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Australian Grain
PO Box 766
Toowoomba 4350
P: 07 4659 3555
F: 07 4638 4520
E: grain@greenmountpress.com.au
www.ausgrain.com.au

Advertising
Michael Cook
(National Advertising Manager)
P: 07 4659 3555
F: 07 4638 4520
M: 0428 794 801
E: advertising@greenmountpress.com.au

Editor
Lloyd O'Connell
Associate Editor
David Dowling
Production and Design
Mick Allan
Accounts
Deb Meddleton

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Gavin and Brad Egan use clay delving to ameliorate non wetting sand soils on their Scaddon (WA) district farm. Now the big job is to level the paddock again!

(PHOTO: Quenten Knight)

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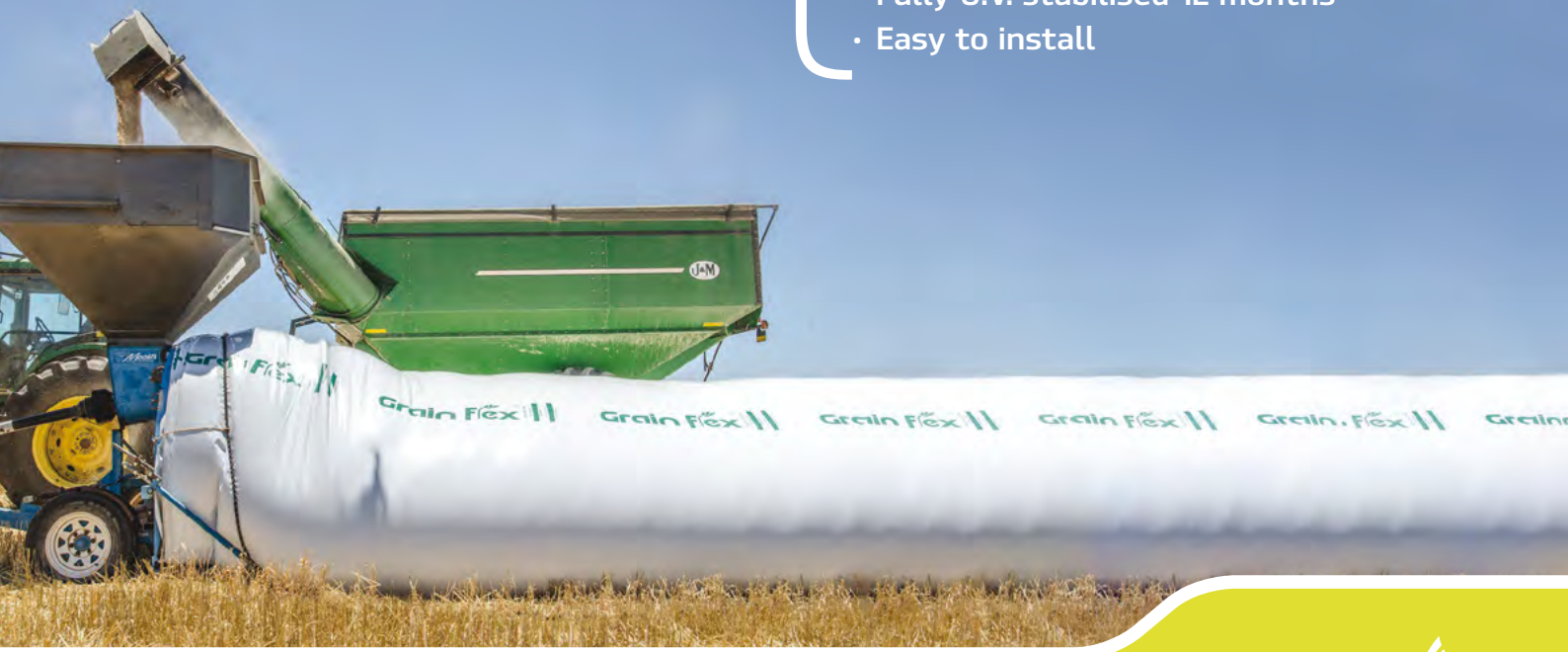

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Editorial... Lloyd O'Connell

THERE'S a world food crisis happening – and it's been flying pretty much under the radar for the past 12 months. The highly contagious viral disease of pigs, African Swine Fever (ASF), has been detected in European and African herds and is now spreading throughout many Asian countries. Some analysts are predicting that as a result of ASF deaths in the global pig herd – combined with the culling programs to control the spread of the disease – more than 20 per cent of the world's meat protein will be lost. And this has big ramifications for global food security, particularly in Asia where pigmeat is a major protein source, as well as for the world's feedgrain suppliers.

The disease is not new. ASF was first detected in the Caucasus region more than 10 years ago and has been slowly spreading through Russia and into eastern, central and western Europe. ASF has now been detected in the wild pig population of Belgium in western Europe. More than 1 million pigs have been culled in Europe since 2007 to attempt to stem the spread of the disease.

But it is in Asia where the concern and impact is much more significant for not only the local populations but also the Australian feedgrain and pork producing industries. South Korea now has ASF in its pig herds and according to FAO figures, Vietnam has culled 4.7 million pigs to try to control the disease. To put this figure into perspective, Australia has a herd of around 3 million domestic pigs. But as always, the big player is China.

The official line out of China is that nearly 40 per cent of their pig herd has been killed or culled. Many analysts view this 'official' figure as too low and that the actual figure could be almost twice that amount. Victorian based consultants, *Mercado Analysis*, has looked at the impact on Chinese feed demand under various reduced pork production scenarios. Mercado estimates that if Chinese pork production drops by 50 per cent, the demand for feed into that industry will fall from 145 million tonnes a year to 72 million. On the face of it, this will have a big impact on exporters – such as Australian feed barley producers – particularly in light of the huge grain stores held by China. But there's more to this story.

Alternative protein sources to satisfy demand

Australian beef and sheepmeat exporters are currently enjoying strong demand out of Asia as alternative sources of meat protein are being consumed instead of pork. This recent spike in demand for meat protein underlines the importance of well thought through trade deals between Australia and various Asian countries to make sure our exporters can efficiently and profitably deliver the product.

We also need to remain extremely vigilant in terms of bio-security to ensure devastating diseases such as ASF and foot and mouth do not enter Australia. Over the past 12 months more than 20 tonnes of pigmeat food items coming in from ASF countries have been impounded by Australian quarantine authorities. Around 15 per cent of the product impounded had tested positive to the ASF virus. This is a chilling situation for Australian pork and feedgrain producers. If ASF ever entered Australia and worse still, made it's way into our 10 to 20 million (who really knows?) feral pig population, the disease spread would be uncontrollable.

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Feathertop Rhodes grass – is it the beginning of the end?

By Lindsay Ward[1], Paul McIntosh[2] and Bhagirath Chauhan[3]

AT A GLANCE…

- Feathertop Rhodes (FTR) grass (*Chloris virgata*) is emerging as one of the biggest weed threats in Australia and challenges the 'farming system' as we currently know it.
- It produces thousands of seeds, which spread through several means.
- Employing different chemical and non-chemical tactics are needed to combat this problematic weed species.
- Prevention is the best control measure.

NO-TILL and conservation agriculture systems are common in Australia with environmental and sustainability advantages leading to much-improved soil erosion control, increased fallow efficiency, increased water use efficiency, reduced labour requirement, lower costs of operation, reduced machinery inventory, and other benefits compared to conventional farming systems.

But weeds are a major biotic constraint in conservation farming agricultural systems.

The presence of Feathertop Rhodes (FTR) – a grass weed species – in cropland and pastures is probably the biggest threat to no-till farming in the northern region of Australia (Queensland and NSW). It is very difficult to control with herbicides – knockdown, residual or both.

Small FTR grass seedlings in a fallow paddock.

The following traits make FTR grass a problematic weed:

- It is a prolific seeder and has been shown to adapt to management. A single plant of FTR grass can produce over 40,000 seeds.
- It germinates at temperatures common in winter and summer. Recently, we observed that FTR grass can germinate at temperatures ranging from 15/5° to 35/25°C (day/night temperatures). The only negative is that many winter growing seedlings are killed by frost but not all. In a dense population, only a few plants are enough to produce seeds for the next generation.
- The plant can be tall (one to two metres) and has a wide germination and emergence timeline.
- Over-reliance on glyphosate has resulted in the evolution of herbicide resistance in FTR grass populations.
- The seed is easily spread by vehicles, farm machinery, wind, waterways and animals (domestic as well as wild).
- The FTR seed bank, mostly at shallow depth, is in an ideal position for best emergence and FTR grass has a reputation for 'false starts'; that is, it will germinate and establish after small falls of rain, unlike many Australian native grasses. But with competition, many of those plants would not survive.
- The widespread adoption of crop residue retention and furrow seeding with all their benefits, provide a favourable environment for germination, establishment and survival of FTR grass. It means moisture is held around the seed for longer.
- It is also becoming more common that Australian roadsides and stock routes have become arteries for further spread of FTR grass. It establishes well along fence lines and roadsides because of the favoured environment created by frequent grading (placing seed at a shallow depth), combined with regular rainfall events providing water runoff from the typically

Lindsay Ward.

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near impervious road surface. Even small rainfall events then become beneficial for this tough and serious weed.
- Council roadside slashing, along with roadside upgrade works, can facilitate dissemination of mature FTR grass seeds into near-perfect weed-free conditions. Coolatai grass, plus other declared weeds, are being spread in a similar manner.
- Local authorities also face future challenges keeping rural quideposts and signs clear of weeds and visible. In the past, this was achieved by herbicide spot spraying operations on plants like FTR grass. But these plants are fast becoming more herbicide-tolerant or resistant every year.
- Constant slashing or mowing (e.g., lucerne fields, roadside verges) can result in FTR grass setting seeds closer to the ground, suggesting that this weed has adapted to this practice.

What can we do about FTR grass?

Spraying with herbicides can be useful if FTR grass plants are very young and not stressed. At this stage, high rates of knockdowns in the form of glyphosate with the best surfactants available, and some group A products, can reduce the population. There may be too many escapees, but utilising the double-knock principle can improve the imperfect results.

Residual herbicides have much to offer. Unfortunately, like knockdowns, they need moisture for best results, and that moisture has been scarce in recent years. Prevention is still a key component of weed control.

Mechanical tillage or the 'Reset Principle' appears essential to break the cycle. Patch tillage has been trialled, but it appears the implement and tractor are also modes of seed dissemination, as it travels from one patch to the next. Some producers realise the need for whole paddock tillage and achieving good general machinery hygiene, when moving between fields. Mechanical tillage can provide good short-term control of FTR grass – but there are consequences of increased mechanical tillage:
- Besides the obvious loss of surface crop residue, there is likely to be increased wind and water erosion.
- Tillage results in moisture loss from the fallow. About 12 mm is lost per operation. So fallow efficiency is reduced from around 26 per cent to less than 19 per cent. Different years and fallow lengths give varied results.
- The chances of extending a crop seeding operation after a rain event are reduced significantly because of mechanical disturbances and reduced stubble load.
- Weed seeds are buried to varying depths, which influences their survival longevity and increases the time for a tillage only practice to control the potential population.
- Tillage destroys soil organic matter in its various forms. An important consequence is the impact on water-stable aggregation. These mechanical practices change the particle size distribution or soil structure and as a result, various degrees of surface sealing occur. At the very least, a reduction in water infiltration results.
- Water is the lifeblood of any farming operation. Anything that reduces infiltration has serious short- and long-term consequences for crop production.

Machinery – particularly headers – spread FTR grass seeds. Therefore, cleaning of machinery (including contractors' gear) before moving to another field is essential to reduce the spread of FTR grass.

In any natural disaster situations (e.g., drought, flood, etc), hay is supplied from one region to another. Because of this practical urgency, hay may not be physically checked for weed seeds or even have a statutory declaration attached, which may unintentionally spread weed seeds, like FTR grass. This will pose a serious problem if the weed seeds are resistant to herbicide(s).

Processes should be in place to check for weed seeds in any hay to help reduce the spread of FTR grass seeds. End-users need to be prepared to control the feeding area if possible, on these suspect loads.

Water channels, head ditches, and on-farm roadways are also a source of weed seed production with resultant spread factors and should be kept clean from any weed growth.

Agronomists and researchers visit growers' fields often. They need to strictly follow the rule, "Come Clean, Go Clean".

The price of 'tillage' is high. In the long-term, it results in soil degradation – physical, chemical and biological. The economics of farming will change, negatively. We need to arrest this weed!

1. Rural consultant and farmer, Goondiwindi, Qld 4390.
2. Pulse Australia and Australian Herbicide Resistance Initiative, Highfields, Qld 4352.
3. QAAFI, The University of Queensland, Gatton, Qld 4343. ■

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No knockdown, no worries, if...

By Peter Newman

THINGS just aren't like they used to be. Aussie rules football used to be about the full forward taking screamers and defenders could actually tackle hard – now it's all about flooding the backline and netball rules apply to contact.

There used to be one type of beer on tap and buying a round of drinks was easy. It was a yes or no question.

We used to be able to rely on the break to the season.

It seems to be getting harder and harder to get reliable autumn rains to germinate weeds that we can knockdown before seeding the crop.

Should we be setting ourselves up to delay seeding, even when there is a late break, to get a knockdown before seeding?

As AHRI and Weedsmart Western region agronomist, I recently gave a presentation to a group of high rainfall farmers who were concerned that they hadn't had a decent knockdown for three years in a row. What I came up with, based on research and experience, was that we definitely should not be waiting for a knockdown, but we need to throw enough weed management at the farming system to make it work.

Research by Chris Preston's team in South Australia has shown that early sown crops can compete better with weeds because they grow in warmer conditions, and as a result set a similar amount of ryegrass seed as late sown crops with an extra knockdown. The key to success here is a robust pre-emergent herbicide package.

In the immortal words of Ray Harrington, "We want the farmer calling the shots, not the weeds". This has got to be one of the best weed control quotes of all time. Ray is right. If the weeds call the shots, there's little doubt that farmers will lose money if they are forced to change rotation, or delay sowing, or heaven forbid – leave a paddock out of crop altogether! We want the farmer to choose the time of sowing to maximise profit.

South Australian delayed sowing research

First, let's take a look at the time of sowing research by Sam Kleemann, Gurjeet Gill and Chris Preston from the University of Adelaide. Through several years of research at two sites, they have concluded that farmers should not delay sowing to get another knockdown prior to sowing.

In this trial at Hart SA, there were similar weed numbers in crop despite the later time of sowing receiving an additional knockdown prior to seeding. There was similar ryegrass seed set in crop between the two times of sowing, and there was a spectacular yield increase for the earlier time of sowing.

This is why we want the farmers calling the shots!

TABLE 1: Ryegrass density in crop, headcounts in spring and wheat yield for two times of sowing at Hart, where Sakura 118 g/ha was applied pre-sowing

	Ryegrass in crop (plants/m^2)	Ryegrass heads in spring (ryegrass heads/m^2)	Wheat yield (t/ha)
Time of sowing 1 (May 4, 2014)	8	39	4.1
Time of sowing 2 (June 2, 2014)	8	41	2.9

This research was repeated in 2015 at Hart at a lower ryegrass density site and a similar trend was seen. The trial was moved to Roseworthy in 2016 to a higher density ryegrass site. This time the earlier time of sowing had more weeds in crop than the later

Research has shown that farmers should not delay sowing to get another knockdown opportunity prior to sowing.

time of sowing but they went on to set similar amounts of seed. In 2016 there was little difference in yield between the two times of sowing.

The researchers believe that this may have been because Mace wheat was sown at both timings and it was better suited to the later sowing time than the early sowing time. They suggest that for earlier seeding, growers should choose an appropriate longer season variety to maximise the yield benefit.

TABLE 2: Ryegrass density in crop, head counts in spring for two times of sowing at Roseworthy, SA 2016 where Sakura 118 g/ha was applied pre-sowing

	Ryegrass in crop (plants/m^2)	Ryegrass heads in spring (ryegrass heads/m^2)
Time of sowing 1 (May 6, 2016)	77	60
Time of sowing 2 (June 1, 2016)	40	71

This research group concluded from these trials and other trials at Lake Bolac, that farmers should not delay seeding to get another knockdown on ryegrass. They firmly believe that early seeding benefits the crop due to warmer conditions, giving the crop greater capacity to compete with weeds and keep a lid on ryegrass seed set.

They also concluded, for this tactic to work, a robust pre-emergent herbicide package is needed. The results above are for the Sakura 118 g/ha treatment, and they saw even better results where Sakura was mixed with trifluralin or triallate.

No knockdown, no worries, if.....

So, we can get away without a knockdown, and seed early if the following is in place:

- A robust pre-emergent herbicide package is applied. What we mean here is a mix of two herbicides. This is good for resistant weed management (mix and rotate), it suits a range of soil moisture conditions (e.g. trifluralin can be good in relatively dry conditions where Sakura needs some rainfall to activate it), and can maximise the length of residual herbicide control. If seeding without a knockdown why not spend the money that you would have spent on knockdown, on a second pre-emergent herbicide in the mix instead. Keep mixing herbicides (see *https://ahri.uwa.edu.au/keep-mixing-herbicides/*).
- Grow a competitive crop. Early sowing does improve the crop's competitive ability as does narrow row spacing, higher seeding rates, east west sowing, competitive cultivars and healthy soil. We don't need to employ all of these tactics at once, but we need to use at least one or two crop competition factors, and it doesn't have to be expensive. East-West sowing is free as is choosing a competitive cultivar (see *https://ahri.uwa.edu.au/easy-to-adopt-crop-competition-tools/*).
- Stop weed seed set with crop topping or hay cutting where appropriate. If you don't get a knockdown at the beginning of the season, try and get one at the end of the season.
- Use harvest weed seed control (HWSC).

To sum up

If we are aggressive, we can throw enough weed management at the system to make it work. We want the farmers calling the shots – not the weeds. ■

Taking a tactical approach to in-season nitrogen application

HOW much nitrogen should be applied in-season? That is the burning question many grain growers contemplate following good winter or spring rains which trigger a revision of the outlook for yields.

For example in Western Australia this year, after the late start to the season, rainfall in many parts of the state in June spurred growers into activating growing season nitrogen (N) application programs in a bid to capture water-limited yield potential.

Manager of agronomy, soils and farming systems – west, Rowan Maddern, advises that growers need to consider a number of factors in their fertiliser decision making in an effort to match a crop's N requirements.

"Knowing the status of existing nutrient levels and any change in yield potential is important in determining how much nitrogen should be applied," Rowan says. "It's a balancing act – growers don't want to miss out on capturing yield potential but they also don't want to be spending money on inputs if a return on that investment is not likely."

Rowan says growers should consult with their advisers about any review of their nutrient programs, and recommends plant tissue testing as a useful in-season tool to refine initial recommendations.

The GRDC also has available to growers a suite of GrowNotes publications for all crop types which offer information on in-season application of N. For example, the Western Wheat GrowNotes includes a 'best-bet nitrogen strategy' and a decision tree for in-season N applications according to the progress of the season and crop developmental stage.

Key in-season N recommendations for wheat

- Match wheat N requirements as the season unfolds. Even in low rainfall areas, potential yields can vary between less than 0.5 tonnes per hectare and more than 4 tonnes. Implementing a best-bet strategy to account for this yield variation limits fertiliser costs in poor seasons and forgone yield in good seasons.
- A best-bet nitrogen strategy pivots on sowing the crop with enough nitrogen for a low or average yield. If the season continues to be dry there is enough nitrogen applied at sowing for the expected yield. If the season continues as poor there is enough nitrogen applied at sowing for the expected yield.
- During late tillering, if an average or better season is developing, apply more N at first node to match the new water-limited yield potential.
- From stem elongation to ear emergence, further assess the season. If it seems average or drier, apply no more N. If it is wetter than average, apply more N but still observe the requirements of moist soil and a reasonable prospect of follow-up rain.

GRDC manager of agronomy, soils and farming systems – west, Rowan Maddern, says making nitrogen decisions involves consideration of a number of factors. (PHOTO: GRDC)

Barley recommendations

- The pattern of barley crop demand for N during the growing season should be considered. The highest demand is when the crop is growing most rapidly.
- Most responses to nitrogenous fertiliser (particularly in WA) are the result of an increased number of ears or grains. The response is largely caused by increased tillering, which is determined early in the life of a barley plant. The number of grains per ear is also determined early. Therefore, a good supply of N is needed early in crop growth.
- Early application is preferred in the production of malting barley because it is more likely to increase yield without raising grain protein levels. The other consideration is that in sandy soils in higher rainfall areas, the application should be split or delayed 3 to 4 weeks. This allows the crop to establish a reasonable root system and avoid large leaching losses.
- The best time of application in any one season can vary depending largely on the incidence of leaching rains in relation to time of application. Profitable responses can often be obtained up to 10 weeks after sowing. Late applications are more likely to result in increased grain protein.

More decision tools on the way

Rowan says growers are asking how they can capitalise on good seasons in time to make more profitable nitrogen decisions, thereby making optimum nitrogen applications for protein and best economic response while maintaining or increasing yield.

To address this, the GRDC is investing in a new project, 'Tools for growers that can enable best practice in-season nitrogen management to optimise economic returns and grain protein'.

Running until early 2021, the project's outputs will include nutrition masterclasses in the Esperance, Kwinana East and Kwinana West port zones, providing growers with a summary of N cycling and availability within a cropping season and enhancing their understanding of the basic requirements to improve cost-effective fertiliser decisions and ultimately grower profitability.

Other outputs from this new investment include new resources for growers and consultants to aid in N decision making to optimise economic returns.

Further information: Rowan Maddern; 08 9230 4600, 0477 707 225; rowan.maddern@grdc.com.au
GRDC GrowNotes at *https://grdc.com.au/grownotes.* ■

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The unlikely tractor

By Ian M. Johnston

The blockade

In the year 1946, the Cold War was at its height. The Soviet Union, bristling with demonic arms, not the least of which included a rapidly expanding arsenal of nuclear weapons, occupied the eastern half of Germany.

A broad 7000 km long corridor, festooned with death-trap mines and patrolled by heavily armed East German communist guards, separated the Soviets from the British, French and US allies. German families, in an endeavour to reach forcibly separated loved ones, were slaughtered mercilessly, if they dared attempt a crossing of the hundred metre wide 'no-man's-land'.

Berlin, the capital city, was also divided, but in this case by a weaving barbed wire encrusted high stone wall. The Brandenburg Gate, through which military and political dignitaries irregularly passed, for the fruitless purpose of attending endless non-productive peace talks, was also heavily guarded and was the only access between the two sectors.

Berlin was located in the communist Eastern Block, with the hitherto population of 4.3 million, reduced by the ravages of war and forced migration to 2.8 million. Its location placed it 160 km east of the allied Western Sector.

The infamous Soviet's Berlin Blockade occurred in 1948–49. The East German Commander General Vasily Sokolovsky abruptly banned all road, rail and canal traffic access into the city. Accordingly, all food, fuel and other essentials had to be flown in by RAF, New Zealand, Canadian and US Airforce transports.

A remarkable 200,000 sorties landed at Berlin's Tempelhof Airport during the 323 day blockade, amounting to an average 12,000 tons of supplies each day! The density of the air traffic was unprecedented in aviation history. Therefore, sadly but not surprisingly, numerous accidents occurred resulting in the loss of 70 aircrew members.

Berlin 1945.

The Tiergarten

Astonishingly, in the midst of the ruins and devastation of a shattered post war Berlin, there remained a remote corner of hope, enterprise and expectation. By some miracle, the engineering firm of Orenstein and Koppel, founded way back in 1876, had escaped the devastation of war and conflagration. The red brick factory was located a short distance from the resplendent and world renowned Tiergarten.

Today the Tiergarten is the heart of Berlin's soul. It is comprised of 519 magnificent acres of stunning velvet green parkland, liberally sprinkled with colourful deciduous trees and through which meanders a gently flowing tributary of the River Spree. Remarkably this vast green oasis is situated in the epicentre of the city, adjacent to such famous landmarks as The Reichstag, Potsdamer Platz, Brandenburg Gate, and The Schöneberg Zoological Gardens.

During World War 2, the Tiergarten was obliged to suffer the indignity of the hostilities. Thousands of starving citizens descended upon it armed with spades and axes. The spades for the growing of desperately required vegetables and the axes for the hewing down of trees to be used as firewood for the provision of warmth. Others fled to the park simply seeking refuge from the danger of collapsing bombed buildings.

Upon the cessation of hostilities, a descendant of the founder of Orenstein and Koppel, Carl Orenstein, often escaped from his office in the company's factory building, and strolled to the nearby Tiergarten. There he experienced a feeling of profound sadness at the state of the once grand park.

Two years prior to the outbreak of the conflict, his firm had produced the first of a range of high quality innovative

The Tiergarten today.

The restored Orenstein and Koppel S32K. Note the compressed air receiver tank located in front of the offside rear wheel.

agricultural diesel powered tractors. But the production had to be halted in 1940 owing to the unavailability of steel, coupled to the shortage of skilled technicians, all of whom had been forced into military service.

The proposition

Orenstein was a man of strong resolve. In 1947 he personally approached the military headquarters of Brian Robertson, the commander of the British controlled section of Berlin, and presented him with a proposition.

Owing to the fact that the Orenstein and Koppel factory was miraculously still intact, if his firm could be granted a license to purchase steel, he could promise to have tractors back in production within two years.

Plus, he added, this would enable the Tiergarten to be proficiently cultivated by tractors with ploughs and harrows, as distinct from the burgeoning conglomeration of inexpertly dug plots. This in turn would yield considerable quantities of desperately needed fresh food. Also of course, these activities could be expanded to other parklands within the restricted Berlin region.

Because the German heavy industrial plants had been almost entirely destroyed, steel was practically unobtainable. Despite this fact, the British administration could see the wisdom of Herr Orenstein's proposal. But the agreed protocol between the four Berlin administrating powers (USSR, USA, France and Britain) dictated that all four were obliged to agree jointly to any such request before it could proceed.

Upon being presented with the facts, the Soviets refused to append their signature to the proposal.

Already in Russia plans were well ahead to reinstate the huge tractor manufacturing plants at Kharkov, Leningrad, Minsk and Kishinev. Accordingly, they were not enamoured with the thought of Orenstein and Koppel kick-starting the tractor industry in

A rear view of the S32K. The only attachments missing that were specified by the Soviets are the oxy acetylene bottles, the generator and the winch.

The offside cylinder. Note the control wheel for changing the function from combustion to air compressor.

An archival photo showing the missing attachments.

Berlin. So they introduced provisions which they were sure would negate the scheme.

They only agreed to approve the program if the proposed tractor would be capable of ploughing at night and then clearing bomb rubble in daylight hours. This would involve the utilisation of a builtin air compressor, capable of operating a jack hammer and rock drill! A tall order indeed and one that the Russians were certain could not be met.

But they underestimated the ingenuity of Orenstein and Koppel. Yes, they could arrange that – no trouble!

Somewhat bewildered by this response, the Russians realised that to have the entire concept thrown out they would have to insist upon a seemingly impossible technological design feature. Accordingly, they were emphatic that the tractor must also include integral gas welding and cutting equipment enabling the operator to cut up destroyed tram rails and damaged steel structures.

Following a tense pause of a few days, they were assured by Orenstein and Koppel this new demand would not be a problem for the tractor design team.

Thoroughly foiled, the frustrated Russians held a council of war. Their most brilliant city engineers were summoned. Right! A scheme was considered that would definitely put a halt to the entire project!

"Demand the tractor must also include an inbuilt generator for supplying emergency 230 volt power and arc welding, plus a heavy duty winch for pulling down teetering building walls".

They felt assured that such equipment loaded on to what began as a basic farm tractor, plus the attachments already insisted upon, would be beyond the capabilities of even these 'obnoxious' Orenstein and Koppel 'full of themselves' designers.

But they were so wrong! On the assurances given by Orenstein and Koppel that such a tractor would be built, the Russians had no choice but to concede defeat and sign the necessary approval documents.

The Orenstein and Koppel S32k

Only an unspecified very few number of the proposed tractors were subsequently produced, commencing in 1949. They were identified by the model number S32K. But an identical machine, minus all the Russian specified accoutrements, designated the Model S32, entered volume production the same year.

The engine was a development of the massively robust 3.2 litre 1938 diesel and featured two cylinders in V formation. The water cooled unit developed a lazy 36 hp at an easy vibration free 1300 rpm.

The tractor featured a leaf sprung front beam axle, a five forward speed gearbox, a limited slip differential and 12 volt electrical equipment.

Compressed air for operating a jack hammer and rock drill was supplied by utilising one of the twin cylinders as a compressor, which charged an air receiver fitted to the offside of the tractor. Oxy and acetylene cylinders were mounted on the flat top mudguards. A powerful 250 amp generator, located behind the operator's seat, was driven by a belt drive from the rear belt pulley. A pto driven winch, complete with sprags, was attached to the rear of the transmission housing.

The S32K was indeed a versatile tractor, as of course it could also perform normal farm tasks.

Tailpiece

In 1991 I was fortunate to be offered a rusty wreck, discovered under the collapsed roof of a garden shed. To my profound amazement the mass of rust turned out to be the remains of an Orenstein and Koppel S32K. Apparently a German immigrant imported it in the 1950s thinking he could continue his business as a plumber, using the tractor compressor to blow out clogged sewerage lines. But the Sydney Metropolitan Water Sewerage and Drainage Board forbade the practice and the unit was parked in a small shed and forgotten for several decades.

Over a 12 month period, I returned this amazing find into a completely restored condition. It became the crown in my classic tractor collection!

Also, Margery and I have been privileged in recent times to have had the opportunity of exploring the magnificent reborn Tiergarten. We found it hard to visualise how it must have looked during the devastation of the 1940s. ■

IAN'S MYSTERY TRACTOR QUIZ

Question: What on earth is this weird little crawler?

Clue: It is as British as Rolls Royce!

Difficulty: 'New' tractor people (i.e. under 50s) may have difficulty.

Answer: See page 48.

Noble gases and clever science equals better grasp on groundwater

By Thea Williams, CSIRO

THE gas trapped in Antarctic ice cores is known to provide unique insights into Earth's ancient atmosphere. Perhaps lesser known is the value of gases in Australian groundwater – the terrestrial equivalent.

That's because underneath parts of our flat, dry, ancient continent runs – very slowly – some of the oldest water on Earth.

A new laboratory at CSIRO is now able to contribute to telling us the history of Australian groundwater, its origins and how it has moved through space and time, with much greater precision and accuracy.

The Noble Gas Facility – the first in the Southern Hemisphere – provides an entirely new facility to contribute to Australian groundwater investigations. It has been a labour of love, taking physicists three years to build from scratch, especially adapted to Australian conditions.

Its applications range from paleoclimate studies to pollution and hydrology. Most of all, we'll get a much better understanding of the precious resource and how it might be impacted through use and by development.

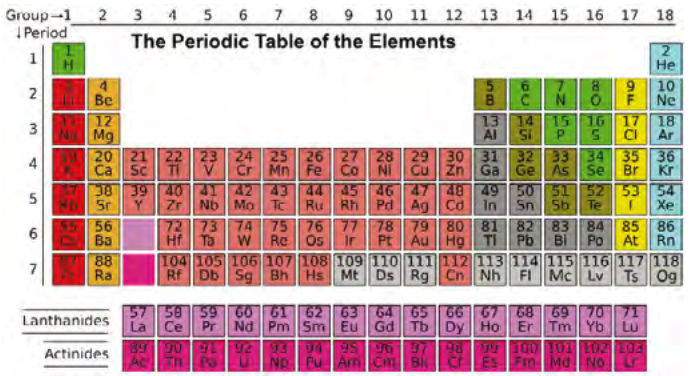
Back to the periodic table

Forgotten your high school chemistry or physics?

It's UNESCO's International Year of the Periodic Table this year, 150 years since Dmitri Mendeleev discovered the Periodic Law on March 1, 1869, which came to be considered the 'common language for science'.

CSIRO physicist Dr Axel Suckow has made a career from noble gases.

"They're the elements on the right side of the Periodic Table



The periodic table.

CSIRO physicist Dr Axel Suckow has made a career from noble gases.

of elements and they don't react – and they are helium, neon, argon, krypton, xenon and radon," he says.

"Helium was first seen on the sun when Bunsen and Kirchhoff developed spectral analysis. Argon has the highest mixing ratio in the atmosphere – there is 10,000 times more argon than helium.

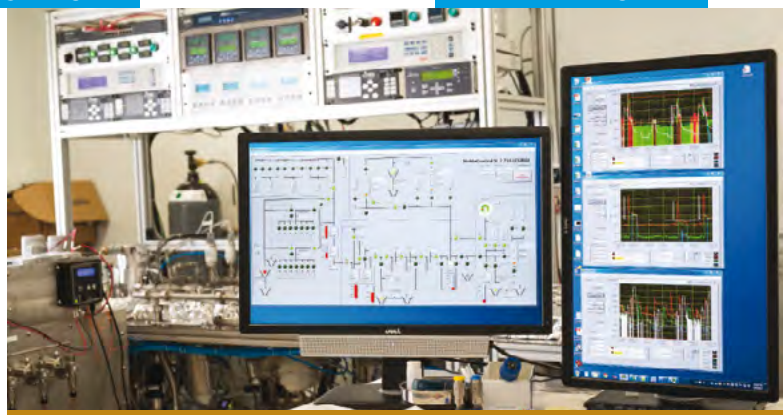
"Krypton and xenon are difficult because they are hard to separate."

They have unique signatures because of radioactive decay from the rocks hosting aquifers where the groundwater flows, and each tells a different story of geological history of the groundwater.

Axel likens them to a footprint in the sand – pieces of information you can follow. They are, in fact, called tracers.

"A traced substance can allow you to follow a natural process – in water it can tell us how fast water moves, how does it mix, where does it infiltrate, at which temperature, how fast does it infiltrate, where does it exit," Axel explains.

The copper tubes contain the gas extracted from water samples and, here, attached to the mass spectrometer for analysing. (IMAGE: CSIRO)



The first noble gas machine in the Southern Hemisphere, capable of analysing fossil water unique to Australia. (IMAGE: CSIRO/James Knowler)

Building a noble gas facility

There aren't many people in the world who know how to build a noble gas machine. Axel spent time towards the end of his PhD in Heidelberg sleeping in the lab with an alarm waking him up every 20 minutes to change valves. He knew then, the machine had to be automated.

He built a noble gas machine in Vienna – 3.5 years to build the hardware, two years spent developing the software and another 18 months 'teaching' it to calibrate the data from samples. With that experience, and help from CSIRO staff in the 'Environmental Tracers and Applications' team, it has 'only' taken three years to build the new machine in Adelaide – instead of seven.

The Noble Gas Facility in Adelaide is completely automated. This doesn't just make it simpler to use, it makes it much more accurate, he says.

The water samples are collected in the field in copper tubes that can be tightly clamped off to ensure there is no contact with air.

Back in the laboratory the water samples start in the gas preparation line, where the gas is extracted – using liquid nitrogen which freezes the H_2O, to an industrial hairdryer which progressively releases noble gases.

A second room is dedicated to the mass spectrometer.

Here, the noble gas machine uses three cryotraps, separating out the gases at extreme cold temperatures – 10 Kelvin where 0 K is equivalent to –273.15 °C.

The mass spectrometer blasts the gas with electrons to ionise the inert atoms and uses magnetic fields to measure the ratio of each gas.

The mass spectrometer provides a clear ratio of the chosen noble gas in the sample and its isotopes.

"We constructed the machine for Australian groundwater. There are about 12 noble gas machines, mostly in Europe and Northern America, this is the first in the Southern Hemisphere," says Axel.

He explains that the new noble gas machine is especially adapted for analysing Australian groundwater which includes high concentrations of reactive gases such as CH4 (methane) and helium.

And, put simply, distinct ratios of these gases define precise periods in Earth's history, in rock or water.

What noble gases tell us about Australia's ancient groundwater

CSIRO has a long-standing history with capability in the use of environmental tracers across various projects. But historically, other existing environmental tracers used to investigate

groundwater challenges have a limited range for dating old groundwater, are often not geochemically inert and provide limited information on recharge conditions, for example the temperature at the time the water entered the underground system.

Noble gases – helium, neon, argon, krypton and xenon – can be used to quantify very small flow velocity through aquitards and can determine recharge temperatures, says Axel.

Noble gases are particularly useful in telling us about groundwater because they can be traced to show us how quickly, or slowly, water moves through underground aquifers; providing a better understanding of the connection between surface water and groundwater flow, and the replenishment of aquifers; and showing if water can move between shallow aquifers and deep underground aquifers through geological layers with low permeability.

Noble gases provide a unique contribution to characterising and understanding groundwater flow processes, surface water–groundwater interactions, groundwater-seawater interactions, aquitard permeability and inter-aquifer connectivity.

Specifically, some of their isotopes allow estimating flow velocities on time scales from years (85Kr), centuries (39Ar), millennia (4He), up to one million years (81Kr) and beyond (4He, 40Ar, 21Ne, 134Xe, 136Xe).

"Because Australia is dry and flat, groundwater in many deeper aquifers moves very, very slowly and that means we need tracers for old water," he says.

"Knowledge of flow velocities is indispensable when managing groundwater as a resource for drinking water, agriculture, industry and mining. Infiltration processes, such as recharge after flooding a dry riverbed or constant infiltration from a permanently losing stream, can also be identified using noble gases.

"We need a better understanding of the nature and extent of our groundwater systems and how they are recharged to ensure that, as we continue to use this valuable resource and with a changing climate, we also protect it from overuse or contamination."

Sampling groundwater from an artesian stock bore screened in the Poole Sandstone aquifer of the Fitzroy catchment.

Taking samples from the surface water of the Fitzroy River was an important element in understanding the connectivity between groundwater and surface water.

A bigger regional picture

Among the first water samples to be tested at the new Noble Gas Facility came from the Fitzroy catchment in Western Australia's Kimberley region. It was part of groundwater analysis done for the Northern Australia Water Resource Assessment and aimed to identify the potential for, and risk of, increasing water-related development opportunities in northern Australia.

Groundwater hydrologist Andrew Taylor explains that in the Fitzroy catchment, the Kimberley plateau in the far north of the catchment receives high precipitation in the wet season which runs off the land surface draining into ephemeral rivers and flows downstream to flood the Fitzroy valley where it's quite flat. The river eventually bursts its banks and comes out on to the flood plain where it saturates large parts of the landscape before a portion of the flood water infiltrates into the groundwater systems of multiple aquifers.

When the wet season subsides, the river flows also subside. But large reaches of the river, as well as persistent instream water holes are sustained by the inflow of groundwater, discharging from aquifers.

The hydrogeology and groundwater systems of the Fitzroy catchment is largely a greenfield region which has never been properly characterised.

Taylor describes the aquifers and groundwater systems as a cake with different layers: Alluvial aquifers occur at the surface in association with the rivers, their tributaries and their flood plains, while underneath this there are multiple layers of sandstone, mudstone, siltstone and limestone, some of which allow water to flow (aquifers) and some which don't (aquitards).

He has travelled across the Kimberley taking water samples from bores, as well as surface water from persistent water holes and reaches of the Fitzroy River to better understand the nature of groundwater systems in different aquifers and how hydrologically connected they are to the Fitzroy River.

"Groundwater resources occur over vast geological areas but information is sparse because there is only a certain number of bores associated with the occasional pastoral lease, mining operation or community water supply," he says.

"First, we needed to review all of the available data, then get out and do some sampling from existing bores, as well as drilling in areas with no bores to gain a better understanding of the nature and extent of aquifers.

"Then we wanted to know how the groundwater systems in different aquifers interacted, particularly those aquifers that are deep.

"We also wanted to know where and how the groundwater systems are connected to the river itself."

Taylor took a helicopter and flew the length of the Fitzroy River taking surface water samples for tracers.

Comparing those samples from bores and also from the river, they were able to test those samples using the Noble Gas Facility and conceptualise the groundwater systems of the region.

"Environmental tracers allow us to fingerprint the history of that water and that's what you need to know in an area where you don't have much groundwater level information. If you can't see where its water levels are going up and down – it's hard to understand groundwater recharge, water that's replenishing the groundwater, and whether is it coming from rainfall or flooding of rivers.

"We know, for example, in the Fitzroy where we did the helicopter survey, there are high levels of noble gases in the deep regional aquifer which we then found in the river itself. That showed us that groundwater from deep aquifers is discharging up into the river where regional faults cut through overlying aquitards.

"We take a lot of care in trying to conceptualise how things are behaving and using multiple lines of evidence to validate if that is real or not. Every time we do a new study, it tells us a different story, sometimes you get a nice story coming out of environmental tracers.

"We have now used this new conceptualisation to underpin a regional groundwater model which covers more than the Fitzroy River catchment and which is used to estimate the inflows and outflows of the deep regional sandstone aquifers (Grant Group and Poole Sandstone). It can also be used to assess the volume you can extract from the aquifer without affecting existing users and environmental assets like the river itself."

Clues to paleoclimate

Axel Suckow points out that for the Great Artesian Basin the flow time from the site of infiltration to the springs in South Australia is roughly considered to be two million years.

"Helium, for instance, increases due to radioactive decay of uranium in the rocks and that means the higher the helium content in the groundwater the older the groundwater is," he says.

"The other noble gases tell us about the infiltration conditions. If you give me a water sample that is 10,000 years old then, from the concentration of argon, krypton and xenon, I can tell you the ground surface temperature 10,000 years ago which is very valuable information for paleoclimate studies inland.

"We can reconstruct infiltration conditions such as temperature, salinity and altitude."

With the new facility, it's anticipated that data from groundwater systems across the country will progressively paint a picture of the continent's paleoclimate. As such, the facility also stands to contribute to a better understanding of climate change.

"Everyone sees the Murray Darling. With groundwater you can't do that, it's hidden in the ground but no less important. It's much more difficult and challenging to investigate and I love that."

The Science and Industry Endowment Fund (SIEF) awarded $550,000 to CSIRO for the acquisition of the noble gas spectrophotometer as part of the Noble Gas Facility.

■

Profitable legumes for WA's difficult soils

By Alana Hartley, Research Agronomist & Coordinator – Liebe Group

Results at a glance…

- Adequate pre and post emergent weed control is critical for maintaining yield potential and quality of grain legume crops.
- Canola remains the most profitable non-cereal crop type demonstrated at this site in 2018.
- Where vetch grain is not harvested and sold as feed, consideration of this legume crop type for its grazing value may be advantageous for a mixed farming system.
- Results reported here are for Dalwallinu which is one of four sites within the Liebe region. The other sites being Kalannie, Carnamah and Koorda.

Why do the trial?

The Liebe Group is investigating the suitability and profitability of alternative legume crops in the Western Region of the WA wheatlbelt.

Previous research has suggested that most legume and pulse crops are best suited to fine textured soils of neutral to alkaline pH. While previous attempts to grow legumes and pulses on 'un-preferred' soil types have had varied success, there has been limited adoption of these crop types. This is in part due to suitability of soil type, weed competition and weed control options, yield, market access and overall profitability of legume crops.

This two year GRDC-funded project, aims to demonstrate how – and if – certain grain legumes are a suitable and profitable alternative crop choice for the farming systems of each region in which the project will be implemented. The four trial sites (Dalwallinu, Kalannie, Carnamah and Koorda) cover a vast range of soil types, rainfall zones and farming systems (cropping and mixed farming).

Dalwallinu Legume Demonstration Trial details, 2018

Location	Ian and Ainsley Hyde, Bell Rd, Dalwallinu, Western Australia. The 2018 Growing Season Rainfall measured at the Dalwallinu site was 300 mm.			
Plot size & replication	18.28 m x 300 m x two replications			
Soil type	Heavy red loam			
Soil pH (CaCl2)	0–10 cm depth: 6.1; 10–20 cm depth: 6.8; 20–30 cm depth: 7.7			
Paddock rotation:	2015: Wheat 2016: Wheat 2017: Barley			
Sowing date	Canola, Vetch, Chickpeas – 25/05/2018, Field peas – 11/06/2018			
Sowing rate	Striker chickpeas: 90 kg/ha Twilight field peas: 100 kg/ha Volga vetch: 40 kg/ha Bonito canola: 3 kg/ha			
Fertiliser	22/05/2018: NPK CZ 60 kg/ha (canola, vetch, chickpeas) 11/06/2018: Double-Phos 60 kg/ha (field peas)			
Pre-emergent sprays	**Canola** Trifluralin 2 L/ha Simazine 1.1 kg/ha Chlorpyrifos 200 ml/ha	**Chickpeas** Trifluralin 2 L/ha Simazine 1.1 kg/ha Chlorpyrifos 200 ml/ha	**Field peas** Metribuzin 150 g/ha Diuron 600 g/ha Glyphosate520 1.5 L/ha Chlorpyrifos 150 ml/ha	**Vetch** Trifluralin 2 L/ha Simazine 1.1 kg/ha Chlorpyrifos 200 ml/ha
Post-emergent sprays	**13/06/2018** Atrazine 1.05 kg/ha Enhance 0.5%	**18/07/2018** Clethodim360 330 ml/ha Verdict520 50 ml/ha Chlorpyrifos 250 ml/ha Hasten 1%	**18/07/2018** Clethodim360 330 ml/ha Verdict520 50 ml/ha Chlorpyrifos 250 ml/ha Hasten 1%	**18/07/2018** Clethodim360 330 ml/ha Verdict520 50 ml/ha Chlorpyrifos 250 ml/ha Hasten 1%

Treatment details

Plot	Replications	Treatment #	Treatment	Plot	Replications	Treatment #	Treatment
1	1	1	Chickpeas	2	1	C	Canola
3	1	2	Field peas	4	1	3	Vetch
5	2	C	Canola	6	2	2	Field peas
7	2	1	Chickpeas	8	2	3	Vetch

PO Box 340
Dalwallinu, WA 6609
Phone: 08 9661 1907
E: admin@liebegroup.org.au
Website: www.liebegroup.org.au

Executive Officer: Chris O'Callaghan
Email: eo@liebegroup.org.au

Region: The Liebe Group is a dynamic, grower-driven, not for profit organisation that operates within the Dalwallinu, Coorow, Perenjori, Moora and Wongan-Ballidu Shires in the West Australian wheatbelt. As a leading 'grass roots' group, the Liebe Group provides its members with access to innovative, timely and relevant research along with grower and industry network opportunities from all over Australia. The Liebe Group was established by progressive local farmers in 1997 due to concern of the local area being isolated from existing agricultural research and development. The group was founded to ensure research and development remained local, innovative and relevant to a whole farm systems approach to agriculture.

Commercial sponsors: Rabobank, CSBP, CBH Group, RSM, AFGRI, Farmanco, Imtrade Australia, Elders Scholz Rural, Bayer, Precision SoilTech, Syngenta, Pacer Legal, Agrimaster, AGT, Scott's Watheroo Dolomite, Pacific Seeds, Refuel Australia, Landmark, Grain Growers, Nufarm, Adama Australia, Intergrain, Boekemans Machinery Dalwallinu.

This article reports on results from the Dalwallinu Legume Demonstration site where three legumes – chickpeas, field peas and vetch – were compared to canola. Canola is the current break crop option of choice in the area.

Trial and treatment details for the Dalwallinu site in 2018 are detailed in the accompanying chart.

Table 1: Baseline soil nutrition status, Dalwallinu, February 2018

Depth	pH	PBI	Col P	Col K	KCl S	NO_3N	NH_4N	EC	OC
0–10 cm	5.7	80.4	37	430	16.6	51	6	0.182	1.30
10–20 cm	7.4	157.3	9	258	4.8	9	1	0.047	0.90
20–30 cm	7.7	204.8	7	118	3.4	4	1	0.069	0.50
30–40 cm	7.7		5	94		4	2	0.133	
40–50 cm	8.3		3	96		3	1	0.179	

What we found

Soil analysis

A soil analysis was conducted at the beginning of the project, to measure base line nutrients (Table 1). Further soil testing was conducted prior to seeding in 2019, to determine the change in N status from the baseline results.

PreDicta B was conducted prior to the trial being sown, to determine the disease profile and risk at the beginning of the project (Table 2).

The results indicated that there was a low presence of disease at the site. PreDicta B was conducted again prior to the 2019 season – and entering into the wheat phase – to determine if the legume crops have had an impact on the disease profile.

Plant and weed counts

Weed and plant counts were taken at establishment (four weeks after sowing) and again at late establishment, when the legume crops were at branching.

Table 2: PreDicta B soil-borne disease rating, 2018

Test	Result
Cereal Cyst Nematode (CCN)	Nil
Take All (Wheat & Oat race)	0.9
Rhizoctonia solani	1.1
F. pseudograminaerum (test 1)	3.4
F. pseudograminaerum (test 2)	Nil
Pyrenophora tritici-repentis (YLS)	1.3
Bipolaris	0.8
Pythium	1.4
Macrophomina phaseolina (collar rot/stem rot)	2.0
Disease detection rating	Low
	Medium
	High

Table 3: In-crop plant and weed counts, August 2018

Crop type	Average plants per m^2	Log weeds per m^2
Canola	37	5
Chickpeas	41	38
Field peas	41	54
Vetch	38	25
P value	*0.982*	*0.247*
Lsd	NS	NS

There were no significant differences in plant numbers between crop types in these early counts. A log transformation of weed counts suggest that there was some influence of weeds on crop establishment, but this was not highly significant. Counts were not taken for field peas, as they had only just been sown at the time the establishment counts were taken.

Later plant and weed counts in August (Table 3), showed no significant difference between crop type, and weed counts by crop type.

But there was a significant difference between weeds in the canola plots compared to other crop types. Canola had the lowest average weed counts of all crop types, due to crop competition and shading of weeds and the addition of a post emergent herbicide.

Only a grass selective was applied to the legume crops, meaning broadleaf weeds and some grass weed survivors and late germinations remained uncontrolled. This had some influence over the reduction in plant numbers from early establishment to late counts. Weed burden also has an influence on crop yield.

Harvest yield

This demonstration was harvested using grower equipment, with yield being measured by weigh trailer. Crop yield by replicate (Figure 1) illustrates a downward trend in yield from replicate one to replicate two. This is due to a slight soil type change at depth across the site.

Figure 1: Crop yield (t/ha) by replicate

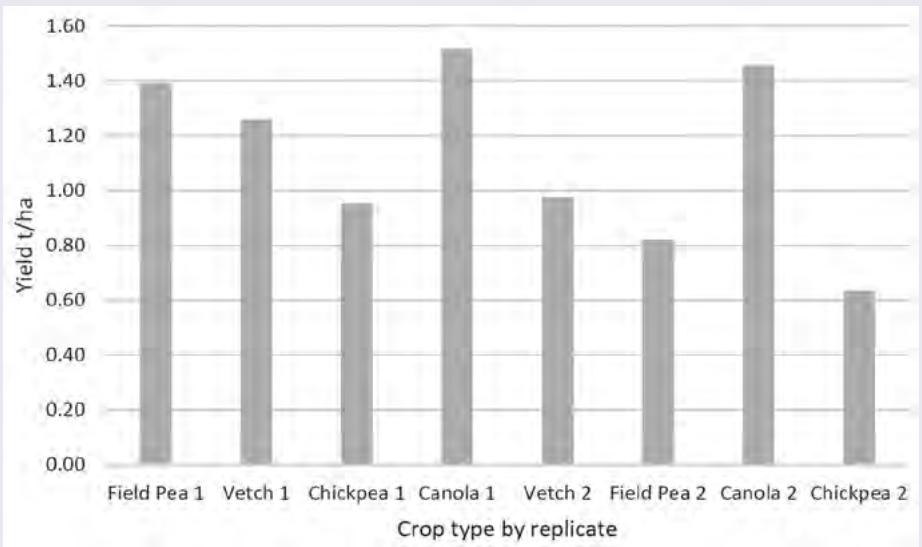
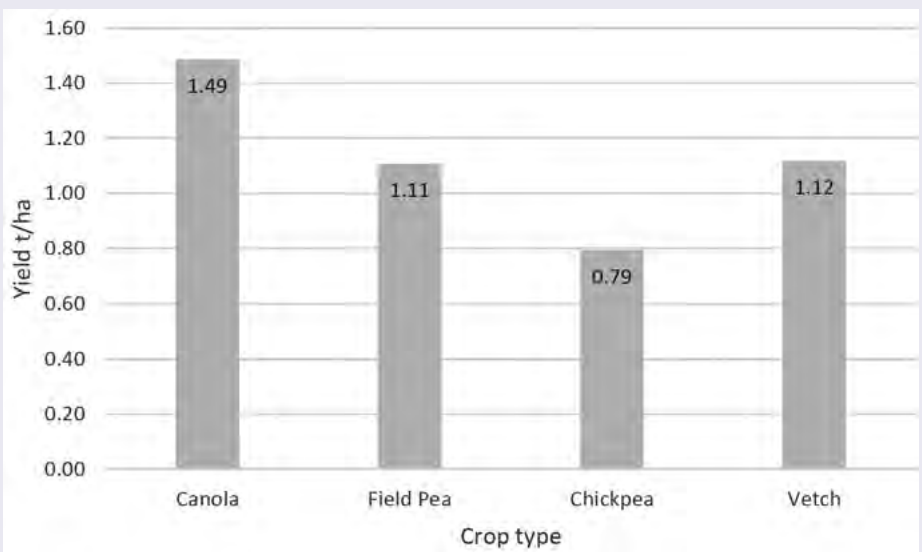


Figure 2: Combined average yield (t/ha) by crop type



Replicate 2 had a sandy texture and marginally lower pH compared to Replicate 1.

Canola was the only crop type in this demonstration that was not influenced by spatial variation in soil and weed burden. This is because canola is a more competitive crop. The cabbaging canola competed for sunlight and nutrients by shading the germinating weeds.

All other crop types were heavily influenced by the presence of broadleaf weeds such as double gee, turnip, capeweed, thistles and grasses.

This underlines the need to adequately manage weeds both pre and post emergent. Chickpeas was the crop most influenced by weed burden.

Combined average yields (Figure 2), indicate that canola remains the most competitive break crop option at this site.

But given sufficient post emergent weed control, field peas and vetch have a potential fit as a legume option for a farming system in this region.

Economic analysis

Assessment of enterprise profitability was conducted on the results from a single season, across each replicate, with the combined economic performance shown in Table 4.

Figure 3 summarises operating profit as earnings before interest and tax (EBIT).

The value of nitrogen or updated disease status has not been factored into this analysis but will be adjusted for the wheat phase in 2019.

The highest earning crop demonstrated by this project was canola, with an operating profit of $382 per hectare.

Field peas also yielded a positive operating profit at $194 per hectare but was not as profitable as canola due to the lower yield.

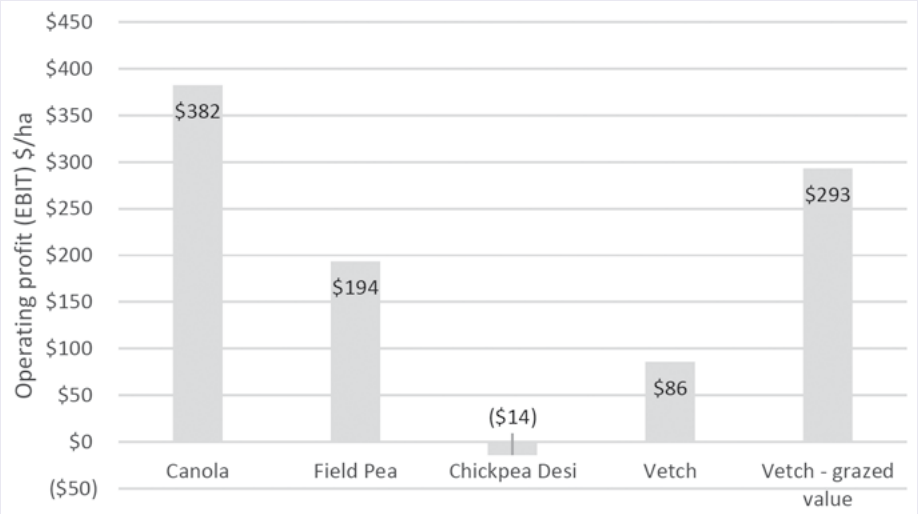
Chickpeas were affected by poor yields and quality due to the weed burden, resulting in a loss of $14 per hectare.

The grain value of vetch achieved a modest $86 per hectare operating profit.

The role of vetch in the rotation

Vetch is a legume pasture species and will often

Figure 3: Combined enterprise operating profit ($ /ha) before interest and tax (EBIT), 2018



be grazed, brown manured or cut for forage hay. The variety demonstrated at Dalwallinu, Volga, is a multi-purpose variety where livestock producers can maximise their returns from grazing both crop biomass and grain. A vetch grazing value has been calculated in Table 4.

The following assumptions have been made;

- One DSE consumes 1 kg dry matter (DM) per day.
- At the end of grazing there is budgeted to be 1000 kg DM per hectare remaining in order to retain enough cover to avoid paddock damage.
- In this example this means of the 3000 kg grown, 2000 kg would be consumed. From this 2000 kg consumed, lamb and wool production has been calculated and represents income.
- It is assumed that there would be single bearing ewes on this paddock which would turn off a lamb as well as a fleece.
- Average sale price of sheep is $122.
- Average wool cut is 5.39 kg per head at an average price of $10.57 per kg.
- The dry matter figure is only a visual assessment and information taken from this analysis needs to be considered with caution.

For livestock producers considering a legume species in the rotation, the Dalwallinu demonstration site indicated that grazed vetch provides significant economic advantage to both lamb and wool enterprises with a calculated operating profit of $293 per hectare.

To sum up

To successfully grow a legume crop in the Dalwallinu region, suitable agronomic and management practices must be considered.

Adequate pre and post emergent control of weeds in pulse crops is required to limit the impact on crop yield and quality.

Matching crop soil requirements with soil type and using the right harvesting equipment/settings to avoid yield losses are also important in the planning for – and success of – a legume crop.

Results from the 2018 trial at the Dalwallinu site show that canola remains a highly profitable non-cereal crop option within our local rotations.

Table 4: Assessment of enterprise profitability at the Dalwallinu site from a single season (2018)

Crop enterprise		Canola	Field pea	Chickpea (desi)	Vetch	Vetch grazing value
Yield	t/ha	1.49	1.11	0.79	1.12	3.00
Carrying capacity for 150 days	DSE				13.33	4.8
Annualised carrying capcity	DSE					5.48
Average grain price (FIS)	$/t	$582	$600	$600	$500	
Income	$/ha	$865	$664	$476	$558	$758
Variable operating costs	$/ha					
Seed, treatment & EPR's	$53	$2	$61	$91	$61	$61
Grain freight (Up Country)	$26	$34	$25	$18	$29	
Grain handling charges	$16	$23	$16	$11	$16	
Crop contract	$35	$35	$35	$35	$35	$35
Other crop costs & crop insurance	$22	$22	$22	$22	$22	$22
Wages (Gross)	$28	$28	$28	$28	$28	$28
R&M mach/plant/vehicles	$42	$42	$42	$42	$42	$42
Fuel & oil	$27	$27	$27	$27	$27	$27
Fertiliser, lime & gypsum	$60	$104	$45	$45	$45	$45
Pesticide	$35	$32	$36	$38	$35	$35
Variable operating costs	$	$349	$337	$358	$339	$295
Variable operating costs	$/ha	$349	$337	$358	$339	$295
Operating gross margin	$	$515	$327	$119	$219	$463
Operating gross margin	$/ha	$515	$327	$119	$219	$463
Fixed operating costs	$	$133	$133	$133	$133	$170
Fixed operating costs	$/ha	$133	$133	$133	$133	$170
Total operating costs	$	$482	$470	$491	$472	$465
Total operating costs	$/ha	$482	$470	$491	$472	$465
Operating profit (BIT)	$	$382	$194	–$372	–$253	$293
Operating profit (BIT)	$/ha	$382	$194	–$14	$86	$293
Finance costs	$	$36	$36	$36	$36	$56
Earnings before tax (EBT)	$	$346	$158	–$50	–$289	$237
Earnings before tax (EBT)	$/ha	$346	$158	–$50	$50	$237

Where soil type permits, field peas have an economic fit within the farming system. Further work is required to determine the suitability of chickpeas in a rotation.

While vetch performed well, the ability to control the weed burden must be considered prior to planting. Where stock are a part of the farm program, the grazing value of vetch needs to be considered beyond the value of grain.

Acknowledgements:
Liebe Group would like to thank the Hyde family for hosting this trial site and for the time and effort they have contributed to the management of the demonstration. The economic analysis for this project has been conducted by Ben Curtis and Stacey Bell of Farmanco.
This project has been made possible through the GRDC investment: Demonstration of legumes for reliable profitability in the Western Region.
Project Code: LIE1802-003SAX

Peer Review: Alan Meldrum, Grain Growers.

Contact: Alana Hartley, Liebe Group
E: research@liebegroup.org.au

Liebe Group research is showing that adequate pre and post emergent weed control is critical for maintaining yield potential and quality of grain legume crops in the region.

NORTHERN FOCUS
COVERING NORTHERN NSW AND QUEENSLAND

IMI-tolerant sorghum and concerns related to shattercane

By Gulshan Mahajan[1] and Bhagirath Chauhan[1]

AT A GLANCE...

- Introduction of imidazolinone (IMI)-tolerant sorghum technology in Australia has provided an opportunity for a wide spectrum of weed control in this valuable summer crop.
- But it could increase the risk of gene flow for herbicide-resistant traits from sorghum to closely-related weed species such as shattercane, if not carefully managed.
- To reduce the risk of outcrossing and survival of weed-crop hybrids, IMI-tolerant sorghum systems must be integrated with stewardship guidelines.
- Research is needed to address issues concerning outcrossing for herbicide-resistant traits and fine-tuning of IMI-tolerant sorghum technology, including stewardship guidelines.

SHATTERCANE (*Sorghum bicolor*) is a troublesome annual weed in sorghum and can significantly reduce crop yield. It is de-domesticated sorghum with similarities to grain sorghum. Shattercane competes greatly for sorghum's growth resources (light, nutrients and water) and it is difficult to identify this weed plant in a sorghum crop at an early stage. It resembles forage sorghum, having waxy leaves, and reaches to a height of 1.5–2.5 metres at maturity.

Shattercane seeds are egg-shaped, a little bit smaller than sorghum seeds, shiny and of black to deep reddish-purple colour. The seed head of shattercane is loose and seeds tend to shatter easily. The shattercane plant can produce more than 2000 seeds per panicle, indicating its high reproduction potential. In addition, seeds have variable dormancy, allowing them to germinate over a long time period.

Chemical control of shattercane in conventional sorghum is very difficult as sorghum and shattercane are the same species.

Introduction of IMI-tolerant sorghum

Recently, imidazolinone (IMI)-tolerant sorghum was introduced in Australia. No doubt, it provides a great opportunity for a broad spectrum of weed control – including shattercane – in sorghum with the use of IMI herbicides such as Intervix. But widespread use of IMI-tolerant sorghum technology in the future could cause serious concerns due to high selection pressure on shattercane and other weed species.

IMI-tolerant sorghum could also result in uncontrolled movement of pollen containing herbicide-resistant genes, also known as gene flow/escape. Evidence of gene flow has already been reported in the US, where herbicide-resistant genes from IMI-tolerant wheat was naturally transferred to goatgrass (*Aegilops cylindrica*) and now herbicide-resistant biotypes of goatgrass is a serious problem. The probability of gene flow or escape is greater when the plant species are closely related because of the high possibility for cross-pollination.

This US experience underlines the risk of gene flow for herbicide-resistant traits from sorghum to shattercane while using IMI-tolerant sorghum technology in Australia.

Proper use of herbicide-tolerant technology – that is, the right dose at the right time – as a part of integrated weed management, is essential if we are to extract the maximum benefit of this technology. This research was conducted to optimise the dose and application timing of Intevix for weed control of shattercane while achieving a high yield of IMI-tolerant sorghum.

An Intervix-applied plot of IMI-tolerant sorghum.

Shattercane-infested plot (unsprayed) of sorghum.

FIGURE 1: Effect of Intervix application time (2 and 6-leaf sorghum growth stage) and dose (0, 0.5, 1.0 and 2.0 L per hectare) on shattercane biomass (g/m^2)

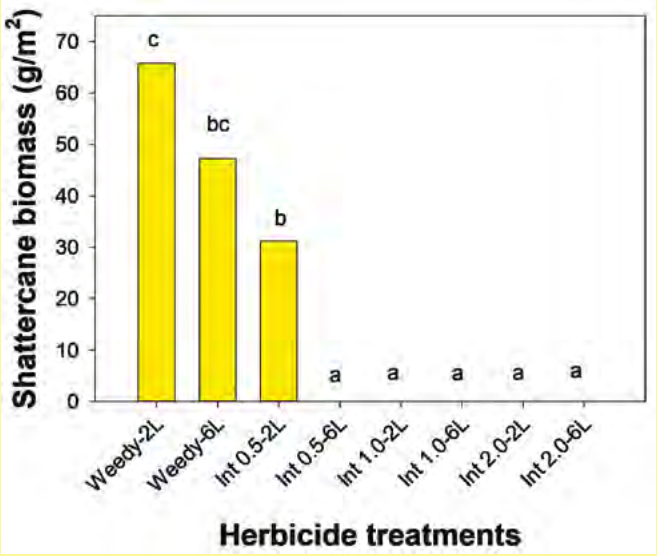
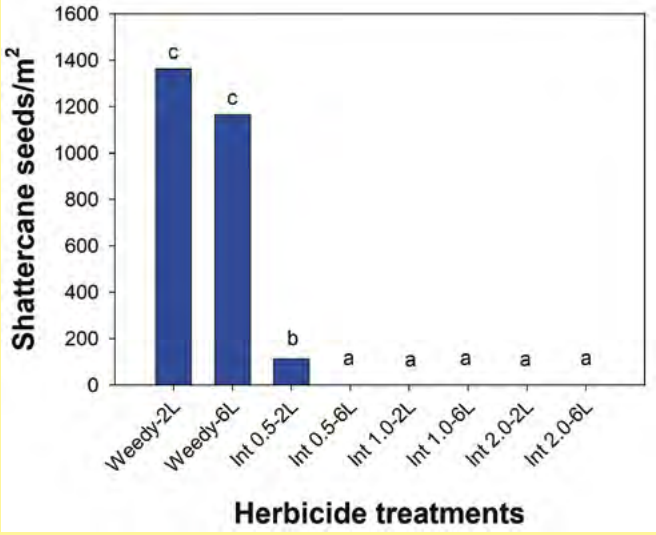


FIGURE 2: Effect of Intervix application time (2 and 6-leaf sorghum growth stage) and dose (0, 0.5, 1.0 and 2.0 L per hectare) on shattercane seed production (seeds/m^2)



How the research was done

A trial was conducted in 2018–19 at the Gatton research farm of the University of Queensland to evaluate the dose and time of application of Intervix (33 g/L imazamox plus 15 g/L imazapyr) in IMI-tolerant sorghum.

The experiment was conducted in a randomised block design (in a factorial arrangement) comprised of eight treatments: Two application timings (2 and 6-leaf stage of sorghum) and four herbicide treatments (non-treated weedy, Intervix at 0.5 L per hectare, Intervix at 1.0 L per hectare and Intervix at 2.0 L per hectare). There were three replications of each treatment. Hasten at one per cent was used with Intervix.

The crop was planted with a tractor-mounted planter on December 4, 2018 using an IMI-tolerant sorghum cultivar 'Elite Sentinel IG' at a row spacing of 70 cm and a density of 10 plants per square metre. Intervix was applied using a CO_2-pressurised backpack sprayer equipped with flat-fan nozzles delivering a water volume of 160 litres per hectare at the 2 and 6-leaf stages of the crop in the respective plots.

Shattercane in the non-treated (weedy) plot at maturity.

Shattercane biomass and seed production were determined before desiccation of the crop using a quadrat (50 cm by 50 cm) placed randomly at two locations in each plot. Samples were collected by cutting weeds at the ground level and dried in an oven at 70°C for 72 hours.

The harvested area for grain yield was 9.8 m^2 and the grain yield from the harvested area was converted to kg per hectare at 12 per cent moisture content.

What we found

Results revealed that the plots treated with Intervix at 1.0 and 2.0 L per hectare provided complete control of shattercane (Figure 1). Shattercane plants survived in only those plots that were treated with Intervix at 0.5 L per hectare at the 2-leaf stage.

This treatment had 47 per cent shattercane biomass of the non-treated control treatment. This treatment also produced 110 shattercane seeds per square metre (Figure 2).

The season-long weedy plots produced the lowest yield (0.4 tonnes per hectare) among all weed control treatments (Figure 3). Averaged over the leaf stage treatment, plots treated with Intervix at 0.5, 1.0 and 2.0 L per hectare gave 3.9, 6.5 and 7.8 times higher yield, respectively, as compared with the weedy plot.

Plots treated with Intervix at 1.0 and 2.0 L per hectare had similar yields, but yield in these plots was higher than the plots treated with Intervix at 0.5 L per hectare.

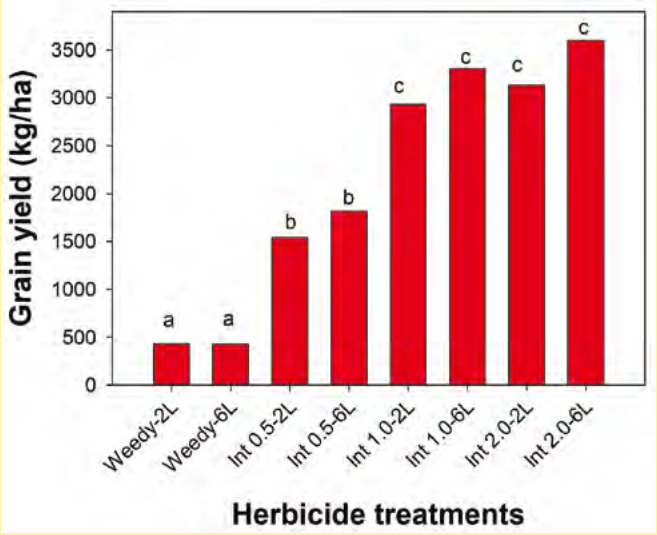
Stink grass (*Eragrostis cilianensis*) and black pigweed (*Trianthema portulacastrum*) were also present in the weedy plots (data not shown). Intervix provided good control of these weeds at 2.0 L per hectare but proved inferior at lower doses (0.5–1.0 L per hectare). Therefore, the yield loss of sorghum grains was not only due to shattercane but also due to other weed species.

To sum up

This trial suggests that the infestation of shattercane (and other weeds) significantly reduced sorghum grain yield. The post-emergence application of Intervix at 1.0 and 2.0 L per hectare provided complete control of shattercane and resulted in seven to eight times higher yield as compared with the weedy plots.

The results also suggest that shattercane plants could survive

FIGURE 3: Effect of Intervix application time (2 and 6-leaf sorghum growth stage) and dose (0, 0.5, 1.0 and 2.0 L per hectare) on sorghum grain yield (kg/ha)



at a lower dose of Intervix (0.5 L per hectare), especially if the spray is done at an early stage of the crop (e.g. 2-leaf stage).

Late application of Intervix (at the 6-leaf stage) could kill the late cohorts of shattercane.

Survival of shattercane in IMI-tolerant sorghum paddocks could result in gene flow of herbicide-resistant traits from sorghum to shattercane as the chances of outcrossing are high. Shattercane and sorghum are sexually compatible, which can result in hybridisation.

A study in the US observed hybridisation (pollen transfer through wind) up to 200 metres from the edge of the sorghum field. If shattercane gains the herbicide-tolerant trait from IMI-tolerant sorghum, it will produce herbicide-resistant populations.

This means IMI-tolerant sorghum systems must be integrated with stewardship guidelines to reduce the risk of outcrossing and survival of weed-crop hybrids.

These guidelines must be implemented with the aim of preventing shattercane resistance resulting from outcrossing as well as from selecting spontaneous mutation in the paddock. Seed producers of IMI-tolerant sorghum are required to follow strict guidelines which ensure that fields used for seed production are free from shattercane.

Growers should follow the recommended dose of IMI herbicides. Growers are required to purchase certified seeds each year and seed companies should ensure that seeds are free from shattercane. In Queensland, some legal issues are already pending concerning shattercane contamination in sorghum seeds.

Growers may also be required to sign a stewardship agreement and complete stewardship training before using this technology.

Rotating crops and paddocks should be encouraged while using IMI-tolerant sorghum. This practice may reduce the risk of development of resistant weeds.

This research also suggests that research is required on issues concerning outcrossing for herbicide-resistant traits and fine-tuning of this technology.

1. Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Gatton, Queensland 4343. ■

Australian grain-fed beef exports on the rise with focus on China

GRAIN-FED production is set to play a larger role in Australia's beef sector, with the opportunity to triple the nation's exports of grain-fed beef to China by 2030, according to new industry research.

In its report, *Opportunities for growth in Australian grain-fed beef,* agribusiness banking specialist Rabobank says while the backbone of the Australian beef industry will remain a grass-based production system, grain feeding is forecast to play an increased role in the country's overall beef production over the coming 10 years.

Continued growth in beef consumption in Asian countries, particularly China – along with Australia's strong market access and competitive supply chain – will provide the opportunity for the nation's total grain-fed beef exports to increase 65 per cent to more than 500,000 tonnes by 2030, according to the research.

Exports of Australian grain-fed beef to China alone could triple in the same period – from the current 50,000 tonnes to close to 200,000 tonnes.

"Rabobank believes there will be strong growth in the global demand for grain-fed beef, fuelled principally by China," the report said.

Report author, Rabobank senior animal proteins analyst Angus Gidley-Baird, acknowledges Australia's vast areas of pastured land – and limited and volatile feed-grain production – suit a grass-based beef production system. But at a time where China is the centre of global beef demand, there is an opportunity to capitalise on the growing need for grain-fed beef for part of the Australian industry, he says.

Angus Gidley-Baird.

"Since the opening of the Chinese market more widely to Australian beef imports in 2013 – and with a growing appetite for beef among Chinese consumers – there has been an increasing demand for grain-fed beef," he said.

"Chinese beef consumption will continue to grow over the next decade and, with limited growth in local Chinese beef production, imports will play a much larger role in meeting this demand. At the same time, consumers in Asian markets, including China, have a strong affinity with highly-marbled grain-fed beef as it suits their palate and cuisine, fuelling a demand for grain-fed beef imports that has the potential to grow at a faster rate than overall beef imports.

"Given projections in Chinese income growth, per capita consumption of beef and food service trends – it is reasonable to expect Chinese grain-fed beef imports to grow to represent 20 per cent of China's total beef imports by 2030 (from an estimated six per cent today)."

But the report says, while increasing Australia's focus on grain-fed beef production is an opportunity worth pursuing, it comes with risks and challenges.

Enough room for everyone

While Australia is in a strong position to capture a sizeable portion of the growing global demand for grain-fed beef, particularly in China, the report says, it will not be on its own.

Other major grain-fed beef exporters – primarily the US, Canada and also likely South American countries in the future – are also expected to increase their export volumes.

But the good news is, says Angus, with the Chinese market forecast to require close to 500,000 tonnes of grain-fed beef exports by 2030, "there will be enough room for everyone".

"Rabobank believes that the other suppliers of high-quality grain-fed beef would not fill more than 300,000 tonnes of this increased Chinese demand," he said.

"Given the potential size of the Chinese grain-fed beef market and, provided Australia is competitive on price, the opportunities for Australia will likely outstrip the production growth of grain-fed beef in Australia."

Competitive position

Although Australia's grain-fed system is faced with higher feeding and processing costs than the US and Brazil, the reports says costs of cattle, reduced freight costs and free trade agreements "balance out the equation" when it comes to being competitive in export markets.

As such, Rabobank believes Australian grain-fed beef – with its own particular characteristics – can be competitive in the global market for grain-fed beef.

If Australia is to compete successfully with the US and Brazil, the report says, the local industry will need to increase the number of genetically-suitable cattle and the number of cattle that spend a longer time on feed.

"The real value of grain feeding cattle destined for a higher-end Asian export market is in the ability to more consistently deliver a high degree of marbling," Angus said. "Australia lags the US in terms of higher marbled beef production. Generally speaking, Australia's grain-fed beef production is less focussed on marbling, with less time spent being grain fed and lower marbling scores."

Maximising chances

Maximising the chances of growing grain-fed beef exports to meet increased global demand will require adjustments to the Australian beef system, the report says.

"Producers, backgrounders, feedlots and processors will all need to work together – a challenge in the current system which is heavily influenced by the availability of grass," Angus said.

"Producers and backgrounders will need to deliver consistent volumes of high-quality feedlot-performing animals. And choosing cattle genetics that perform under a feedlot environment and produce the desired quality traits will be essential.

"Feedlots will need to manage feed-grain supplies and encourage crop farmers to focus on feed-grain production while processors will need to play an active role in incentivising and providing market information to encourage the supply of appropriate animals for the system."

External challenges

There are also a number of challenges outside the sector itself which need to be considered and managed, the report says.

These include social and environment issues (such as concerns about animal welfare and environmental impacts of feedlot production), the use of Australia's valuable grain supply for animal production and an increasingly volatile global trade outlook. ■

WEED smart
every weed every seed
every farm every year

ASK AN EXPERT –

WHAT'S THE BEST WAY TO MANAGE ANNUAL RYEGRASS IN CHICKPEA CROPS?

■ With Bhagirath Chauhan, weeds researcher, QAAFI

ANNUAL ryegrass is becoming increasingly prevalent in the northern cropping region, and many populations already have a high level of resistance to the major Group B and Group A herbicides registered for use in chickpea crops.

To keep this important crop as a viable option, growers are looking for ways to add non-chemical in-crop options to an integrated weed control program to prevent a yield-limiting blow-out in ryegrass populations.

The principles of crop competition are fairly well known but making the necessary changes to planting gear can be daunting, so it is important to know that any changes will achieve the desired effect.

To assist growers to better implement crop competition in chickpeas, A/Professor Bhagirath Chauhan, principal research fellow and weed team leader, QAAFI, UQ looked at the effect of narrow rows, variety and early weed control to assess which is the most powerful suppressant of annual ryegrass.

"In a weed-free environment, it has been shown that narrow-sown chickpeas will produce higher yield, so we wanted to see if narrow sowing also suppresses weed growth and seed set," says Bhagirath. "We also wanted to understand whether a more-prostrate variety like PBA Seamer would suppress more weeds than the more-erect PBA HatTrick. The third aspect we considered was the effect of weed infestation at different growth stages of the crop."

The results were pretty conclusive: PBA Seamer sown at 25 cm and kept weed-free for at least the first three weeks after planting is a winning combination for ryegrass control.

QAAFI weeds researcher Baghirath Chauhan has completed several studies to investigate ways to make pulse crops, including chickpeas and mungbeans, more competitive against weeds.

What is the best way to reduce ryegrass growth and seed set?

Short answer: Narrowing the row spacing and ensuring good early weed control are the most effective tactics in chickpeas.

Longer answer: Plant architecture made some difference, but only in very weedy conditions. Narrowing row spacing from 75 cm to 25 cm reduced weed biomass by 16 per cent and reduced seed set by 26 per cent.

Keeping the crop weed-free for at least three weeks had the biggest effect, driving down weed biomass at the end of the season by 52 per cent and weed seed set by 48 per cent. This shows that, once established, chickpea can hold its own against weeds that emerge later in the season.

Can more competitive crops also produce higher grain yield?

Short answer: Yes. If you can't do narrower rows then put an emphasis on early weed control.

Longer answer: Averaged across both cultivars and all weed infestation periods, sowing chickpeas on 25 cm row spacing (same seeding rate) produced 20 per cent more grain than sowing on 75 cm row spacing. This is most likely due to the crop plants being more evenly spaced and able to better exploit the available soil and light resources.

This research was conducted across two growing seasons and demonstrated that controlling annual ryegrass for the first

Averaged across both cultivars and all weed infestation periods, sowing chickpeas on 25 cm row spacing (same seeding rate) produced 20 per cent more grain than sowing on 75 cm row spacing, and reduces annual ryegrass seed production.

three weeks after planting increased crop yield by a whopping 200 per cent compared to the season-long weedy scenario. Annual ryegrass that emerges 6 weeks or more after planting does not impact on chickpea yield, but if allowed to set seed, can contribute to the weed seed bank present at seeding the following year.

Is annual ryegrass a serious weed in chickpea?

Short answer: Yes, annual ryegrass is a yield limiting weed and is adapting to farming systems further north than its traditional range.

Longer answer: Averaged over row spacing and cultivar, the penalty attributable to annual ryegrass was 1.2 tonnes per hectare less grain yield between the weed-free plots (1.8 tonnes per hectare) and the season-long weedy plots (0.6 tonnes per hectare). Without any competition, season-long weedy plots produced more than 129 annual ryegrass seed spikes per square metre.

By planting PBA Seamer at 25 cm row spacing and keeping the crop weed-free for three weeks, the number of annual ryegrass spikes is reduced to just eight per square metre.

How can I achieve this early weed control?

Short answer: Start the year ahead in the paddocks you plan to grow chickpeas and do everything possible to reduce the ryegrass seed bank using effective herbicides, weed seed burial, competitive cereals and harvest weed seed control tactics or hay-making. Back this up with registered pre-emergents for chickpea and as many non-herbicide tactics in-crop as possible.

Longer answer: Annual ryegrass is a master at evolving herbicide resistance. In southern regions it has evolved resistance to the registered in-crop herbicides for chickpeas. This will also occur in the northern region if steps are not taken to preserve the efficacy of Group A post-emergent chemistry across the crop sequence.

An over-reliance on pre-emergent herbicide use will also select for herbicide resistance, just as it has for post-emergent herbicides. To minimise this risk, it is important to use a diverse range of weed management tactics in-crop, such as crop competition, inter-row cultivation or chipping, to remove survivor weeds before they set seed.

Where possible, rotate registered pre-emergent herbicide modes of action groups J, D and K between years and consider mixing pre-emergent modes of action groups where permitted, always at full label rates for all active components of the mix.

ALWAYS READ AND FOLLOW LABEL INSTRUCTIONS. ■

HOW TO ASK A WEEDSMART QUESTION

Ask your questions about the competitive crops on the WeedSmart Innovations Facebook page WeedSmartAU, Twitter *@WeedSmartAU* or the WeedSmart website *www.weedsmart.org.au/category/ask-an-expert/*

'WeedSmart' is an industry-led initiative that aims to enhance on-farm practices and promote the long term, sustainable use of herbicides in Australian agriculture.

Research delivers a heads-up on barley head loss

RESEARCH has generated findings and genetic material that could help produce future barley varieties that are less susceptible to 'head loss' – an issue that significantly reduces barley crop yields in some areas and seasons.

The work has also highlighted the importance of growers comparing the risk for different varieties and ensuring barley crops at critical growth stages have adequate access to potassium and copper, as crops deficient in these nutrients were found to be much more prone to the issue.

Barley crops in areas such as Western Australia's south coastal districts and South Australia's Lower Eyre and Yorke Peninsulas are especially susceptible to head loss. This is caused by straw under the head breaking and results in yield losses of five to nine per cent in typical seasons in these areas.

Collaborative project

The research findings are from a project with Grains Research and Development Corporation (GRDC) investment, led by Chengdao Li, director of the Western Barley Genetics Alliance. This collaborative project involved work by the Department of Primary Industries and Regional Development WA, Murdoch University and the University of Adelaide.

Chengdao said the laboratory work and field trials at Esperance, Katanning and Geraldton had revealed information and developed advanced breeding lines, new germplasm and molecular markers which had the potential to be used in breeding programs.

"Our research suggests barley varieties will be less susceptible to head loss if the barley 'peduncle' – the straw beneath the barley head – is bred to have greater flexibility and strength," he said.

"A significant finding from this project is the relationship between straw strength and straw flexibility, and some varieties are significantly more flexible and are less prone to breakage.

"We identified quantitative trait loci (QTL) associated with straw strength on three chromosomes and these could be used as selection targets by barley breeders."

Seasonal impact on straw strength

Chengdao said seasonal conditions were shown to have a significant effect on straw strength, with some varieties demonstrating a significant variation in straw strength in different years of the trials.

He said the head loss risk of barley varieties varied significantly and several high yielding, new varieties and advanced breeding lines had an even greater head loss risk than current susceptible varieties.

Potassium levels also have an impact

"The research also demonstrated that varieties respond differently to low levels of potassium, suggesting that genetically improving potassium use efficiency in barley varieties will not only enhance yields and reduce the need for fertiliser, but also improve straw strength and reduce head loss," he said.

Chengdao said the project showed that the same variety sown at the same trial could have head loss levels up to two to three times greater if copper and potassium were deficient during the stem elongation and head formation stage of the crop.

"This shows the importance of providing adequate levels of these nutrients, particularly during this growth stage," he said.

"For example, up to 30 per cent of soils in WA's cropping regions are deficient in potassium and this can be exacerbated on sandy soils in the south coastal region where nutrients are prone to leaching."

Varietal head loss risk information is available in sowing guides such as the Barley Sowing Guide for WA, available at *http://bit.ly/2MYdYnV* ■

Professor Chengdao Li inspects barley at a field trial of the genetic, environmental and management factors that reduce barley head loss. (PHOTO: DPIRD)

Barley head loss in the field. (PHOTO: DPIRD)

Spring into action with fallow residuals

WHILE frost on winter crops is often growers' main concern in August and September, this is also the time when some summer weeds start germinating if conditions are favourable. A spring rainfall event, followed by a week or two of warmer weather, can quickly kick off the season for summer weeds.

Mark Congreve, consultant with Independent Consultants Australia Network, says fleabane, sowthistle and feathertop Rhodes can all start germinating as early as August in northern regions when temperatures are suitable.

"Establishment at this time of year may result in plants that are large and very difficult to control with knockdowns if control is left until after the busy harvest period," he says. "Once this happens the only options for control are a robust double-knock herbicide strategy, or tillage."

The full canopy cover in a dense winter crop generally prevents most germinations within the crop, but these weeds can establish in open crops, in missed rows or wide guess rows, around crop edges or in winter fallows.

Apply pre-ems before the spring storms

Mark suggests that pre-emergent herbicides applied in late winter or early spring fallow, before the first spring storms, can play an important role in managing these early germinations of 'summer' weeds, by helping create weed-free winter-spring fallows until it is time to sow a summer crop.

"This is easiest when a paddock has been ear-marked for a specific summer crop," he says. "Rotation planning is really important – where you know what you will be planting, there are normally one or more options with acceptable plant-back periods for most crop choices. Where you are unsure about what crop will be planted into the paddock, then decisions are more difficult."

To 'keep the options open' growers are restricted to using products with shorter plant-back periods, and therefore less residual control. If using a product with potentially damaging residual activity on subsequent crops, growers are reliant on further rainfall to breakdown the herbicide in the soil prior to summer crop planting.

"In some situations, it may be possible to plant the summer crop any time after the residual is applied in spring," says Mark. "A good example of this is using Dual Gold for feathertop Rhodes grass control in paddocks going to sorghum."

For other combinations of residual herbicides and summer crops a plant-back period may be required. Mark said it is very important to use the label information to determine the level of risk involved in applying a particular product and judge whether it is safe to plant the summer crop or not.

"Where plant-back periods exist, the breakdown of these herbicides needs a combination of time and soil moisture over the warmer months, so it is important to look at how the rain has fallen, as well as the totals," he says. "Having the soil surface wet for a few weeks from regular rainfall events during these warmer months will support more microbial breakdown of the herbicide than one storm event that delivered the same quantity of rainfall, followed by weeks of dry weather."

A knockdown may be needed

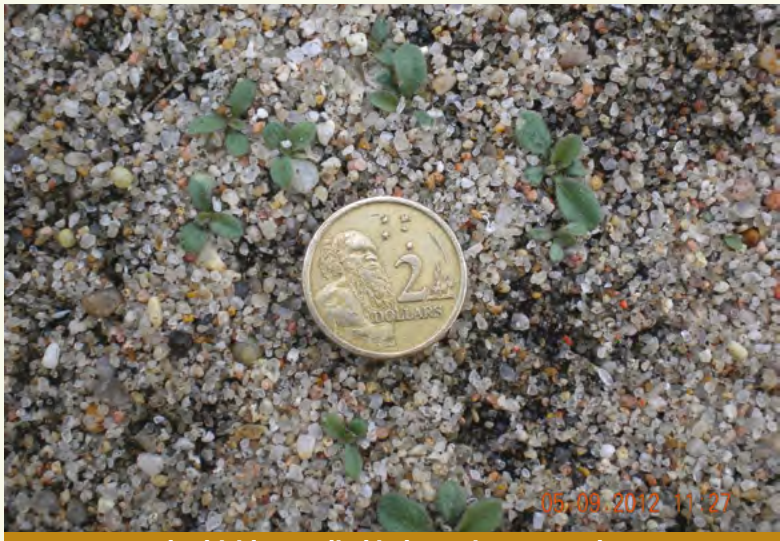
Ideally, a well-timed spring residual herbicide will keep the fallow clean until the summer crop planting window opens. Assuming the appropriate plant-backs have been met, an effective knock-down herbicide may be needed to remove weeds germinating on the planting rain, should the spring residual herbicide be running out.

The decision around the choice of additional pre-emergent applied at planting will depend upon the length of residual expected from the spring application, the known weed pressure in the field, the availability of inter-row cultivation or post-emergent in-crop herbicide options and the predicted rainfall outlook.

Growers and agronomists interested in learning more about the benefits and risks of pre-emergent herbicides can access a free online course at www.diversityera.com, presented by Mark and Dr Chris Preston.

For more information about pre-emergent herbicide to control summer weeds visit the WeedSmart website: *www.weedsmart.org.au* ■

Mark Congreve, consultant with Independent Consultants Australia Network, says summer growing weeds that establish in late winter and early spring may result in plants that are large and very difficult to control with knockdowns if control is left until after the busy harvest period.



Pre-emergent herbicides applied in late winter or early spring fallow, before the first spring storms, can play an important role in managing these early germinations of 'summer' weeds, helping to create a weed-free winter-spring fallow until it is time to sow a summer crop. (PHOTO: Ben Fleet)

SOUTHERN AUSTRALIA FOCUS

COVERING CROPPING SYSTEMS OF SOUTHERN NSW, VICTORIA, TASMANIA, SOUTH AUSTRALIA & WESTERN AUSTRALIA

Research delivers a heads-up on barley head loss

RESEARCH has generated findings and genetic material that could help produce future barley varieties that are less susceptible to 'head loss' – an issue that significantly reduces barley crop yields in some areas and seasons.

The work has also highlighted the importance of growers comparing the risk for different varieties and ensuring barley crops at critical growth stages have adequate access to potassium and copper, as crops deficient in these nutrients were found to be much more prone to the issue.

Barley crops in areas such as Western Australia's south coastal districts and South Australia's Lower Eyre and Yorke Peninsulas are especially susceptible to head loss. This is caused by straw under the head breaking and results in yield losses of five to nine per cent in typical seasons in these areas.

Collaborative project

The research findings are from a project with Grains Research and Development Corporation (GRDC) investment, led by Chengdao Li, director of the Western Barley Genetics Alliance. This collaborative project involved work by the Department of Primary Industries and Regional Development WA, Murdoch University and the University of Adelaide.

Chengdao said the laboratory work and field trials at Esperance, Katanning and Geraldton had revealed information and developed advanced breeding lines, new germplasm and molecular markers which had the potential to be used in breeding programs.

"Our research suggests barley varieties will be less susceptible to head loss if the barley 'peduncle' – the straw beneath the barley head – is bred to have greater flexibility and strength," he said.

Professor Chengdao Li inspects barley at a field trial of the genetic, environmental and management factors that reduce barley head loss. (PHOTO: DPIRD)

"A significant finding from this project is the relationship between straw strength and straw flexibility, and some varieties are significantly more flexible and are less prone to breakage.

"We identified quantitative trait loci (QTL) associated with straw strength on three chromosomes and these could be used as selection targets by barley breeders."

Seasonal impact on straw strength

Chengdao said seasonal conditions were shown to have a significant effect on straw strength, with some varieties demonstrating a significant variation in straw strength in different years of the trials.

He said the head loss risk of barley varieties varied significantly and several high yielding, new varieties and advanced breeding lines had an even greater head loss risk than current susceptible varieties.

Potassium levels also have an impact

"The research also demonstrated that varieties respond differently to low levels of potassium, suggesting that genetically improving potassium use efficiency in barley varieties will not only enhance yields and reduce the need for fertiliser, but also improve straw strength and reduce head loss," he said.

Chengdao said the project showed that the same variety sown at the same trial could have head loss levels up to two to three times greater if copper and potassium were deficient during the stem elongation and head formation stage of the crop.

"This shows the importance of providing adequate levels of these nutrients, particularly during this growth stage," he said.

"For example, up to 30 per cent of soils in WA's cropping regions are deficient in potassium and this can be exacerbated on sandy soils in the south coastal region where nutrients are prone to leaching."

Varietal head loss risk information is available in sowing guides such as the Barley Sowing Guide for WA, available at *http://bit.ly/2MYdYnV* ■

Barley head loss in the field. (PHOTO: DPIRD)

Using stubble as a trellis points to more profitable field peas

FIELD pea production could become a more viable option for growers, with researchers from the Centre for Crop and Disease Management (CCDM) investigating a simple and cost-effective method for reducing disease and increasing yield.

Results of student-run trials – at Curtin University in Western Australia in 2018 – show that using precision sowing and retaining the previous year's wheat or canola stubble as a trellis to elevate the canopy, combined to provide a double benefit to growers.

The natural trellis provided by the stubble limited disease spread, increased final yield and reduced crop lodging.

CCDM researcher and Curtin Agriculture and Food Discipline lead Sarita Bennett led the study and said the findings could be key in realising the potential of field pea as a valuable component of crop rotations.

"As with other legumes, disease is an issue for field pea and this, combined with mixed success from the use of fungicides to control disease impact, has deterred many growers from adopting them into their cropping rotations," Sarita said.

"For disease control to be effective, fungicides must be combined with other management strategies. Our researchers set out to identify these strategies in this study and achieved some promising results."

The CCDM is co-supported by Curtin University and the Grains Research and Development Corporation (GRDC).

"A key focus of the CCDM is to help grow the next generation of agriculture research leaders, so it is a great outcome to have Curtin agribusiness students actively involved in trials with our researchers, leading to on-farm advice for growers," CCDM co-director, Professor Mark Gibberd said.

Stubble retained vs flattened

During the trials, plants were grown under small-scale experimental conditions and evaluated with two treatments – one where the stubble was retained and another where the stubble was flattened, or rolled.

Sowing was conducted at two times, four weeks apart – the first in mid-May 2018 and the second in mid-June 2018.

The results found:

- Ascochyta blight (or black spot) infection – which is the main contributor to field pea losses to disease – was significantly reduced in plants that were trellised on standing stubble.
- Disease incidence was highest in early-sown peas without stubble, with around an infection score of about 25-30 per cent in the third week of August, increasing to 50 per cent by mid-September.
- In contrast, where the stubble was retained, the infection rates were similar for both times of sowing mid-season, and significantly lower from mid-September, than when the stubble was flattened.
- The highest yield of 2.3 tonnes per hectare came from the earlier sown plants growing in retained stubble, and this is most likely due to reduced disease.

"Finding alternative solutions to fungicides, such as the use of stubble to elevate the canopy and limit disease spread, could be invaluable to pea production," Sarita said.

"It's a simple and cost-effective method for growers to adopt by using equipment and resources that most would already have at their disposal."

CCDM pulse researcher Rob Lee, who assisted in the study, said the solution would potentially allow growers to fully realise the yield benefits of an earlier sowing date while reducing disease by keeping the plants off the ground.

"Although early-sown trellised crops would be heavier and prone to some lodging late in the season, adoption of stubble trellising could still improve harvestability over non-trellised crops that have reduced biomass due to disease," Rob said. "We look forward to testing this on a broader scale."

In an earlier trial in 2016, the research team looked into the impact of nine different fungicide treatments at two times of sowing to determine the best timing and mode of action for controlling Ascochyta blight in field peas.

They found that time of sowing had a greater impact on reducing disease levels (that were lower in the later time of sowing) than the use of fungicide treatments, but the shorter season brought about by late sowing limited the yield potential for the crop.

Field pea losses to disease are estimated to cost around $23.7 million annually, which equates to $73.35 per hectare.

Growers who adopt the stubble method are encouraged to share their experiences, whether positive or negative, by emailing ccdm@curtin.edu.au.

Sarita presented the field pea research at the 19th Australian Agronomy Conference 2019 in Wagga Wagga in August . ■

Recent field pea research has been led by CCDM researchers Dr Sarita Bennett and Dr Rob Lee. (PHOTO: CCDM)

Crop assessment project proves drone accuracy

By Andrew Spence

DRONES have proven to be just as accurate at taking plant measurements as more hands-on traditional methods, paving the way for a range of agricultural applications.

A two-year University of Adelaide project funded by the South Australian Grain Industry Trust used drone imagery to measure biomass, growth rate and greenness at trial sites in the wheat belt of South Australia.

Not only did the measurements correlate with physically collected results but data was able to be gathered more regularly because the drones are more efficient than manual techniques.

The ability for drones to potentially replace labour-intensive farming tasks has been known for some time. But the previous high cost of drone technology and doubts about the accuracy of the data they captured, have held them back from widespread use in agriculture.

University of Adelaide Agricultural Scientist and Researcher Dr Rhiannon Schilling and Dr Ramesh Raja Segaran from the university's Unmanned Research Aircraft Facility worked together on the project, which began in 2017 and finished in July this year.

The project used drones to capture aerial images of the GRDC-NVT wheat trial sites every few weeks during the five growth stages from early tillering through to late grain ripening.

Rhiannon said the more efficient use of drones not only allowed for data to be gathered more regularly but also avoided the destructive practice of physically taking biomass samples.

"At the moment when you try and measure biomass throughout the season, every biomass cut we take is reducing the grain yield from the plot so we want to minimise that," she said.

"It's really fast to go out and image our sites using a drone – within half an hour we can have our site imaged and the data processed in a few hours back at the university – so it's going to speed up the process.

"Because biomass cuts are so time intensive they were only being done at one or two time points in the growing season. Now we can watch the plant growth rate through time in the field throughout the whole season so it's a lot more informative."

Rhiannon said the technology could improve crop research capabilities and offer more efficient methods for plant breeders and pre-breeding researchers and growers.

Drones and new opportunities

She said that while the project focused only on the biomass, growth rate and greenness of trial wheat crops, the confirmation of drone accuracy opened up many opportunities in other areas.

"What we've done here is we've been able to show that we can measure crop growth through time," Rhiannon said.

"In terms of this project, farmers should be able to use this method to assess the amount of biomass for something like hay production but also assess responses through time.

"So looking at grazing pressure or assessing the effect fertiliser had on the growth rate of your crop or pasture – this is where this sort of technology is going."

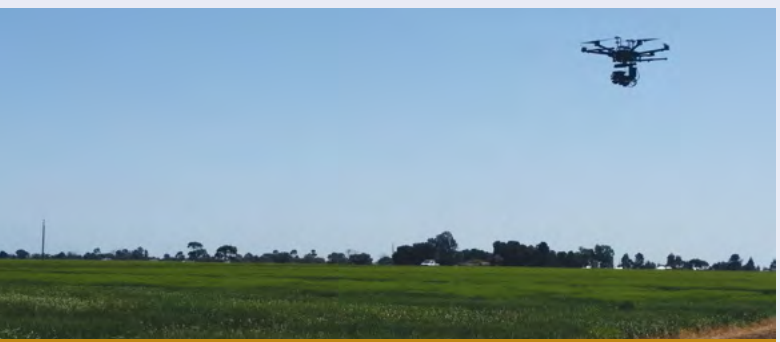
To take the bulk of the images, the project used a standard DJI Phantom 4 drone, which is available to farmers and comes fitted with a good quality RGB camera for about $2000.

Rhiannon said the quality and affordability of sensing equipment that could be added to drones was also constantly improving.

She said more fine-tuning was needed to maximise the value extracted from drone images including overlapping them with data collected from soil and satellite imagery.

"We should be able to put all the layers together now and we've been starting to work with some machine-learning experts to do that," Rhiannon said.

"Drones have been around for a long time but I don't think they've been used to their full potential yet. One of the limitations has been that until now we didn't know if what they measure is actually accurate and that's what this project has achieved." ■



The project found that drone measurements are accurate.

A widely available DJ Phantom 4 drone was used to capture the majority of imagery during the trial.

The drone images were analysed at the University of Adelaide to produce the crop growth data.

Turning Australia's arid land into green pasture

MILLIONS of hectares of sandy, low fertility Australian farmland could benefit from the commercialisation of a South African shrub, allowing farmers and graziers to better carry sheep over the summer-autumn period.

Researchers at Murdoch University's Centre for Rhizobium Studies have undertaken a decade-long global search for legume plants capable of surviving harsh, dry summers and sandy soils.

They discovered lebeckia, a perennial legume, in the Western Cape of South Africa and commenced trials on the poorest sandplain soils of the Western Australian wheatbelt.

Lead researcher Professor John Howieson said lebeckia was designed to be used by farmers on soils that may otherwise be completely unproductive.

"Lebeckia has real potential to turn as much as three million hectares of Australia's marginal farming lands into much more productive country, where its presence in pasture over summer could allow farmers to carry more sheep, grow more wool and provide better animal husbandry," said John.

"We have recorded very promising results in agronomy, soil fertility and feed quality trials.

"It is a long sought after outcome of legume science given its ability to grow during summer on infertile sandy soils."

Worth up to $400 per hectare each year

John said the plant had the potential to create substantial savings for farmers, reducing the need to purchase supplementary feed, and support higher animal stocking rates.

"Economic analysis has shown that using lebeckia on sandy soils could be worth up to $400 per hectare per year to the farmer," he said.

"We think it will be incredibly valuable for farmers who can lamb or wean into it, and provide high-quality feed and shelter."

Murdoch has been working with the South African government to secure full commercialisation rights.

South African Agricultural Research Council President and CEO Dr Shadrack Moephuli said the growing of lebeckia had economic benefits to farmers, especially those with sandy and acid soils.

"Lebeckia is an acid tolerant legume that has been developed by the Agricultural Research Council and Murdoch University from genetic material collected on the acidic soils derived from sandstone in the Western Cape," Shadrack said.

"As cultivation and alien invasion reduces the soil pH, this species can be grown in soils affected by acidification.

"This is another milestone and innovation by the two institutions to assist farmers to produce food for the growing population."

WA Agriculture Minister Alannah MacTiernan recently witnessed the signing of a commercialisation agreement for the new cultivar of lebeckia called Isanti (Chosa for sand) by Murdoch University Deputy Vice Chancellor, Research and Innovation, Professor David Morrison and Shadrack.

Under the agreement, a royalty on seed sales will be paid to the Agricultural Research Council. The new crop will be also made available to South African farmers, meaning farmers in both Australia and Africa will have access to the benefits of this research.

A group of South African scientists and administrators recently visited one of the trial sites at Harrismith in the Wheatbelt region of Western Australia where the first five hectare crops are in the ground.

Lebeckia is a promising legume for sandy soils.

John thanked David Quartermaine and Ted Astbury for their strong support for the lebeckia program by allowing intensive field research on their farms for the past six years.

The research project was funded by Murdoch University, with support from the Australian Centre for International Agricultural Research. The first seed will be available for sale next year.

The South African scientists and administrators visited WA to attend the 9th Annual Africa Australia Research Forum Annual Africa-Australia Research Forum which forms part of the Africa Down Under conference.

The forum is part of the Third Murdoch Commission, a research investigation bringing together international experts and thought leaders to work on pressing problems and issues of public concern to Africa. ■

Workshops optimising summer weed management

THE breadth of summer weed species present in the Australian grainbelt can make management decisions difficult, yet it is important to identify species early and correctly. This maximises the effectiveness of summer weed control by allowing growers to select appropriate techniques that can be used on small, actively growing weeds.

Andrew Storrie from Agronomo said summer rain often occurred in cropping areas and growers needed to not only identify weed species early, but to 'speak the same language' when referring to them, as common names varied.

"While it is relatively simple to identify weeds when they are flowering, correct identification of seedlings is more challenging," he said.

"Every grower understands that large weeds are harder to control and that in summer, weeds grow faster and can set seed in weeks.

"Large weeds also use more soil water and can cause problems at seeding. Therefore, waiting until identification is easier is not the best option.

"Growers attending the workshops will have the opportunity to identify weeds that are at an early stage of development, using live specimens, and will be shown identification short cuts and handy tools to use."

Andrew will also address how to get good control of summer weeds using 2,4–D, under the regulations relating to this herbicide that were introduced late in 2018.

"Using very coarse or coarser spray quality may require changes to application set-up to maintain efficacy. We will run through how to select the best nozzles for the task and discuss tank mixes for dominant local weed species," he said. "Local innovative weed management practices will be workshopped at each event."

DPIRD representatives will cover results from WA weed surveys in recent years and present specific management programs for common locally-found weeds.

Andrew said that, in addition to information about plant identification, the workshops would cover:

- Best management practices for summer weeds, including presentation of local trial results;
- Maximising spray application coverage when conditions are not ideal;
- The regulations on the use of 2,4–D and how this affects summer spraying;
- How to get the best control and stay within the regulations;
- Understanding how to maintain efficacy using a very coarse or coarser spray quality with 2,4–D tank mix partners; and,
- New technologies for weed management.

Timing of the workshops varies so to register and for more information, go to *https://www.agronomo.com.au/training/,* or contact Andrew on 0428 423 577 or andrew@agronomo.com.au.

For information about how to comply with Australian Pesticides and Veterinary Medicines Authority (APVMA) 2,4–D application requirements, download the GRDC Fact Sheet Maintaining efficacy with larger droplets – new 2,4–D application requirements at *http://bit.ly/2GpWz4h*

SUMMER WEED WORKSHOPS…

Summer weed workshops will be held in various locations including Wagin on October 11, Moora on October 14, Dalwallinu on October 15, and Lake Grace and Narrogin on October 17 – the second in a series of hands-on events in the WA grainbelt.

These workshops have GRDC investment and are the result of GRDC Regional Cropping Solutions Network (RCSN) groups highlighting summer weed control as a high priority issue for grain growers.

Andrew Storrie, of Agronomo, is organising the events, with assistance from Department of Primary Industries and Regional Development (DPIRD) weeds researchers Catherine Borger and Alex Douglas, as well as local grower groups.

Summer weeds such as melon can deplete stored soil water and create problems at seeding time. (PHOTO: Agronomo)

New oaten variety stacks up

KINGBALE, the world's first imiadazolinone (IMI) tolerant hay oat, was launched by InterGrain at South Australia's premier agronomic field day site at Hart on Tuesday, September 17.

Bred by Michael Materne, the IMI hay oat, formerly known by its breeding code GIA1701, was developed by Grains Innovations Australia (GIA) and will be commercialised by InterGrain following a recent agreement with GIA.

According to Michael, Kingbale offered growers a new herbicide option for their oaten hay rotations, while significantly improving weed control.

'Looking over the fence' towards a new variety

"While looking over the fence from our pulse trials, we saw weedy oat crops and quickly learnt that herbicide options were very limited. This presented us with an opportunity to develop IMI herbicide tolerant oats to improve weed control within this crop and the broader rotation.

"Kingbale's imiadazolinone tolerance supports the variety as an excellent option where there are residue concerns from imidazolinone use in previous crops," Michael said.

While yield information is currently limited, 2019 independent industry trials across southern Australia will provide an excellent opportunity for further hay and grain yield testing, while preliminary data at hand is very pleasing.

InterGrain CEO Tress Walmsley said InterGrain and GIA were proud to join with Nufarm to bring innovative herbicide technology systems to market to help Australian farmers overcome challenges in controlling weeds in their oaten hay.

"The Nufarm partnership means InterGrain and GIA can introduce expertise in weed control and further sharpen our focus on innovative solutions that will help solve identified challenges for grain growers.

"InterGrain always prioritises maximising grower returns from the varieties we introduce to them and strategic partnerships can value add that proposition," Tress said.

A tall oat variety, Kingbale has good early vigour and preliminary data shows it has a similar disease profile to Wintaroo.

The perfect fit

Tress said launching Kingbale at the Hart field day was the perfect fit, with South Australia's mid-north a large export oaten hay producer.

"Our new partnership with GIA and the Kingbale launch complements the current wheat and barley varieties we have available to growers and supports our Australia wide market leading cereal breeding programs.

"Kingbale is the first of what we like to call the new oat dynasty, with other lines in the GIA pipeline also set to deliver agronomic and yield benefits that will boost Australian oat and oaten hay production and subsequent profitability for growers," Tress said. ■

Kingbale's breeder Dr Michael Materne and GIA Commercialisation Manager Janine Sounness inspect the new variety at Landmark Manangatang's Victorian trial site.

Manganese deficiency in lupins makes an unwelcome return

LUPIN growers are encouraged to assess their crops for manganese deficiency – a problem which has resurfaced in recent years – particularly in the northern grainbelt of Western Australia.

Narrow-leafed lupins have a poor ability to translocate manganese from the leaves to the grain, resulting in split seed and in some instances substantially reduced yields.

Grains Research and Development Corporation (GRDC) Grower Relations Manager – West, Jo Wheeler, says manganese deficiency has been a 'sleeping issue' since the 1970s when it impacted significantly on yields.

"It has re-emerged as a problem in recent seasons, so growers need to keep an eye on their crops and consider treatment if symptoms of manganese deficiency symptoms are presenting," Jo says.

According to the GRDC's Western Lupin GrowNotes publication (*https://grdc.com.au/GN-Lupin-West*), yield penalties of up to 70 per cent can be incurred as a result of manganese deficiency causing split seed disorder.

The publication states that the incidence and severity of split seed disorder in WA lupin crops will vary according to the maturity of the variety, sowing date, amount of rainfall received during the growing season and soil type.

More prevalent on lighter pH soils

High pH soils (above pH 7) tend to have lower manganese availability to lupin crops than soils with lower pH, and therefore manganese deficiency is more likely to occur in those soils.

Lime application to raise soil pH has been found to induce split seed disorder on some soils in some years in Western Australia.

Common symptoms of manganese deficiency in narrow-leafed lupin crops include:

- Plants with straggly growth and delayed maturity with 're-greening';
- Dropped leaves;
- Re-shoot leaves with a 'tufty-type' growth on branches;
- Seeds split through the seed coat;
- Discoloured seed around the margins;
- Small, shrivelled seed; and,
- Dirty brown patches on leaves.

Jo suggests growers consult with their advisers about testing and treatment if they suspect manganese deficiency.

Main stem analysis of lupin can be used to diagnose any manganese deficiency at flowering.

The Western Lupin GrowNotes publication states that split seed disorder can be treated by applying manganese fertiliser to soil (with rates based on soil type) and/or using sprays on lupin foliage (typically with manganese sulphate or a range of other manganese products).

Foliar applications of about one kg of manganese per hectare in 75–100 litres of water usually corrects the deficiency – if sprayed when pods on the main stem are about 2–2.5 cm in length.

Soil-applied fertiliser has good residual value and can last for several years. Foliar sprays supply manganese only to the target crop in the season of application.

Management of manganese deficiency in WA lupin crops starts with early sowing of early maturing varieties to reduce the risk of split seed developing when seed fills and matures before soil moisture is exhausted in spring.

Jo says testing lupin seed for manganese concentrations can be important when retaining grain for subsequent sowing, as low levels can affect germination and crop establishment.

It is recommended growers use seed for sowing from lupin crop areas that have had an application of manganese or from better soil types that have a history of producing lupin seed with good manganese levels.

More information about manganese deficiency in narrow-leafed lupins, and how to monitor and manage the issue, can also be found on the Department of Primary Industries and Regional Development website at *http://bit.ly/2XNcu4b*

Symptoms of manganese deficiency in narrow-leafed lupin pods. (PHOTO: Nigel Wilhelm)

Kazakhstan increasing trade ties with China

By Peter McMeekin

KAZAKHSTAN – one of the most important grain producers and exporters in the world – announced in mid-September that it was aiming to triple its wheat exports to China to as much as two million tonnes (mt) annually, but no time frame was charted to reach the goal.


Peter McMeekin.

This announcement came in the same week that the USDA released its latest global supply and demand estimates and in Kazakhstan it cut the 2019–20 season wheat production by 1.5 to 11.5 mt. This is down from 14 mt last season, 14.8 in 2017–18 and well below the record of 22.7 mt produced in 2011–12. The decrease was blamed on deteriorating crop conditions after a sustained spell of dry weather ahead of harvest.

The USDA also decreased Kazakh exports by 1.3 to 5.2 mt on the back of the lower production number. To balance the books, the USDA increased 2019–20 opening stocks by 200,000 tonnes, meaning that ending stocks were unchanged at 1.26 mt.

The Kazakhstan Ministry of Agriculture said that harvest is currently in full swing across all grain-producing regions of the country and it expected to export around 7.0 mt of grain and flour in the 2019–20 marketing year. The Central Asian nation is the world's second-largest exporter of flour behind Turkey.

China is already a major importer of oil, gas and metals from Kazakhstan and in addition to wheat, the government said that they were looking to increase exports of barley, salt, meat, poultry and dairy products to China. Interestingly, Beijing only approved imports of Kazakh barley in late November last year, the same week that the anti-dumping probe was announced into barley imports from Australia.

Kazakh barley production is expected to be 3.9 mt this year – 1.7 per cent lower than last season's record crop. Iran continues to be the biggest importer of Kazakh barley, consistently buying upwards of 80 per cent of production each year.

The last republic to depart the Soviet Union in 1991, Kazakhstan is rich in natural resources and has enormous economic potential. It is the ninth largest country in the world with an area of 2.725 million square kilometres. But with a population of only 18.5 million, it has one of the lowest populated densities in the world at just seven people per square kilometre.

The agricultural sectors' share of GDP is around six per cent, but like many of the former Soviet Union countries, Kazakhstan has enormous agricultural potential. The country is well endowed with fertile land but, like Australia, suffers environmental handicaps such as water availability and a harsh climate.

The total area suitable for primary production, including crops, pastures and grazing, notably the steppes, is approximately 222 million hectares. But only around 24 million hectares – predominantly in the north of the country – is arable and suitable for broadacre cropping.

Kazakhstan is a landlocked country, despite its access to the Caspian Sea. Remoteness from global markets and lack of direct access to ports are significant obstacles for grain exports.

Most Kazakh exports have traditionally been transported by road to neighbouring importers such as Uzbekistan, Tajikistan, Afghanistan and China or barged across the Caspian Sea to the Caucasian countries of Azerbaijan, Armenia and Georgia.

Alternatively, grain exports make their way to Russian and Georgian ports on the Black Sea for shipment to international buyers such as Italy, Turkey, Tunisia and Sweden.

Increased trade relations between China and their Asian neighbours has been a focus for Beijing in recent years as they attempt to shore up alternative supply origins and pathways in the face of the trade war with the US and increased trade tensions with several other key suppliers.

China's Belt and Road Initiative game-changer

This is where China's Belt and Road Initiative (BRI) has the potential to be a game-changer for trade amongst many Central Asian countries, especially Kazakhstan. This ambitious project was the brainchild of Chinese President Xi Jinping. It focuses on improving connectivity and cooperation among numerous countries spread across the continents of Asia, Europe and Africa.

The initiative was announced in 2013 with the purpose of restoring the ancient Silk Road. The scheme involves building a big network of roads, railways, maritime ports, power grids, oil and gas pipelines, and associated infrastructure projects.

Five railway routes and six international highways currently pass through Kazakhstan, connecting China and other Asian countries with Europe and the Middle East. But China wants to improve the speed and efficiency of freight movements and Kazakhstan features highly in the routeing of a number of proposed BRI land transport corridors.

In addition to improving trade pathways and reducing the cost of imports, the multi-trillion-dollar initiative is expected to open up and create new markets for Chinese exports and those of many Central Asian states.

While China pitches the initiative as an all-inclusive project for regional development, many nations perceive it as a strategic move by the Asian powerhouse to achieve significance and control at a regional level, and to play a more significant role at the global level, by building and controlling a China-focused trading network.

Like Kazakhstan, Russia is also looking to take advantage of the changing international trade flows emanating from the US-China trade war by increasing grain exports to China. Russia is the world's biggest exporter of wheat, and it expects Beijing to approve imports of wheat from all production regions of Russia within a year.

Call your local Grain Brokers Australia representative on 1300 946 544 to discuss your grain marketing needs. ■

Is Australia losing relevance as a global wheat exporter?

By Peter McMeekin

THE Australian Bureau of Statistics released their July export data in mid-September and the grain numbers undoubtedly reflect the effects of last year's drought and the many dilemmas for Australian exporters this year.

Wheat exports for July came in at 737,000 tonnes. This was up from the June number of just 585,000 tonnes but well down on the 1.227 million tonnes (mt) exported in May.

Not surprisingly, Western Australia and South Australia accounted for almost the entire volume, shipping 494,000 tonnes and 216,000 tonnes respectively. The balance of 27,000 tonnes were container shipments from east coast ports.

In terms of destinations, Yemen, Vietnam and Japan were the biggest in July taking 113,000 tonnes, 109,000 tonnes and 83,000 tonnes respectively. In June it was the Philippines, followed by South Korea and Japan with 216,000 tonnes, 86,000 tonnes and 81,000 tonnes respectively.

Year-to-date wheat exports now stand at 7.457 mt with 57 per cent, or 5.286 mt, shipped in the January 2019 to June 2019 window. Western Australia made up the lion's share of Australia's wheat production last year, and at a pinch under 6 mt, the state accounts for more than 80 per cent of national wheat exports this season.

South Australian wheat shipments stand at 1.102 mt since the beginning of October last year or around 15 per cent of national wheat exports. Total east coast wheat exports for the marketing year stand at just 355,000 tonnes – mainly in containers.

Barley exports

Exports of barley in July totalled 209,000 tonnes, almost double the June shipments, with Western Australia making up more than 99 per cent of that volume. Malting barley made up 39 per cent of the July exports, and feed barley made up 61 per cent.

Japan was the biggest importer of Australia barley in July with 105,000 tonnes shipped, followed by China at 62,000 tonnes.

Total exports of barley for the 2018–19 marketing year stand at a healthy 3.459 mt. December 2018 is the biggest month thus far at 1.107 mt, more than double the next closest month. The split between malting barley and feed barley is almost equal with 1.751 mt exported as malting and 1.708 mt exported as feed.

Western Australia has exported 3.143 mt of barley this season, almost 91 per cent of total Australian barley exports. At 279,000 tonnes South Australian exports make up most of the balance, and Victoria has chimed in with 37,000 tonnes of containerised trade.

Interestingly, China has been the biggest destination for Australia barley in the October 2018 to July 2019 window. They have taken 2.231 mt, or almost 71 per cent of total Australian barley trade to international clients. This is despite the ongoing anti-dumping investigation, which appears no closer to a resolution.

The investigation commenced in November last year, and the final decision of the 12-month inquiry is due in November this year. But Beijing can extend the investigation by a further six months, to May 2020, if they feel it is required.

While the potential outcomes remain uncertain, it appears that the Chinese government have their hands full on other fronts and are happy to let market speculation and confusion reign in the Australian market until a decision is announced.

Canola exports

On the canola front, July exports totalled 39,000 tonnes, with one 33,000 tonnes cargo loaded out of Western Australia and small parcels of container business out of both Victoria and South Australia.

Marketing season canola exports currently total 1.447 mt, with 79 per cent shipped from Western Australian ports and 14 per cent from South Australian ports.

With a run of poor sorghum crops in northern New South Wales and Queensland, sorghum exports total a paltry 62,000 tonnes for the first 10 months of the marketing season. This is well behind last year and a long way short of the record 1.6 mt exported in 2013–14.

Last year may have been bad, but this season's production outlook is not looking any better as the late winter dry continues into the spring. There are good pockets in most states, but widespread rains are required now, and then follow up falls for at least the next month to arrest the deterioration.

Australia has lost significant market share and relevance as a global wheat exporter as a result of last year's drought and the considerable fall in the continent's exportable surplus.

A repeat of last year is a free leg up for the likes of Argentina and the Black Sea origins who have filled the void into Australia's traditional Asian wheat consumers.

We have even seen export values out of both regions fall in recent weeks as the plight of the 2019 Australian harvest gets factored into global supply and demand calculations.

One thing is for sure, winning back that business in the face of similar competition will not be easy when Australian production recovers.

Article supplied on September 10, 2019. Call your local Grain Brokers Australia representative on 1300 946 544 to discuss your grain marketing needs. ■

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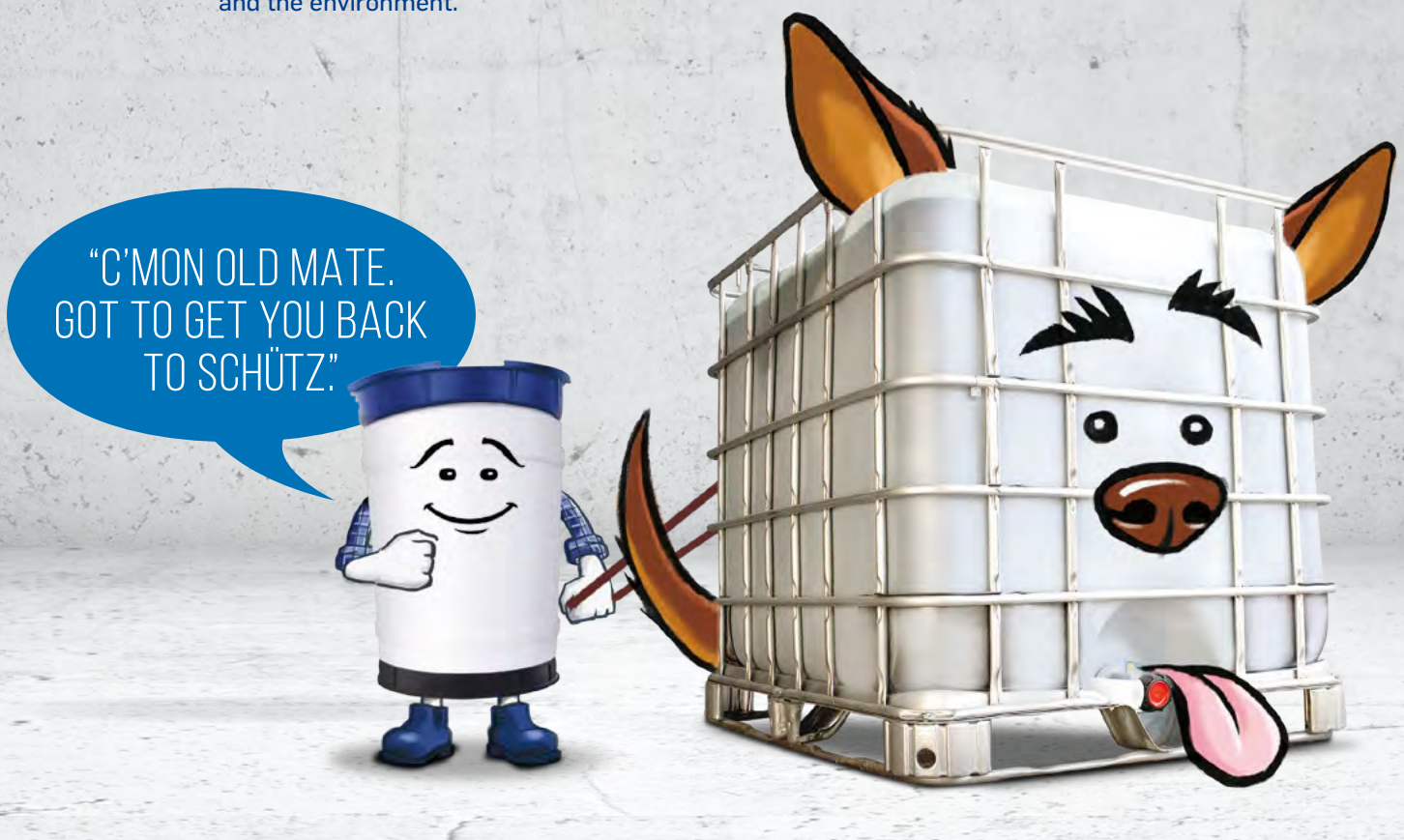

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Drought-fueled production losses in Australia alter global wheat trade

By Claire Hutchins, USW Market Analyst

PROLONGED drought has severely impacted Australia's wheat production and, as a result, contributed to a significant shift in world wheat trade. If current weather conditions in Australia persist, US Wheat Associates (USW) believes these export trends could continue through marketing year (MY) 2019–20 and beyond.

According to USDA data, in the five years leading up to drought conditions that started in 2017, Australia exported an average of 18.5 million tonnes (mt) of wheat per year. In MY 2016–17, Australian wheat production reached a record 31.8 mt and exports reached 22.6 mt – their highest level since MY 2011–12. A significant portion of this volume was wheat exported for animal feed.

But in MY 2017–18, reduced supplies led to a sharp fall in Australian wheat exports to 13.8 mt. In MY 2018–19, exports fell again to 9.0 mt after Australian wheat production declined to 17.3 mt.

Australia produces white wheats that compete effectively in regional bread applications, but most significantly in South and North Asian noodle markets. Even though there is no single US wheat class with optimal characteristics for fine Asian noodle products, over many years, USW has provided technical assistance to millers and noodle manufacturers on blending of US wheat or flour to optimise noodle quality and compete with Australian noodle varieties.

In addition, US hard red spring (HRS) provides a competitive option for higher protein flour needed in many markets to meet expanding demand for loaf bread products and hamburger buns.

Losing market share to the US

USW believes that key customers have turned to the US as Australian farmers struggle to produce enough exportable supplies. Between MY 2016–17 and MY 2018–19, for example, Australia lost market share in six of its top 10 wheat export markets. Notably, Australian wheat exports to the Philippines, Indonesia, Vietnam and Malaysia declined while US wheat exports to those countries increased in MY 2018–19.

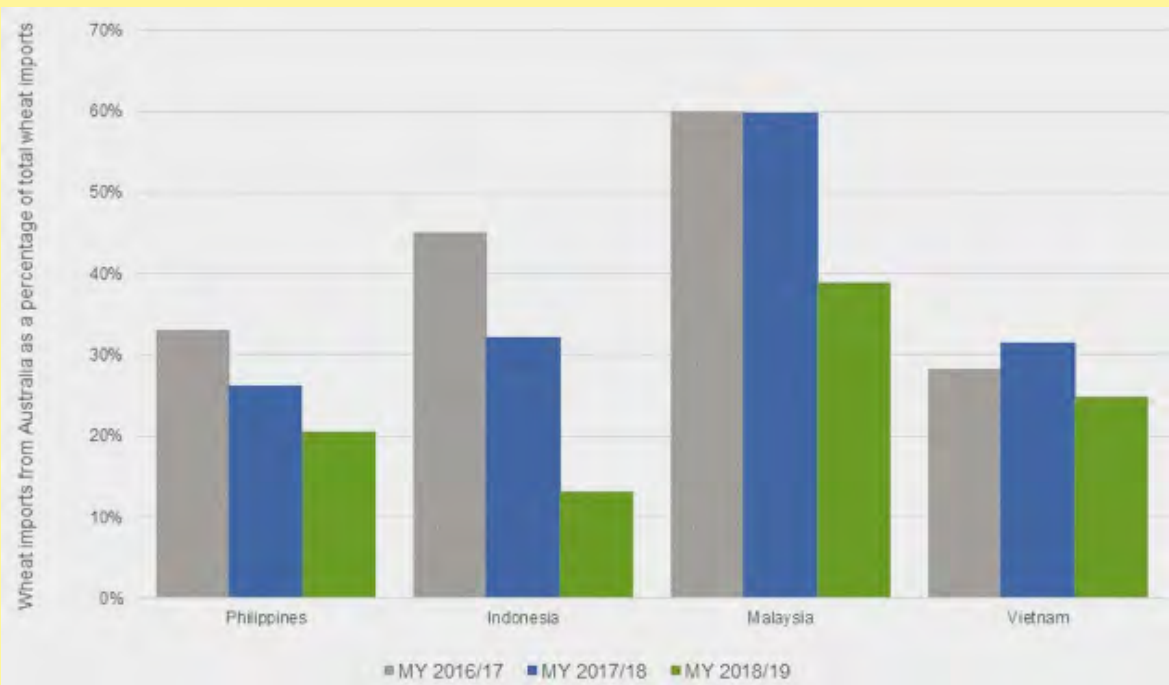
Australian wheat's share as a per cent of total wheat imports in four key export markets has declined over the past two market years (Figure 1). Prolonged drought has significantly reduced exportable Australian supplies.

In MY 2019–20, USDA predicts Australian wheat production will rebound slightly to 21.0 mt and exports are expected to increase to 12.5 mt. Current USDA commercial sales data also show US wheat exports to those four countries are ahead of last year's pace.

US farmers understand all too well the financial strain drought creates for their families and for end users of their wheat. Australian farmers must be concerned about whether their market share will rebound when the drought ends and supplies increase. That too is something US wheat farmers – who have lost virtually all their market share in China under the current trade dispute – can understand.

This USW report was submitted on September 4, 2019. ■

FIGURE 1: Market share of Australian wheat exports in key wheat import markets



Breakthrough in Brassica disease

A GLOBAL team led by Punjab Agricultural University, India, with researchers from The University of Western Australia, have made a significant breakthrough in disease resistance in Brassica oilseed crops.

Brassica is an important genus of plants in the mustard family with varieties that are commonly used for food including broccoli, cauliflower, cabbage, turnip and, in particular, as oilseed crops for production of canola oil and the condiment mustard.

The findings will lead to advances that strengthen crops against attack from Sclerotinia stem rot, a disease that is particularly damaging to Brassica crops, such as canola and mustard, causing major yield losses worldwide.

Published in the journal *Frontiers in Plant Science*, the research describes genetic markers associated with resistance against the Sclerotinia stem rot disease in *Brassica juncea* (Indian mustard).

Professor Martin Barbetti from the UWA School of Agriculture and Environment and UWA Institute of Agriculture said that managing Sclerotinia stem rot could be achieved by the genetic resistance present within Brassica crops.

"Developing crops with greater disease resistance is the only effective avenue for long-term, cost-effective management of this devastating, worldwide pathogen," Martin said.

"Our research has opened the way for deployment of the introgressed resistance genes from wild weedy Brassicas into a wide range of high-yielding cultivars, of *B. juncea* initially and, subsequently, into canola and other crop and horticultural Brassica species," he said.

The research has significant benefits for agriculture in Australia and India.

"*Brassica juncea* is the premier oilseed crop of India, and has great potential for drier regions in Australia," Martin said. "This research will provide the opportunity to develop disease resistance in other Brassica crops, such as canola, the major oilseed crop in Australia."

Further information: Professor Martin Barbetti – E: martin.barbetti@uwa.edu.au; Ph: 08 6488 3924

This study was supported by the Department of Biotechnology, Government of India, the Indian Council of Agricultural Research and The University of WA. ■

Prof Martin Barbetti and Prof Surinder Banga are part of a global research team achieving significant breakthroughs in developing disease resistant Brassica oilseed crops.

56 million eskies: Supporting Australia's largest barley market

■ By Australian Export Grains Innovation Centre

THE amount of Australian barley exported to China every year could fill 4.5 Melbourne Cricket Grounds, 2900 Olympic sized swimming pools, or 56 million eskies. It's Australia's largest barley market, which is why the Australian barley industry is so committed to maintaining and enhancing the long-term relationship with Chinese brewers, maltsters, processors and traders through continual technical support.

Recently the Australian Export Grains Innovation Centre (AEGIC) and Barley Australia hosted two Australian Barley Technical Conferences in Guangzhou and Beijing, in collaboration with Seed Force, University of Adelaide and Victorian grain grower Simon Tickner. Three Australian government agencies – DFAT, DAWR and Austrade – provided valuable support.

AEGIC Barley Markets Manager Mary Raynes said the conferences had been run for three years and were highly valued by attendees.

"These events are an effective way to help maintain and enhance the excellent relationship between the Australian barley industry and the Chinese brewing industry in the long term," she said. "The response this year was again excellent, with 130 people choosing to take part, including representatives of brewing companies, maltsters, traders and students."

Mary said China imported 4.5 million tonnes of Australian barley each year worth $1.2 billion on average.

"Like Australians, Chinese people love a beer and premium Australian malting barley is in high demand. Feed barley is an even larger export volume and this sector is still showing strong growth," she said.

"Helping Chinese brewers, maltsters and traders boost their understanding of the production, accreditation and processing of Australian barley helps enhance the value of Australian barley in the long term."

- At both conferences, Mary and Barley Australia CEO Dr Megan Sheehy provided an explanation of the Australian barley industry and accreditation system.

AEGIC Barley Markets Manager Mary Raynes.

- AEGIC Barley Malting Quality Research Biochemist Dr Qisen Zhang provided an overview of his research into the possibility of using existing barley grain protein more efficiently.
- Victorian grower Simon Tickner gave an insight into the barley industry from a grower's perspective and what factors influence farmers' decision making processes.
- Seed Force Technical Services Manager David Leah provided an overview of Australia's newly accredited malting barley variety RGT Planet.
- The University of Adelaide's Associate Professor Matthew Tucker spoke about his team's exciting research into the barley grain components that contribute to germination and flavour. ■

The Australian barley industry delegation.

Wimmera grower Simon Tickner at the 2019 Australian Barley Technical Conference in Beijing.

BUILDING AUSTRALIAN BARLEY'S BEER MUSCLE IN CHINA

By AEGIC

Cutting-edge gene technology is being used to boost the brewing performance of current Australian barley varieties in our biggest market – China.

Australia exports more than five times as much barley to China than the next largest market (Japan) with premium malting barley making up a healthy share of the demand.

AEGIC Barley and Oat Program Manager Mark Tucek said supporting this demand and the premium prices received was critical to the profitability of Australian barley farming.

"Previous AEGIC market intelligence confirmed that Australian barley is well-regarded in China for its excellent malting properties," he said. "But China's preferred barley protein levels are higher than Australia typically supplies.

"Barley protein is important in brewing. Too much protein can mean there isn't enough starch available for optimum beer fermentation. Not enough protein affects beer flavour and foam characteristics, and can also affect the level of free-alpha-amino nitrogen (FAN), which feeds hungry yeast."

Mark said Australia had an opportunity to take action to maintain the Chinese market by coming up with ways to enhance the performance of Australian barley protein for brewing.

Using barley protein more efficiently

"AEGIC's response is to ask the research question: 'is it possible for brewers to use existing barley protein more efficiently?'," he said.

"Currently, a considerable amount of malt protein is discarded during brewing in the form of spent malt. Developing new ways to harness this wasted protein could be an opportunity for the Australian barley industry."

Mark said the project was using the latest biochemical tools to identify, down to the level of individual genes, the important enzymes that affects malt protein utilisation and beer qualities.

"The ultimate aim of this research is to develop – and demonstrate to Chinese brewers – new techniques for malting and mashing to get the most out of existing barley protein, while maintaining beer quality."

Mark said the project involved collaboration with Murdoch University. Chinese malt and beer producers have provided enthusiastic input to the project and are set to join as collaborators. The project could have impact in other markets beyond China in the future.

Go-to guidelines for correct treatment of grain in storage

THE Grains Research and Development Corporation's Grain Storage Extension Project team has developed a set of guidelines to support growers in their endeavours to adhere to fumigation best practice.

The team says correct treatment is imperative in ensuring grain remains free of pests during storage on-farm and chemical residues are avoided.

Grain storage expert Philip Burrill says implementation of simple, standard measures will eliminate the risk of rejection of deliveries – and potential fines – and will protect human and livestock health, as well as important grain markets.

"Correct fumigation of grain in storage is really non-negotiable," Philip says.

"It is not onerous for growers to implement best practice, yet the implications of poor practice can be extremely costly."

The following are examples of good practices to reduce phosphine residue and therefore rejection of deliveries:

- Get in the habit of checking grain in storage each month for pests and quality. This eliminates the risk of nasty surprises when it comes time to outload grain for sale and being tempted to perform a poor, rushed fumigation;
- Keep up-to-date monthly storage records of grain inspections, pests detected and grain treatments applied;
- Have clear procedures understood by all on the farm of how fumigation and venting is to be undertaken according to the label, the correct dose rates, and which silos can be used as they need to be gas-tight sealable; and,
- Plan ahead for grain fumigations – allow from 10 to 27 days for exposure + ventilation + withholding period depending on temperature and method as stated on the phosphine label.

Avoid the following practices

- Don't fumigate in the truck – it is not gas-tight/sealable, it is difficult to vent, it is illegal and dangerous to the operator and the public;
- Do not mix tablets in with the grain – the tablet dust can be toxic to stock if grain is fed, and when grain is moved tablet dust can release more phosphine gas;
- Avoid tablet residues in the grain; and,
- Do not add water to tablets – it is dangerous and it also releases all the gas too quickly to be effective against insects – it is illegal.

More information on effective treatment of grain in storage is available on the GRDC Stored Grain Information Hub at *http://bit.ly/2XOLqxp and http://bit.ly/2Y1lyCx.*

Growers unclear of best practices and good procedures for on-farm fumigations should contact the GRDC Grain Storage Extension Project team on 1800 WEEVIL or attend a storage workshop.

The GRDC Grain Storage Extension project team is conducting a series of storage workshops across Australia over the coming months, with each workshop tailored according to regionally-relevant grain commodities. Details can be found on the Stored Grain Information Hub at *www.storedgrain.com.au* for details. ■

The GRDC's Grain Storage Extension Project team has developed a set of guidelines to support growers in their endeavours to adhere to fumigation best practice. (PHOTO: Chris Newman, Department of Agriculture and Food, Western Australia)

Hot vs cold: Balancing the risks of abiotic stresses in wheat

By Felicity Harris[1], Rick Graham[2], David Burch[3], Greg Brooke[4], Peter Matthews[5] and Hongtao Xing[1]

AT A GLANCE…

- The optimal flowering period (OFP) to maximise grain yield potential and minimise effects of abiotic stresses varies across environments.
- Grain yield is optimised by different genotype and sowing date combinations across environments.
- Grain yield is primarily determined by grain number – even under terminal drought conditions – indicating late reproductive phases are most susceptible to abiotic stresses.

IN wheat, flowering time is a critical determinant of grain yield potential. Across environments of the northern grains region (NGR), the optimal flowering period (OFP) is defined by decreasing risk of frost and increasing risk of moisture and heat stress. The cost associated with lost yield potential from heat and frost stress has been estimated to be $600 million and $100 million per year respectively in south-eastern Australia. In the NGR, a range of commercial cultivars that vary in phenology from slow developing winter types to fast developing spring types are available to sow from April–early June, to ensure that flowering occurs at an optimal time in spring.

In this article, we present the OFP across six locations in the NGR (Figure 1) and discuss the phenology and yield responses for a core set of wheat genotypes in varied yield environments in 2018.

How does the optimal flowering period vary?

The OFP was defined from simulated wheat yield and flowering dates using the APSIM cropping systems model, based on historical climatic records (1961–2018) according to the parameters for a fast spring genotype. The OFP varied significantly in timing and duration, as well as for different yield levels across environments (Figure 1).

As flowering time is a function of the interaction between genotype, management and environment, the genotype x sowing time combinations capable of achieving OFP and maximum grain yield also varied across environments of the NGR (Figure 2).

2018 results – Wagga Wagga, Condobolin and Tamworth, NSW

Field experiments were conducted at Wagga Wagga, Condobolin and Tamworth in 2018 to determine optimal combinations of genotype x sowing date to maximise wheat grain yield. A range of genotypes with varied development (through different responses to vernalisation and photoperiod) were sown across sowing dates from early April to late May.

All sites required supplementary irrigation to ensure timely establishment due to lack of reliable autumn rainfall.

The Condobolin site received 30 mm prior to all sowing dates and a final irrigation of 20 mm in early September. At the Wagga Wagga site, all sowing treatments were established with 15 mm via drippers at sowing (except May 3 which was established with 6.9 mm rain May 4), and the site was rainfed thereafter. At the Tamworth site, all sowing treatments were established with 16 mm via drippers, and a further 24 mm was applied to the site mid-July. In 2018, grain yield and phenology responses were significantly influenced by below average rainfall in combination with frost and heat stress events at all sites (Table 1).

Generally, flowering date is a strong predictor of yield, with

In southeast Australia alone, the cost of frost damage to wheat is estimated at $100 million per year.

TABLE 1: Growing season rainfall (GSR) from April to October (long term average in brackets), number of frost and heat events for Wagga Wagga, Condobolin and Tamworth sites in 2018

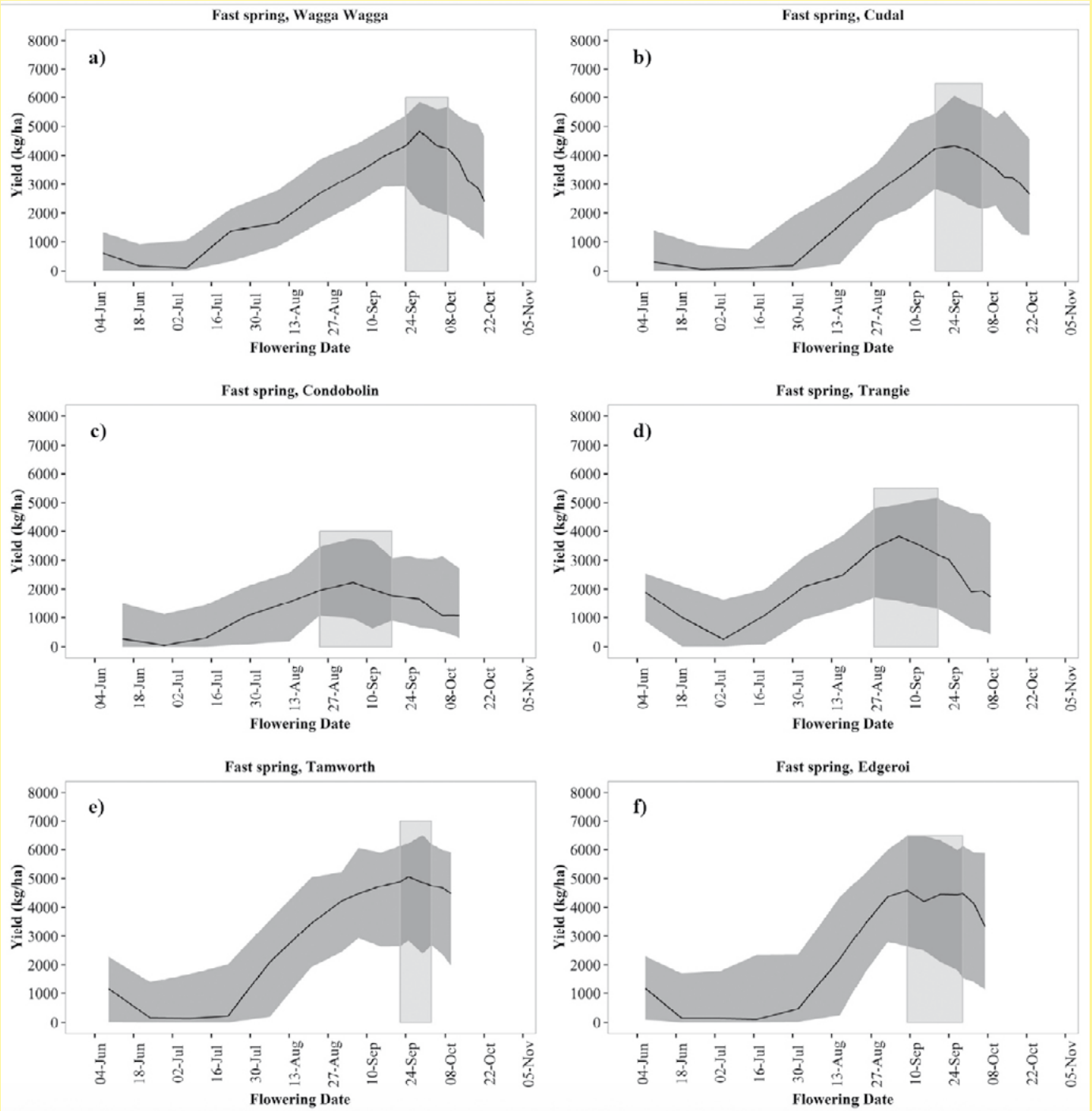
Site	GSR (mm)	Frost events (days <-0°C)	Heat events (days >30°C)	Comments
Wagga Wagga	135 (355)	36	16	11 days <-2°C, including -4.9°C (28 Aug), -6.3°C (29 Aug), -5.4°C (30 Aug) and -3.9°C (17 Sep)
Condobolin	91 (246)	30	15	11 days <-2°C. 4 consecutive days >35°C (30 Oct–2 Nov)
Tamworth	165 (318)	38	29	10 days <-2°C, including -2.8°C (13 Aug) and -3.0°C (21 Aug) GSR (5 Apr-31 Jul) was only 24.8 mm, 85% rainfall received in 2018 occurred Aug-Oct

genotype and sowing date combinations that flower in late-August to mid-September at Condobolin, late September to mid-October in Wagga Wagga and late-September to early-October at Tamworth capable of achieving the highest yields. This aligns with APSIM simulations in Figure 1. In 2018, there was significant variation in grain yields for genotype x sowing date combinations which flowered within the optimal period at all sites (Figure 2).

At the Wagga Wagga site, optimal flowering time and highest grain yields were achieved by both winter type DS Bennett sown early–late April and the best performing spring types sown early-May (e.g. Beckom sown May 3). Severe yield penalties occurred when fast developing spring wheats were sown prior to May and exposed to severe frost conditions; and when slow winter genotypes, characterised as having a strong vernalisation and photoperiod response, flowered too late and grain filling occurred under terminal drought conditions (Figure 2).

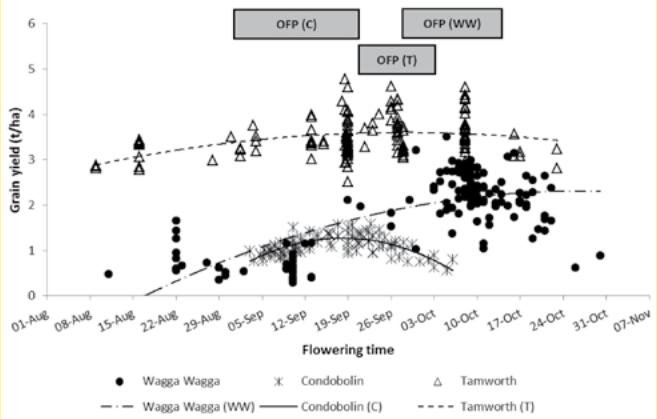
At the Condobolin site, stable grain yields were achieved across sowing dates from slower spring genotypes (e.g. Cutlass and EGA Gregory), or fast winter type Longsword, as they were exposed to fewer frost events during reproductive development

FIGURE 1: The optimal flowering period (OFP) for a fast spring cultivar of wheat determined by APSIM simulation using methods of Flohr *et al*. (2017) for a) Wagga Wagga, b) Cudal, c) Condobolin, d) Trangie, e) Tamworth and f) Edgeroi



Black lines represent frost and heat limited yield (kg/ha), with standard deviation in grey. Shaded columns are the estimated OFP defined as ≥ 95% of the maximum mean yield.

FIGURE 2: The relationship between flowering date and grain yield of genotypes with varied phenology patterns sown early April–late May at Wagga Wagga (WW), Condobolin (C) and Tamworth (T) in 2018



Shaded bars (e.g. OFP (C) for Condobolin) indicate APSIM simulated Optimal Flowering Period (OFP) for the three sites.

and were better able to utilise late October rainfall. Whilst slow-mid winter type DS Bennett flowered too late for the earlier OFP of Condobolin.

In contrast, despite the lack of rainfall early in the growing season at Tamworth, highest yields were achieved by winter and slow spring types sown April–early May which were able to utilise August–October rainfall (Figure 2).

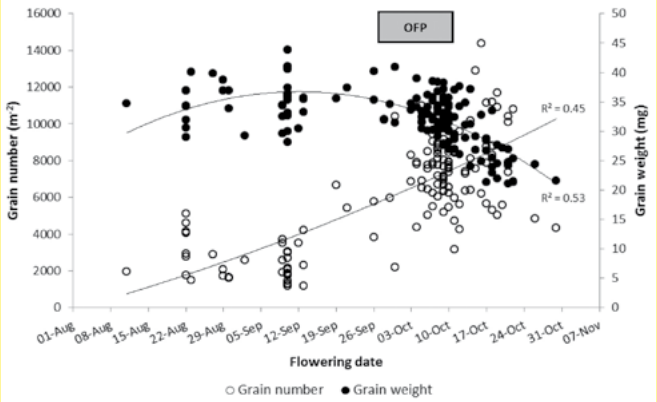
Timing of stress and yield development

The timing and duration of specific development phases are directly related to the formation of the key grain yield components – grain number (per unit of area) and individual grain weight. During the vegetative phase, leaves and tillers are formed prior to the transition into the reproductive phase, which coincides with the start of spikelet development.

Spikelet primordia continue to be initiated until early stem elongation. From here until flowering, rapid growth (accumulation of biomass), spike growth and differentiation occur, thus maximum grain number is determined during this

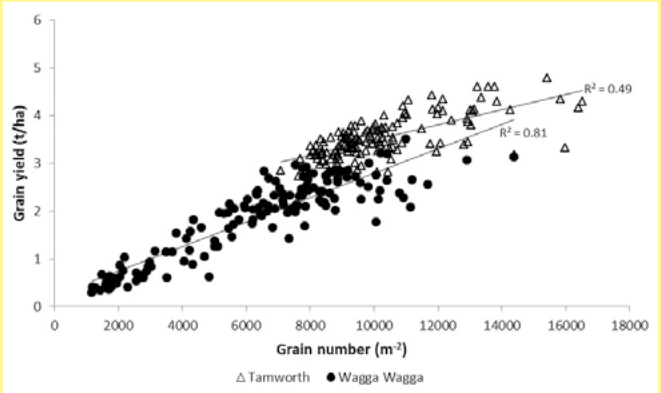
The most critical wheat growth stage for yield determination is from early stem elongation through to flowering.

FIGURE 3: Relationship between flowering date with grain number and grain weight for genotypes with varied phenology patterns sown early April-late May at Wagga Wagga in 2018



Shaded bar indicates APSIM simulated Optimal Flowering Period (OFP) for Wagga Wagga site.

FIGURE 4: Relationship between grain yield and grain number for genotypes with varied phenology patterns sown early April-late May at Wagga Wagga and Tamworth in 2018



time. This phase is known to be the critical period for yield determination, and as such, grain yield is very sensitive to stress, and any limitation to the crop at this time results in reduction in grain number.

After flowering, and during the grain-filling phase, the embryo develops, producing viable seed for the subsequent generation, this phase coincides with the establishment of grain weight.

The extent to which timing of stress events influences yield formation is highlighted in Figure 3, which illustrates the relationship between flowering time with grain number and grain weight at the Wagga Wagga site in 2018. Treatments which flowered earlier than the OFP, and were exposed to frost events, had reduced grain number, whilst treatments which flowered later than the OFP, and were exposed to heat and moisture stress during grain filling, had lower grain weights.

Despite the critical importance of the timing of stress events with corresponding yield components, grain yield has been more closely associated with grain number than grain weight in cereals, and this relationship has been maintained in environments characteristic of terminal drought or in low yielding seasons such as 2018 (Figure 4).

To sum up

We determined that the OFP, and the genotype x sowing date combinations which achieved the OFP and maximum yield varied between the locations. Variation across the sites was largely attributed to seasonal water supply and demand, and temperature extremes. The relationship between grain yield with grain number and grain weight indicated that yield losses are directly associated with timing of stress.

But even under the severe drought conditions in 2018, grain yield was primarily associated with grain number, reaffirming that the critical period for yield determination in wheat is from early stem elongation until flowering.

[1]NSW Department of Primary Industries, Wagga Wagga.
[2]NSW Department of Primary Industries, Tamworth.
[3]NSW Department of Primary Industries, Condobolin.
[4]NSW Department of Primary Industries, Trangie.
[5]NSW Department of Primary Industries, Orange.

Sincere thank you for the technical assistance of Hugh Kanaley, Cameron Copeland, Dean Maccallum and Hayden Petty at the Wagga Wagga site; Nick Moody, Leisl O'Halloran, Karen Brangwin and Daryl Reardon at the Condobolin site; and Stephen Morphett, Michael Dal Santo Jim Perfrement, Jan Hosking and Bruce Haig at the Tamworth site.

We also acknowledge the support of NSW DPI and their cooperation at the Wagga Wagga Agricultural Institute, Condobolin Agricultural Research and Advisory Station and Tamworth Agricultural Institute.

This research was a co-investment by GRDC and NSW DPI under the Grains Agronomy and Pathology Partnership (GAPP) project.

Contact:
Felicity Harris, NSW Department of Primary Industries, M: 0458 243 350
E: felicity.harris@dpi.nsw.gov.au
Rick Graham, NSW Department of Primary Industries, M: 0428 264 971,
E: rick.graham@dpi.nsw.gov.au ■

Step up Russian wheat aphid monitoring

GRAIN growers in southern and northern cropping regions are advised to keep an eye on their crops over the coming weeks as warmer spring conditions may promote flights of Russian wheat aphid (RWA).

RWA numbers have been minimal so far this season, due largely to low survival rates over the hot and dry 2018–19 summer.

Higher temperatures in spring may lead to an increase in aphid migration, but scientists say crops older than growth stage (GS) 40 do not appear to be attractive to migrating RWA, therefore colonisation of such advanced crops during spring is unlikely.

Rare cases of RWA presence and symptoms, below intervention thresholds, have been reported this year by growers and advisers in areas such as Victoria's southern Mallee and East Gippsland, as well as the New South Wales Riverina, Central West Slopes and Plains, and the Central Tablelands.

Entomologists involved in GRDC research investments say economically significant yield impacts are more likely from infestations that occur before stem elongation, but only if these persist during the later (heading and flowering) stages.

Maarten van Helden, an entomologist with the South Australian Research and Development Institute (SARDI) – the research division of Primary Industries and Regions SA – says detecting RWA in crops is not difficult as indications of infestation are usually quite obvious.

"A tell-tale sign is white or purple leaf streaking in cereal crops," says Maarten. "And at late tillering and during stem elongation, leaf rolling may occur."

Growers should search for the presence of aphids by peeling back rolled leaves, since symptomatic tillers do not always contain aphids and therefore treatment may not be required if the aphids have either moved on or died.

First identified in Australia in 2016, RWA is now present in many cropping areas of SA, Victoria, Tasmania and NSW. The aphid has not been detected in Western Australia, the Northern Territory and Queensland.

RWA expected to move north

RWA distribution is expected to move northwards again this year to northern NSW and possibly southern Queensland.

Since RWA has only been confirmed in Australia in recent years, limited research under local agro-climatic conditions and farming systems has been conducted. As such, a GRDC investment – 'Russian wheat aphid risk assessment and regional thresholds' – has been established to investigate regional risk and management tactics for RWA.

The collaborative investment is being led by SARDI, which is conducting research in partnership with sustainable agriculture research organisation cesar. Operation of field trials also involves a number of farming systems groups.

SARDI entomologist Dr Maarten van Helden features in a new GRDC podcast, discussing a GRDC research investment to determine economic thresholds to guide Australian growers in effective management of Russian wheat aphid. (PHOTO: GRDC)

The GRDC investment is investigating how RWA survives between winter cropping seasons. This knowledge is considered pivotal in determining the risk of infestation and potential damage ahead of each new cropping season, as well as aiding RWA management planning and development of cultural controls.

It is also seeking to determine the regional production risk 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.

This work is discussed in a new GRDC podcast (*http://bit.ly/2TxL2T7*) which features Maarten outlining research efforts to provide Australian growers with guidance about if and when to action chemical control measures in order to avoid significant yield loss, and – conversely – to avoid time and money being wasted on unnecessary treatments, especially if sufficient predatory insect populations are present to act as a biological control.

Economic thresholds

"When the aphid was introduced into the US in the 1980s, the Americans developed economic thresholds and so we are determining whether those same thresholds are valid in Australia," Maarten says. "Current threshold recommendations for chemical control, based on US research, are more than 20 per cent of seedlings infested with aphids up to the start of tillering and 10 per cent of tillers infested thereafter."

Trial sites have been set up in SA, Victoria, Tasmania and NSW to determine scientifically robust thresholds under varying Australian conditions.

Maarten says trials so far have shown that a considerable amount of RWA population pressure is required before yield loss is incurred.

"Overall, yield loss in our trials has not been as high as expected when aphid numbers have largely been above the overseas' threshold. It seems that the overseas thresholds are, at this stage, acceptable for affected Australian grain growing regions.

"Be aware that RWA seems to develop better on stressed plants so in very dry conditions the risks may be somewhat higher."

The current research effort builds on previous GRDC investments conducted by SARDI and cesar which focused on seasonal factors influencing RWA population growth, biotype confirmation, varietal susceptibility, damage and yield loss, and chemical efficacy.

Research will culminate with an update of the GRDC RWA Tips & Tactics guide, which can be found at *https://grdc.com.au/TT-RWA*. Growers and advisers will also have the opportunity to keep up to date with the research through fact sheets, research updates, newsletters, webinars and trial site visits.

In the meantime, further information on RWA management is contained in the Russian Wheat Aphid: 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*.

A RWA resource portal (including a constantly updated aphid distribution map) hosted by cesar is available at *http://bit.ly/2Px67tu*. A cesar-produced Pest Bites video on identification of RWA can be viewed via *http://bit.ly/2N7uwIG*.

Growers and advisers are encouraged to report occurrences of RWA in known areas of distribution to the GRDC's PestFacts services (*http://bit.ly/2O3hoBj for south-eastern, and http://bit.ly/2O35bMX* for SA) and the Beatsheet (*https://thebeatsheet.com.au/*) for the northern grains industry.

Suspected infestations in previously unaffected regions should be reported to the Exotic Plant Pest Hotline on 1800 084 881.

Growers can take advantage of pest identification services provided by cesar and SARDI through the National Pest Information Service. ■

Maarten van Helden shows plants with typical symptoms of Russian wheat aphid infestation, such as leaf streaking. (PHOTO: GRDC)

Retaining staff in tough times: A grower's perspective

NEW South Wales grain and cotton grower Gus O'Brien has a straightforward philosophy when it comes to successful staff retention – 'pay well, provide reasonable accommodation and give them some rein'.

From Warren in the state's central west, Gus spoke about the challenges of keeping staff during the current drought as part of a Grains Research and Development Corporation (GRDC) *Dealing with the Dry* forum.

Gus employs two fulltime staff, complemented by five to six casuals during busier times on his 7000 hectare aggregation of owned and leased land, which has a mix of irrigated and dryland farming.

"I work on having two key people – who are very capable and can oversee most parts of the day-to-day operation – but at full capacity we need eight to nine people, so the slack is taken up by backpackers and local contractors," he said.

"When it's dry and finances are tight, I know most of us look closely at our labour costs, but I would recommend doing whatever you can to hold onto your key staff.

"Importantly, involve them in the conversations about your strategy for getting through the drought. Ask for their input. Remind them you value their opinions and you are in this together looking for solutions that will help you all through."

Gus said he had worked hard selecting the right people for his permanent crew and ensuring they had the skills, and or training, to do their job successfully.

"These days I spend 50 per cent of my time in the office, so I have people I can trust doing a lot of the operational work and the key to making that work is stepping back and giving them some rein to do what they do well," he said.

"I try not to stick my head in too much, but we do have weekly meetings.

"My strategy is to employ great people and work to make myself redundant. Of course, it is my business and it will always be my business, so I want to oversee what's going on, but the best way to do that is to have the right people working with you."

Ongoing dry conditions have reduced the area under crop this year at Hatton, and Gus has little need for more than two permanent employees, but he is confident activity will 'ramp up again with rain'.

"I have intentionally structured my workforce so when things are tough, I have the flexibility to unload casual employees, but I am committed to keeping my full timers."

When it comes to securing and retaining permanent staff, he offers this advice to potential employers:

- Pay them well;
- Provide reasonable accommodation;
- Offer them opportunities for further learning and training; and,
- Include and encourage them to have input into business decisions.

Selecting the best 'temporary' staff

Most seasons Gus also employs a temporary team – primarily backpackers – who come via word of mouth or through social media sites, such as Gumtree. These staff tend to stay between three and six months and in Gus' experience finding the best fit for his farming operation has involved:

NSW grain and cotton grower Gus O'Brien understands when it's dry and finances are tough, people start scrutinising labour costs, but he advocates "doing whatever you can" to keep key employees. (PHOTO: GRDC)

- Employing backpackers who are over 21 years of age;
- Ruling out any who rings up and ask how many days they have to work to retain their visa; and,
- Giving preference to applicants with a farming background.

"Regardless of whether you are employing permanent or casual staff, you have to be prepared to 'sell' your business, for example let them know you have quality machinery and good accommodation," Gus said.

"Once they're hired you really need a workplace health and safety induction process. In our operation we have identified vehicles as presenting the most risk, so we have two strict rules – wear a seatbelt and no mobile phones while operating any vehicle."

In summary, Gus said being an employer had its challenges but being the right 'boss' meant you attracted and kept well-trained and committed employees.

"I am always interested in how long people have stayed in positions – not backpackers or casuals because the nature of that arrangement is different – but length of time in a job reflects on both the employer and the employee," he said.

"Being a fair, considered and reasonable boss who trusts his team, works to create an environment where employees are committed, feel valued and will go out of their way to make sure jobs are done well.

"Once you establish that sort of rapport and relationship you want to do everything you can to keep those people working with you, especially in tough times."

For more GRDC resources on Dealing with the Dry, go to *https://bit.ly/2WItQhO* or for information on employing people in agriculture go to *https://www.peopleinag.com.au/*

Croplands and Weed-It setting the standard for precision spraying

EFFECTIVE weed detection and elimination is becoming increasingly important in cropping systems around the world with herbicide resistance on the rise, less precipitation and increased environmental awareness. To help growers gain the advantage in weed management and control, Croplands Equipment introduces Weed-It Quadro – the next generation of spot spraying.

The new Weed-It Quadro system incorporates 10 years of worldwide experience and has been extensively tested and calibrated for Australian conditions.

The Quadro sensor offers an updated appearance and blue light source with increased power efficiency. Blue LEDs have proven to be more sensitive to weeds and less sensitive to background noise than the red LED-lighting used to date.

Adding to the increased accuracy and efficiency is the new dual core processor which delivers fast communication and high sampling frequency.

To provide better penetration in stubble and minimise shading of small grasses, Weed-It sensors are placed at one metre intervals across the boom and control four nozzles (individually) on 25 cm spacings. The system can be built onto any type and brand of ground glider and trailed sprayer, quad, orchard sprayer, toolbar, self-propelled sprayer and even autonomous sprayers with working widths up to 36 metres.

Croplands Equipment Portfolio Manager, Steve Norton, has been working closely with Weed-It manufacturers to test and calibrate the Quadro sensor with the goal of providing the next level of weed detection.

Weed-It Quadro sensor – the next generation in spot spraying.

"Initial testing was undertaken in Australia in January 2018 and since then the Quadro sensor has undergone substantial changes to both the hardware and software," says Steve.

"In March 2019, a team of three engineers from Rometron in the Netherlands, spent four weeks in Australia conducting extensive field trials in the Mallee region of South Australia and Queensland. These field trials were crucial in validating the functionalities and finer settings of the new sensor to ensure maximum effectiveness in our varied Australian conditions."

New blue light source is more sensitive to weeds and less sensitive to 'background noise'.

Long history of quality products

Croplands has a long history of manufacturing and importing high-quality spray equipment, working alongside growers in the battle against weeds and continuously striving to develop innovative spray solutions.

Central to this is the sophisticated Weed-It optical spot spray technology. Designed and manufactured in the Netherlands by precision spraying specialists Rometron, Weed-It is the world's best-selling optical spot spraying system.

Using advanced sensors to detect chlorophyll in the leaves of weeds in fallow fields, the Weed-It system triggers a targeted herbicide application. Weed-It is the only technology that calibrates and corrects automatically and ultrafast for different soil and background conditions (dry, wet, shade, night-time).

Croplands has led the charge in bringing Weed-It to market, having sold over 10,000 Weed-It cameras in Australia alone and recently taking on the distribution of the technology in Canada.

Weed-It technology has proven to assist Australian broadacre farmers delay the onset of herbicide resistance, lower their weed seed bank, improve water retention and achieve substantial chemical savings.

"Croplands is committed to the on-going development of Weed-It, we will continue to work with growers to understand the challenges they face so that we can create sustainable solutions for the future," says Sean Mulvaney, Croplands Equipment General Manager. ■

Seamless switch and great results with new canola herbicide

KATANNING farmer Ian Knapp is looking forward to ratcheting-up the use of a new rotation tool against grasses in his cropping operation after a seamless introduction and good results early this season.

Ian applied the new selective pre-emergent herbicide for use in canola – Devrinol-C – with some of his canola varieties this year.

Devrinol-C, from UPL, offers another chemical mode of action to assist growers' weed management programs as well as help extend the life of existing herbicides.

The Group K pre-emergent herbicide, which contains the new active ingredient napropamide, controls annual ryegrass, barnyard grass, crowsfoot grass, innocent weed, liverseed grass, pigweed, potato weed, redshank, sowthistle, stink grass, summer grass and winter grass.

Ian runs a 50:50 cropping and sheep operation on the family's 'Craigmore' property, in Western Australia's Great Southern region growing wheat, barley, canola, lupins and oats. It allows him to follow a flexible cropping rotation that can include canola or lupins before two to three years of cereal production and a return to pasture if required.

He said, like many growers, he encountered problems controlling grasses in some areas and so decided to apply Devrinol-C with some Roundup Ready and triazine-tolerant canola varieties this season.

Longer residual

"It's a new chemical mode of action for the canola phase and so puts another tool in the toolbox," Ian said. "The longer residual control it provides will be a big benefit."

The pre-emergent herbicide does not control germinated weeds, but it is compatible with a range of complimentary herbicides including trifluralin, atrazine, propyzamide, metazachlor, glyphosate and paraquat, allowing flexibility in weed management programs.

Ian applied the Devrinol-C in three different mixes in various crops, including with glyphosate, paraquat, as well as atrazine and glyphosate.

In an ideal situation, a knockdown herbicide is also applied upfront, but this season the first application with most crops was a pre-emergent herbicide mix of glyphosate and propyzamide, with paraquat used where weed germinations had occurred.

Less than ideal mixing prior to application can cause problems with products, but Ian said the application of Devrinol-C through their 1386 Rogator sprayer went very smoothly.

"We use a chemical batch mixer and we make sure it is in suspension before it goes into the machine," Ian said.

"If you rush it, you can have a problem. Some guys get white line fever. I'd rather take an extra five minutes mixing than have to clean the boomspray out.

"You can have a problem with atrazine if you go too fast."

Ian first mixed the Devrinol-C in water and then followed the mixing order with other products before applying it through the Rogator with a water rate of 80 litres per hectare.

The pre-emergent herbicide has a label rate of 1.75–2.25 kilograms per hectare, with the higher rate advised to be used to target high grass populations.

Ian Knapp, Katanning, and his agronomy consultant, Frank Boetel, Primary Agronomy, inspect the excellent early weed control provided by the new selective pre-emergent herbicide in canola.

"We used normal agitation and put it through 100 mesh filters that we checked after each load and it was all good. We never found a skerrick in the filters."

UPL has also reinforced to growers that it is important to add Devrinol-C into a pre-mixing vessel slowly with good agitation, and while it is compatible with a wide range of commonly used products, tank mixtures should be tested prior to use.

Ian said the early results with the new herbicide were excellent.

"The difference in control is quite remarkable between where the Devrinol-C was applied and propyzamide was applied."

Ian's agronomy consultant Frank Boetel, of Primary Agronomy based in Katanning, has observed the excellent control being offered by Devrinol-C at 'Craigmore'.

Another chemistry option

Frank said the pre-emergent herbicide provided growers with another Group K chemistry option, good compatibility and crop safety, and a broad range of weed control and suppression.

Trials across Australia over the past four years have consistently highlighted the crop safety, longer residual control and yield benefits of using Devrinol-C in canola compared with existing standards.

In over 16 trials in WA, South Australia, Victoria, Tasmania and New South Wales, Devrinol-C showed more than 90 per cent control of ryegrass 14–20 weeks after application, whereas propyzamide showed 77.5 per cent control. Trials in NSW have also shown yield advantages of up to 450 kg per hectare where the herbicide has been applied compared with propyzamide.

Further work is now being undertaken with Devrinol-C to assess its effectiveness against wireweed, toadrush, lesser loosestrife, shepherds purse, silvergrass, common chickweed, capeweed, waterbutton, wild oats and clover. The work also includes a focus on extending the time between application and incorporation, better understanding of plant back to rotational crops and assessing new formulations.

For further information contact your local sales agent or *www.upl-ltd.com/au* ■

Bigger on-farm grain storage capacity

THE forecasts for winter crop yields this year are certainly much more encouraging than this time last year. Victoria and southern NSW should recover from the poor season and will achieve closer to normal yields. Northern NSW and Queensland are still suffering from drought and these areas will be about one third of a 'normal' year. Prices – while not at the levels achieved in 2018 – are still good. High protein wheat is expected to remain in tight supply and a major grain trader is forecasting Manildra will be importing this type of grain again due to local short falls.

As of mid-August a major grain trader is expecting the NSW crop to be 25 per cent of a 'normal year'. ABARES is forecasting Victoria to produce no more than the 10 year average while Queensland is likely to produce 1.5 million tonnes (mt) which is the lowest in the past 10 years. All this means the east coast winter crop volume will be around 10 mt and 40–50 per cent down on recent years.

Despite this, there will be opportunities for east coast grain growers. Given a reasonable spring, WA may have a record harvest but traditionally not much grain from that state finds its way to the eastern states. The opportunities for east coast growers will be in the domestic market.

Higher prices post-harvest

In past years when prices have been high, growers sent their harvest straight to the local grain receival depot and took advantage of getting the cash sooner. But in the past five years or so, according to Bayer's K-Obiol EC Market Manager, Daryle Swarz, the volume of grain stored on-farm has increased rapidly.

"Growers can now manage the logistics at harvest time more easily and they are finding grain prices are better if the grain is sold later and not at harvest time," Daryle says.

"Higher prices favour the growers who have been prepared to make the investment in silos and to spend the time to understand correct storage of grain. They need to manage moisture levels and to be able to control insects".

In the past grain moisture levels were managed by the timing of harvest but silos set up with good aeration give the grower another tool to manage grain moisture.

According to Daryle control of insects has become more sophisticated. "Silos that are gas tight can use fumigants such as phosphine and get excellent results. But if silos are not sealed then fumigant levels cannot be maintained for long enough. The result is less than total control of insects leading to reinfestation and the possible development of resistance."

"When silos are not gas tight the grower needs to use a grain protectant like K-Obiol EC. The use of grain protectants has changed in the past two to three years," says Daryle. "Previously a manufacturer would recommend its product be used on its own. Now reputable companies like Bayer recommend a mixture of products with different modes of action. The mixing partner product is usually from another supplier but the mix is recommended to manage insect resistance. To further manage insect resistance, suppliers are recommending rotation on an annual basis with products with a different mode of action – again often from another supplier."

"We know that continual use of products with the same mode of action can lead to the development of insect resistance, so rotation of products with different modes of action is good for the grower and means our product will have a longer effective life," Daryle added.

For more information on the use of K-Obiol EC, go to *https://www.environmentalscience.bayer.com.au/K-Obiol/Training* ■

Broadacre cropper toppers

A.F. Gason Pty. Ltd. is an Australian manufacturer of agricultural and industrial machinery with over 70 years' experience – beginning as a tractor cabin producer in 1947 before cabs were a standard issue on tractor models.

Since Gason acquired Chris Grow Engineering in 2010, for the past decade they have been developing and manufacturing mowing solutions that suit Australian conditions. Their extensive range of mowers and slashers – from 6 ft vineyard mowers through to 41 ft cropper toppers – operate in a variety of industry, predominantly agriculture and public works.

The range of Gason Cropper Toppers have a pedigree of reliable and dependable service that emanates from more than 35 years' experience in mower and slasher design and manufacturing engineering.

Four models of broadacre cropper toppers give you the choice of size and capacity to suit your application and property. Gason Cropper Toppers have 'all gear drive' (no belts) and meet the requirements of serious cereal growers who demand a higher level of trashing efficiency coupled with reliable performance and a long service life. Every model has been engineered to stringent parameters of quality and workmanship to produce a machine which is designed to exceed expectations.

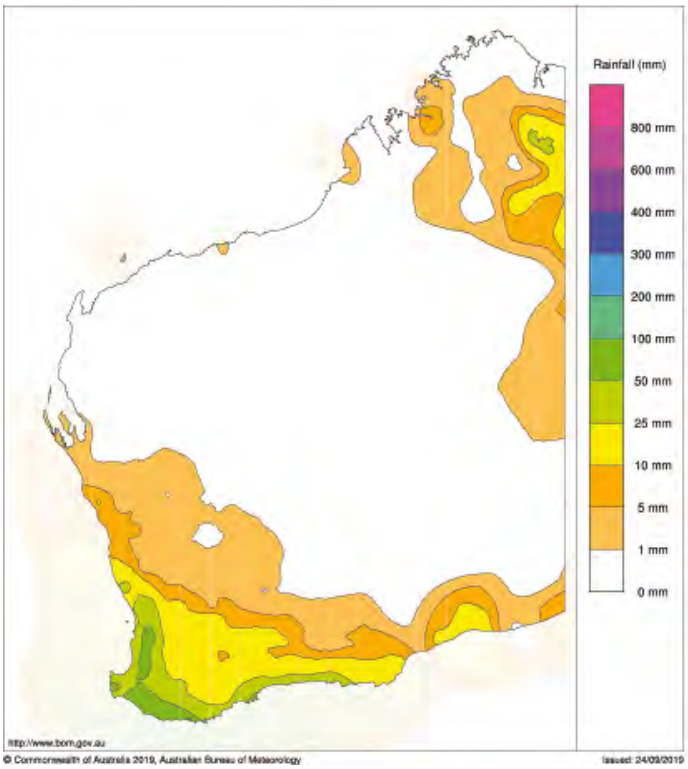
Contact your local Gason stockist today for a great deal on these cropper toppers. Order before December 2019 and receive an extended two year warranty and a set of replacement blades absolutely free.

For further information visit *www.gason.com.au* or the Gason Agriculture Facebook page. ■

Western region

Western Australia rainfall totals (mm) September 1 to 24, 2019

Australian Bureau of Meteorology



Low rainfall and frosts during September have dashed hopes of an above average season in WA.

WESTERN AUSTRALIA SUMMARY

Hopes of an average season for Western Australian grain growers following rain in late August have been dashed with continuing warm dry conditions in the northern half of the state and recent frost events in the southern half of the state. It is unclear exactly how much potential grain yield has been lost in the last two weeks, although no matter how the figures are formulated it is unlikely WA grain production will exceed 12.5 million tonnes for all crops.

Rainfall near the end of August could have pushed production for the state past the 15 million tonne mark if growing conditions in September were about average. The Department of Primary Industries and Regional Development (DPIRD) climate specialists had been predicting a warmer and slightly drier September since June and the first half of the month has followed this trend.

Growers away from the southern regions were always factoring in the risk of below average grain yields from the late break and little subsoil moisture. The disappointing aspect is the cereal crops in general still looked like they could produce close to average grain yields as little as two weeks ago.

Crops in the southern regions were further advanced than the north as many had germinated prior to the general break to the season in the first week of June. Unfortunately, this contributed to the wide scale damage from the frost events near the end of the first week in September. Crops generally had more top on them and were running the moisture profile down when the very severe frosts occurred. These frost events were then followed by a blast of heat. The worst possible combination of susceptible growth stage; very cold temperatures for extended periods during the night, followed by extreme heat. This has resulted in unprecedented crop loss for some growers and a significant reduction in tonnage for most in the worst affected regions.

Whilst total grain production has been downgraded, the greatest effect on individual crop production will be for canola, lupins and pulses. These crops in the north have simply not had enough time to yield anywhere near average and have also taken the greatest hit in the south from frost. All crops have been badly affected in the worst frost impacted areas, although, as you move north where cereals have been less affected from frost, the canola and pulses particularly have had the top taken off their potential yield as they were in the middle of flowering.

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

GIWA Crop Report – September 9, 2019

NORTHERN DISTRICT

What a season! After a couple of wet weeks in June, the season has dried up in most of the northern grainbelt of WA. Annual rainfall tallies are between 160 mm in the east and 270 mm in the west of the region. Most of this rain came in 16 days between June 7 and 23. Since then the rain in most areas has been well below average to the point where crops are dying in some locations. Most other parts of the landscape are losing significant potential with high temperatures coupled with rapidly depleting soil moisture.

There are two areas of the northern region that are notable exceptions. One is the northeast which had April or May thunderstorms and crops were seeded onto moisture at that time. Some of the crops in this area are already finished with good yield potential.

2019 GIWA Western Australia crop production September estimates (tonnes)

Port zone	Wheat	Barley	Canola	Oats	Lupins	Pulses	State total
Kwinana	3,900,000	1,950,000	300,000	220,000	130,000	5,000	**6,505,000**
Albany	900,000	1,250,000	220,000	230,000	45,000	5,000	**2,650,000**
Esperance	750,000	600,000	150,000	10,000	15,000	8,000	**1,533,000**
Geraldton	1,240,000	83,000	122,000	15,000	171,000	4,000	**1,635,000**
Totals	**6,790,000**	**3,883,000**	**792,000**	**475,000**	**361,000**	**22,000**	**12,323,000**
% change to August 2019	-8.9%	-11.6%	-19.2%	-4%	-7.4%	-60.7%	-10.4%

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

District Reports…

September–October 2019

The second area is the southwest of the region which has had a little more rain and is currently remaining fresh. No more rain in the south will see yield potential drop off.

Generally, crop yield potential is mirroring soil types with the highest potential on the better medium soils. The heavy clay soils and lighter sand soils have run out of water or were washed out earlier and the crops are rapidly losing potential.

A rare outbreak of budworms in cereals

Budworms have been a problem in all crops with unusually high numbers in cereal crops. Around 50 per cent of the wheat area would have been sprayed for budworm this season. This has not happened before in our region. Canola and lupins have also required a budworm spray.

Diamond Back Moth and aphid numbers are very low with, unusually, no crops requiring a spray for these insects.

The majority of the region had a late break on June 7 which means grain fill has just started in most wheat crops. Yield potential in the whole region is dropping dramatically with most areas enduring more than a week above 30° with some days over 35°. With this in mind, and no rain forecast for the next week or so, we are likely to have a well below average year with the couple of exceptions mentioned above.

It will be interesting to see how the various crop types cope with these conditions with barley filling grain earlier than wheat. This may give barley a big advantage this season. Lupins have variable pod set and many are very short so getting them into the harvester will be difficult.

Wider row spacings in canola and lupins are helping some crops cope with the dry finish.

There may also be some low laying areas of the landscape that have been frosted. Our thoughts are with growers in the many areas that have been severely damaged by the extreme cold.

Hopefully the current hot and dry conditions change. If not we will be in for very low crop yields and potential quality issues. I hope that things do change and we can somehow get at least break-even yields.

Peter Norris
Agronomy For Profit and Synergy Consulting, Geraldton
September 14, 2019

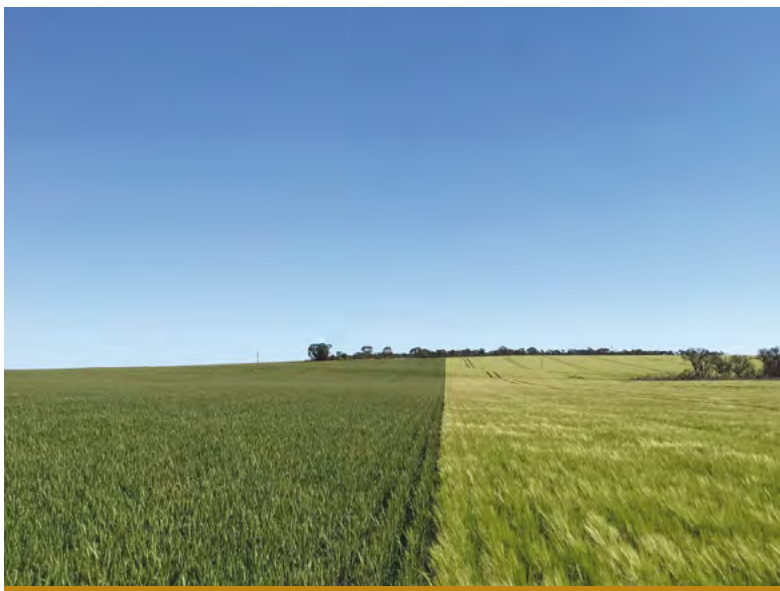
SOUTH COAST

To say the very least, seasonal conditions in the South Coast region of WA over the past two months have been dramatic.

July was extremely dry; mid to late August was quite good for rainfall which really turned the season's prospects around; and then came September which can only be described as an absolute shocker!

In early September there were three consecutive nights of frost with the worst on the night of September 5. Temperatures dropped below zero by 9.30 pm and were down as low as –3° to an extreme of –5.2° across a large portion of the northern mallee area. This was one of the worst frosts the region has ever experienced and has caused extensive damage and yield loss to all crop types.

Scaddan district farmers Gavin and Brad Egan in a paddock recently clay delved to ameliorate non-wetting sand. Now the big (and very obvious) job is to to level the paddock again!



Where two crops meet: Scepter wheat and Planet barley side by side on 'Lobethal', a Warakirri Cropping farm to the east of Condingup.

Stem frosted Scepter wheat being cut for hay at Schutz Grains at Grass Patch.

Unfortunately, the Esperance port zone is not in a strong position to cut frosted crops for hay. Transport and a lack of suitable hay cutting equipment are big obstacles as well as not knowing if there will be a suitable market either within WA or interstate.

The 2019 season is going to be remembered for all the wrong reasons – a very challenging year full of climatic fluctuations.

Quenten Knight
Agronomist, Agronomy Focus, Esperance
September 19, 2019

Southern region

SOUTH AUSTRALIA SUMMARY

Winter rainfall in South Australia's major cropping regions was average to below average. But the rainfall was timely and benefitted crop development in most regions. Soil moisture levels at the beginning of spring were below average in most northern cropping regions and mostly average in the lower Eyre Peninsula, the Mid-North, the lower Murraylands and the South East.

The seasonal conditions that BOM predicts as most likely over spring will hamper grain development, especially in the northern Mallee, the Upper-North and the northern Eyre Peninsula. Crops in regions with average or better soil moisture levels at the beginning of spring will be in better condition and benefit most from timely rainfall and average temperatures in October.

Winter crop production in South Australia is forecast to be around 6.6 million tonnes. This forecast reflects an estimated 9 per cent increase on last season in planted area to around 3.6 million hectares and expected yield improvements in key growing regions.

Yields are forecast to be around average in the lower Eyre Peninsula, the Mid-North, the lower Murray lands and the South East, and below average in most northern cropping regions.

Canola production is forecast at around 300,000 tonnes. Canola crops in most regions were generally in good condition at the beginning of spring and the average yield is forecast to be close to the 10-year average.

ABARES *Australian Crop Report*, September 2019

VICTORIA SUMMARY

Seasonal conditions were generally favourable for crop development during winter in Victoria. Rainfall in most cropping regions was sufficient to put most cereal and canola crops in good to very good condition at the beginning of spring.

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		Autumn		Winter		Spring	
			25yr Annual Average (mm)	2018–19	25yr Annual Average (mm)	2019	25yr Annual Average (mm)	2019	25yr Annual Average (mm)	2018 to date
Emerald Qld	564	259	251	52	106	182	67	44	125	0
Toowoomba Qld	679	282	276	73	138	232	86	25	180	1
Roma Qld	579	151	256	36	119	133	75	18	134	0
Goondiwindi Qld	619	149	253	66	123	110	98	27	147	0
Narrabri NSW	621	140	217	69	119	111	123	15	162	1
Gunnedah NSW	627	195	211	65	108	144	126	28	183	2
Dubbo NSW	588	188	184	117	125	70	129	24	152	11
West Wyalong NSW	437	205	118	84	79	85	120	48	122	8
Wagga Wagga NSW	531	231	134	111	109	83	147	78	141	16
Swan Hill Vic	308	155	69	57	64	58	87	72	88	10
Bendigo Vic	490	265	100	60	105	78	158	138	128	31
Horsham Vic	365	233	76	41	71	66	120	133	99	22
Lake Bolac Vic	506	397	108	72	103	171	153	170	142	35
Murray Bridge SA	358	192	66	30	80	53	120	109	94	23
Kadina SA	327	192	60	9	76	70	110	76	82	43
Cummins SA	390	306	51	6	89	115	174	148	76	41
Esperance WA	618	362	90	38	136	96	251	239	140	24
Wagin WA	391	274	50	7	90	51	165	211	85	12
Northam WA	407	244	61	32	87	30	189	199	80	13
Mingenew WA	347	253	33	0	86	13	171	232	57	7
Moora WA	385	229	46	6	82	20	189	199	68	9
Mullewa WA	320	182	56	12	90	37	131	146	43	5

Last rainfall reading September 23, 2019.

District Reports…

September–October 2019

Soil moisture levels in most parts of the Wimmera, North Central and Western districts at the beginning of spring were at, or above, average, which is expected to support grain formation in these regions.

The major exception to these favourable seasonal conditions was in the northern Mallee where winter rainfall was below average and soil moisture levels fell to be below average at the beginning of spring.

Winter crop production in Victoria is forecast to increase dramatically by more than 80 per cent on last season to around 6.9 million tonnes.

This forecast production increase also partly reflects a 14 per cent increase in area planted. Some winter crops in regions with low soil moisture levels are likely to be cut for hay this year, given currently high hay prices and prospects of below average rainfall in September. But this practice is not expected to be as widespread in 2019–20 as it was last year.

Canola production is forecast to more than double last season's drought-impacted result to around 620,000 tonnes.

ABARES *Australian Crop Report*, September 2019

VICTORIAN MALLEE

For the southern Mallee, soil moisture probe data indicate crops are really on the move and accessing a lot of moisture at depth. Crops in the northern Mallee have been dealt much tougher conditions.

Frosts continue to cause concern in all parts of the Mallee, particularly with many crops reaching the flowering stage. But the incidence and severity of frost is highly dependent on location and growth stage.

Upper canopy blackleg has been observed in some canola paddocks, particularly untreated and early sown varieties. But as the weather dries, risk of new infection reduces. Assessments are currently being made whether to windrow or direct head for canola.

Insect activity is high at this time of year but not all activity necessarily warrants control. Native budworm is active, army worm, aphids and grubs are all present and moth flights have been observed. Growers will soon decide whether to 'pull the trigger' on spraying lentils to protect them based on economic thresholds.

Shearing and livestock feeding has been keeping mixed enterprise growers busy and in the drier regions, the question of salvaging crops for hay is being considered. Hay cutting has already commenced in some locations.

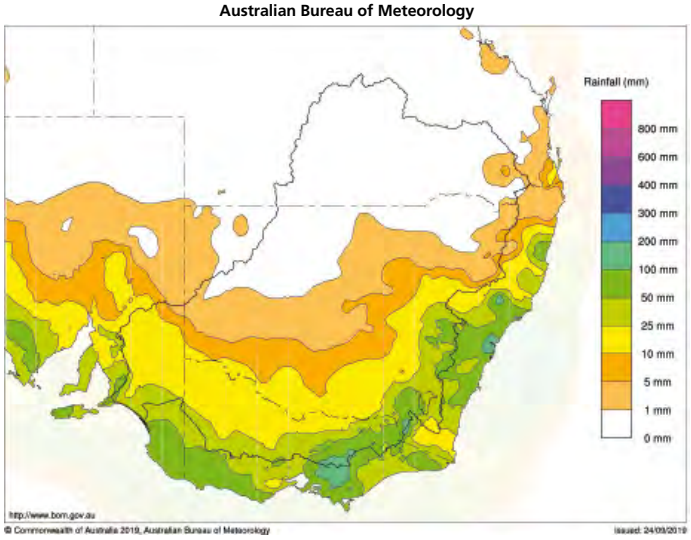
Attention now turns to harvest logistics including managing grain storage options and ensuring harvest equipment and labour requirements are ready to go.

Most of the relevant weather forecasting models are predicting drier conditions for the coming three months.

Louisa Ferrier
Engagement and Member Services Leader,
Birchip Cropping Group
September 18, 2019

The BCG's Main Field Day this year (September 11) was a well-attended event held at Andrew and Lachlan Barber's farm just west of Birchip.

Murray–Darling Basin rainfall totals (mm) for September 1 to 24, 2019
Australian Bureau of Meteorology



The southern states have enjoyed some very handy September rain while the dry story continues for much of NSW and Qld.

Northern region

NSW SUMMARY

The area planted to winter crops in central and northern NSW was well below average reflecting the prolonged hotter and drier than average conditions leading into the planting window.

Winter rainfall was generally below to very much below average in all cropping regions of NSW, and in some northern cropping regions, was the lowest on record.

After a promising start to the winter crop season in southern NSW, winter rainfall was generally below average and soil moisture levels fell significantly. The low levels of soil moisture mean early spring rainfall will be critical for grain development in regions that still had viable crops at the start of spring.

Winter crop production is forecast to be around 5.0 million tonnes in 2019–20 which is half the 10-year average.

The area planted to winter crops this season in NSW is

District Reports...

estimated to be 3.7 million hectares. This is well below average, which reflects prolonged the drier and hotter than average seasonal conditions. Area planted in central and northern NSW is very low. Additionally, some winter crops with adequate biomass in southern cropping regions are likely to be cut for hay, reflecting current high hay prices and the risk of grain yields falling significantly during a hotter and drier than average spring.

Canola production in NSW is forecast to reach 370,000 tonnes in 2019–20. Yields are forecast to be well below average at around 1.0 tonne per hectare and some canola crops will be cut for hay.

NSW summer crop

The area expected to be planted to 2019–20 season summer crops in NSW is forecast to be the lowest on record at around 230,000 hectares. This is because soil moisture levels are close to zero and supplies of irrigation water are very low. It will take significant rainfall for this outlook to improve.

ABARES *Australian Crop Report*, September 2019

QUEENSLAND SUMMARY

Winter rainfall in most cropping regions in Queensland was very much below average. Seasonal conditions in the southern cropping regions were hotter and drier than average and reduced soil moisture to below average levels. But average winter rainfall fell north of Emerald in central Queensland.

Winter crop production in 2019–20 in Queensland is forecast to be 732,000 tonnes, driven by expected reasonable yields in some parts of central Queensland. This forecast production is 60 per cent lower than the 10-year average of 1.8 million tonnes.

The area planted to summer crops in Queensland in 2019–20 is forecast to be around 514,000 hectares. This is largely due to a significant fall in area planted to cotton and grain sorghum.

ABARES *Australian Crop Report*, September 2019

DARLING DOWNS

Weather conditions

What a shocker of a season – of a year really – with many growers having under 150 mm of rain for the year and under 50 mm for the past five months. The outlook for spring is grim with little chance of returning towards average falls of rain until January 2020.

Winter crop

All the dryland cereal crops across the Downs are being harvested for hay or silage, and even those growers considering grain are finding conditions too harsh to fill heads properly.

The small irrigation areas are producing some grain crops, but again many of these have been cut for hay or silage, with stockfeed prices increasing every week. An early assured and profitable return is attractive compared to possible pest attack close to harvest, and

District Reports...

Irrigated barley headed towards a silage crop.

the increased likelihood of storm damage this spring.

Chickpeas on the Central Downs are now flowering and being attacked by large populations of helicoverpa grubs. Some of these crops have been looking OK but they are now running out of moisture.

Summer outlook

The lack of spring rainfall looks like delaying planting until November/December – if it rains by then. There is a small area of fallow ground that could go in if rainfall is on the way, but many growers are looking for 50 mm plus to start with.

Sorghum will be the main crop, with both grain and forage crops on the agenda. The cotton area will possibly be only 20 per cent of last season with the accompanying lack of available irrigation water. Silage corn is a very attractive option for growers with water, as crops are being contracted at record prices, and so the early season irrigation is being used for this.

The later the break in the season, the more popular mung beans will become, and this could be a big season for the crop.

Record prices for stockfeed make crops such as silage corn a very attractive option – if you've got the water!

A graphic depiction of the self cracking clay soils of the Darling Downs.

Discussion points

The effects caused by the prolonged dry are showing up in soil test results, with higher levels of N left following lower yielding crops last summer, along with some higher levels of salt.

The amount of nutrition being removed in hay and silage is also of a concern, and how this will be replaced. Short term, cover crops are being considered for this summer to combat the number of bare paddocks and help any moisture to infiltrate into the profile.

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

ANSWER TO IAN'S MYSTERY TRACTOR QUIZ

It is a Ransoms MG crawler powered by a BSA air cooled single cylinder engine. Remarkably, in the 1950s this was Britain's top selling crawler tractor.

ADVERTISERS' DIRECTORY

(ADVERTORIAL)

Sunchaser, a variety full of great attributes

Australian Grain Technologies (AGT) released a new high-performing APH quality wheat variety on the 18th of September at the annual Plant Breeding Institute Field Day held in Narrabri. Sunchaser offers lower screenings and improved yields, with trial results proving it can outperform its major competitors in key attributes.

AGT's marketing manager Douglas Lush says the new variety, called Sunchaser and tested as SUN843E, offers growers in NSW and Queensland a 'package deal' with its unique combination of features.

"Our team are excited to release this variety as a lower risk alternative to Suntop, with excellent grain size, reduced levels of screenings, improved yields, a longer coleoptile and increased disease resistance," Mr Lush said.

"Over the last three years of testing, Sunchaser has produced grain with lower screenings levels than Suntop and Reliant while proving very similar to Spitfire," he said.

"In fact, the screenings levels of Sunchaser have consistently been 2 per cent lower than Suntop, from low to high screenings risk situations.

"Elevated screenings can contribute to downgrades at point of sale, so this feature in Sunchaser has the potential to improve grower's profitability compared to variety's such as Suntop, amongst others.

"Trial data also shows that Sunchaser displays a yield improvement over Suntop, while performing competitively with Reliant."

AGT wheat breeder Meiqin Lu, based The University of Sydney's Plant Breeding Institute at Narrabri, says that one of her main breeding objectives was to improve Suntop's grain size and disease resistance while retaining its very wide adaptation, yield and agronomic suitability.

"We believe that we have achieved this goal with Sunchaser," she said.

AGT's Narrabri breeding team officially launch their new variety, Sunchaser.

"Another key attribute of Sunchaser is its coleoptile length. Three years of testing has shown that Sunchaser has a longer coleoptile than Suntop, Spitfire and Reliant.

"In a region where moisture seeking planting is a regular occurrence, the longer coleoptile of Sunchaser should be valued by growers.

"We are also pleased to report that Sunchaser offers an improved disease resistance package in comparison to Suntop, with greater resistance to stem rust, leaf rust, yellow leaf spot and crown rot.

"Sunchaser is suited to the main season planting window and matures slightly quicker than Suntop and Reliant, and a little slower than Spitfire

Sunchaser has an APH quality classification for NSW and Queensland.

Commercial seed will be available for the 2020 season through AGT Affiliates or local retailers.

For more information contact:
Douglas Lush, Marketing Manager – northern NSW & QLD
M: 0407 177 029
E: douglas.lush@agtbreeding.com.au

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