub' with co-located wind, solar, battery and hydrogen production. A recent example of technology development in Australia was CSIRO's new membrane technology for converting ammonia – a more cost-effective and easily transportable form of hydrogen – back to hydrogen at the fuel pump.

What's the next step?

We want CSIRO to play a key role in helping inform the public, the industry and government on the opportunity and where we are with science and technology are at. By highlighting the opportunities, we want industry to use the roadmap to make decisions about where they invest in the hydrogen value chain and identify appropriate technology choices.

Many of the technologies in the hydrogen value chain are mature, but some require further investment and scale-up, as well as policy and regulatory support from government, particularly for infrastructure development.

Both the Australian Renewable Energy Agency (ARENA) and the Office of the Chief Scientist (on behalf of COAG, the Council for Australian Governments) have recently published reports on the opportunities and challenges for Australia in joining the world's emerging hydrogen economy.

The CSIRO roadmap and the other two reports provide an information base, not just for Australians, but also for people in other countries who can now see the level of interest here. We hope that will stimulate further government and industry interactions with Australia. ■

Western region

WESTERN AUSTRALIA SUMMARY

Despite the impact of harvest storms, spot fires and rainfall events, frosts and a dry September, Western Australian grain yields for the 2018 season were generally better than expected.

Harvest was later than usual due to the late break to the season and in a number of regions, pushed into the Christmas period. The northern areas were largely wound up by mid-December but the southern regions in the west and south coast were later.

The cool conditions across the WA grain belt during October – coupled with rainfall in early October in the central regions and some parts of the southern regions – contributed to more optimistic projections of yield as the season progressed.

Total statewide grain production in 2018 is estimated by GIWA at around 17 million tonnes (see Table).

Cereal grain quality and protein was very good in the medium and higher rainfall regions, reflecting the extra nitrogen applied following the very favourable conditions early in the season. Proteins were more erratic in the lower rainfall regions with many deliveries of very low grain protein from yield dilution.

Some barley deliveries exceeded protein limits and there were incidences of high screenings for both barley and wheat from 'over-cooking' crops with too much nitrogen.

Wheat protein in the lower rainfall regions – and to a lesser extent in the higher rainfall areas – was generally low again in 2018. This is partly due to new varieties bringing grain yields to a new potential. This has resulted in protein dilution from higher yields. There has also been a tendency for growers to manage (or target) production risk and grain yields to 80 per cent potential and not chase premium grades due to the lack of price spread over ASW.

Canola tonnage for WA in 2018 is estimated to have come in at the lower end of recent years' production rather than well below recent production. Canola yields in the northern and western areas of the state were good and the poorer areas were not the complete write-off that was expected.

Trends which emerged during the 2018 season included the increase in barley plantings to non-traditional areas and the success of some of the new higher-yielding varieties and the weed control options they provide.

Wide adaptation across WA of the newer noodle varieties has seen a similar expansion in the area planted. These trends are likely to continue.

The success in 2018 of hybrid canola in the north, central and lower rainfall regions on suitable soil types will see an increase in plantings in the future. This will be constrained only by seed supply.

GIWA gratefully acknowledges the support of DPIRD, CBH and contributions from independent agricultural consultants and agronomists in the production of this report.

GIWA Crop Report – December 7, 2018

District Reports...

January–February 2019

SOUTH COAST

Conditions have been quite dry over the South Coast of WA for the past two months. Most growers managed to finish harvest just before Christmas and were pleasantly surprised by yields, particularly barley and wheat which exceeded expectations largely due to a long soft cool finish.

Spreading lime at Lawson Grains, Munglinup, about 100 km east of Esperance. The operator is Brayden Wulf from Canada.

Mid December, 2018 – GIWA WA crop production estimates (tonnes)

Port zone	Wheat	Barley	Canola	Oats	Lupins	Pulses	State total
Kwinana	4,800,000	2,200,000	550,000	285,000	140,000	5,000	7,980,000
Albany	1,450,000	1,190,000	455,000	230,000	55,000	1,000	3,381,000
Esperance	1,340,000	685,000	330,000	20,000	50,000	35,000	2,460,000
Geraldton	2,100,000	240,000	270,000	15,000	350,000	2,000	2,977,000
Totals	**9,690,000**	**4,315,000**	**1,605,000**	**550,000**	**595,000**	**43,000**	**16,798,000**
% change to Nov 2018	6.5%	10.6%	9.9%	0%	9.2%	–10.4%	7.3%

Note: the grain totals reported are for whole farm production. This includes on-farm seed and feed requirements as well as trade outside of the CBH network.

District Reports...

January–February 2019

After some time off during the festive season growers have been busy emptying grain bags, some summer weed spraying and a range of soil amelioration jobs including deep ripping, clay spreading, clay delving and spreading lime and gypsum.

Some summer rain at the end of February would be welcome to kick of the 2019 season with some stored soil moisture.

Quenten Knight
Agronomist, Agronomy Focus, Esperance
January 18, 2019

Southern region

SOUTH AUSTRALIA SUMMARY

Seasonal conditions were generally unfavourable in the cropping regions of South Australia during the 2018 spring.

Winter crop prospects deteriorated in September because of lower than average September rainfall and significant frost events. September rainfall in most cropping regions was in the 10th percentile.

Rainfall was below average and temperature above average during October in most eastern cropping regions, which decreased soil moisture levels and hampered grain development.

Timely October rainfall benefitted crops in some other cropping regions, especially Eyre Peninsula, Yorke Peninsula and the south east. November rainfall slowed harvest but did not result in significant degradation of crop quality.

Winter crop production in South Australia in 2018 is estimated to have been around 5.2 million tonnes, the lowest since 2008–09.

Wheat production is estimated to have fallen by 30 per cent on 2017 to around 2.9 mt and the the lowest in 10 years.

Barley production also decreased by around 15 per cent on the previous season to 1.5 mt.

Canola production in 2018 was also reduced by an estimated 22 per cent on 2017 to around 250,000 tonnes. This was largely due to a 20 per cent decline in planted area.

ABARES Australian Crop Report
December, 2018

VICTORIA SUMMARY

Production prospects in all major cropping regions in Victoria were adversely affected by unfavourable seasonal conditions during spring 2018. September rainfall was in the 10th percentile in most cropping regions and minimum temperatures were the lowest on record in most cropping regions. Frosts had a significant impact.

Above average temperatures and not enough rain in October further reduced yield prospects in most cropping regions. But timely rainfall benefitted crops in the southern Wimmera and the south west.

Winter crop production in Victoria in 2018 is estimated to have decreased by more than 50 per cent on 2017 to 3.7 million tonnes. The harvested area was down more than 10 per cent with many wheat and canola paddocks cut for hay.

Canola production fell by an estimated 63 per cent to 275,000 tonnes – the lowest in 10 years.

ABARES Australian Crop Report
December, 2018

VICTORIAN MALLEE

The 2018 season was disappointing for many Mallee growers with below average rainfall, and as a result, low yields.

Yields in 2018 spanned a wide range. Averages would be around 0.8 tonnes per hectare for wheat, barley 1.0 tonne and pulse crops struggling to average 0.3 tonnes per hectare.

Most canola sown was cut for hay or not harvested.

Grain quality was generally quite good across the region which helped achieve the higher grades when selling.

The Mallee received a growing season rainfall of approximately 100–140 mm. Fortunately, grain prices have been exceptional – and the highest seen in a long time – which provided some valuable cash flow. Those growers who held grain over from 2017 are capitalising on the high commodity prices.

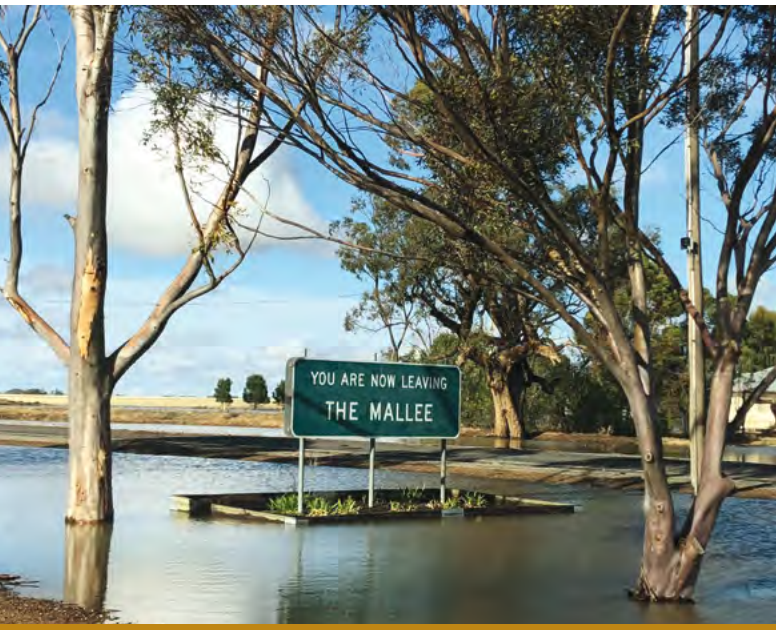
Most of the Mallee received excellent, and in some cases, record-breaking December rainfall. The highest recording was

Heliotrope is a problematic weed across the region.

District Reports...

in Birchip with 190 mm for the month, of which 186 mm fell in 48 hours. Some areas received twice their years' rainfall in just a couple of days.

As a result, summer spraying has been essential with many starting to spray before the New Year. A lot of growers have finished the spraying for now, except where there's another pass needed to capture the later-to-germinate weeds.



Up to 190 mm fell in the Mallee during December resulting in summer spraying to conserve precious soil moisture.

But the sprayer probably won't be staying in the shed for long as there is still a lot of summer left for rain to fall.

There was a significant amount of hay produced in the Mallee in 2018 due to a dry spring/low rainfall growing season. This, together with anywhere from 150–190 mm of rainfall in December, has resulted in many hay-stack fires.

Paddock planning for 2019 is now well underway, with crop rotations and variety selection being decided, and even fine-tuned based on December rainfall.

Many growers will look to plant canola this season following the large summer rainfall. Farmers are also soil sampling to find out nutrient requirements and the soil moisture status of their paddocks to plan for fertiliser budgeting throughout the year.

Brooke Bennett
BCG Extension Manager, Birchip
January 18, 2019

Seasonal rainfall across the grain regions – 25 year averages and year to date

Brought to you in association with JOHN DEERE

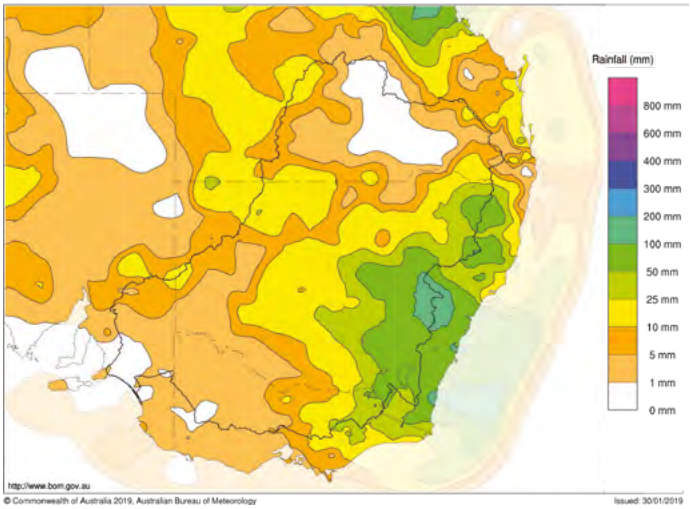
	25yr Annual Average (mm)	2019 rainfall to date (mm)	Summer 25yr Annual Average (mm)	Summer 2018–19 to date	Autumn 25yr Annual Average (mm)	Autumn 2018	Winter 25yr Annual Average (mm)	Winter 2018	Spring 25yr Annual Average (mm)	Spring 2018
Emerald Qld	564	8	251	27	106	21	67	29	125	113
Toowoomba Qld	679	5	276	54	138	82	85	36	180	184
Roma Qld	579	1	256	36	119	94	75	34	134	106
Goondiwindi Qld	619	4	253	57	123	62	98	45	147	174
Narrabri NSW	621	10	217	66	119	67	123	47	162	149
Gunnedah NSW	627	20	211	64	108	35	126	42	183	207
Dubbo NSW	588	64	184	99	125	24	129	57	152	166
West Wyalong NSW	437	27	118	47	79	40	120	60	122	86
Wagga Wagga NSW	531	37	134	94	109	47	147	77	141	149
Swan Hill Vic	308	2	69	44	64	28	87	59	88	41
Bendigo Vic	490	2	100	45	105	70	158	128	128	61
Horsham Vic	365	0	76	30	71	54	120	109	99	47
Lake Bolac Vic	506	1	108	52	103	103	153	165	142	73
Murray Bridge SA	358	0	66	24	80	39	120	83	94	47
Kadina SA	327	1	60	7	76	18	110	76	82	58
Cummins SA	390	0	51	5	89	55	174	241	76	48
Esperance WA	618	0	90	36	136	68	251	284	140	146
Wagin WA	391	1	50	7	90	50	165	213	85	61
Northam WA	407	1	61	31	87	40	189	263	80	55
Mingenew WA	347	0	33	0	86	50	171	203	57	40
Moora WA	385	1	46	6	82	51	189	286	68	65
Mullewa WA	320	0	56	12	90	47	131	165	43	24

Last rainfall reading January 29, 2019.

District Reports...

January–February 2019

Murray–Darling Basin rainfall totals (mm) for January, 2019
Australian Bureau of Meteorology



In late spring and early summer 2018–19, some excellent but patchy rainfall fell in a number of northern NSW and Qld cropping regions. This encouraged summer crop plantings across a wide date range. Unfortunately the tap was turned off in January putting many crops under extreme pressure.

Northern region

NSW SUMMARY

At the start of the 2018 spring many crops in the North-West cropping region of NSW had already failed while crops in the Central West needed favourable seasonal conditions to avert failure. But rainfall during September was below average and temperatures above average. Additionally, frost events in late August and September damaged some crops in southern cropping regions and high fodder prices provided a strong incentive for producers to cut frost affected crops for hay, particularly canola.

October and November rainfall boosted crop prospects in the south-east cropping region and yields were close to average. But this rainfall was too late to benefit crops in most other regions.

Winter crop production for NSW in 2018 is estimated to have dropped by almost 60 per cent on the previous season to around 3.1 million tonnes – the lowest since 1994–95.

Canola production is estimated to have fallen by 75 per cent to around 150,000 tonnes. Well below average rainfall and severe frost events in late August and September 2018 resulted in large areas of canola being cut for silage and hay.

It is estimated that more than half of the area planted to canola was abandoned, grazed or cut for hay.

ABARES Australian Crop Report December, 2018

QUEENSLAND SUMMARY

Winter crops in Queensland were generally in poor condition at the start of the 2018 spring. Although seasonal conditions during September were generally unfavourable, this did not damage

winter crop prospects significantly because of the advanced stage of crop development.

Good rainfall fell in October, with between 50–200 mm falling in most cropping regions. But this rainfall was generally too late to benefit winter crops.

Total 2018 winter crop production for the state is estimated to be around 800,000 tonnes. This production was from a reduced planted area due to low soil moisture levels. Also, some grain paddocks were cut for hay.

Wheat production is estimated to have been around 430,000 tonnes with an average yield of 1.06 tonnes per hectare.

Chickpea production fell by more than 62 per cent on the previous year to around 245,000 tonnes in 2018. This mostly reflects a fall in planted area in response to a decline in expected returns from growing chickpeas.

Chickpeas in Central Queensland and the northern Darling Downs generally fared better than elsewhere, with crops being able to access deeper stored soil moisture. But the state average yield is estimated to have been only 1.1 tonnes per hectare – or almost 20 per cent below the 10 year yield average.

ABARES Australian Crop Report December, 2018

DARLING DOWNS

Weather conditions

Once more crops are very keen for rain across the Downs, with the last falls in mid-December being extremely variable from 200 to 300 mm around Dalby to only 10 mm on parts of the eastern Downs. It is amazing how well some crops are hanging on using stored soil moisture. But there have been paddocks failing and have been cut for hay or abandoned.

Paddocks on the Downs with reasonable soil moisture have been sown to a summer crop – unfortunately there are not too many of them. At the very attractive price of more than $300 a tonne on-farm, sorghum has been popular.

District Reports...

January–February 2019

Summer crop

Grain sorghum has been the main crop this spring/summer and most paddocks were planted in September and October and are now filling grain and starting to colour.

Yields for many growers should be fair thanks to stored soil moisture and timely control of heliothis after prolonged pressure over the past month. But there will be concerns about screenings from the current heat and dry spell.

The weather over the next three weeks will have a significant effect on the crops' performance.

On the central and western Downs particularly, there was a late December plant and these crops are growing where secondary roots have reached moisture. But other paddocks are suffering from the conditions.

Corn crops are between grain fill and ripening with dryland crops suffering whilst irrigated crops are using plenty of water. The corn crops did have some vegetative damage from heliothis with some paddocks controlled to preserve quality.

The corn crop this summer is destined to be split between silage for feedlots of all sizes, and filling some well-priced gritting contracts.

Sunflowers are in peak flower across many paddocks on the eastern Downs, attracting tourists who hopefully will avoid damaging the crop to take their photos.

The mungbean plant is about 70 per cent of the expected area due to the lack of planting rain and the large sorghum plant. But most mungbean crops have emerged well, and growers are still prepared to plant up to early February if rain was to fall.

Forage sorghum has also been a major crop this summer season with keen demand for round bales leading to high prices. As with all crops, the final economic result is very dependent on rainfall and stored soil moisture.

Fallow ground

The number one concern across the region is a lack of stored soil moisture. Rainfall for 2018 has varied from a low of only 250 mm in some regions to approaching an average of 600 mm in others.

Almost every paddock that had some soil moisture is now planted. So our fallow paddocks are very dry. The recent Cyclone Penny was tracked with great hope by growers – but Penny was no Debbie – and we are still looking for good rain.

There will be good interest in winter crops if there is enough rain, but with the chance of double cropping being so low, the area available will be reduced.

Hugh Reardon-Smith
Agronomist – Landmark, Pittsworth
January 18, 2019

ANSWER TO IAN'S MYSTERY TRACTOR QUIZ

The tractor is a 1926 Renault PE1 restored by D. Berthelson of Gayndah, Queensland.

ADVERTISERS' DIRECTORY

Darling Downs sunflowers in bloom during January.