AUSTRALIAN GRAIN

www.ausgrain.com.au
September–October 2018

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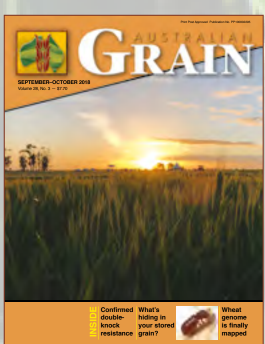
Published by Berekua Pty. Ltd.,
40 Creek Street, Brisbane

Registered by Australia Post Publication No. PP100002295. ISSN 1449–2970.

Published bi–monthly.
Grain Yearbook published in April

FRONT COVER



The mid-September sun sets on another successful Birchip Cropping Group Field Day. This year's Main BCG Field Day was held at the Narraport site in Victoria's Mallee.
(PHOTO: Ciara Cullen)

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Southern Australia Focus

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

Northern Focus

Covering Northern NSW and Queensland

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Editorial... Lloyd O'Connell

WHEN you hear of veteran farmers in one of Australia's most reliable cropping areas not getting a winter crop in the ground for the first time in more than 60 years in the game, you know it's dry. The rich, dark soils and temperate climate of the eastern Darling Downs of Queensland creates prime winter and summer cropping country – but for this season at least – the gloss has well and truly come off. And many other farms in the eastern states' grainbelt are in the same predicament.

In the ABARES mid-September *Australian Crop Report*, our official commodities forecaster estimates this season's national production of winter grains and oilseeds to be around 33 million tonnes. To put this into perspective – and to soften the impact of the "we'll all be rooned" headlines – this figure is only 9 per cent below the 20-year national average for winter crop production.

Hardest hit will be many growers in Queensland and New South Wales where winter crop production is estimated to be 900,000 tonnes and 3.9 mt respectively – or around half of the 20-year production averages in those states.

Many Western Australian growers are currently enjoying an excellent season and are on track to deliver around 16 mt of winter grains and oilseeds to the national coffers – in other words, about half the Australian total.

East-west disparity

Way back in the 2002 drought we saw a similar east–west grain production disparity. NSW and Queensland growers could only scrape together just over 4 mt of winter grains between them. But in Western Australia, a state which typically finds international homes for almost 100 per cent of its production, grain deliveries (into the WA port system) were nearly 7 mt.

As grain marketing consultant Peter McMeekin points out (see article page 25), when we have surplus grain on one side of a vast country, and some of that grain is wanted by an increasing number of domestic consumers on the other side of the country, there is an inevitable interest in importing from overseas.

At current prices, US corn could be imported into Brisbane for around $130 (AUD) per tonne less than bringing wheat around the coast from Western Australia. Sounds a no-brainer to import the cheap corn – until you consider the biosecurity risks.

We did import some grain from the United Kingdom in early 2003 to ease the 2002 drought-induced domestic shortage. But for biosecurity purposes, the grain had to be extensively treated and consumed very near to the port of entry. Its movement up-country as viable seed was not allowed – and those same restrictions still apply.

In the interests of Australian biosecurity, there is no such thing as a 'cheap' imported farm product.

Hopefully the season in your patch has been kind enough to let you harvest some grain – or better still – you have a few on-farm silos full of a now extremely valuable commodity.

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In this issue...

What's hiding in your stored grain?

On-farm grain storage has become a significant component of many Australian cropping operations. Grain producers are acutely aware that it is not safe to simply store and forget grain held in storage for future sales, stockfeed or planting seed.

I spy with my drone's eye

Ben Single was standing with his father near a boom-mounted selective spray system from the late 1990s in a shed on the family property. Ben was an inquisitive mechanical and aeronautical engineering uni student and he asked dad: "How did the detect spray system work?"

The boats will keep coming...

The increasing requirements of Australia's domestic grain market have been under the spotlight in recent months as the drought worsens across the eastern states. This is the second consecutive year that we have seen below average grain production in New South Wales and Queensland.

The disjointed United

In the year 1929, no less than 32 independent US farm equipment manufacturers and distributors amalgamated to form a mega operation, based in Chicago, trading under the somewhat grandiose title of The United Tractor and Farm Equipment Co-Operative. But there was only one problem. They did not have a tractor!

Wheat growers are changing nitrogen use

More than a third of growers and advisers in northern New South Wales and southern Queensland have changed their approach to nitrogen rate, application method or timing in wheat crops during the past five years, according to a new survey.

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Confirmed double-knock resistance in tall fleabane

By Cindy Benjamin, WeedSmart

THE double knock is a widely-utilised and highly effective weed management tool but without monitoring and removal of survivor weeds, the commonly used 'glyphosate followed by paraquat' system is still open to failure.

For weeds that have a natural tolerance to glyphosate, the double-knock has provided growers with an excellent tool to take two swipes at weeds like fleabane, sowthistle and feathertop Rhodes grass and achieve a greater level of control.

NSW Department of Primary Industries weeds researcher, Dr Md Asaduzzaman (Asad) has uncovered disturbing evidence of double-knock resistance in tall fleabane (*Conyza sumatrensis*) samples collected during weed surveys funded by the Cotton Research and Development Corporation (CRDC).

"Our surveys in 2016 and 2017 showed that cotton fields were generally weed-free but herbicide resistance is building in weeds along farm roadsides, drains and channels and around infrastructure," he said. "We identified two tall fleabane biotypes that have resistance to glyphosate, paraquat and the double-knock tactic of an initial glyphosate application followed with an application of paraquat seven days later."

The rate response analysis showed that one of these biotypes is 4.9 times more resistant than the susceptible biotype, requiring 2.5 litres per hectare of Paraquat-250 to kill 50 per cent of the plants from the resistant population compared to just 0.5 litres per hectare to achieve the same result in the susceptible population (see Table 1).

While this level of resistance is generally considered 'moderate' it is clear that resistance is building and must be taken very seriously given the importance of the double-knock tactic in most cotton and grain production systems in Australia.

First to be identified in Australia

These two populations, collected near Nandi, Queensland and Coleambally, NSW, are the first paraquat-resistant tall fleabane to be identified in Australia (Figure 2). Resistance to paraquat in this species has previously been recorded in Japan, Sri Lanka and Taiwan.

"Although the tall fleabane plants from these two populations showed signs of herbicide damage, such as narrowing of leaves and slow growth, when the double-knock was applied, they were able to survive and produce seed," said Asad. "This species produces a large quantity of seed, germinates quickly and the seed can travel over 10 km in the wind so dispersal of paraquat/glyphosate resistance traits will be impossible to contain."

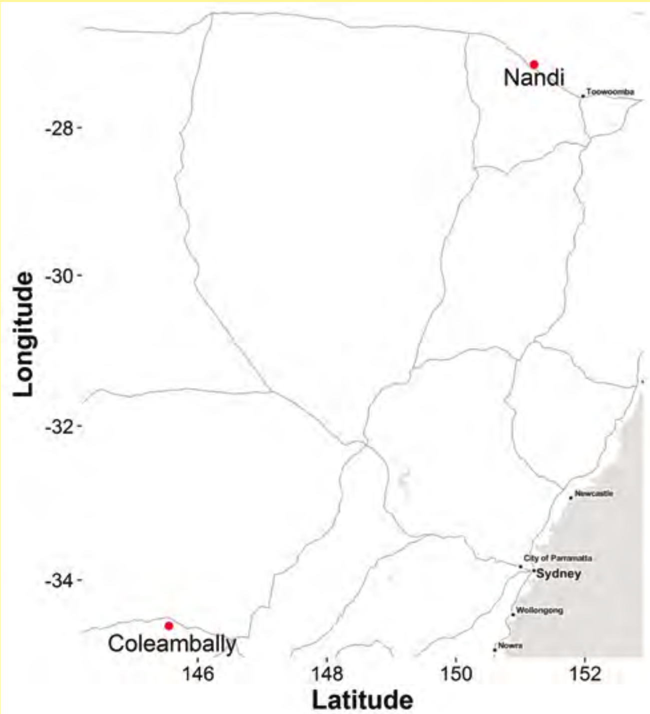
TABLE 1: Resistance levels of tall fleabane screened against paraquat, glyphosate and glyphosate + paraquat

Tall fleabane biotype	Percentage of plant survival under:		
	Paraquat 250 @ 2.0 L/ha	Glyphosate 540 @ 1.2 L/ha	Glyphosate followed by paraquat (double knock)
TFB01	>75	100	75
TFB02	75	75	75
TFb-S	0	0	0

NOTE: (R-resistant > 50% survival; DR-developing resistance < 50% and > 20% survival; and, S-susceptible < 20% survival)

NSW Department of Primary Industries weeds researcher, Dr Md Asaduzzaman (Asad) has uncovered disturbing evidence of double-knock resistance in tall fleabane samples.

FIGURE 1: Nandi (southern Qld) and Coleambally (southern NSW) are the first conformed Australian locations for paraquat resistant tall fleabane



This discovery makes tall fleabane the second species in Australia to have confirmed resistance to both glyphosate (Group M) and paraquat (Group L) – the first being a population of annual ryegrass identified in Western Australia in 2013.

Having demonstrated resistance to the dual application of these herbicides in the otherwise effective double-knock tactic is cause for great concern.

Weed populations take longer to evolve resistance to paraquat and glyphosate compared to some other modes of action, but it will happen after years of regular applications without survivor control.

Like other fleabane species, tall fleabane is susceptible to crop competition but flourishes in poorly competitive, wide-row crops such as dryland cotton.

Wider range of tactics needed

Combatting herbicide resistance and keeping weed numbers low will require the implementation of a wider range of weed control tactics rather than relying heavily on the double knock tactic.

"Growing more competitive crops and using a wider range of pre- and post-emergence herbicides and strategic tillage will help manage this weed," said Asad. "Above all is the need to monitor and remove any survivor weeds in line with the cotton industry's weed control strategy of '2 + 2 and 0' that recommends two non-glyphosate tactics in-crop plus two non-glyphosate tactics in the fallow and zero survivors."

In other research Asad is testing the opportunities for growers to use cover crops to create additional opportunities for herbicide rotations, run down the seed bank and delay the adaption of weed populations by reducing the frequency of single modes of action herbicide use.

Paraquat resistance has previously been confirmed in 10 species in Australia, including flaxleaf fleabane (*Conyza bonariensis*).

For more information about managing herbicide resistant weeds, visit the Weedsmart website: *www.weedsmart.org.au*

WeedSmart is an industry-led initiative aimed at enhancing on-farm practices and promoting the long term sustainability of herbicide use in Australian agriculture. Australian research partners, commercial entities, Government, advisers and growers have joined forces to ensure weed management remains at the forefront of global farming practice. Viable herbicide use will help secure the weed control productivity gains made by the current generation of Australian farmers. ■

Tall fleabane seedlings 28 days after the double knock (glyphosate + paraquat) tactic was applied.

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CNH INDUSTRIAL CAPITAL

Spoiled rotten – the sequel

■ By Peter Newman – Australian Herbicide Resistance Initiative

"We used to have to get up out of the shoebox in the middle of the night and lick the road clean with our tongues, eat half a handful of freezing cold gravel for dinner working 24 hours a day at the mill and when we go home our dad would slice us in two with a bread knife. And you tell that to the young people of today and they won't believe you." – Monty Python.

Peter Newman.

FOUR years ago, we suggested in AHRI insight that farmers were spoiled for choice with five harvest weed seed control (HWSC) tools to choose from with a sixth in development. Well, a lot has happened since then. Back in 2014, we had a tow behind Harrington Seed Destructor and what we now call "chaff lining" was called "windrow rotting".

We now have seven harvest weed seed control tools to choose from – see Table 1 – so if farmers were spoiled for choice in 2014 they are absolutely spoiled rotten now!

We thought it high time to update you on all of the choices that farmers have to choose from when it comes to HWSC along with what we now know about the cost of operating the various HWSC tools.

There's now something for everyone!

"We used to have to get up in the middle of the night half an hour before we went to bed, check the weather on the internet, and go out into the freezing cold to burn narrow windrows, hold a firebug out the window of the ute until our arms fell off, and if the fire got away we had to call all of our neighbours and go and fight it. And you try and tell that to the young farmers of today and they won't believe you".

How much does HWSC cost?

To work this out we need to decide on farm size and crop yield. This will, of course, vary for every farmer and by giving you the numbers you'll be able to make a more accurate estimate for your farm.

TABLE 1: A snapshot of the seven HWSC options

	Windrow Burn	Chaff Cart	iHSD	Seed Terminator	Bale Direct	Chaff Tramlining	Chaff Lining
Capital cost	$0 to $500	$30,000 to $85,000	$160,000	$120,000	$340,000	$15,000 to $20,000	$200 to $5000
Nutrient cost	High	Moderate	Nil	Nil	High	Moderate	Moderate
Controlled traffic farming (CTF) required	X	X	X	X	X	✓	X
Best suited to	Canola/pulses and low rainfall	Everywhere – good with sheep	High production	High production	Market for bales	Controlled traffic farming	Everywhere, harvester must be CTF
Negatives	Nutrient removal, burning	Burning	Cost maintenance	Cost maintenance	Nutrient removal, market access	Weeds still in paddock, CTF only	Weeds still in paddock, some poor crop establishment in chaff lines
Positives	Low cost of entry	Cost effective, whole farm, sheep feed	Residue retention, whole farm	Residue retention, whole farm	More profit if market for bales	Cheap, easy, whole farm	Cheapest, easy, whole farm

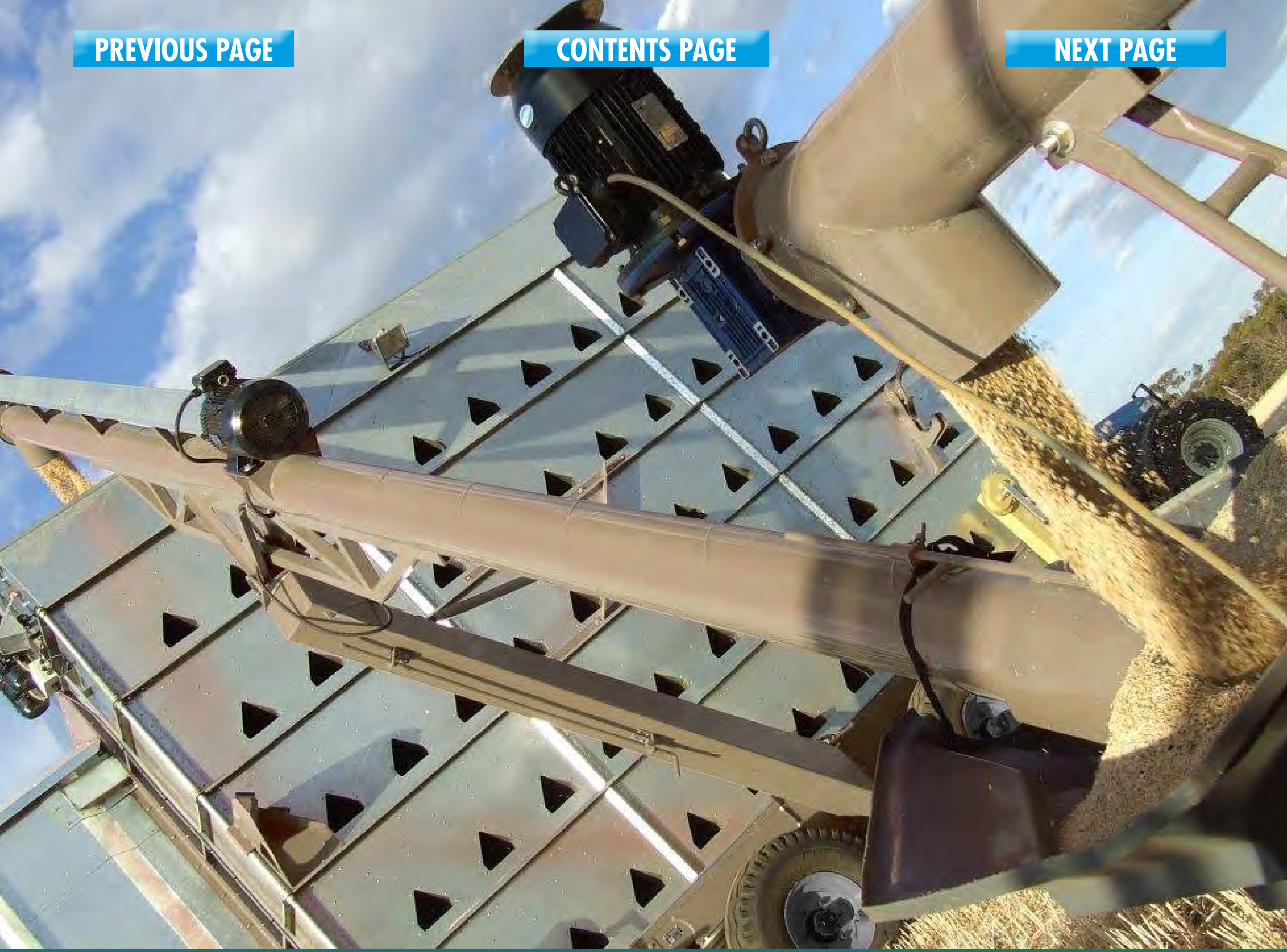

TABLE 2: How much does HWSC cost?

	Windrow Burn	Chaff Cart	iHSD	Seed Terminator	Bale Direct	Chaff Tramlining	Chaff Lining
Capital cost	$500	$80,000	$160,000	$120,000	$340,000	$20,000	$5000
Depreciation (10% per year)	$50	$8000	$16,000	$12,000	$34,000	$2000	$500
Depreciation ($/ha)	$0.02	$2.67	$5.33	$4.00	$11.33	$0.67	$0.16
Extra fuel (L/t)		0.2	1.5	1.5	0.4		
Extra fuel ($/ha)	0	$0.55	$4.12*	$4.12*	$1.10	0	0
Annual repairs and maintenance	0	$2000	$9000	$9000	$9000	$500	0
R & M ($/ha)	0	$0.67	$3.00	$3.00	$3	$0.16	0
Reduction in harvest capacity	0	5%	16%*	16%*	16%	0	0
Reduction in harvest capacity ($/ha)	0	$1.67	$5.33*	$5.33*	$5.33	0	0
Nutrient removal cost ($/ha)	$20.62	$6.25	0	0	$20.62	$6.25	$6.25
Burning cost (labour $/ha)	$2.00	$1.00	0	0	0	0	0
Total cost ($/ha)	$22.64	$12.81	$17.78	$16.45	$41.38	$7.08	$6.41
Income from bales ($/ha)					$75–$125		

*Note: Future developments in mill technology is likely to lead to reductions in power consumption.

The assumptions we have used are:

- Crop area: 3000 hectares;
- Average wheat yield: 2.5 tonnes per hectare;
- Nutrient cost: $2.50 per hectare per tonne wheat harvested for options that remove only the chaff fraction and $8.25 per hectare for options that remove straw and chaff.
- Fuel cost: $1.10 per litre; and,
- Cost of harvester operation: $400 per rotor hour. Includes depreciation, fuel, labour, repairs etc operating at 30 tonnes per hour.

A few explanatory notes on our estimation of costs

We don't know the true depreciation cost of these tools. Ten per cent depreciation was used as this is an industry standard used by farm consultants for farm machinery depreciation.

Windrow burning appears to be low cost until we factor in the nutrient cost. Estimating nutrient cost is not straightforward!

Firstly we have only counted half of the total value of nutrients as we know that not all of the nutrients retained in the residue are available to following crops. If we count all of the nutrients we can double this number. Some soils have very high potassium levels, so we could roughly halve the nutrient costs on these soils. In some cases, removing some residue can reduce nitrogen tie up and actually reduce nitrogen costs.

When you line up all the HWSC options, we really are spoiled for choice!

At the end of the day, some nutrients are lost or redistributed in narrow windrow burning and the cost estimate that we have used is just that, an estimate.

The nutrient cost of chaff cart, chaff tramline and chaff line may possibly be removed for growers who are grazing these paddocks as sheep redistribute the nutrients – but not the weed seeds – to the rest of the paddock. Only one to three per cent of weed seeds survive passage through the sheep gut. This could make chaff lining and chaff tramlining almost free, but a word of caution – we need to measure this to confirm.

The running costs of the seed destroying mills were taken from the Kondinin Group report and have been made available via WeedSmart. This is an excellent report and is highly recommended for anyone considering adopting Harvest Weed Seed Control.

The numbers used for the bale direct are very much a rough estimate only.

The capital cost of the chaff line system was taken from the commercial kit that is sold by Westoz Boilermaking. They make an excellent, reliable product. Many growers are modifying their own harvesters at very low cost.

The capital cost of chaff tramlining was taken from the EMAR chaff deck that is sold by Primary Sales. The cost of the chaff deck varies a little between different harvester makes and model. The $20,000 capital cost that we have used is at the upper end of this cost.

Which of these seven tools are Australian grain growers adopting?

A GRDC funded grower practices survey led by Rick Llewellyn from CSIRO surveyed 600 grain growers after harvest 2014. The survey showed that 43 per cent of grain growers were using Harvest Weed Seed Control, with narrow windrow burning being the most popular practice making up 30 of the 43 per cent.

These are very encouraging levels of adoption, but if we do the maths based on what percentage of their crop that growers said they were treating with HWSC it works out that only about 15 per cent of the Australian grain crop is treated with one of the HWSC tools.

A short online survey was conducted by WeedSmart and promoted on Twitter in 2017. These results may have a little bias as it was completed by growers who were already following WeedSmart Figure 1.

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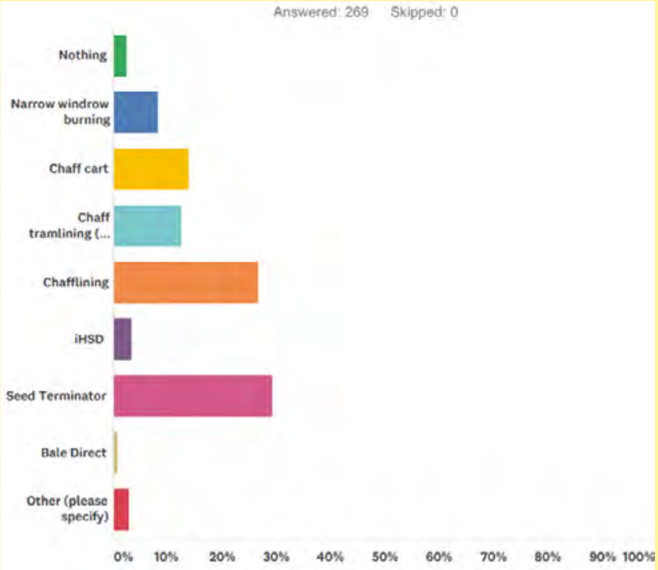
FIGURE 1: Which harvest weed seed control tool do you plan to be using in three years time?



But the results were extremely encouraging and show that many grain growers are moving away from doing nothing and windrow burning and are planning to adopt chaff lining, chaff tramlining or one of the seed destroying mills.

This is a positive result as these tools remove the need to burn, have less nutrient drain, and are tools that can be adopted over an entire cropping program.

A bold (but believable) statement

Based on all of this, we believe that harvest weed seed control could be practised by 80 per cent of Australian grain growers over at least 50 per cent of the entire Australian grain crop by harvest 2021.

And you try and tell that to the young farmers of today and they **will** believe you!

The decision questionnaire

Sometimes too many choices can be a bad thing as it makes decision making harder. Below are a few questions that growers can use to help choose between the systems available.

- Is your farm in a fully matched controlled traffic system where the harvester runs on permanent tramlines? If yes, consider chaff tramlining or chaff lining. But be aware that we're currently relying on anecdotal evidence of their efficacy. Growers using the systems are very happy and the demand for the 'Chaff Deck' is evidence that this is a popular system.
- Are your soils responsive to potassium fertiliser? If yes, there is a large hidden cost for narrow windrow burning and bale direct due to the large amount of potassium contained in straw. The seed destroying mills are ideal for these soils and the residue retention makes it cost-effective when the cost of nutrients are considered. The chaff cart, chaff tramlining or chaff lining options have lower potassium removal than windrow burn or bale direct. It's best to speak with your agronomist about this.
- Do you have sheep? Sheep are not very compatible with narrow windrow burning as overgrazing can spread windrows and create many firebreaks in the windrows. The seed destroying mills are likely to reduce the grazing value of stubbles (yet to be measured). The chaff cart may be a great option. Some growers are grazing chaff dumps with great success. Grazing may also work well with chaff lining or chaff tramlining but is yet to be measured. Anecdotal evidence is very encouraging.
- Do you have a ready market for large amounts of straw close to the farm? Bale direct may be the best option. Growers considering this option must be aware of the logistics involved in handling thousands of bales and careful consideration should be given to nutrition and the straw price required to make this system viable. Find out more about bale direct via WeedSmart and the Glenvar Harvest video.
- Are you a low rainfall grain grower with a low cost production system? Windrow burning, chaff deck and chaff lining are the lowest cost systems. But there are hidden costs of nutrient removal, particularly potassium, which should be given careful consideration. The chaff cart is also cost-effective in these areas.

On that note...

It's fantastic to have choices and we largely have grain growers to thank for developing seven harvest weed seed control systems. There's little doubt that innovative grain growers will be dreaming up new systems that we'll research in the future. What a fantastic world we live in.

Perhaps being spoiled rotten is not such a bad thing and it's actually sheer luxury!

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What's hiding in your stored grain?

■ By Philip Burrill, Greg Daglish and Manoj Nayak, Queensland Department of Agriculture and Fisheries

ON-FARM grain storage has become a significant component of many Australian cropping operations. Grain producers are acutely aware from past experience that it is not safe, to simply store and forget grain held in storage for future sales, stockfeed or planting seed.

Recent field trials conducted at the Hermitage Research Facility in southern Queensland highlighted a feature of storage pests that can cost us dearly due to the old problem of 'out of sight out of mind'.

The four key strategies that tend to provide successful grain storage results are:

- Regular monthly monitoring;
- Good storage hygiene;
- Well managed aeration cooling; and,
- Effective fumigations when pests are found.

One of the enduring rewards from managing storage facilities well, is establishing a 'good reputation' over time as a reliable supplier of quality grain. This leads to both formal or informal preferred-supplier partnerships with grain buyers and traders, providing tangible and profitable benefits.

Grain sales are not the only rewards. Looking after planting seed in storage, to maintain seed germination and vigour, will always provide rewards through improved crop establishment in the paddock.

So keeping a close eye on what is going on with grain in storage, both in terms of grain quality and potential problems with insect pests, is crucial for all grain producers.

The lesser grain borer is fast and destructive

While there are six or seven common storage pests found throughout Australia, the lesser grain borer (*Rhyzopertha dominica*) has a reputation as a hidden, destructive pest, rapidly destroying grain in storage.

The lesser grain borer has a reputation for causing serious damage to stored grain.

The small 3 mm long, dark brown adult beetle lives for two to three months and is known to be a strong flier capable of travelling more than one or two kilometres.

Each female beetle lays 200–400 tiny eggs in the grain, only 0.6 mm long and 0.2 mm in diameter. The life cycle – from egg, larvae, pupae through to adult beetle – is completed in as little as four weeks when grain temperatures in storage are around 30 to 35°C. These temperatures are not uncommon during our warm harvest time conditions.

Both larvae (grub stage) and adult beetles eat out the inside of each grain leaving hollow shells and grain dust.

Storage pest behaviour

"I can see weevils in my grain" is a statement we are all familiar with. But what is hiding in your grain is what we don't see! Understanding a bit about storage pest behaviour helps us out here.

Under some conditions, storage pests can be fairly easy to see. If they are in very large numbers and ambient conditions

The natural habitat of flat grain beetles (pictured) and lesser grain borers is to stay hidden in grain. Unless we sieve the grain and use insect probe traps, we can be completely unaware we have an infestation.

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are warm, pests will be actively moving over the grain surface or crawling over grain handling equipment. We may see them while augering grain into a truck.

Some storage pests have the ability to climb out of grain up vertical smooth surfaces. Rice weevils (*Sitophilus oryzae*), saw-toothed grain beetles (*Oryzaephilus surinamensis*) and bruchids such as the cowpea weevils (Callosobruchus spps.) have a habit of doing this.

While the rust-red flour beetles (*Tribolium castaneum*) cannot climb a smooth vertical surface, it can often be seen moving over the grain surface, particularly when it is warm.

For some of our storage pests in grain this behaviour helps us see we have a problem. Unfortunately, when we can easily see them like this, it is often far too late. By this stage, the grain is usually heavily infested with pests.

Two of our common storage pests, the lesser grain borer and flat grain beetles (Cryptolestes spps.) – which includes the rusty grain beetle – have behaviours that are completely different.

Their natural habit is to stay hidden in grain. Unless we sieve the grain and use insect probe traps, we can be completely unaware we have large numbers of them in our stored grain.

The hidden life cycle

Often when we use an insect sieve or probe trap and find one or two beetles or weevils in our sample, we have completely forgotten about the other parts of the insect's life cycle.

How many tiny eggs did that single female lesser grain borer lay in the grain? The answer is possibly 200 to 400 eggs. And how many undetected larvae and pupae are also there?

In a recent experiment, 15 grain samples were taken from each of four 30 tonne silos of wheat while augering from one silo to another.

These samples were taken back to the laboratory and all the adult lesser grain borer beetles were counted and then removed.

Grain samples from Silo 1 gave an adult lesser grain borers density of 588 per tonne.

In Silo 2, there were 250 beetles per tonne.

But in silos 3 and 4 there were no adult beetles found in the wheat sample (see Table 1).

The wheat samples were then incubated in the laboratory under warm conditions to allow time for the undetected eggs, larvae and pupae to develop into beetles over a number of weeks.

Following this incubation period, the second counting of adult lesser grain borers now showed how many immatures (egg, larvae, pupae) were hiding in the wheat that we could not see.

A pest density of nearly 60,000 per tonne in Silo 1 was hidden from detection as immature stages. This is compared to a density of 588 adult beetles we could see.

In Silos 3 and 4, we initially detected no adult beetles. The experiment showed there was in fact the start of an infestation

TABLE 1: Numbers of beetles versus undetected immatures (eggs, larvae or pupae) in four 30 tonne wheat silos

Silo	Insects per tonne	
	Beetles	Immatures*
1	588	59,413
2	250	21,913
3	0	4,220
4	0	15,533

*Samples were incubated in the laboratory until any eggs, larvae or pupae developed into beetles.

occurring with densities of 4220 and 15,533 immature stages respectavely per tonne of wheat.

This indicates that sieving and trapping adult beetles can greatly underestimate infestation levels in grain because of the undetected immatures' life stages.

Slowing or stopping the pest breeding life cycle

In the experiment above (Table 1), to hatch those very large numbers of beetle pests from the immature stages (eggs, larvae and pupae) we placed the wheat samples in special rooms in the laboratory when provided continuous, warm, high humidity conditions. This was ideal for incubating the insect life cycle.

But what realistic numbers of pests could we expect to build up in on-farm grain storages under normal day and night ambient temperatures?

In a second experiment, recently harvested wheat was placed in a one tonne bag from October 2017 to June 2018 in southern Queensland. The bag was thoroughly sampled using a grain spear and adult beetles (lesser grain borers) were counted a number of times over the nine month storage period (Figure 1).

The number of lesser grain borer beetles increased to almost 4000 per tonne by three months, then to about 30,000 per tonne by six months, with little change in numbers between six and nine months.

There are three key conditions that support rapid increases in grain pests:

- A good sheltered site with uniform conditions, such as the inside of a grain silo or grain handling equipment, including the header that sits in the shed during the off season;
- A food source, such as grain residues left sitting in a silo that may be empty, but not cleaned out well; and,
- Warm ambient conditions along with warm grain in storage encourages both grain insect flight around the farm and significantly favours rapid breeding activity.

We know for the lesser grain borer grain pest examined in

FIGURE 1: Rate of population increase of the lesser grain borer in one tonne of wheat over nine months

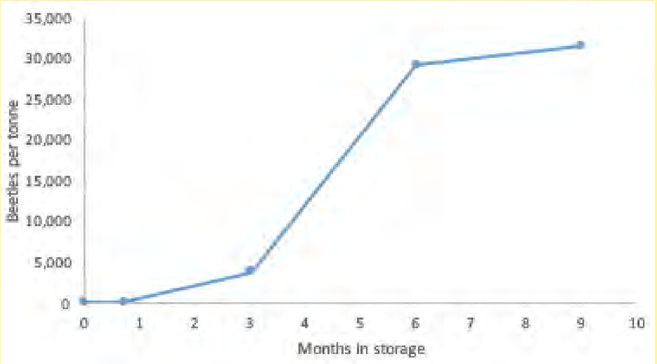
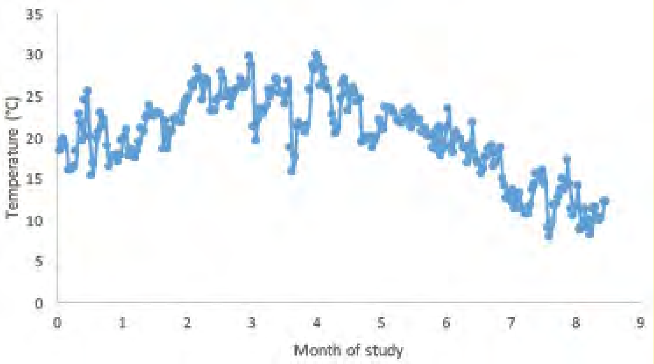


FIGURE 2: Median daily ambient temperature during our one tonne bag experiment



When a grain storage pest's natural habitat is to stay hidden, sieves and insect probe traps are needed to detect them.

our two experiments, the ideal conditions for rapid breeding are temperatures around 34°C and a relative humidity of 70 per cent.

Under these warm conditions the life cycle is quick – 25 days from egg through to the new adult beetle.

Figure 2 shows the 'median' ambient temperatures (midpoint between minimum and maximum temperatures) during the nine month period the one tonne bag of wheat was monitored for insect pests. When looking at the range of ambient temperatures during this experiment, it was common to see daily 'maximum' temperatures in the range of 27 to 37°C between mid-November and early March.

This was the period of rapid increase in lesser grain borer numbers during the experiment.

One of the most effective, non-chemical strategies we can use to slow down or stop this rapid increase in grain pests in Australia's favourable climate conditions, is to lower the grain temperatures.

Aeration cooling systems – when correctly managed – have the ability to reduce grain temperatures in storage to 18–23°C in summer and well below 15°C during winter.

Achieving these grain temperatures in storage will either significantly slow, or completely stop, any increases in the grain pest population.

For the lesser grain borer, instead of the rapid 25 day life cycle achieved at 34°C, the life cycle is slowed to 50 days when grain temperatures are lowered to 22°C.

This has a very large impact on the pest population rate of increase. At grain temperatures of 18°C and below, there will be no increase in the lesser grain borer population.

Successful grain storage results

There are clear rewards for those prepared to build a good reputation for supplying the grain quality required by the market, along with delivering grain with no pest problems.

Some key areas to focus on to provide reliable results for stored grain include:

- Hygiene – A good standard of grain storage and handling equipment hygiene is a vital starting point in keeping initial pest numbers to a minimum and reducing the risk of grain contamination;
- Aeration – With appropriately managed aeration cooling fans, grain temperatures can be reduced to assist with preserving grain quality attributes and significantly reduce storage pest numbers;
- Monitoring – Regular monthly checking of grain in storage with an insect sieve, probe traps and checking grain temperatures is vital if you are to prevent costly surprises. Pest infestations can quickly cause serious losses and damage your reputation as a reliable grain supplier;
- Storage records – Make a habit of keeping records. Identify and record pests found, any grain treatments applied, plus other helpful details of what is in each silo; and,
- Fumigation – In Australia we only have gas treatments to control insect pests in infested grain. To achieve effective control of the full insect life cycle (eggs, larvae, pupae and adults) we require a gastight – sealable silo to hold the required gas concentration for the length of time specified on the label.

For futher information: Philip Burrill, Greg Daglish or Manoj Nayak, Department of Agriculture and Fisheries, AgriScience Qld. DAF Hermitage research facility, Warwick and DAF Postharvest research laboritories, EcoScience precinct, Brisbane. Mobiles: 0427 696 500 and 0481 905 650

Emails: philip.burrill@daf.qld.gov.au, greg.daglish@daf.qld.gov.au or manoj.nayak@daf.qld.gov.au

Clean up grain storages before temperatures rise

GRAIN growers are advised to closely monitor their grain storages over the coming weeks as increasing temperatures are likely to stimulate stored grain insect pest activity.

Grain remaining on-farm from the previous harvest is a common breeding ground for pests, so growers are encouraged to regularly monitor stored grain and clean up any grain residues.

The Grains Research and Development Corporation (GRDC) Grain Storage Extension Project manager, Chris Warrick, says early detection of grain pests allows them to be identified, treated appropriately and removed before they spread and become a much larger problem.

Grain residue is an ideal pest breeding site

"Grain residues in storages or older grain stocks held over from last season provide ideal breeding sites for pests," says Chris. "Meticulous grain hygiene combined with structural treatments, such as diatomaceous earth (DE), can play a key role in reducing the number of stored grain pests."

Chris says effective grain hygiene requires complete removal of all waste grain from storages and equipment. "Pests only need a small amount of grain for survival, and those surviving populations can quickly multiply and spread when conditions start to warm up.

"One bag of infested grain can produce more than one million insects during a year, and these can easily move to other grain storages where they will start new infestations.

"Regular inspection of storages and equipment where grain is present is important – if any pest infestations are detected, they can be controlled before pests spread.

"Pests can be commonly found in empty silos and grain storages, aeration ducts, augers and conveyers, harvesters, field bins and chaser bins, left-over bags of grain, trucks, spilt grain around grain storages, seed grain and stockfeed grain."

Practical information and advice

Chris says practical information and advice on grain storage pest identification and treatment is available via the GRDC's comprehensive stored grain information hub at *www.storedgrain.com.au*. He also encourages growers and their advisers to contact their regional grain storage expert, by calling the national hotline 1800 WEEVIL (1800 933 845).

Following the recent passing of respected Victoria-based grain storage expert, Peter Botta, Chris is now the designated specialist for Victoria, South Australia, Tasmania and southern New South Wales. He can be contacted via the national hotline or email info@storedgrain.com.au.

Chris has been a part of the Grain Storage Extension team for nine years, developing information resources, co-ordinating the team and presenting workshops. He welcomes invitations for workshops to be conducted in the southern region.

The storage expert for Queensland and northern NSW is Philip Burrill (philip.burrill@daf.qld.gov.au), while Ben White (ben@storedgrain.com.au) is the expert for Western Australia. Both can also be contacted via the national hotline. ■

Grain remaining on-farm from the previous harvest is a common breeding ground for pests, so growers are encouraged to regularly monitor stored grain and clean up any grain residues. (PHOTO: GRDC)

I spy with my drone's eye, better and cheaper weed control

By Lloyd O'Connell

BACK in 2010, Ben Single of "Narratigah" Coonamble, was standing with his father John near a boom-mounted selective spray system from the late 1990s gathering dust in a shed on the family property. At the time, Ben was an inquisitive mechanical and aeronautical engineering uni student and he asked John: "How did the detect spray system work?"

After a brief consideration of the best explanation John could offer, Ben responded with a confident: "I can do that."

Half an hour later Ben had convinced Dad to back him, especially as John was not happy with the cost, operating requirements and weed detecting ability of existing sprayer-mounted systems.

The seed of *Single Shot* had been sown and Ben set about developing his own selective – and very much improved – system to map weeds in-fallow.

Eight years on and *Single Shot* is a drone (UAV) mounted and custom built sensor capable of detecting and mapping weeds in-fallow with excellent precision and speed of field coverage.

Putting the problem before the solution

"I think a lot of people have approached drones the wrong way," says Ben. "They have data or a solution but no problem to solve. *Single Shot* has evolved because we have identified a serious and growing problem in herbicide resistance, and have set about developing a very practical technology to help tackle it.

"Early on in the piece we realised that operating a weed detection system, mounted on a sprayer, places some fundamental restrictions on the system. The added weight, cost and power requirements – as well as dust – compromised and limited what can be achieved on a sprayer.

"I wanted to divorce the weed detection system from the

The second prototype: The *Single Shot* sensor unit is mounted under the drone.

THE FARM AND PEOPLE BEHIND THE PROJECT

Narratigah is a 6500 hectare dryland cropping and beef operation located 50 km south east of Coonamble in northern NSW. Annual average rainfall is 530 mm (with only 555 mm in the past 24 months – the driest two-year period since 1874).

Soils are predominantly grey and self mulching. Cropping was introduced in the late 1950s with the area gradually increasing to the present day 4500 hectares. By 1991, Narratigah was a totally zero till, controlled traffic farm.

The cropping system today is water responsive driven by water models and planting trigger points. The rotation is largely driven by this water model/trigger point system and includes wheat, durum, barley, chick peas, faba beans, mustard, canola, sorghum and opportunity cotton.

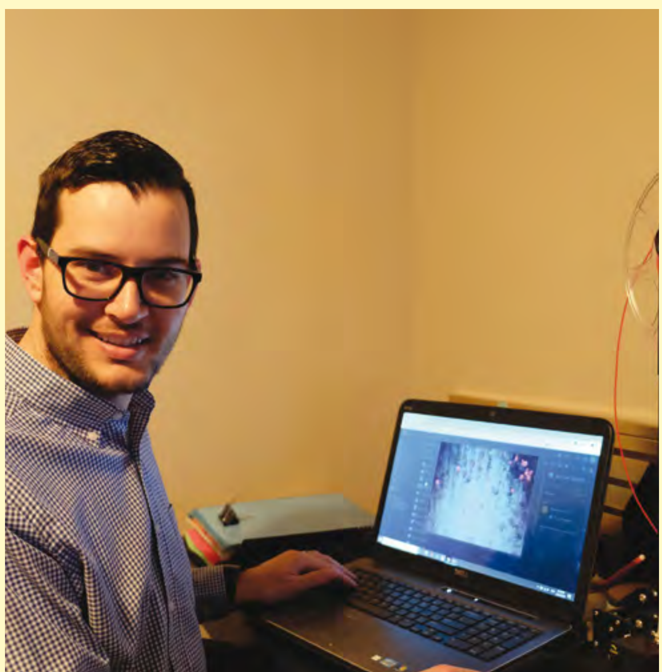
The Single family has held the property since around 1920.

The people

John Single is an innovative farmer having won several prestigious awards in his 30-plus year career on Narratigah.

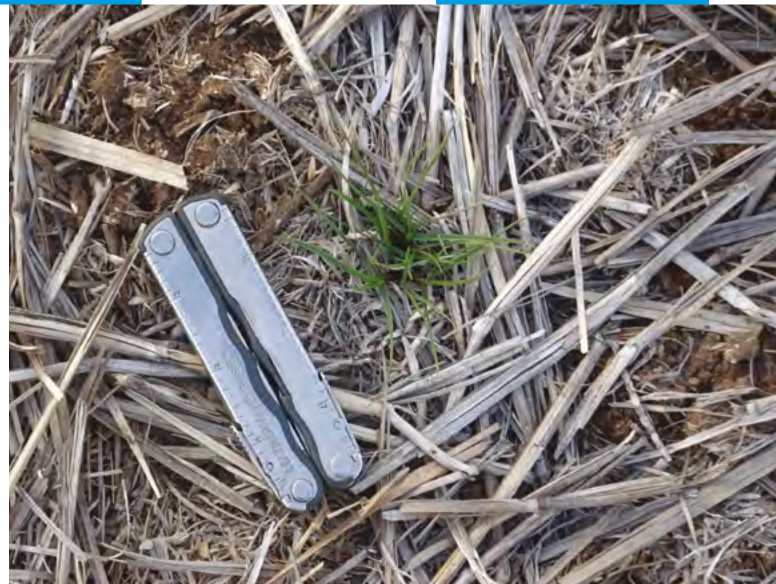
John and Mary Single's son Tony, is Narratigah's cropping manager. Tony has previously worked as a trials' agronomist with a "take no prisoners approach to weed control". Tony is also active in local grower groups and organisations.

Ben Single, the inventor of Single Shot, has a Bachelor of Mechanical & Aerospace Engineering (with Honors). Ben is working as a professional engineer/project manager.



Ben Single, the inventor of *Single Shot*.

The sensor unit weighs 3 kg. The future prototype will be capable of extended flight times in the field.



The system has shown the potential to detect ryegrass plants of this size at an altitude of 60 metres. The coverage rate at 60 metres is around 260 hectares per hour. With this type of technology, there will be a trade-off between coverage rates and weed size detected.

sprayer and then link (or overlay) the location of the weeds back to the sprayer via a weed map. A very good technique to achieve this was to mount a sensor on a drone," explains Ben.

After many hours of design, consultation and in-paddock trials working with mechatronics and UAV specialists, Ben considered the initial sensor and drone prototype to be unsuited to the task at hand. Key problems were the slow processing time of the enormous amount of geolocation data after flights as well as the low number of hectares per hour achievable in each flight due to the hi-resolution images required to detect small weeds.

The second prototype

Ben approached Robotics Systems, a mechatronics and UAV development company, to help design and build a weed sensor which would overcome these initial problems.

After hundreds of man hours and nearly 600 flights testing and developing the technology – and with no major mechanical failures or bird strikes – the *Single Shot* prototype was ready.

After a huge team effort, the first weeds were very successfully spot sprayed on Narratigah on September 19, 2018

Advantages over the initial prototype include:

- *Single Shot* aims to process data at the same speed as the mapping device can be flown. And with a standard Windows 10 laptop, usable weed maps are available shortly after a flight;
- Ground control points are not required; and,
- The current prototype is capable of covering up to 250 plus hectares per hour. But the system is also scalable and it is estimated that in the future, coverage rates of 750 to 1000 hectares per hour can be achieved while detecting weeds at one cm resolution.

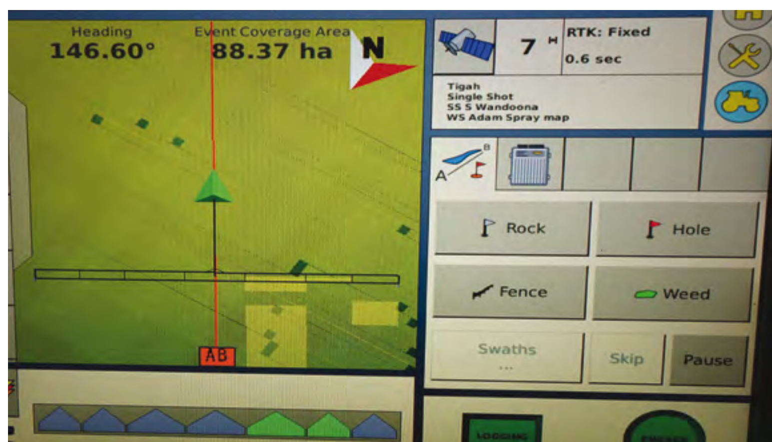
How are weed maps generated?

In very basic terms, the *Single Shot* sensor identifies green on brown and subsequently produces a weed map (a series of shapefiles) directly useable by spray controllers.

A 'hole' in the shapefile indicates a weed has been detected at that exact location. The spray controller then does its job by activating the corresponding section of the boom as the sprayer passes that location (see screenshot photo below).

Weed mapping advantages

Ben believes that the advantages of weed mapping will grow



A weed map generated by ***Single Shot*** loaded on to the Trimble GPS boom spray controller used on Narratigah. It shows the tractor (green arrow) followed by the boom. The solid areas have no weeds and the holes are weeds. The system automatically sprays over the holes in the map as the GPS see these holes as being missed spray areas. This screenshot shows two right hand sections spraying weeds.

THE NEXT STEPS

- The Singles have more work to do with the current *Single Shot* prototype which will include commercial applications of spot spraying. But they have clearly demonstrated the fundamental process of flying over an area, through to selectively and efficiently spraying that area.
- They are currently negotiating with investors to help them build the next prototype which will be designed as a forerunner to a commercial product.
- Contact Ben Single at bensingle@tigahfarming.com.au

as we learn how to use it. "It will be like owning a front end loader," he says. "You don't know how good it is until you have one and more uses will become apparent over time."

Just some of the weed mapping benefits and uses Ben identifies include:

- Reducing the amount of chemical that is used;
- Out-performing existing boom mounted spot sprayers in cost of application, weed identification and stubble occlusion;
- Existing sprayers can spot spray with GPS controlled sections;
- Weed maps will provide a history of where weeds are;
- Maps can be built on over successive germinations;
- The capacity to treat weeds by their size;
- Having the ability to scout for weeds, identifying those that may have escaped a blanket spray application (ie are resistant) and so can be controlled before they become a patch of weeds;
- Providing the mechanism for differing types of selective control from a hoe through to cultivation or robots;
- Linking in with other available GPS technologies such as prescription and elevation maps;
- To map weeds such as barnyard grass over the summer months. A perimeter could then be added to the mapped areas and pre-emergent herbicides could be selectively sprayed at those locations. This would reduce herbicide costs as well as help to overcome plantback problems; and,
- Once a weed map is produced, the operator is not restricted by light conditions as to when they choose to use it. ■

The *Single Shot* team (standing L to R) Adam Amos Director Robotic Systems, James Alford, Tony Single and John Single. Seated (L to R) Oliver Bamford, Ben Single and Sam Farquhar.

Innovative plant breeding could mean drought tolerant crops

By Dennis O'Brien, Agricultural Research Service – USDA

AT A GLANCE

A new technology is being used to boost resistance to a disease in potatoes that can destroy entire fields and often requires growers to repeatedly spray fungicides.

The technology also may be used to breed improved varieties of many other important crops.

AGRICULTURAL Research Service (ARS) scientists in Albany, California, have found a way to streamline the process that scientists use to insert multiple genes into a crop plant, developing a reliable method that will make it easier to breed a variety of crops with vastly improved traits.

The technology is expected to speed up the process for developing new varieties of potatoes, rice, citrus and other crops that are better equipped to tolerate heat and drought, produce higher yields and resist a myriad of diseases and pests.

Crops with greater resistance to pathogens and insects could greatly reduce pesticide use and prevent billions of dollars in crop losses.

"Making genetic improvements that were difficult or impossible before will be much easier because we can now insert not just one or two genes, but multiple genes, into a plant in a way that will lead to predictable outcomes," said Roger Thilmony, an ARS molecular biologist in Albany.

A paper describing the achievement by Roger, James Thomson, an ARS geneticist in Albany, and Ray Collier, a former ARS postdoctoral researcher, was published in the August 2018 issue of *The Plant Journal*.

The GAANTRY gene stacking technology will be freely available to anyone interested, and a commercial firm is planning to use it to introduce multiple genes into potatoes to make them more resistant to late blight, which is caused by a fungus-like organism.

Late blight can destroy entire fields and force some farmers to spray fungicides up to 15 times a year.

"We have struggled to put multiple late blight resistance genes into potatoes for years. They are very long, complex genes, and with existing technologies it's been extremely difficult. But the GAANTRY technology will help us tremendously," said Craig Richael, a director of research and development for J.R. Simplot Co., an Idaho-based company that produces French fries, frozen vegetables, fertiliser, turf grass seed and other products.

Ray Collier, who is now research manager of molecular technologies at the Wisconsin Crop Innovation Center, also plans to promote use of the technology among agricultural scientists and plant biologists.

Multiple gene insertion is notoriously difficult

Scientists over the years have modified the genetics of soybeans, corn, canola and other crop plants to develop varieties that tolerate specific herbicides and resist insect pests.

But those traits were controlled by one or two genes, and in most crop plants, important traits such as cold and drought tolerance, yield and seed production are almost always controlled by multiple genes. Inserting more than two or three genes into the same site on a plant chromosome has been notoriously difficult.

The researchers' unique platform stabilises large "stacks" of DNA needed for conferring key traits, allowing researchers to insert suites of genes "so precisely that no unintended DNA is added or lost during the process," says James Thomson.

"Before this, assembling 10 genes to insert into a new line would be difficult or impossible, but this technology basically stabilises the stack and makes for results that are more stable and much easier to predict," Roger Thilmony said. ■

The breakthrough GAANTRY technology can be used to introduce multiple genes into potatoes – as well as grain crops – to breed more disease and drought tolerant varieties. (PHOTO: Scott Bauer)

Dryland cotton: Risks and rewards

By Cotton Seed Distributors Extension and Development Team

DESPITE the dry conditions, current cotton prices are making dryland cotton a very attractive option for the 2018-19 season.

According to the ABARES returns to Australian cotton growers are forecast to reach the highest levels in 16 years.

- Ex-gin cotton returns to Australian growers are forecast to reach $656 per bale in 2018–19. If realised this would be the highest return in real terms since 2003–04.
- Rising world demand and populations are boosting demand for cotton.
- China is importing high-quality cotton to complement its government's release of lower quality stocks.

In the event of a late spring break, the potential remains for a record dryland cotton planting with large tracts of fallowed ground carried over from a small winter crop this year.

Dryland cotton Vs sorghum

Table 1 shows the actual yields and estimated returns for a dryland cotton grower located between Goondiwindi and Moree, who uses both dryland cotton and sorghum in their rotation.

Annually, the farm has areas sown to both crops, based on a five-year rotation program.

Some comments about the comparisons:

Yield – actual farm averages for both crops in a similar planting window.

Prices – actual farm prices after premium/discounts. Cotton includes seed proceeds and discounts or premiums.

Variable costs – Using CSD's Dryland Gross Margin Budgets.

Row configuration – Cotton: double skip;
Sorghum: solid (1 metre).

TABLE 1: Average dryland cotton Vs sorghum gross margins, 2007–2017

10 year average	Cotton	Sorghum
Yield	3.45 b/ha	3.40 t/ha
Price	$481 per bale	$223 per tonne
Variable costs/ha	$925	$424
Gross margin/ha	$756	$320

DRYLAND COTTON – LESS RISK

Some key considerations when evaluating the crop:

- Strong prices;
- Improved CSD varieties containing Bollgard 3 and Roundup Ready Flex biotechnology;
- Monsanto's End Point Royalty payment scheme; and,
- CSD's Industry Support Program.

It should be noted that the yields, growing costs and commodity price fluctuate from season to season. The average yield for the cotton is 3.45 bales per hectare with a range of 1.5 to 5.6 bales (higher yields when rain fell in the New Year).

The average yield for sorghum is similar in tonnes, at 3.40 tonnes per hectare (higher yields when rain fell before the end of December).

What does this analysis tell us?

- Dryland cotton in this rotational cycle is 58 per cent more profitable than sorghum (over the past 11 summer seasons).
- It highlights the importance of having dryland cotton in the rotational program each year to ride out the difficult years and take advantage of the years when price and seasonal conditions combine.

Current prices make dryland cotton a very attractive option – if we get rain!

- A mixture of both cotton and sorghum in the summer rotation program provides opportunity to benefit from in-crop rainfall – whenever it falls in a particular season. It also is an avenue for disease and weed breaks which are important in modern farming practices.

Over a full rotational cycle, cotton's profitability has been proven to surpass other rotational options as long as costs are kept in check and reasonable yields and quality are achieved.

Critically, it should be noted that soil moisture is the limiting resource for all dryland farmers regardless of what crop is grown.

The profitability of a particular crop is dependent on its ability to turn soil moisture into yield and therefore returns. In essence we are farming soil moisture. The aim should be to get the best return from every millimetre of moisture available.

Comparison of planting and picking price

It's important to note that commodity prices at planting time have a large influence on the crop chosen. Dryland cotton growers cannot forward sell with the surety that their irrigated counterparts have, due to their reliance on seasonal rainfall.

Australian cotton production has very little influence on the international price of cotton. Cotton prices can fluctuate largely throughout the growing season where international forces and the Australian dollar can alter the price on a daily basis.

TABLE 2: Comparison over 12 years of cotton prices at planting Vs final prices received post harvest

Planting year	Lint price ($/bale) at Sept 1	Farm return post-harvest ($/bale)
2006	403	401
2007	432	435
2008	404	475
2009	400	494
2010	519	514
2011	495	491
2012	400	467
2013	502	525
2014	412	518
2015	484	430
2016	504	545
2017	503	580

NOTE: Cottonseed receipts not included.

Choice of variety

Growers should choose a dryland variety with a proven track record in yield and fibre quality over a range of seasons.

The varieties offered by CSD have varying season lengths, depending on where and when planting will take place.

TABLE 3: Variety performance comparison spanning three years and eight regions and a total of 61 trials

	Sicot 746B3F	Sicot 748B3F	Sicot 714B3F
Yield (bales/ha)	3.23	3.21	3.19
Length	1.07	1.10	1.08
Micronaire	4.2	4.3	4.2
Strength	28.8	29.3	28.7
Turnout	41.8	40.5	39.2
Uniformity	78.1	79.5	79.5

The CSD Variety Comparison Tool compares yield and quality data from all CSD dryland variety trials over several regions and growing years. Table 3 illustrates the output of this tool, tabulated to show the performance of Sicot 748B3F, Sicot 714B3F and Sicot 746B3F over the past three seasons.

Standout dryland variety choices

As dryland growers are dependent on rainfall to produce yield, a variety needs to be able to respond to favourable conditions if and when they occur. The ideal variety is a vigorous, longer season variety, which will be able to hang on in dry times and then rebound and quickly put on yield when rain arrives.

Sicot 748B3F is derived from Sicot 74BRF, and offers a good yield potential/fibre quality package which is desirable in dryland production. It is a full season indeterminate variety which has a vigorous growth habit and may require growth monitoring and management to ensure plants don't get too tall.

As with all low-density varieties, care should be taken when planting this variety and an additional one to two seeds per metre be planted to ensure a desired plant population is achieved.

Sicot 746B3F also has a Sicot 74BRF background. It is a full season indeterminate variety which is best managed to reduce any stress events, which can be particularly difficult in a dryland farming setting. In CSD's variety trials, Sicot 746B3F has shown some increased sensitivity to the extreme heat of some western regions, so is more suitable to the milder conditions of the eastern growing regions. CSD dryland variety trial results have also shown a slight reduction in length compared to Sicot 748B3F.

As is the case with Sicot 748B3F, Sicot 746B3F is a low-density seed variety and will therefore require extra care and favourable conditions to achieve the desired establishment. This characteristic does however translate to an increased turnout percentage.

Sicot 714BRF has a background from Sicot 71BRF. Is a mid to full season maturing variety which has historically performed well in dryland production areas. It achieved an impressive yield result from the Bongeen variety trial in 2016/17 yielding 11.69 bales per hectare on a single skip configuration.

Sicot 714B3F has also demonstrated superior establishment in dryland conditions over Sicot 748B3F. In marginal planting conditions, Sicot 714B3F is a preferable option in terms of gaining a viable plant stand. It will be well suited in all growing regions but may offer a high yielding option for short season areas. Care should be taken in crop management immediately post flowering as this variety quickly accumulates fruit.

Amassing a high boll load in a short period of time will stress late season boll retention as well as predisposing this variety to late season premature senescence. ■

Winter pulses can compete, even without herbicide

CHICKPEAS and faba beans now have a permanent place in most northern region farming rotations and, while they offer some diversity in herbicide options, they have been considered comparatively less competitive against weeds than other crops.

Back when growers had a number of effective herbicide options available, the lower competitiveness of these pulse crops was less problematic because the herbicides were keeping weed numbers low. In the light of increasing herbicide resistance in many weeds, strong crop competition is required to do more of the 'heavy lifting' within an integrated weed management program.

Sowthistle is a major winter weed in pulse crops and growers are finding it is increasingly able to escape herbicide control, robbing the crop of valuable resources while setting huge numbers of seeds which increases weed pressure in the following season.

Dr Michael Widderick, Queensland Department of Agriculture and Fisheries principal research scientist, is leading the work on crop competition within the multi-facetted GRDC-funded 'Innovative crop weed solutions for northern region cropping systems' (US00084) project led by Dr Michael Walsh, University of Sydney.

The first round of southern Queensland data was collected for faba bean (PBA Warda) and chickpea (PBA HatTrick) trials harvested in late October 2017, at the Hermitage site near Warwick.

Common sowthistle control options

Sowthistle is a major winter weed in pulse crops and growers are finding it is increasingly able to escape herbicide control, robbing the crop of valuable resources while setting huge numbers of seeds that increase weed pressure in the following season.

There are known populations of sowthistle with resistance to glyphosate and chlorsulfuron in the northern grains region (and 2,4–D resistance confirmed in SA), making non-herbicide control tactics all the more important in driving down numbers of this moisture-sucking weed.

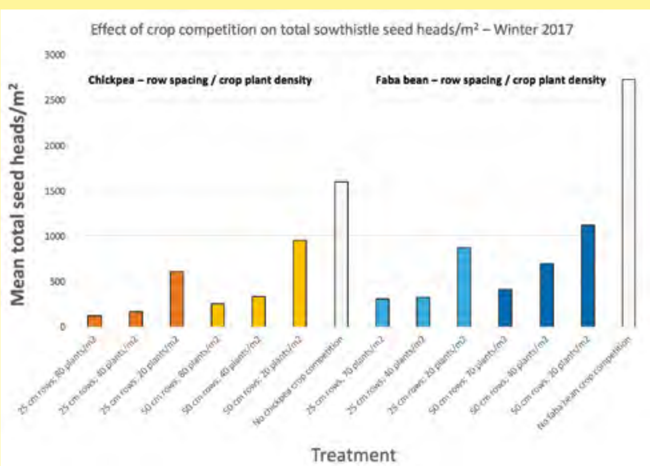
Dr Michael Widderick, DAF, is leading the crop competition work in summer and winter cereals and pulse crops within the multi-facetted GRDC-funded 'Innovative crop weed solutions for northern region cropping systems' project.

In chickpea, reducing row spacing from 50 to 25 cm cuts sowthistle biomass and seed production by about 50 per cent at a crop density of 40 plants per square metre.

"We are looking at optimal row spacing and crop density to combat common sowthistle, and also determining if more competitive crops are also higher yielding," says Michael. "The trials are being replicated at sites near Warwick, Narrabri and Wagga Wagga and will run for five years."

The faba bean and chickpea crops were trialled at narrow and wider row spacing, and low, medium and high crop densities in both weedy (sown sowthistle) and weed-free plots.

FIGURE 1: Sowthistle seed production was greatest for both crops at wide row spacing (50 cm) and low (20 plants/m^2) crop density. Seed production was progressively reduced as crop competition increased.



The sowthistle seed sown in the trials all came from the same, non-resistant population and no herbicide was applied to any of the plots.

Michael says sowthistle is definitely susceptible to crop competition, with even the least competitive faba bean and chickpea crops cutting weed biomass and seed production by at least 50 per cent compared to plots where the weed was allowed to grow free of any crop competition.

"In chickpea we found that reducing row spacing from 50 cm to 25 cm further reduced weed biomass and seed production by about 50 per cent at a crop density of 40 plants per square metre," he says. "In this trial, row spacing had no effect on crop yield but increasing plant density did generate a significant and progressive increase in yield for both chickpea and faba bean in weedy plots."

When sowthistle is present, increasing crop density from 20 to 70 plants per square metre in faba beans, or to 80 plants per square metre in chickpea, generated around 0.5 tonne per hectare yield increase. Averaged across all treatments for both crops, controlling sowthistle with crop competition alone (no herbicide applied) was worth approximately 0.25 tonne per hectare in crop yield.

To sum up

This research has measured the effect of increasing the competitiveness of chickpeas and faba bean without the use of any herbicide. On farms, growers usually have some herbicides at their disposal and other research shows that combining effective herbicides with strong crop competition is the best way to control herbicide resistant weeds.

For more information about improving pulse crop competitiveness, visit the Weedsmart website: *www.weedsmart.org.au* ■

Pushing a tropical crop into the arctic zone – risks and rewards

By Loretta Serafin[1], Mark Hellyer[1], Annie Warren[1], Andrew Bishop[1] and Michael Mumford[2]

AT A GLANCE…

- Plant establishment was significantly impacted by the super early (early August) and early (late August) sowing times when soil temperatures were between 8.4 and 12.2°C.
- Plant populations from the early August sowing were approximately half the population established from the standard sowing time (October) when soil temperatures were consistent with or greater than current recommendations of 16–18°C.
- Viable plant stands were established at sub optimal temperatures and produced higher yields than the standard sowing time at Mallawa and Breeza. Sowing sorghum into cool soils has the potential to shift the flowering window and reduce the risk of heat and moisture stress during flowering and grain fill and increase the likelihood of double cropping opportunities. But this is dependent on being able to establish the crop in a timely manner.

GRAIN sorghum is the most important summer cereal crop in NSW, providing important rotational, logistical and cash flow benefits for the northern grains region.

Many in the industry would agree that climatic variability in the past 10 years has seen an increasing trend of crop yield reduction, and sometimes failure, as a result of sorghum crops flowering and filling grain in periods of extreme heat and moisture stress.

NSW DPI and GRDC have partnered in research to evaluate options for sorghum sowing and agronomic management that challenge our current practices. This includes our accepted views on ideal sowing time and hybrid selection by comparing alternative practices which could be readily adopted by growers using current genetics and technology.

Overview of treatments and seasons

Three sites were sown in northern NSW in the 2017–18 season – Gurley (south east of Moree), Mallawa (west of Moree) and Breeza on the Liverpool Plains. At each of these sites three treatments were included:

- Varying time of sowing, based on soil temperature at 8am EST; super early (~10°C), early (14°C) and a standard (16–18°C) in an attempt to bring flowering and grain fill forward.
- Varying sowing depth; standard (3–4 cm) and deep (7–8 cm) seeding depth to chase warmer soil temperatures.
- Comparing cold tolerance of nine commercial hybrids: MR Buster, MR Apollo, Cracka, Tiger, HGS114, HGS102, Archer, Agitator, G33.

The 2017–18 season produced three distinct environments as outlined in Table 1:

- Breeza which experienced cool spring temperatures; 21 days with temperatures <0°C for the early August sowing; and warm summer temperatures 35 days >36°C;
- Gurley which had mild and wet late spring conditions (109 mm in October), warmer flowering and grain fill conditions compared to Breeza;
- Mallawa which had cool conditions for August (12 days <0°C) and then extreme heat (60 days >36°C) and dry summer conditions for December–January.

TABLE 1: Summary of weather conditions for sorghum trials sown during the 2017–18 season. Soil temperature is at 8 am across seven days after sowing.

Site	Time of sowing	Sowing date	Sowing depth	Average soil T (°C) at sowing	Mean max T (°C)	Mean min. T (°C)	In-crop rainfall (mm)	No. days ≤ 0 °C	No. days ≥ 36 °C
Gurley (NE NSW)	Super early	Aug 2	Shallow	10.8	29.8	13.7	315	2	39
			Deep	11.4					
	Early	Aug 21	Shallow	12.0	30.5	14.5	293	2	39
			Deep	12.2					
	Standard	Oct 17	Shallow	20.0	33.0	17.5	206	0	39
			Deep	19.1					
Mallawa (NW NSW)	Super early	Aug 1	Shallow	8.4	31.5	13.2	222	12	60
			Deep	10.5					
	Early	Aug 24	Shallow	9.2	32.7	14.6	222	6	60
			Deep	10.8					
	Standard	Oct 18	Shallow	18.6	35.2	17.9	149.5	0	57
			Deep	15.6					
Breeza (LP)	Super early	Aug 10	Shallow	9.7	29.3	11.6	225	21	35
			Deep	10.2					
	Early	Aug 28	Shallow	10.8	30.2	12.8	225	12	35
			Deep	11.5					
	Standard	Sept 21	Shallow	15.8	31.4	14.7	220	0	35
			Deep	15.7					

A split-split plot design was employed at each of the three sites. The data was analysed using the REML procedure in ASReml-R and the level of significance for least significant difference (LSD) testing was set at five per cent.

What we found

Plant establishment

The early August (super early) sowing times established only half the number of plants compared to the standard sowing time (Table 2) at Gurley and Mallawa. Establishment improved for the late August (early) sowing but was still less than the standard.

In addition to the lower plant populations established, the time taken for these plants to emerge was substantially longer. For example there were no plants present until three weeks post sowing at Breeza for the two early sowings and plants were still emerging up to six weeks post sowing.

There was no difference in the establishment of hybrids except at the Mallawa site where Agitator had significantly lower establishment (data not shown).

TABLE 2: Established plant populations at sorghum trials sites – averaged across treatments

Site/ established population (plants/m^2)	Super early (early August)	Early (late August)	Standard (mid Oct[1], late Sept[2])	LSD value
Mallawa[1]	1.9	2.5	4.1	0.9
Gurley[1]	1.6	2.8	4.4	0.6
Breeza[2]	3.2	3.3	5.0	0.5

Days to flowering

There was a large reduction in the time taken to reach 50 per cent flowering at the Mallawa site when moving from the super early (120–136 days) and early (105 –116 days) sowing times (Figure 1, i). The spread of flowering times between hybrids also became smaller with the later planting, from 16 down to 11 days.

Similarly, at Gurley the days to 50 per cent flowering was reduced between each of the sowing times, super early (116–132 days), early (101–116 days) and standard (66–69 days) planting dates, as was the spread between hybrids (Figure 3,ii).

This equates to flowering in late November – mid December for the super early panting times and mid-December for the early sowing time at Gurley and Mallawa. The standard sowing time flowered between Christmas and New Year and so no dates were recorded. There was a significant TOS by hybrid interaction effect at both sites. Sowing depth had no significant impact on flowering date at either site.

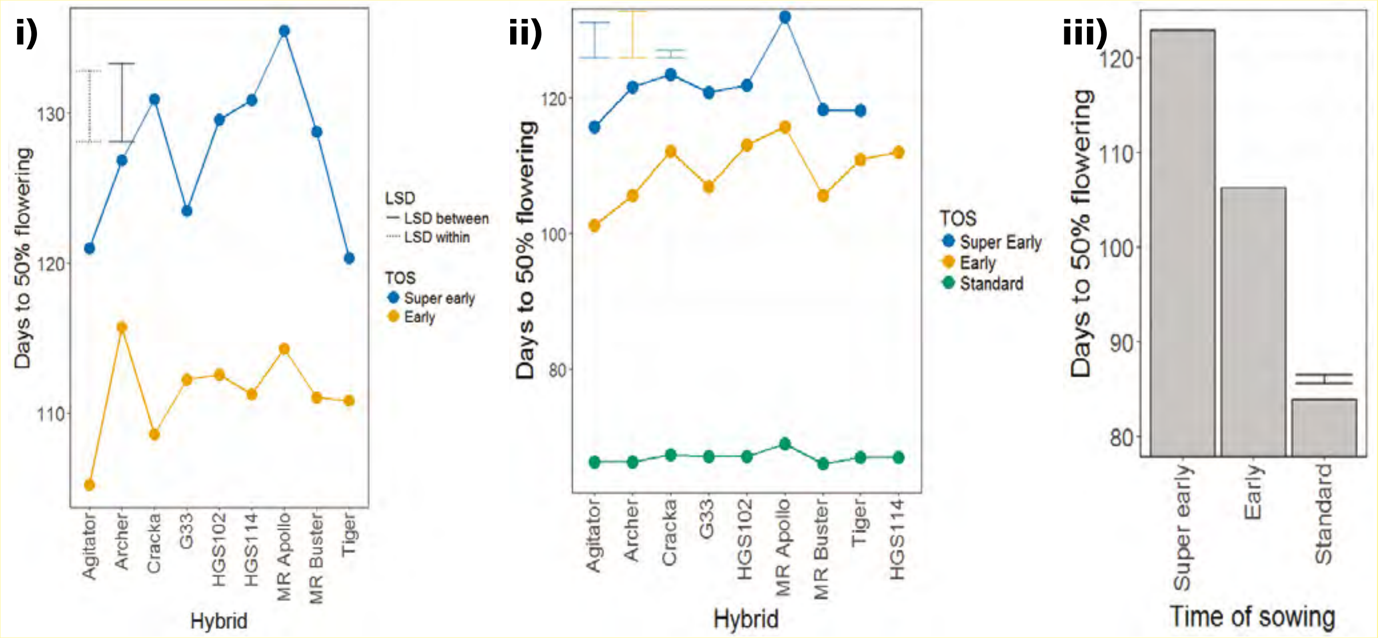
At Breeza, there was very little impact of sowing time on days to 50 per cent flowering with all three flowering similarly around early to mid-December. This is likely due to emergence being spread over an extended period at this site for the super early and early sowing times.

There was a significant hybrid effect with MR Buster and Agitator flowering much earlier than the other hybrids with MR Apollo being the slowest to reach flowering. This was a similar trend at the other two sites.

At the Breeza site only, the shallow sowing depth was quicker to reach 50 per cent flowering than the deep sowing.

In one year of trials, the benefits of deeper sowing to enable earlier sorghum emergence, were only minor.

FIGURE 1: Days to 50% flowering at i) Mallawa; ii) Gurley; and, iii) Breeza



Grain yield

Grain yields ranged from a low of 1.3 tonnes per hectare on average at Mallawa to 3.2 tonnes at Gurley and 3.4 tonnes at Breeza averaged across treatments at 0 per cent moisture content.

At Mallawa the early August (super early) and late August (early) sowing time produced higher yields than the standard sowing time despite having highly reduced plant establishment (Figure 2). There was no difference in grain yield associated with varying the sowing depth (data not shown).

At Gurley, the standard October sowing performed generally better than the early August (super early) and late August (early) treatments. MR Apollo showed no significant response to time of sowing which was similar to the Mallawa site (Figure 2). MR Buster, Agitator and Archer showed the same relationship with the standard sowing time out yielding the super early and early sowing times. G33 and HGS102 showed similar yield performance for the super early and early sowing times.

For HGS102 there was a significant interaction between hybrid and seeding depth, with the shallow seeding depth increasing yield while other hybrids had no significant response to seedling depth.

At Breeza, yields were generally higher from the early August (super early) and late August (early) sowing times compared to the September sowing even though established plant populations were only two thirds of the plant stands achieved with the standard sowing time in September (Figure 2).

There was also a significant TOS by seedling depth interaction effect with the early TOS having a significantly higher yield than the standard TOS for the shallow but not the deep seedling depth.

Archer, Cracka and MR Buster performed relatively well in terms of yield across all three times of sowing at Breeza. G33 and HGS114 performed well in the super early and early sowing times but were disappointing for the standard sowing time. Agitator did not perform well across the three sowing times at this site in 2017–18.

To sum up

Growers currently have access to a range of tools to vary the time to flowering and the conditions experienced by their sorghum crops during grain fill. But these tools are accompanied by an increased level of risk.

In this single year of research across three sites, benefits were minor from varying sowing depth to seek warmer soils for early sowing conditions.

While differences in soil temperatures between the two depths shallow and deep were detected this did not equate to improvements in plant establishment or grain yield at two of the three sites.

Sowing in early and late August at all three sites, showed that sorghum can be established at sub optimum temperatures and handle some cold (<0°C) conditions. But this early sowing time came at a significant establishment cost. Further, evaluation of the impacts of severe frosting on plant growth and survival are needed.

At Mallawa and Gurley, establishment was less than half that which occurred in the standard sowing time. Therefore a lot of seed never contributed to grain yields but an input cost had been incurred.

The impact of drying soil conditions at these two sites also needs to be considered.

In contrast, at Breeza where soil moisture was controlled through irrigation, establishment losses from the early and late August sowing were still significant but not as great as the other two sites, when compared to the standard sowing time.

At all three sites viable plant stands were established. At Mallawa and Breeza, the two early sowing times resulted in superior yields compared to the standard sowing time. At Gurley it was the opposite, most likely due to the timing of in-crop rainfall.

Flowering data has shown that it is possible to move the flowering and grain fill window to earlier in the season, provided that the time taken for crop establishment is not excessively prolonged by cool early growing conditions such as occurred at Breeza. At Breeza there was little difference in days to flowering between all three sowing times even though sowing time varied from 10th august to 21st September.

As expected, these results should be considered preliminary as they are the results of three experimental sites in one season. It is hoped that this research can be continued into the future to further validate these preliminary findings.

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC and NSW DPI. The authors would like to thank them for their continued support.

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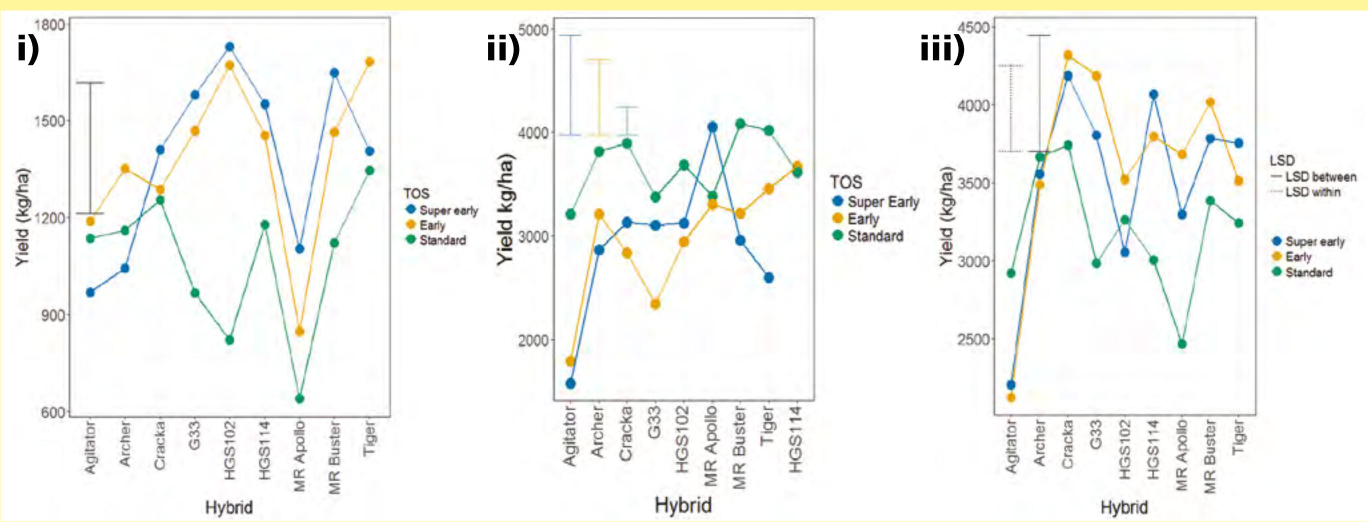
FIGURE 2: Grain yield at 0% moisture i) Mallawa; ii) Gurley; and, iii) Breeza



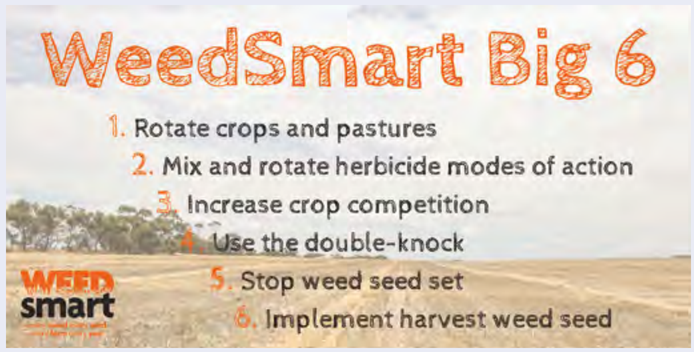
A big six points to kick weed control goals

CHRIS Davey, partner and director of YP AG at Kadina has worked with growers on the Yorke Peninsula of South Australia for over 20 years, assisting them to devise weed control programs that reduce the impact of herbicide resistance.

His group of 20 clients farm between Port Broughton and Arthurton with annual rainfall ranging from 300 to 500 mm and very diverse soil types. Chris initiated the Northern Sustainable Soils farmer group in 2007 to provide growers with the opportunity to research farming system tactics and discuss their 'fit' for the highly variable soils found on the peninsula.

"The soils here range from shallow sheetrock and limestone to grey calcareous loams, dune and swale systems to heavy red fertile clay," he says. "This variability drives many management decisions and has a direct relationship with many of our weed problems."

Chris has used resistance testing services to keep track of herbicide resistance in the main weeds, with growers managing resistance in annual ryegrass, brome grass and wild radish for some time and more recently finding milk thistle, Indian hedge



YP-AG partner and director, Chris Davey works with his grower clients including Gary Bruce (left), to plan integrated weed management programs that include as many of the WeedSmart Big 6 tactics as possible.

Lentils have provided several economic and weed control benefits to farming systems on the Yorke Peninsula but the short lentil/wheat rotation is a definite weakness when it comes to managing herbicide resistance.

mustard and prickly lettuce increasingly problematic. Annual ryegrass and brome grass on the peninsula are known to have resistance to herbicides in Groups A (fop and dim), B, D and M and wild radish is resistant to Groups B, F and I.

"This area was the home of ryegrass resistance and growers are trying hard to avoid the same blow-out situation with brome grass," says Chris. "Growers are well aware of the potential consequences if resistant brome grass gets out of hand so most are using some form of patch management and even chemical fallow in blocks where the brome grass has out-competed the crop."

In response to increasing herbicide resistance, 85 per cent of Chris' clients have adopted some form of harvest weed seed control within their weed management program. "Sixty per cent of my clients are using narrow windrow burning and 25 per cent are using either a chaff cart or chaff lining chute," he says. "In the 2017 harvest there was also one iHSD and one Seed Terminator operating here."

Chris is a strong supporter of all the tactics in the WeedSmart Big 6 and actively promotes the inclusion of all tactics in his clients' integrated weed control programs.

Crop and pasture rotation

The close lentil – wheat rotation that has dominated farming systems on the northern Yorke Peninsula in recent years is acknowledged as a weak link in terms of weed control. This rotation has led to an increase in broadleaf weeds such as milk thistle and prickly lettuce, with bifora, tares and medic also exploding in the lentil phase in some years, leaving a high weed seed bank for the following year as well as increasing the risk of herbicide resistance evolution.

Chris says the economic drivers for the rotation can make weed control decisions difficult and there is a need for other profitable rotation options that can assist in reducing weed pressure.

The main problem with the short rotation is that weeds are exposed to the same herbicide modes of action every two years. Although imi-tolerant (Clearfield) varieties have been very useful, particularly PBA Hurricane lentils – allowing the use of Group B herbicides in the crop or in previous seasons, the alkaline soils on the peninsula have expedited the more rapid evolution of Group B resistance in wild radish, mustard, milk thistle and ryegrass.

Double knock to protect glyphosate

Glyphosate resistant ryegrass is widespread on the Yorke Peninsula, primarily along fencelines but as fences are removed to form larger paddocks, there is a significant risk that the resistance gene will be spread by headers.

In 2013, the peninsula had the dubious honour of having the first confirmed case of glyphosate resistant brome grass on a farm near Maitland, and this season, glyphosate resistance in barley grass was observed for the first time on northern Yorke Peninsula.

An annual double knock application before seeding is considered very important to help protect the efficacy of glyphosate and is widely practiced on the peninsula. Sowing earlier to achieve a yield advantage and dry sowing can impact on the use of double knock.

Chris advises his clients to avoid early or dry sowing in weedy paddocks and to hold off sowing until the double knock has been implemented, even though there could be a yield penalty.

Under dry, dusty conditions most growers will choose two contact herbicides such as paraquat or paraquat/diquat rather than glyphosate/paraquat for the double knock.

Mix and rotate herbicide groups

There is a heavy reliance on pre-emergent herbicides on the Yorke Peninsula and in weedy paddocks growers need to use additional shots to drive down weed numbers to preserve yield.

In cereals, the Boxer Gold and Sakura applications are often spiked with triallate to strengthen the pre-emergent efficacy because there are no in-crop herbicide options in wheat and barley crops.

Pre-emergent herbicides are also very important in lentils as the main break crop to reduce ryegrass numbers so there is less pressure on the clethodim/Factor mix in crop.

Trifluralin susceptibility in ryegrass has been very low since the late 1990s and unless targeting broadleaf weeds like wireweed or three corner jack – is not a tank mix option.

Stop weed seed set

Chris says Yorke Peninsula growers generally use their late fungicide application in August or September to scout for weed escapes in crop. Taking a nil tolerance approach, growers might hand pull small areas, or spot spray.

Using paraquat or paraquat/diquat, growers can avoid using glyphosate on potentially resistant individuals when chemically fallowing areas of their crop. The permit for Weedmaster DST use to crop-top in barley provides a useful control tactic for radish and ryegrass at the end of the season, but is often too late for brome grass, which has usually already set seed by this stage of the crop.

In blow-out situations Chris often advocates for the 'short-term pain for long-term gain' of a chemical fallow using paraquat or Spray.Seed.

Chris suggests that the chemical fallow is the best tool to use if brome numbers are building up in a paddock. In his experience, the performance of the following crop usually makes up for the one-year sacrifice due to increased nutrients and moisture availability. He says some growers plan for the inclusion of a small portion of the rotation to be sown as a chemical fallow, while a larger number would use chemical fallow only in a failed crop or for a weedy portion of a paddock as a patch management option.

Crop competition

Where the soil type allows, Yorke Peninsula growers have readily adopted east-west sowing having seen the benefits of this row orientation promoted through AHRI and WeedSmart.

Some soil types, such as the sand swales around Port Broughton, dictate sowing direction but it is an option in other areas.

Barley is the most competitive crop grown across the peninsula and growers usually consider choosing the most competitive cultivars available. This is coupled with high sowing rates and narrower row spacing of 22–30 cm (9–12") spacing, although there is local research that suggests there could be benefits of even narrower row spacing.

Harvest Weed Seed Control (HWSC)

Chris' trial work with HWSC shows the importance of getting the weed seed into the header. He says brome grass can be difficult as its flexible stem doesn't always get cut and can flick back up once the harvester has passed. Wild radish generally stands up well with 70 to 80 per cent of seed entering the header. Even with a 50 to 60 per cent capture of brome grass – depending on the season and how early harvest occurs – HSWC is still an important part of any weed management program.

Capture of ryegrass seed is seasonal with the ryegrass lodging in some years and not picked up by the header, while it will stand up well and achieve 80 per cent capture in other years.

Once weed seed is in the header, Chris' research has shown that it doesn't matter what HWSC method is used – all are effective. Chaff carts and narrow windrow burning have been widely adopted for many years but Chris expects that chaff lining and chaff decks are likely to increase while NWB will decrease

Chris Davey's trial work with various harvest weed seed control methods has shown that the amount of weed seed entering the header can vary, but once in the header all methods are equally effective at reducing the weed seed bank for the next season.

in use. Chaff lining was widely adopted in 2017 harvest as an economical and easy way to manage weed-laden chaff.

He also expects some growers with larger areas and some contractors to purchase iHSD and Seed Terminator modules, with one each of these operating in the 2017 harvest on the peninsula.

For more information about the WeedSmart Big 6, visit the WeedSmart website: *www.weedsmart.org.au* ■

Better crop establishment aim of new research

NEW research aims to increase the profitability of growers in Australia's southern and western grain producing areas by providing them with knowledge about how to optimise the establishment of their crops.

The Grains Research and Development Corporation (GRDC) is investing almost $2 million in the project, and co-investment from the University of Adelaide, farming systems groups and growers will total $1.9 million over four years.

The purpose of this significant investment is to help growers improve sowing practices and increase crop establishment rates.

Research is being led by the University of Adelaide, with the Western Australian No-Tillage Farmers Association (WANTFA) coordinating the WA component of the project.

Involves farming systems groups

The research team also includes farming systems groups. In the southern region these are the Hart Field-Site Group, Northern Sustainable Soils, the Birchip Cropping Group, Southern Farming Systems and the University of South Australia. In the western region, groups include the Liebe Group, Facey Group and Corrigin Farm Improvement Group, in addition to WANTFA.

Project leader Glenn McDonald, Associate Professor at the University of Adelaide's School of Agriculture, Food and Wine, said the project aimed to improve crop establishment and decrease seed costs associated with the use of conventional air-seeders for canola, lentil and faba bean in the southern region, and canola, wheat and lupin in the western region.

Precision seeding for winter crops?

"Research outcomes will also enable growers to consider the costs and benefits of precision seeding technology (or precision planters), which are designed to reduce seed costs and lift crop yields by sowing in a uniform pattern," he said.

"This type of planting technology is not widely used for winter crops in Australia, but it could have potential."

Glenn said initial work would include a survey to determine typical rates of crop establishment achieved by growers using conventional air seeder systems, and a survey of all growers in the regions testing precision planters.

"The survey of growers using conventional air seeder systems will examine seeder technology, crop establishment, depth of sowing and uniformity between plants," he said.

"Information sought in the survey of growers using precision planters will include relevant details and data about their seeder set-up, and their perceptions of the challenges and successes of this technology."

Glenn said several seeder demonstration and comparison trials would be conducted, as well as small plot trials.

"Commercial scale air-seeders and precision planters will be demonstrated and trialled at sites in each region," he said.

"In the southern region, trials will be conducted with local machinery dealers and growers at Horsham and Inverleigh. In the western region, trials will be conducted at Tammin and at Kalannie.

"Relevant machinery, soil and plant information will be recorded, and plant establishment, early growth, yield and quality will be measured and analysed."

Glenn said information generated through the project could provide spill-over benefits to the improved establishment of additional grain crops not specifically studied in the project – including chickpea, field pea, vetch and barley. ■

Discussing crop establishment trials to be conducted at Tammin, WA, are (lrom left) WANTFA executive director David Minkey, grower Brad Jones and Glenn McDonald, Associate Professor at the University of Adelaide's School of Agriculture, Food and Wine. (PHOTO: Julia Easton, GRDC)

Glenn McDonald (left) with GRDC Manager of Systems and Agronomy – South, Andrew Etherton. Glenn says new GRDC research aims to help growers improve sowing practices and increase crop establishment rates. (PHOTO: GRDC)

Growers urged to check paddocks now for canola pest

DIAMONDBACK moth (DBM) caterpillar populations are increasing in Western Australian canola crops this spring and growers are advised to start regularly checking crops for the potentially damaging pest.

DBM (*Plutella xylostella*) caterpillars, or larvae, grow to 12 mm long, are pale yellowish-green and tapered at both ends, and can cause severe yield losses in canola, through feeding, when in high numbers. Chris Wilkins, of Synergy Consulting encourages all growers to start sweep netting their canola crops twice a week to gauge numbers of DBM caterpillars.

"Sweep net your crops early, sweep often and be aware that you can often obtain economically viable results even from spraying crops that have lower yield potential," Chris said.

"It is important to sweep net canola crops regularly because, as they go through their life cycle, DBM numbers picked up from sweeping can go through 'waves' and can vary depending on what stage the population is at in its life cycle."

Chris – who is also a Grains Research and Development Corporation (GRDC) Western Region Panel member – says the DBM control threshold for the mid to late-flowering stage of canola that is not moisture stressed is more than 100 caterpillars per 10 sweeps.

"A lower threshold may be used during extended dry periods and information on thresholds is available in the GRDC Diamondback Moth Fact Sheet at *www.grdc.com.au*," he said.

Agronomist Michael Lamond, another GRDC Western Region panellist, encouraged growers to be vigilant and aware of the potential for DBM to damage crops.

Crops are later this season

"This season, canola crops are finishing later in the season than they have in recent years, which means the plants are maturing during a warmer period in spring," he said.

"Warmer conditions allow DBM populations to go through their life cycles more quickly and exponential increases in numbers can happen very quickly.

"This year is shaping up to be more of a problem year for DBM than in the recent past, and in most canola crops there are currently low levels of the pest which have the potential to increase rapidly."

Michael encouraged canola growers to contact their adviser or retail agronomist for guidance on DBM management this season.

Information is also available in the GRDC Resistance Management Strategy for DBM (see *www.grdc.com.au*) as well as the South Australian Research and Development Institute (SARDI) PestFacts articles (see *www.pir.sa.gov.au*).

"Last year, many canola crops in low rainfall regions were either not sprayed or sprayed too late, resulting in significant grain yield loss," he said.

Michael said other canola pests this season included turnip aphids (*Lipaphis pseudobrassicae*) which he said were building up in numbers in WA's southern cropping areas. ■

Diamondback moth can be a serious pest of canola particularly in seasons where the crop is later than normal and is maturing in warmer spring temperatures. (PHOTO: cesar)

MORATORIUM ON GM FOODS IN SA TO BE REVIEWED

An independent review of South Australia's moratorium on the cultivation of Genetically Modified (GM) food crops is underway and will be undertaken by Emeritus Professor Kym Anderson AC. The current South Australian genetically modified food crop moratorium exists for trade and market access purposes and is in place until 2025.

Once completed, the review will enable better informed policy decisions regarding GM food crops in South Australia.

Under the terms of reference, the review will:

- Assess available evidence on the market benefits of South Australia's moratorium on the commercial cultivation of GM crops.
- Assess the degree of awareness of South Australia's moratorium amongst key trading partners and food production businesses operating in South Australia and other Australian states.
- Where there is evidence of market benefits resulting from the moratorium, examine whether it is possible to retain such benefits for industry through the use of systems of segregation in the supply chain, having regard to segregation protocols adopted in other jurisdictions.
- Consider evidence from South Australian businesses and industry, market and trade data, the experience in other Australian and international jurisdictions and other relevant evidence to inform the analysis.
- Explore whether there are potential innovations likely to be available for commercial adoption by South Australia's agricultural industries prior to 2025 that would justify a reconsideration of the moratorium on grounds of economic benefit to the state.
- Quantify where possible the economic costs and benefits of maintaining, modifying or removing the moratorium, not limited to but including on-farm impacts, food manufacturing, supply chain costs and impacts on research and development investment in South Australia.

The review will not consider aspects of gene technology which are covered under commonwealth legislation. These include human health, safety and environmental impacts.

Call for submissions

Written submissions, addressing the terms of reference, are being sought for consideration by the independent reviewer via email pirsa.gmreview@sa.gov.au by Friday October 26, 2018.

New Buff barley gets a workout

LATHAM (Western Australia) grain grower Dylan Hirsch sees great potential for the new high-yielding, acid soil tolerant Buff barley to significantly boost gross margins within his deeply acidic, poorer performing, wodjil soil types.

Officially released at the Liebe Group's recent spring field day, Buff is InterGrain's first commercially-available white aleurone, acid soil tolerant barley variety. This marks a significant breakthrough in barley breeding.

Buff, formerly known as IGB1506, has been extensively trialled within InterGrain's breeding program over the past six years and has been present in National Variety Trials (NVT) for the past two years. The variety has consistently demonstrated a yield advantage over Litmus in acidic environments, where pH is below 5.5 ($CaCl_2$) and significant yield advantage in neutral soil types.

Dylan, who crops 6000 hectares with his partner Kirraly and parents Brad and Joanne, is trialling Buff on 15 hectares this year and is so far impressed with its performance.

"We have sown it on our worst performing paddock, with a topsoil pH of 4.8 ($CaCl_2$), subsoil pH of 4 and significant aluminium toxicity, and it is standing up to the challenging conditions," he says.

"It went in on May 29 after good early rains at a sowing rate of 55 kilograms per hectare, alongside Litmus and, so far, its biomass production and tiller counts are the same as Litmus, although the ear/head length is definitely longer."

"If Buff can yield better than Litmus – our barley crop average is two tonnes per hectare – it will replace much of the Litmus in our system."

Widespread salinity limits yields

Like many of Western Australia's central and northern grainbelt growers, widespread topsoil and subsoil acidity across sandplain and gravel country is the Hirsch family's biggest yield-limiting factor for barley production and affects parts of almost every paddock.

These areas can have topsoil pH levels between 4 and 5 and subsoil pH at 4 ($CaCl_2$) or lower, which reduce rooting depths and subsequently yields by about 0.5–1.5 tonnes per hectare.

"Finding the 'best fit' cereals that can perform well in these conditions would be a major breakthrough for us and I can see a lot of potential for Buff to fill this gap," Dylan says.

He is also excited that Buff has been accepted into Barley Australia's (BA) malt accreditation program.

"If it can be classified as a malt variety, there is potential for Buff to produce higher gross margins than wheat on our acidic soils," he says.

"That would be a very good incentive to grow more of this variety as part of our 1500 hectares annual barley program, which makes up about 25 per cent of the farm's total cropped area each year – in rotation with wheat and canola.

"Its early maturity suits our early season sowing opportunities, reducing risks of moisture and heat stresses to the developing crop, and its good early vigour is a key advantage in out-competing weeds."

New barley a real alternative to wheat

InterGrain Barley Breeder David Moody said, "Buff is derived from a complex breeding strategy aimed at simultaneously combining as many quality, disease resistance and agronomic traits as possible into an adapted genetic background using molecular markers.

David says Buff is a real alternative to wheat, providing WA growers with another rotational option.

"Buff has good net form net blotch resistance although has a weaker disease profile for all other diseases. But in medium-low rainfall environments this level of resistance should be sufficient."

He says the variety has moderately good grain plumpness and hectolitre weight and, with good straw strength, should improve harvestability.

Buff will be included in BA's commercial malt and brewing trials during the next three years and, if successful, could potentially receive malt accreditation in March 2021.

Seed is available for planting in 2019, but supplies are limited and it is recommended that interested growers place seed orders as soon as possible with local Seedclub members and/or resellers.

For more information about Buff refer to:
https://www.intergrain.com/varieties/barley/ ■

Latham grower Dylan Hirsch is pleased with how Buff barley is performing against Litmus so far this season.

(L–R) Pithara grower Ben Strickland and InterGrain Barley Breeder David Moody impressed with Buff's NVT performance so far at the Liebe Group Spring Field Day (September 13).

GST – a tax on herbicide molecules

By Peter Newman – Australian Herbicide Resistance Initiative

WHEN you buy a birthday cake, the goods and services tax (GST) makes the cost of the cake bigger. If only John Hewson could have explained it so succinctly he may have been Prime Minister!

There's another type of GST in plants that does the same thing to herbicide molecules. It makes them bigger and then the whole thing gets smashed to pieces.

You already know that AHRI researcher Roberto Busi created Sakura (Pyroxasulfone) resistant ryegrass in the lab before the herbicide was even released to the market because we reported on it here. Now Roberto and others have worked out how this ryegrass evolved resistance to Sakura before Sakura resistant ryegrass has become a problem in the field in Australia!

It was metabolism based resistance.

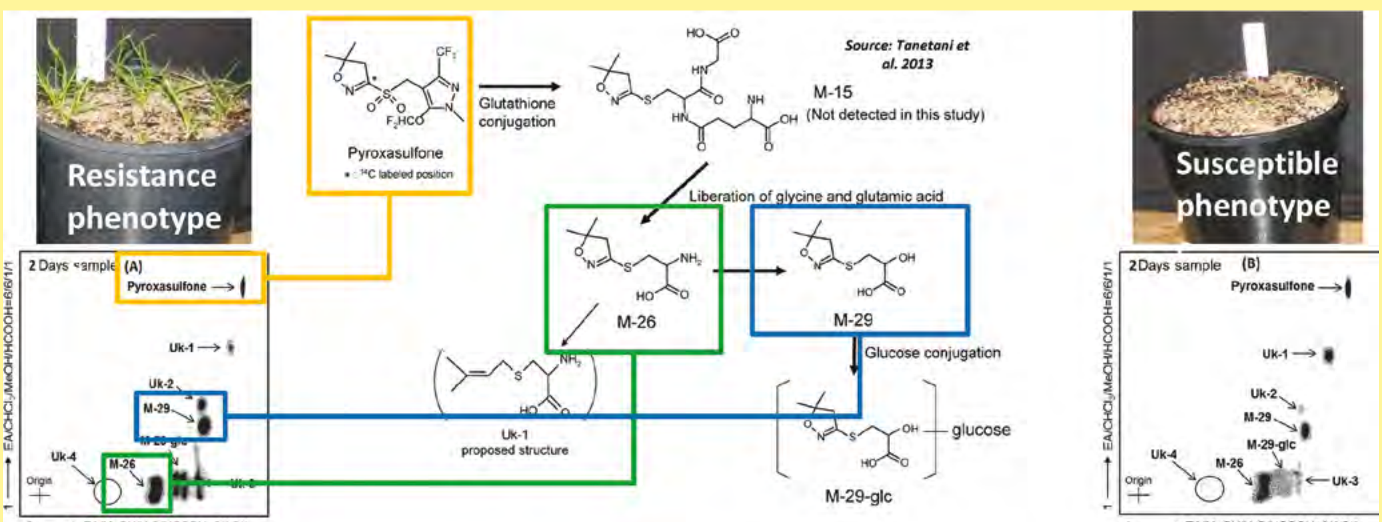
The GST in plants are enzymes called glutathione-S-transferase. In other words, they join or transfer the big molecule glutathione onto other molecules. In this case, the herbicide Sakura. This roughly doubles the size of the Sakura molecule, and then other processes take place to break the whole thing into little pieces. And it appears that this is how wheat tolerates Sakura too.

It's rare for researchers to discover a herbicide resistance mechanism before it becomes a problem in the field and hopefully, this understanding will help us manage this problem when it becomes a reality.

Metabolism-based resistance to Sakura was suspected from the outset because when Roberto evolved resistance to this herbicide in ryegrass in the lab, he also found cross-resistance to some other herbicides namely prosulfocarb, triallate and Metolachlor. Cross-resistance is typical of metabolism-based , but there are several different types of metabolic resistance, so the challenge for the researchers was to work out which one was at play here.

Roberto Busi and others have worked out how ryegrass evolved resistance to Sakura before Sakura resistant ryegrass has become a problem in the field in Australia!

FIGURE 1: Sakura and metabolism (GST) based ryegrass resistance



Radio-labelled Sakura

The first step to figuring out this puzzle was to apply some radio labelled ^{14}C-labelled Sakura to some known resistant and susceptible plants. The researchers found that:

- 84 per cent of the ^{14}C Sakura was metabolised (broken down) by resistant plants compared to 54 per cent of the ^{14}C Sakura being metabolised by susceptible plants 24 hours after treatment.

The resistant plants broke down the Sakura molecule nearly twice as fast as the susceptible plants did.

GST or P450 enzymes?

The team then measured some known GST and P450 enzymes by PCR. PCR is a common technique used by molecular biologists to effectively read the code of a segment of DNA or RNA. In this case, they used quantitative PCR to measure how much RNA was present in the cells. RNA is the code for the P450 and GST enzymes, so if there is an upregulation RNA then there should be an upregulation of the enzyme.

They found that two different GST enzymes were overexpressed anywhere from three to nine times more in resistant plants than in susceptible plants.

GST is the prime suspect

This research concludes that GSTs are the prime suspect but further research wheach measures the specific enzymes themselves – rather than just the RNA – is underway to confirm this once and for all.

How it works

- GSTs are enzymes that take a glutathione and join it onto another molecule. In this case, we're talking about glutathione joining (or conjugating as the scientists like to call it) with the Sakura molecule.
- This big molecule now gets broken down into little bits (metabolites).
- A sugar (glucose) molecule is joined onto one of the little bits.
- The Sakura molecule is no more.

Figure 1 is for the science nerds out there.

Wheat uses the same trick to tolerate Sakura

Japanese researchers from Kumiai – the company that discovered Sakura – concluded the same thing. Wheat tolerates Sakura through metabolic resistance mediated by GST enzymes.

You may also remember that ryegrass mimicked wheat when it came to the first cases of diclofop (Hoegrass) resistance. In general, terms, if cereals can tolerate a grass selective herbicide eventually the grass weeds evolve to survive the herbicide in exactly the same way.

To sum up

We have spoken a lot about P450 enzymes over the years in their role in so-called metabolic herbicide resistance and we now know that there are other superfamilies of enzymes such as GSTs that are also responsible for this type of resistance.

In this case, the researchers are 99 per cent sure that GST enzymes are the cause of this case of Sakura resistance in ryegrass and future research will confirm this once and for all. ■

The boats will keep coming...

By Peter McMeekin, Grain Brokers Australia

THE increasing requirements of Australia's domestic grain market have been under the spotlight in recent months as the drought worsens across the eastern states. This is the second consecutive year that we have seen below average grain production in New South Wales and Queensland.

This has led to a significant deficit of feed grains, milling wheat, and malting barley in the eastern states. This grain shortfall must be filled by imports of suitable grain from regions of surplus.

In normal production years, it is quite traditional for grain to move interstate to satisfy domestic demand. NSW is generally the biggest producer of grain on the east coast and commonly has a surplus which is available to interstate domestic consumers or the export market. Wheat and barley produced in southern NSW regularly makes its way into the Victorian market and the same commodities produced in northern NSW are always required to satisfy the huge feed grain demand in southern Queensland.

Australia is traditionally a significant exporter of grain. Consequently, domestic grain prices tend to be highly correlated to world prices. But in years of drought, the supply and demand imbalance can often lead to grain prices in the affected areas increasing significantly. In fact, they can increase to such an extent that they exceed import parity.

Import parity price is the value of a commodity imported from another country at a location within the importing country (usually the port of entry). It can help to determine whether importing a particular commodity is cheaper or more expensive than procuring it within the country at that same location.

Why don't we import grain from overseas?

Widescale droughts in Australia, such as we are experiencing this year, always invoke the inevitable question. Why don't we import grain from overseas if it is cheaper than moving grain within the country?

At current prices, US corn could be imported into Brisbane for around $130 (AUD) less than bringing wheat around the coast from Western Australia.

The Commonwealth Department of Agriculture and Water Resources (DAWR) is responsible for administering two sets of requirements for imported food. These requirements are designed to protect Australia against biosecurity risks, under the Biosecurity Act 2015, and to address food safety, as set out in the Imported Food Control Act 1992.

Australia has imported grain in previous droughts – the most recent being from the United Kingdom in 2003. In accordance with the biosecurity provisions of the import permits issued at the time, the grain had to be devitalised in dedicated processing plants near the ports into which the grain was imported. It then made its way to nearby feed grain consumers, primarily the poultry industry.

The UK grain could not be transported as viable seed into the cropping regions, and those same restrictions would still apply.

Fast forward to 2018 and the geographical footprint of Australia's feed grain consumers has changed. No longer is a significant proportion located close to the ports. Much of the investment in the last 15 years has been made up-country, closer to the grain production regions. The expansion of the lotfeeding sector, particularly in southern Queensland, has been dramatic.

Biosecurity concerns mean that it is cheaper – and safer – to use grain from Western Australia for domestic consumption in the eastern states.

This means that a vast majority of the east coast feed grain deficit is located within the cropping regions rather than close to the ports.

The Biosecurity Act 2015 requires that all imports of food comply with strict biosecurity conditions for their import.

The DAWR is not responsible for ensuring a cattle feedlot on the Darling Downs or a poultry operation in the Riverina has adequate feedgrain supplies. Their mandate is to ensure that Australia is protected from harmful pests and diseases (such as exotic weeds or foot and mouth disease) and they work with the import cargo and shipping industries to enforce the strict quarantine regulations.

Increased scrutiny since white spot outbreak

These regulatory requirements have been under increased scrutiny in the past two years with the discovery of the highly contagious white spot disease in Queensland prawns in 2016. Australia was one of the few countries in the world which had remained free of the disease affecting crustaceans – but it has already decimated prawn farms in parts of Queensland since the outbreak.

Biosecurity breaches such as this have only heightened the resolve of authorities to protect the viability of agriculture in Australia. It is a $60 billion industry employing thousands and contributes three per cent to the country's Gross Domestic Product.

The movement of grain within Australia – whether it be by road, rail or sea – does not attract the same biosecurity restrictions as foreign imports. Whilst the drought may be severe in the eastern states, Australia will still have an exportable surplus courtesy of an above average season in Western Australia.

With this biosecurity concern, the shipping lineup (stem) at Western Australia's ports will continue to have vessels loading with the eastern seaboard of Australia as their destination. The boats will keep coming until the east coast deficit is rectified.

Peter McMeekin is a consultant to Grain Brokers Australia. Call 1300 946 544 to discuss your grain marketing needs. Article supplied September 25, 2018. ■

Rise in rural commodities index

SOLID grain, lamb and wool prices drove a 0.7 per cent rise in the National Australia Bank (NAB) Rural Commodities Index in August. But despite this modest upturn, results were highly region and commodity specific given varying seasonal conditions across the country.

Grain-dependent Western Australia saw the biggest gain of all states, at 5.2 per cent while Queensland was the weakest performer down 3.1 per cent.


Phin Ziebell, NAB Agribusiness Economist.

NAB Agribusiness Economist, Phin Ziebell, said that with much of the east still in severe drought, state-based wheat production forecasts have shifted significantly.

"Ongoing drought conditions have seen the New South Wales wheat production forecast drop to 2.3 million tonnes, while the forecast for Western Australia has risen to 9.5 million tonnes," Phin said.

"The national wheat production forecast is down slightly during September from 18.4 million tonnes to 18.1 million tonnes, but the Western Australian wheatbelt remains on track for a good season.

"Late frosts are posing a problem right around the country, with some crops being cut for hay, but we still anticipate that Western Australia will still see above average yields.

"In addition, domestic prices remain high with the ASX wheat futures reaching $450 per tonne in late September."

The persistently dry conditions will also be felt across the outlook for many other winter crops.

"High demand is expected to continue driving prices for most feed grain types, including barley, and frost activity in some areas is expected to keep yields under pressure," he said.

"Canola prices have also seen a decent upside for the first time in several years, but a lack of rain has led to some crops being cut for hay. While high demand has led to strong sorghum prices, yields could be poor unless the season dramatically improves between now and the end of the year."

Mixed results for livestock

Livestock has been mixed, with lamb prices receding slightly and cattle showing resilience in tough seasonal conditions.

"Lamb prices remain very strong, despite coming back slightly from a peak of 875 c/kg in early September to around 768 c/kg later in the month.

"The expansion of the competing New Zealand dairy industry and the structural contraction of the Australian sheep flock over the past decades has set the scene for strong demand, and we anticipate that prices will stay solid this year.

"Wool cheques remain very strong, with the Eastern Market Indicator sitting at 2,067 c/kg. China remains the leading buyer of Australian wool, and while any major trade dispute between the United States and China could impact the market, prices are excellent right now."

Cattle prices have stayed relatively resilient, with the Eastern Young Cattle Indicator breaking 500 c/kg in mid September.

"The ability for cattle prices to stay at these levels is largely weather dependent. The female share of slaughter numbers remains at drought levels, and water and feed shortages could force further destocking."

Pork producers are also feeling the pinch from higher feed grain prices, and pork prices were down 0.5 per cent in August before rising 1 per cent in September (to date).

Cotton still strong but weather outlook is grim

Cotton prices remain strong, despite falling slightly from $645 per bale to $634 per bale in September. The latest ABARES forecast anticipates that cotton production will fall by 44.5 per cent in 2018/19 due to less available irrigation water and a subsequent reduction in plantings.

The Bureau of Meteorology's three-month outlook is grim, with much of the country less likely than average to exceed average rainfall. The Bureau's ENSO outlook remains on El Nino watch, pointing to a roughly 50 per cent chance of El Nino developing in spring this year.

The AUD is expected to trade with a degree of volatility inside a USD 0.70 – 0.75 range. This is in the context of heightened trade tensions between the US and China, and strong US economic data.

Source: NAB Monthly Rural Commodities Wrap, September, 2018. ■

Australian wheat helps Japan and Korea keep on keeping udon

By Australian Export Grains Innovation Centre

SPECIALISED Australian wheat varieties are continuing to underpin the lucrative premium noodle industries in Japan and Korea – and there are opportunities to expand demand for Australian wheat for other products.

For many years, custom-bred Australian noodle wheat has been highly valued in Japan and Korea for premium quality white salted noodles. Both markets have exacting standards for quality and supply.

AEGIC is committed to maintaining the future of this industry and is actively working to strengthen these relationships and identify new uses for Australian wheat.

Earlier this year, AEGIC travelled to Japan and Korea to conduct Australian Wheat Technical Seminars with flour millers.

AEGIC CEO Richard Simonaitis said the annual seminars were an important part of maintaining Australia's relationships with Japan and Korea.

"These seminars give us an opportunity to enhance flour millers' understanding of Australian wheat and its suitability for various noodle, bread and sweet baked products, and work through any issues directly with them," he said.

The Tokyo seminar was attended by about 80 people, with about 35 attending in Seoul. All major flour milling companies in each country were represented. AEGIC Wheat Technical Markets

AT A GLANCE

The term "noodle wheat" generally means the highly specialised ANW/APW blends for white salted (udon) noodles in Japan and South Korea.

But other Australian wheat classes – including APH, AH, APW and ASW – are highly valued for many other types of noodles in different markets across Asia.

Wheat classes:

- ANW: Australian Noodle Wheat.
- ANW2: ANW that hasn't met grade requirements.
- APW: Australian Premium White.
- APWN: Australian Premium White Noodle.
- APH: Australian Prime Hard.
- AH: Australian Hard.
- ASW: Australian Standard White.

Australian wheats have been specifically developed for udon noodle production.

NOODLE WHEAT FOR JAPAN AND KOREA

- ANW varieties have been specifically developed for udon noodle production in Japan and Korea. Collectively these countries annually purchase about 1.6 million tonnes of noodle wheat blend (ANW and APW).
- Australian noodle wheat is preferred for premium udon noodles due to its excellent starch quality (high swelling properties), bright flour colour and excellent colour stability, medium dough strength, and medium protein levels.
- In addition to wheat and flour quality testing, sensory testing is also an important means of evaluating wheat varieties for classification into ANW.
- Ideal udon noodle should have a unique balance of softness and firmness, often described as 'soft noodle with slight surface firmness' combined with good elasticity and stickiness.
- Colour is also important. Favourable traits include good colour and colour stability, with superior udon noodles being described as having a 'bright, creamy, slightly yellow colour'.

Manager Dr Larisa led the technical presentations. This year's seminars also included presentations from Dr Sara Grafenauer, General Manager of the Grains & Legumes Nutritional Council (GLNC), who presented information on the health and nutritional benefits of consuming whole grain foods produced using our white wheat.

A long history of high quality production

Richard Simonaitis said Australia had a long history of producing high quality noodle wheat for Japan and Korea, and there were opportunities to find new uses for Australia wheat in these markets.

"The Australian wheat industry has been working with the Japanese Flour Millers Association (JFMA) for 30-plus years to ensure that varieties classified for ANW (Australian Noodle Wheat) meet the strict Japanese standards for udon noodles," he said.

"On behalf of the Australian industry, AEGIC runs a highly-trained sensory noodle evaluation program, in collaboration with the JFMA. The evaluation involves blind sensory testing (taste, appearance and mouthfeel) of advanced unreleased ANW varieties to help classification and ensure Australian noodle wheat meets Japanese requirements.

"As part of this program, AEGIC periodically hosts a JFMA representative to support sensory evaluation of ANW lines and help with noodle panel training. AEGIC has the only sensory panel trained by Japanese visiting noodle experts."

In recent years AEGIC has expanded the sensory work to also include the hard component of the udon blend – APW (Australian Premium White) and APWN (Australian Premium White Noodle) varieties. This is to better understand the quality of the overall blend.

AEGIC is also conducting a project on the quality requirements for yellow alkaline / ramen noodles. This work is in progress and will lead to better-defined targets for Australian wheat breeders of the preferred quality aspects for ramen noodles. The project aims to understand the potential opportunity for selected AH varieties and their suitability for yellow alkaline noodles in Japan and South Korea.

A separate project is examining opportunities to grow the use of low-protein Australian wheat such as ANW2 (ANW that hasn't met grade requirements) and low-protein ASW for sweet products in Japan and other Asian markets. ■

Why Australia needs to become Asia's innovation partner

By Andy Hall and Jen Kelly, CSIRO

ASIA is emerging as a major hub of agrifood industry innovation. What sort of public and private sector investments are needed to make this a win–win collaboration that strengthens both Australia and its Asian partners' ability to innovate for a sustainable and prosperous future?

Asian economies are growing rapidly and the region is emerging as a major innovation hotspot. Some countries, such as Singapore, South Korea and Japan, now exceed Australia on the Global Innovation Index, and other smaller economies, although at a more formative stage, are catching up quickly. Science, technology and innovation have always been an important part of Australia's trade and economic diplomacy presence in the region.

But an opportunity exists for a new form of regional collaboration where the primary purpose is to co-develop innovation capacity. This recognises that Australia's innovation capacity is not only held within its national borders but also includes the innovation capacity of other countries that it trades and collaborates with. Increasingly, those other countries are the emerging economies of Asia.

The relationships created through this new form of collaboration will be critical to Australia's ability to harness innovation for a prosperous and sustainable future.

If Australia wants to be a participant rather than a casualty of the Asian century, it needs to engage with Asia's huge and growing capability and invest in innovation.

In recent years, Asia has emerged as a major player in global prawn production, evidenced by these aquaculture ponds in Thailand.

The resurgence of Asia

Following in the footsteps of the twentieth century success of Japan, South Korea and Singapore, a new cluster of Asian countries, led by China and India, have achieved staggering levels of economic growth since the start of the 21st century. There are predictions that by 2050, three of the four biggest economies in the world will be Asian. China and India are tipped to take first and second place with the US pushed into third place and Indonesia fourth. Countries like Vietnam and the Philippines are also rapidly moving up the rankings.

Welcome to the Asian Century.

Singaporean intellectual Kishore Mahbubani captured the spirit of this shift in global economic power when he said "the last two centuries of Western domination of world history have been a major historical aberration. From the years 1 to 1820, the two largest economies of the world were those of China and India. All historical aberrations come to a natural end. Therefore the Asian Century is irresistible and unstoppable."

Asia as our innovation partner

Australia has no choice other than to actively engage with the economic resurgence of the Asian countries on our doorstep. We have existing trade and cultural links and traditional exports, including agriculture and food commodities that play well into the emerging demands and prosperity in the region.

But it would be a huge mistake to plan our engagement around the idea that Asia will simply be the new manufacturing hub of the world, giving us affordable consumer goods, and that in exchange, Australia will just be the delicatessen grocer to the region.

If Australia wants to be a participant rather than a casualty of the Asian Century, it needs to engage with Asia's huge and growing capability and invest in innovation. Asia needs to be recognised not just as a trade partner but as an innovation partner.

Australia's long history in public agricultural science (both in CSIRO and Australian universities) is one of its core strengths in the agriculture and food sector. Of equal importance is Australia's experience of different models of mobilising technology for industry innovation.

But the leaders of Australia's agricultural research and development (R&D) community cannot rest on their laurels. They need to adapt to a new role that is more focused on facilitating business and innovation engagement with Asia. Fostering such partnerships will help Australia access and adapt Asian innovations into the Australian context and vice versa.

The innovation figures in China alone are staggering. China is the second largest spender on R&D after the US, accounting for 21 per cent of the world's total expenditure in this sector. But China is not an anomaly. Elsewhere across the region, a picture is emerging of Asia as the new centre of gravity for innovation.

The Asian tiger economies of the late 20th century are already way ahead of Australia's ranking of 23rd in the 2017 Global Innovation Index, with Singapore ranked 7, Korea 11, Japan 14 and Hong Kong 16.

Small economies in the region are also starting to catch up with Australia. The Global Innovation Index highlights the growing innovation capacity of Vietnam, ranked 47, Thailand 51, the Philippines 73 and Indonesia 87.

Much of this is built on public investments in R&D, education, digital and other infrastructure, and economic reforms that have encouraged foreign direct investment and unleashed local entrepreneurial activity.

Innovation in agriculture and food

The successful emergence of Asia as an innovation hotspot is not restricted to hi-tech and manufacturing sectors. It includes agriculture and aquaculture. Thailand and Vietnam are two of the world's biggest agricultural exporters. While rice was historically the main export crop, there has been considerable diversification.

Aquaculture has emerged as a major industry serving both domestic and international markets. The region produces 40 per cent of the world's cultivated seaweed. Since 2000, global prawn aquaculture production has grown 230 per cent, almost all of which is accounted for by South East Asian countries and China. Asian countries are now also major players in coffee and cocoa global value chains.

In the poultry industry, the Thai company Charoen Pokphand Group (CP Group) has driven innovation and is now the world's largest producer of cooked, chilled, ready-meal poultry products. This was achieved after the sector reorganised itself in response to an outbreak of avian influenza in Thailand that resulted in the loss of key raw poultry export markets.

The Philippines' fast-food chain Jollibee Foods Corporation has a growing regional footprint, backed up by inclusive supply chain innovations. Indonesia's Indofood company now has a significant presence in West Africa selling instant noodles. At the same time, Chinese and Thai companies, including the CP group, are starting to invest in the Australian and New Zealand dairy and sugar sectors.

India also has a vibrant agritech start up sector with a huge diversity of digital-enabled solutions, attracting nearly $300 million in venture capital investment in 2016 alone. These range from a start-up company that leases tractors and farm equipment (Uber-style) to thousands of villagers, to digital knowledge hubs for farmers who use apps to monitor plant and soil health. With India expected to become the second largest market for precision agriculture after the US, we can expect explosive growth in innovation in the Indian agritech sector.

It is probably a safe bet to predict that the next generation of global agrifood companies will be Asian.

Implications for Australia

So what impact will Asia's development into an economic centre of knowledge-based innovation have on Australia?

It is easy to comprehend that the rise of Asia means increased spending power in the region, new markets for Australian agriculture and food commodities, new waves of direct foreign investment and maybe even new revenue sources for cash-strapped Australian R&D organisations.

What is much more difficult to grasp is the idea that increasingly, Australia's ability to innovate will be a function of the ability of Asian countries to innovate and the degree to which Australia is linked to the innovation processes in those countries.

To understand this synergy, it helps to remember a few things about innovation.

- Firstly, innovation ideally involves both business and R&D, with policy oiling the wheels through incentives and keeping everything on track with regulation.
- Secondly, innovation is a team sport. In the Asian century this means collaboration between Australian and Asian businesses and public R&D organisations. So Australia's ability to innovate is not just contained within its national borders, but is fueled by participation in other geographic centres where there is dynamic innovation activity. Historically, this meant Europe and North America, but in the future this means Asia.
- Lastly, innovation comes in different national styles suited to the nature of the market, history and politics of a particular country. For example, India's pioneering work on frugal innovation for low-income markets or Japan's long-term innovation collaboration between the public and private sectors. Understanding how to innovate in a particular national setting is critical to the success of businesses in these markets.

Taken together, given the linkage of Australia's value chains and business into Asia, if we are to take advantage of global and regional market opportunities ahead, our businesses and R&D organisations need to be deeply connected to Asia's emerging capacity for innovation.

A picture is emerging of Asia as the new centre of gravity for innovation. For example, China is the world's second largest spender on R&D after the US while other Asian countries are also ramping up their expenditure into innovative research, particularly in the agri-foods sector. (PHOTO: Keith Weller)

Opportunities to co-develop innovation capacity

Australia is already repositioning in response to the evolving innovation landscape of Asia. Recently announced was the $3.2 million Regional Collaborations Programme as part of Australia's National Innovation and Science Agenda. It is an important signal, acknowledging that regional innovation collaboration needs to be an integral part of national efforts to enhance and accelerate our own innovation performance.

After making the case that the Asian century is centred around the rise in Asia's innovation prowess, it seems paradoxical to suggest that Australia's entry point should be to assist with capacity-building efforts. The reality is that in countries like Indonesia and Vietnam, while innovation is a priority for public sector investment, this has not yet necessarily gelled as stronger capacity for innovation. This is despite many of the building blocks being put in place, including conspicuous investments in research and policy reforms to encourage direct foreign investment, and support schemes to encourage local entrepreneurship.

Among the many things holding back innovation capacity in emerging Asian economies is a history of poor relationships between public research agencies and the private sector, and limited R&D and innovation capacity in companies, particularly small and medium-sized enterprises.

Then there are the challenges of supporting innovation in the agriculture sector, where the majority of producers operate at a small-scale. Limited uptake of new technologies by the poorest farmers has frustrated public agencies and private agribusiness suppliers for decades.

Add to this, a challenging development agenda in many countries in the region, where the skewed distribution of the benefits from growth, and looming environmental challenges – in some cases exacerbated by poor governance – could derail the whole Asian Century dream.

What collaboration might look like?

What is interesting about these emerging Asian economies is how much is already being done. Recent scoping work by CSIRO in Vietnam suggests there is already significant investment in international research collaboration, trade and business collaboration and in incubators and start-ups. The challenge is how to knit these various pieces together into a joined up capacity for innovation.

The missing pieces include:

- The capacity of researchers and companies to collaborate around the development, market testing and commercialisation of technologies;
- The ability of the private sector to access technology and expertise locally and internationally; and,
- Commodity or industry growth plans that support technological change and collaboration arrangements.

To address these issues, the Australian and Vietnamese governments are working on a collaboration that will establish and test novel innovation support arrangements. These will focus on capacity development for the commercialisation of technologies, and also analysis of policy gaps and bottlenecks.

Bringing an Australian agency into Vietnam to support this type of capacity building could help build connections between the emerging innovation capacity in the country and counterpart organisations in Australia.

In a similar way, in Indonesia CSIRO helped establish the independent Indonesian Food Innovation Center (IFIC), which aims to foster collaboration between public research and the Indonesian food industry. Part of the long-term plan is to help companies upgrade their innovation capacity, which in turn makes them more attractive innovation collaborators for Australian businesses and R&D agencies.

Another model is being pursued by Murdoch University, which has used its Singapore campus as a base for building partnerships with the emerging Southeast Asian agritech sector that operates out of the city state..

Where to next?

Most OECD countries recognise that access to knowledge and innovation located beyond national borders is critical for continued prosperity. The Asian Century is generating an emerging centre of gravity for knowledge and innovation. Capturing the opportunity to connect Australia's innovation system with Asia will support the long-term prospects for growth and sustainability. ■

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Wheat genome is finally mapped

By Haley Ahlers, Innovation Lab for Applied Wheat Genomics

KANSAS State University scientists, in collaboration with the International Wheat Genome Sequencing Consortium (IWGSC), have published in the journal *Science* a detailed description of the complete genome of bread wheat, the world's most widely-cultivated crop. This work will pave the way for the production of wheat varieties better adapted to climate challenges, with higher yields, enhanced nutritional quality and improved sustainability.

The research article – authored by more than 200 scientists from 73 research institutions in 20 countries – presents the reference genome of the bread wheat variety Chinese Spring.

The DNA sequence ordered along the 21 wheat chromosomes is the highest quality genome sequence produced to date for wheat. It is the result of 13 years of collaborative international research and the generous support of the (US) National Science Foundation and many others.

A key crop for food security, wheat is the staple food of more than a third of the global human population and accounts for almost 20 per cent of the total calories consumed by humans worldwide – more than any other single food source. It also serves as an important source of vitamins and minerals.

To meet future demands of a projected world population of 9.6 billion by 2050, wheat productivity needs to increase by 1.6 per cent each year. In order to preserve biodiversity, water and nutrient resources, the majority of this increase has to be achieved via crop and trait improvement on land currently cultivated, rather than committing new land to cultivation.

Wheat farming needs to be more profitable

In order for farmers to dedicate these precious resources to wheat production rather than production of other crops, wheat farming must become more profitable.

With the reference genome sequence now completed, breeders have at their fingertips new tools to address global challenges. They will be able to more rapidly identify genes and regulatory elements underlying complex agronomic traits such as yield, grain quality, resistance to fungal diseases and tolerance to physical stress-and produce hardier wheat varieties.

Sequencing the bread wheat genome was long considered an impossible task – a huge international research effort has now cracked the code.

"Completion of the sequence is a landmark event that will serve as a critical foundation for future wheat improvement," said Dr. Allan Fritz, Kansas State University professor and wheat breeder. "It is the key to allowing efficient, real-time integration of relevant genetics, making the selection process more efficient – it's a turbocharger for wheat breeding!"

It is expected that the availability of a high-quality reference genome sequence will boost wheat improvement over the next decades, with benefits similar to those observed with maize and rice after their reference sequences were produced.

"The sequence of the bread wheat genome has already had a positive effect on wheat improvement, which not only affects the science behind wheat breeding, but has a long-lasting positive outcome in regard to wheat producer productivity, profitability and, ultimately, livelihoods," says Justin Gilpin, chief executive officer for Kansas Wheat.

Once deemed impossible

Sequencing the bread wheat genome was long considered an impossible task, due to its enormous size – five times larger than the human genom – and complexity. Bread wheat has three sub-genomes and more than 85 per cent of the genome is composed of repeated elements.

"It is exciting to be a part of this landmark achievement," said Dr Jesse Poland, associate professor at Kansas State University and director of the Wheat Genetics Resource Center and the USAID Innovation Lab for Applied Wheat Genomics.

"This international effort, toward something that was once deemed impossible, will have tremendous impact on wheat production worldwide," said Jesse.

"We are already extensively using the new reference sequence for more informed molecular breeding.".

In addition to the sequence of the 21 chromosomes, the *Science* article also presents the precise location of 107,891 genes and of more than 4 million molecular markers, as well as sequence information between the genes and markers containing the regulatory elements influencing the expression of genes.

The IWGSC achieved this result by combining the resources it generated over the past 13 years using classic physical mapping methods and the most recent DNA sequencing technologies – the sequence data were assembled and ordered along the 21 chromosomes using highly efficient algorithms, and genes were identified with dedicated software programs.

All IWGSC reference sequence resources are publicly available at the IWGSC data repository at URGI-INRA Versailles and at other international scientific databases such as GrainGenes and Ensembl Plants.

The IWGSC is an international, collaborative consortium, established in 2005 by a group of wheat growers, plant scientists, and public and private breeders. The goal of the IWGSC is to make a high-quality genome sequence of bread wheat publicly available, in order to lay a foundation for basic research that will enable breeders to develop improved varieties. See *www.wheatgenome.org* ■

The disjointed United

By Ian M. Johnston

The squabbling conglomerate

In the year 1929, no less than 32 independent US farm equipment manufacturers and distributors amalgamated to form a mega operation, based in Chicago, trading under the somewhat grandiose title of The United Tractor and Farm Equipment Co-Operative. But there was only one problem. They did not have a tractor!

It appears that plans to become a major Fordson dealership collapsed, when Henry Ford relocated his tractor manufacturing plant from Dearborne, Michigan, to Cork in Ireland. Accordingly, a crisis meeting was held, attended by worrying and bickering United Co-Operative board members, many of whom believed the new operation would be a short lived identity indeed, unless it had a tractor to offer its farmer members.

The Allis Chalmers Manufacturing Company of Milwaukee, Wisconsin had become one of the world's largest manufacturers of farm tractors. This was despite the fierce competition from tractor giants such as International Harvester, Deere and Company and of course The Ford Motor Company, whose Fordson Model F was the world's top selling tractor.

Finally, following much squabbling, a decision was taken by the United board to approach Allis Chalmers in the hope that a

A 1929 Allis Chalmers Model 6-12, powered by a Le Roy four cylinder 138 cu. inch engine, developing 12.37 hp and capable of a 1142 lbs. draw bar pull. Restored by Steve Rosenboom of Iowa. (PHOTO: IMJ)

A 1928 Allis Chalmers 20-35, painted in the original dark green, discovered in a museum in Alberta, Canada. (PHOTO: IMJ)

tractor could be specifically manufactured for marketing under the United brand.

Enter Allis Chalmers

The Allis Chalmers Manufacturing Company could trace its roots back to 1847. But it was not until the year 1914, following numerous acquisitions and amalgamations, that it first entered the rapidly expanding world of tractors.

The initial Allis Chalmers tractor, the model 10-18, was an ungainly three wheeled contraption, which failed to enthuse American farmers and only a relative few were produced.

But the model 6-12 released in 1919, powered by a four cylinder Le Roy engine, described as a general purpose motor cultivator, proved to be the firm's first volume selling tractor. The 6-12 was proceeded by an extensive broad range of world class Allis Chalmers tractors.

Possibly the most successful of these during the 1920s, was the 43 belt hp model 20-35, introduced in 1923, (see accompanying photo) which was actually an updated earlier model E. Originally the 20-35 shared a dark green colour scheme with all other Allis Chalmers tractors.

An Allis Chalmers Model U awaiting restoration by the author. (Photo IMJ)

One of the few remaining examples of a United in Australia. Restored by David Hawkins of Batlow. (PHOTO: D. Hawkins)

But an unanticipated occurrence took place in 1929.

It is alleged that Harry Merrit, a senior director of Allis Chalmers, was travelling in a privately chartered railway train, when he halted the locomotive for the purpose of a convenience stop, while it wound its way through some remote area in California.

It appears the train came to a halt in a valley in which Persian Orange coloured poppies grew in abundance. Mr Merrit was so enamoured by the distinctive and vibrant colour of the poppies that there and then, in his capacity as Head Designer for the Company, he determined that from hence forth all Allis Chalmers tractors would be painted Persian Orange. (Truth can be stranger than fiction, so they say).

The United tractor

Allis Chalmers agreed to create a new model tractor for The United Tractor and Farm Equipment Co-operative. The requirement was for a unit construction design, featuring a 30 hp engine, capable of being fuelled by petrol/kerosene, and incorporating a four forward speed transmission. In the remarkably short space of one year, Allis Chalmers produced the all new United tractor. But to facilitate its rapid development, the unit was powered by the outside sourced Continental side valve P10 engine.

But due to mismanagement and continuing board level disagreements, and despite having sold around 2000 units, in 1930 The United Tractor and Farm Machinery Co-operative failed (ie. went broke) and left Allis Chalmers with a huge stock of unsold United tractors.

But the switched on Allis executive team members were not daunted by this unexpected development. They could see the tractor had the potential to become a top seller. The name United, cast into the frontal radiator header tank, was replaced with the name Allis Chalmers and the tractor given the new designation – the Model U.

By 1932 over 7000 Continental powered Model U tractors had been sold to farmers around the world. But by that year, Allis Chalmers in conjunction with the Waukesha Engine Company had developed and produced its own 300 cubic inch capacity 34.02 hp type UM engine, which became regarded as one of the all time great petrol/kero tractor engines. With some modifications, it remained in production until 1952.

The Model U, embracing several variants including industrial

A crawler version of the Model U, powered by the Wisconsin engine, operated by Tony McClellans of Tamworth. (PHOTO: T. McClellans)

types, was finally replaced in 1952, following an impressive production run of 33 years.

Tail piece

Allis Chalmers pioneered the usage of pneumatic tyres fitted to agricultural tractors.

In late 1932, in order to overcome a prevailing atmosphere of suspicion being exhibited by many farmers towards the concept of the pneumatics for farm work, a team of specially tuned Model U tractors amazed farmers at North American county shows by firstly tilling with a plough and then racing at high speed around speedway tracks.

But the greatest promotional stunt of all, was when famous racing driver Ab Jenkins created a world tractor speed record by propelling a Model U at 67.8 miles per hour at the world famous Bonneville salt flats at Utah. That record remains to this day! ■

IAN'S MYSTERY TRACTOR QUIZ

Question: Can you identify this tractor?

Clue: It is not a John Deere, despite the colour.

Degree of difficulty: This will test the best!

Answer: See page 48.

Nitrogen needed to fill the gap

THE future of grain growing in Australia is at a crossroads, with cropping soils suffering from falling nitrogen and soil organic matter levels that may limit yields and returns to growers. The caution comes from Dr James Hunt, a well-respected grains researcher from La Trobe University, Melbourne.

"In continuous cropping systems in high rainfall regions, we are mining our soil nitrogen reserves through our failure to match inputs with outputs," James says.

"The evidence suggests that many crops across all rainfall zones are nitrogen deficient, and this is one of the major reasons why cereal yields are on average only half what they should be.

"If you look at average wheat yields across Australia, growers are achieving only 55 per cent of potential yields based on the amount of water received. And when you compare actual yield with potential yield, there is more potential being left on the table in high rainfall zones than in low and medium rainfall zones across Australia."

James says nitrogen deficiency was largely to blame.

His concerns are echoed in recent CSIRO research led by Zvi Hochmann and data from Graincorp receivals in 2015–16 of which 28 per cent was only ASW wheat, which at less than 10.5 per cent protein implies crop yield was nitrogen limited.

What are the megatrends?

Looking at the megatrends over the past 30 years, James says the collapse in wool prices in the early 1990s led to a decline in sheep numbers and pasture area, while the area planted to wheat grew from eight million to 14 million hectares.

"Legume based pastures fix nitrogen and crops use it, but with the swing to more crops, crop nitrogen demand has to be met with nitrogen fertiliser or from the total soil nitrogen pool," James said.

"The problem is that we are mining total soil nitrogen when outputs such as grain, hay and burnt or baled stubble exceed inputs such as nitrogen fertilisers, manures, compost and nitrogen fixation.

"As a consequence, soil organic matter is being dragged down which is bad for soil structure and chemical properties. But the biggest negative is the decline in supply of nitrogen to crops through mineralisation of soil organic matter.

"Mineralisation is very useful in high rainfall environments because it provides a buffer and makes nitrogen management self-correcting. In wet springs with higher yield potential, there is more mineralisation and this nitrogen can support higher yields."

Without this buffer, growers need to be prepared to make late nitrogen fertiliser applications to achieve their full yield potential.

Comparing two similar – but different – regions

Comparing the performance of two high rainfall zones, James says crop and livestock production is still highly integrated in south-east New South Wales while this was not necessarily the case in south-west Victoria.

"In south-east NSW, some growers have restocked and crops are grown in sequence with legume pastures such as lucerne and sub clover, which still provide a large amount of crop nitrogen demand," James says.

"Contrast this with south-west Victoria where growers typically have crop-only paddocks and stock-only paddocks, pastures are typically grass based and so crop nitrogen demand is highly reliant on fertiliser inputs."

Dr James Hunt from La Trobe University at the Agronomy Community forums held in July.

Despite negative climate trends in medium to high rainfall zones, James says yields and water use efficiency were generally increasing due to the combined effects of better cultivars, earlier sowing, better crop sequences and fungicides.

"Leading growers in these medium-high rainfall zones are averaging seven tonnes per hectare wheat yields, with some paddocks reaching nine tonnes and trials exceeding 10," James says. "While these yields are supported by increasing rates of nitrogen fertiliser, most farms are still mining soil nitrogen because outputs are exceeding inputs.

"In high rainfall zones, we face a choice between reintegrating cropping and stock to top up total soil nitrogen from pastures or continue to separate crops and stock and rely increasingly on nitrogen fertiliser.

"We also have a choice between mining soil organic matter or maintaining it by matching outputs to inputs."

Medium rainfall zone not as difficult

James adds that nitrogen management in the medium rainfall zone was easy, compared with the high rainfall zone.

"Managing nitrogen in medium rainfall areas starts with soil testing pre-sowing and topdressing to the calendar," he says.

"In high rainfall areas, nitrogen management is harder because high yielding crops require large amounts of nitrogen, so a 7 tonne wheat crop needs 280 kg per hectare of nitrogen assuming 40 kg per tonne of grain yield potential.

"Secondly, growers have to deal with too much water which can result in nitrogen losses through denitrification, runoff or leaching, makes paddock access difficult and causes waterlogging."

An option to increase nitrogen applications in high rainfall regions was mid-row banding, a technique James describes as 'poor man's slow release'.

"In theory, mid-row banding places high concentrations of urea in a narrow band which creates a high concentration of ammonium, ammonia and nitrite which is toxic to nitrifying microbes and plant roots but allows plants to take up nitrate from the margins," he said.

"This approach means less volatilisation and immobilisation and the potential to reduce leaching and denitrification.

"But it allows plant uptake when the topsoil is dry and improves nitrogen use efficiency," James says.

This article is based on a presentation by Dr James Hunt at an agronomy forum hosted by Incitec Pivot Fertilisers in Melbourne in July 2018. ■

Wheat growers are changing nitrogen use

MORE than a third of growers and advisers in northern New South Wales and southern Queensland have changed their approach to nitrogen rate, application method or timing in wheat crops during the past five years, according to a new survey.

The *2018 Northern Grower Alliance Nitrogen Management in Wheat Survey* received responses from 100 growers and advisers overseeing more than 1.6 million hectares of wheat production along the Queensland–NSW border.

A key aim of the survey was to determine whether growers and advisers in the region had changed nitrogen (N) management strategies in the past five years and if so, what had been the driving motivation behind the adoption of new agronomic practices.

The survey was conducted by the Northern Grower Alliance (NGA), a Grains Research and Development Corporation (GRDC) grower solutions group investment. During the past six years, a total of 25 NGA trials have focused on N management in wheat, as part of a broader national investment by the GRDC into N efficiency.

NGA Chief Executive Officer Richard Daniel said 26 per cent of survey respondents were growers and 66 per cent were private or reseller agronomists, with both groups indicating similar levels of practice change when it came to determining N application rate, application method and timing.

More in-crop spreading of nitrogen

"Confidence for spreading N in-crop has changed quite dramatically in the past five years. This has been apparent from the increased use of spreaders, both for in-crop but also prior to planting application," Richard said.

"Of the growers and agronomists who participated in the survey, more than 70 per cent reported they were more confident with the potential to spread urea in-crop than they were five years ago.

"Respondents indicated they were also more confident with their ability to spread urea in fallow, although most would only consider this approach in lower risk scenarios.

"Growers and agronomists are always searching for opportunities that can improve profitability, but still remain cautious about applying N in fallow and I think that is a sensible thing.

"Our understanding of the importance and magnitude of volatilisation loss has changed markedly in the past few years, but we still need to better identify and understand the 'no-go' situations."

More than a third of survey respondents indicated their preferred timing for N application had also changed. Most growers and agronomists in the survey preferred a combination of in-fallow with top-dressing, or early in fallow, three-to-six months before planting.

Preferred application method also changing

When it came to method of N application, 32 per cent indicated their preferences had changed since 2013.

Banded application of granules or prills in the fallow was still clearly the dominant method, but many were now frequently spreading and incorporating N either in fallow or at planting or even simply spreading in fallow.

NGA's Richard Daniel says a new survey has shown the majority of growers and agronomists had changed their approach to nitrogen rate, application method or timing in wheat crops in the past five years.

The majority of survey respondents said improvements in logistical and/or operational efficiency and/or lower application costs were the reasons for this change.

Nitrogen rate changes

More than a third of respondents had also altered their approach to determining N rate during the past five years.

"The survey results confirmed the key factors guiding application rate were: Yield and protein targets for the next crop; soil moisture availability and seasonal forecasts; and, agronomist or adviser advice," Richard said.

In a summary of survey results about why respondents' approach to N rate had changed, Richard said the predominant responses were:

- Long term N needs of rotation rather than a single crop;
- Use a consistent rate pre-crop and top-up as needed;
- Accommodate risk management; and,
- Use replacement value of nutrition removed.

"A key message from the survey was more than 85 per cent of the growers and agronomists believed NGA had improved their level of knowledge and confidence when it came to N management strategies for wheat," Richard said.

"And importantly this survey showed practice changes have been made on more than 800,000 hectares of wheat growing country, so more than 45 per cent of the area managed by growers and agronomists who completed the survey.

"For those completing the survey the major benefits to changing their N programs were improvements in on-farm logistics, input cost savings, risk management and crop performance." ■

Gene drive technology: A new hope in the fight against feral cats

By Nicholas Kachel, CSIRO

BETTONGS. Greater bilbies. Bridled nailtail wallabies. Before European colonisation, the populations of these iconic marsupials numbered in the millions. But they are now all critically endangered, along with a host of other native species, having been hunted to near extinction at the hands of a damaging pest – feral cats.

First introduced into Australia by European settlers, the feral cat population is thought to number between 1.5 and 5.5 million. They're incredibly adaptable and can live in any habitat across the country. They're also fast, sleek killers – much too quick for most wildlife to stand any chance – and to top it all off they breed quickly.

It has got to a point now where over 1 million native animals are being killed by feral cats every day. It's an imbalance our ecosystem cannot deal with.

So far, traditional controls like baiting have not been effective on cats. In fact, the only way land managers have been able to stop cats from getting at our native animals is to construct cat-proof fencing around reserve areas, like those managed by Australian Wildlife Conservancy, then removing all the cats inside and allowing native mammals to flourish. This isn't considered sustainable in the long term and, outside the fences, this perfect storm of predatory behaviour has continued to darken our biodiversity landscape.

But there is hope on the horizon – gene drive technology. Essentially, gene drives are systems that can bias genetic inheritance via sexual reproduction and allow a particular genetic trait to be passed on from a parent organism to all offspring, and therefore the ability of that trait to disperse through a population is greatly enhanced.

Girls will be boys

Using this type of genetic modification (GM) technology, it becomes theoretically possible to introduce cats into the feral populations to produce only male offspring. Over time, the population would die out due to lack of breeding partners.

A pearl bluebush flat in the extensive mallee woodlands of the Scotia Wildlife Sanctuary in western New South Wales. This is one site where endangered species recovery projects are conducted by the Australian Wildlife Conservancy.

"Gene drive using GM technologies allows all offspring of any coupling between a 'gene construct' (modified animal) and a wild animal to all have the gene construct," says Andy Sheppard, our Health and Biosecurity research director.

"This allows us to drive the single-sex genotypes much more rapidly through the population, without having to introduce vast numbers of genetically modified individuals."

This sort of technology has already been shown to work in the lab for mosquitoes and offers the prospect of eradicating mosquito borne diseases like malaria. The current focus of research is assessing whether it's viable in mammals like mice, which will require many years of work. Only then could it be considered for feral cats, and many more years of research into the genetics and ecology of feral cats in Australia would be required.

Requires public acceptance

In the meantime, there's also a lot of work to be done outside the lab. According to Andy, any application of this technology in Australia will require a full and thorough assessment of the risks it could pose to ensure all reasonable mitigation measures are put in place. It will also require broad public acceptance before proceeding and a public discussion about whether and how we want to use technologies like this to manage biodiversity.

"The main risk that's widely talked about is that if you start to release genetically modified animals into the environment where those animals are a pest, some of those GM animals might be able to escape the area where those species are not a problem," says Andy.

"They could then potentially get into areas where those species are highly valued, and indeed native, and therefore could reduce the fitness of endangered native populations. There's a lot of movement of animals around the world, either legally or illegally, which raises the potential risk of those genetically modified animals being moved around."

But it is important to note that this technology is spread by breeding only, therefore domestic cats are not at risk of 'catching' it like a disease.

Mitigating the risks

There are ways of mitigating these risks and this will be an essential aspect of our research. It will also be essential for Australian regulatory approval. Already there is promising research into low-risk gene drives with high probabilities of success and systems with controls built in at several levels so they can be locally contained.

While gene technology shows great promise, it is still only 'early days' and there is much more to be understood before it could be deployed. Traditional control methods coupled with wildlife reserves like Australian Wildlife Conservancys will remain essential for preserving our native animals in the meantime.

We have agreed to work with the Australian Wildlife Conservancy investigating the potential use of this technology to stop the species decline caused by feral cats through a combination of transparent research and ongoing dialogue with regulators and communities. ■

New thinking needed on resistance management

THE increasing incidence of herbicide resistance requires a rethink in weed control strategies coupled with innovative solutions to cope with this year's drought.

Nowhere is this more so than in the Liverpool Plains, which has the dubious title of the highest percentage of milk thistle herbicide resistance in the country.

While glyphosate has the most widely documented incidence of herbicide resistance, many other products including 'dim' and 'fop' grass herbicides and even DEN group products are also coming under increasing pressure.

Quirindi based agronomist, Peter McKenzie of Agricultural Consulting & Extension Services, has been active in weed management across the Liverpool Plains and Central West, including as a member of various advisory committees and as a conduit between industry and growers to come up with better weed control solutions.

Resistance is already prevalent in milk thistle, fleabane and ryegrass and could soon be followed by barnyard grass, liverseed grass, feathertop rhodes grass, umbrella grass and in some places, Johnsons grass.

Proactive and integrated weed management

His advice is to adopt a proactive strategy using a different chemical group and other methods such as mechanical chipping to avoid the overuse of chemical groups that had the effect of selecting resistant weeds, making them even harder to control.

This requires an integrated weed management strategy including using an effective residual product, but one without restrictive plant-back periods which would allow freedom of replanting options in the event of a crop failure.

"Even if your herbicide has been working well to date, don't keep doing the same things. You've got to use the tools available before you've got a problem," Peter said.

Sumitomo Regional Manager NSW, Phil Glover, said for that reason the best option is the Group G pre-emergent herbicide, Valor (flumioxazin) which is now registered in a broad range of crops and has no recorded resistance in Australia.

When applied at higher rates, Valor provides both rapid burndown and residual control of problem weeds without adding to resistance problems.

Zero, or short, plant-back

Equally importantly, Valor gives wide flexibility on a range of crops because of its zero or short plant-back restrictions compared to other residual herbicides.

"In a drought, growers need flexibility and this could be where Valor comes into its own because it has a very short plant-back period, unlike other products that can tie up paddocks for months."

He added that some growers had applied older pre-emergent herbicides in late summer in anticipation of planting a crop, but hadn't had the normal rainfall so their sowing window disappeared and now they faced long plant-back restrictions which limited their options

No plant-back period is required when using Valor in soybeans, pigeon peas, faba beans and peanuts. Cotton, sorghum, maize, navy beans, field peas and chickpeas only require a one month plant-back period once the Valor has been activated.

A 2017 crop of pigeon peas near Pallamallawa, just east of Moree in northern NSW. The paddock was treated with 210 g per hectare of Valor at sowing. This provided excellent residual weed control right through to canopy closure.

This keeps growers' options open as the season unfolds.

"Early defoliation provides an opportunity to use Valor to control volunteer Bollgard III cotton and glyphosate resistant weeds like fleabane and other harvest weeds without adding to resistance problems. It is also ideal for preparing paddocks for a long fallow or for double cropping without repeated glyphosate applications.

"Moving into the warmer months, Valor is the perfect choice for residual in-crop weed control in a range of summer crops, especially in zero till situations which makes it the ideal product for conserving moisture, maintaining cropping flexibility and managing resistance," Phil said.

"Valor is easily the best product to use in a year like this. It keeps your cropping options open to take advantage of any late season rain to plant other crops, or to fallow paddocks into the following season.

"Because of resistance, pre-emergent sprays are becoming more prevalent than applying multiple knockdowns anyway, and this is where Valor becomes a preferred option compared to most existing alternatives.

"Valor is also the perfect fit in Roundup Ready Flex cotton systems and ideal for use in both cotton and pigeon pea refuge crops," Phil said. ■

Stored grain and marketing opportunities

WITH continuing dry conditions, grain production in the eastern states will be well down on recent years. Despite this there will be opportunities for east coast grain growers.

Given a reasonable spring, Western Australia 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. Prices are high and there will not be much grain exported from the east coast ports.

According to Bayer's K-Obiol Market Manager, Daryle Swarz, the volume of grain stored on-farm has increased rapidly over the past five years.

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

"Higher prices favour the grower who has been prepared to make the investment in silos and to spend the time to understand correct storage of grain. And this means managing moisture levels and controlling 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 this.

According to Daryle, control of insects has become more sophisticated. "Silos that are gas-tight can use fumigants like phosphine and get excellent results. But if they are not sealed, then fumigant levels cannot be maintained for long enough. The result is less than total control leading to insects developing resistance."

Control options when silo is not gas-tight

When silos are not gas-tight growers need to use a product like K-Obiol. And the practice in the use of these types of products has changed in the past two to three years.

"Previously manufacturers would recommend their product be used on its own," says Daryle. "Now the reputable companies like Bayer recommend mixtures of products with different modes of action. The mixing 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 leads to insect resistance developing. So the recommendation of rotating the products is good for the grower and means our product has a longer effective life."

For more information go to: *https://www.environmentalscience.bayer.com.au/K-Obiol/Training* ■

The ultimate farm commodity bin

NEW South Wales based company Brookfield has been busy travelling to field days all over Australia recently to showcase a range of machinery that is specifically designed and manufactured for the farming sector. Born from the minds and built with the hands of everyday farmers, these innovations have proven to be seriously effective in getting better results out of age-old farming practices.

Brookfield lives by their brand and is continually researching, designing and testing farm machinery which is made for Australian conditions.

One machine that is proving very popular is the Brookfield OmniBin – otherwise known as a seed and super or grouper bin. The OmniBin is a highly versatile commodity bin for handling seed and fertiliser at sowing time, stockfeed and general grain handling as well as carting to the silos during harvest.

The OmniBin is unique in its low centre of gravity and high capacity. It features a variable speed conveyor belt, full remote control rear dump facility, silo bag filling and has a massive 360 tonnes per hour unload capacity. The design allows for two, three or four compartments, is self-cleaning to ensure no contamination, features a light tare weight and is 'non-oversize'.

There is no doubt that the OmniBin is the safest, cleanest and simplest bin available.

Brookfield is in a phase of growth and their dealership network is expanding every month. They currently have dealers based in Queensland, New South Wales, Victoria and Western Australia. They invite you to visit a Brookfield dealer to discuss your on-farm needs and see our range of machinery for yourself.

If you would like more information on any Brookfield products, contact us on 1800 774 274 or visit *www.brookfield.net.au* ■

The Brookfield OmniBin is a versatile commodity bin with efficient applications throughout the farming year.

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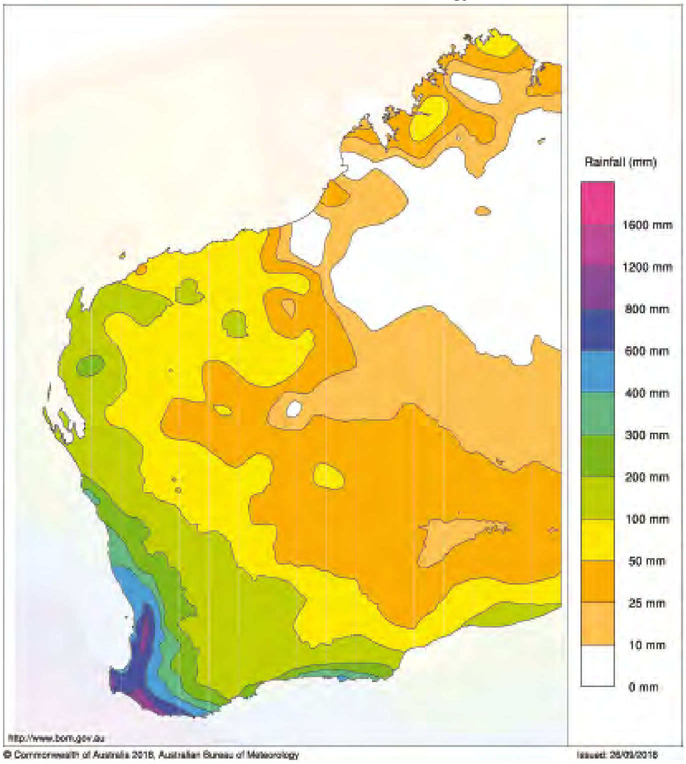
Western region

Western Australia rainfall totals (mm) April 1 to September 26, 2018

Australian Bureau of Meteorology



After a late break to the winter season most Western Australian cropping areas have received excellent growing season rainfalls.

WESTERN AUSTRALIA SUMMARY

The majority of the state is on track for a very good harvest with total crop production estimates increasing by almost 800,000 tonnes since the August report. This increase has been driven mainly by an increase in tonnage of barley, oats and lupins out of the Kwinana Zone.

The cereals have had a dream run up until now with near perfect growing conditions for most of the winter. There has been little frost damage to crops except in the southern and eastern Lakes District and there has been little heat damage to crops to date.

Total wheat production is expected to be close to 10.1 million tonnes with most of the main wheat growing regions in line for average or above average grain yields. The wheat tonnage could still swing either way over the next three weeks depending on frost and the weather conditions as the large wheat growing areas in the east of the state are starting to run out of moisture to finish off crops.

The barley production for the state could reach four million tonnes for the first time on the back of increased plantings in all regions of the state and favourable growing conditions.

The canola tonnage is likely to be lowest for five years due to decreased plantings from the late break, canola maturing later and poor establishment at the start of the season in the southern regions.

Geraldton

The Geraldton Port Zone is still on track to produce up to one million tonnes of total grain more than the 2017 if the season continues to be mild for the next few weeks. The potential to exceed the 2016 harvest is considered less as crops are later and whilst still looking good, will need cool temperatures and in some areas one more rain to achieve the total production from the region similar to 2016. The central and western areas of the zone have had almost exactly the same total rainfall for the calendar year as per 2017, – the difference this season being perfect timing of rainfall events.

The early varieties of wheat are around mid grain fill and the later varieties in the early stages of grain fill. So far, wheat has not had any significant frost events and the maximum temperatures have not exceeded 30°C – also important to note is the lack of hot winds to date. The crops on the heavy country in the east are starting to stress from lack of moisture whilst the remainder of the zone still has some moisture in reserve.

Most wheat crops have been managed well this year for disease and fertiliser so while there may be some lower proteins from grain yield dilution if the finish is soft, grain protein should be higher in general than last year particularly off the fallow and sprayed out paddocks from 2017.

There is a noticeable increase in the barley area this year and a decrease in canola. This trend is similar across the state and will have an impact on total grain delivery figures across the grainbelt as the barley area will produce more total tonnes than a similar area of canola.

Most canola crops are two weeks later than where one would normally like them for this time of the yea. But the cereals made up ground during the winter and are mostly only a week behind. The canola is at higher risk of obtaining below average grain yields than the cereals, although with mild conditions over the next two weeks the potential canola tonnage could lift.

Lupins are also behind in growth stage this year and most have only recently finished flowering.

The standout this year has been the performance of all crops

2018 GIWA WA crop production estimates (tonnes)

Port zone	Wheat	Barley	Canola	Oats	Lupins	Pulses	State total
Kwinana	5,742,000	1,930,000	448,000	215,000	127,000	5,000	8,467,000
Albany	1,120,000	1,110,000	356,000	189,000	55,000	0	2,839,000
Esperance	1,240,000	632,000	319,000	20,000	50,000	48,000	2,306,000
Geraldton	1,980,000	133,000	216,000	15,000	344,000	2,000	2,690,000
Totals	**10,082,000**	**3,805,000**	**1,348,000**	**439,000**	**576,000**	**55,000**	**16,305,000**
% change to Aug 2018	1.8%	7.2%	9.6%	25.4%	25.2%	17%	4.9%

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

District Reports…

September–October 2018

on the deep ripped country. These crops will be significantly higher yielding than those on un-ripped sandplain paddocks.

The Midlands

Crops in the Midlands area are all in very good shape. The heavier country away from the coast is exceptional. The washed out areas along the coast have started to pick up in recent weeks and will yield well without being outstanding.

There has been little frost in the region and the temperatures have been mild so far. The potential grain production is unlikely to exceed that of 2016, and whilst the crops are very good there are more weeds due to the lack of knockdowns used and the lateness of the season. Cereals are very clean from disease and generally have had adequate fertiliser.

The areas in the east of the zone could push tonnages up significantly if there is one more rain and conditions remain mild. But if there is no more rain in the next three weeks, wheat tonnages will drop off significantly.

The wheat is generally one week later than normal with Scepter just starting to flower. The barley is out in ear and the canola is still mid to late flower. The frost risk this year is less, although crops are not in the clear just yet.

Kwinana West

The crops in the West Kwinana Zone have above average grain yield potential at this stage of the season. The western areas of the zone have suffered from waterlogging although as they have been drying out over the past week, they have noticeably picked up. The areas to the east where there was less waterlogging have well above average grain yield potential for cereals.

The canola could still struggle to reach average grain yields as it is quite a bit later than normal with most crops still at mid-flower.

The cereals are well tillered and have a lot of biomass. They are very clean for disease and generally appear to have adequate fertiliser. Even though the start to the season was a little later than normal, the fairly good prices for wheat and barley coupled with very good growing conditions throughout the winter, have encouraged growers to push grain yield – and this is really starting to show up now.

There can still be significant frost events up until the first week in October or hot winds to take the top off the yields so it is not yet guaranteed, although most growers are set up as well as they could be for this time of the season.

Kwinana East

The eastern areas of the Kwinana Zone have looked good since emergence and this is still the case. The western and southern areas have above average grain yield potential. The wheat is well tillered across the zone and areas that only received single digit rainfall in the past three weeks will need more rain to finish crops.

The lateness of the crops is of more concern for most growers than frost as each day passes. There is not the sub-soil moisture as there is in the north of the state and crops have been getting along nicely for most of the winter with regular rainfall. The wheat is more bulked up than normal and could crash if the warm weather comes in the next few weeks. But on the other hand, the wheat could yield above average if there is one more rain and mild temperatures.

Western Albany

The West Albany zone is looking at above average grain yield for cereals following near perfect growing conditions since the break of the season at the end of May. There has been minimal waterlogging in the region which can often reduce individual paddock yields. The crops in general have been well managed.

This region of the state is a major barley growing region and over the past few years – even though there has been an increase of barley in the rotation – growers in general have handled the increased disease pressure wel. Some very high grain yields will be achieved this year if frost damage is minimal.

The canola area is down for the region and the grain yield estimates are also down due to the lateness of crops from the late and difficult start from repeat wind events.

Southern Albany

This area of the state has continued to improve over the past month from the very poor start with unprecedented dry weather and repeat wind events. The areas west of Chester Pass Road, South Stirlings has improved dramatically, although the condition of crops and pastures drops off quickly moving east. Most of the areas west of this line will potentially reach average grain yields for barley and wheat.

The barley paddocks sown on or prior to the initial break to the season at the end of May, have gone from good to very good in the past month in these western areas.

The average barley yields in the eastern areas for individual paddocks will be down as many of these were sown following failed canola crops.

The canola area is down by about half and grain yields will be down by up to one tonne per hectare in the eastern areas and close to average yields in the western areas.

Eastern Albany (Lakes Region)

The northern areas of the zone around Kulin and Kondinin are in good shape to reach above average grain yields for cereals. But as you move south in the region the potential drops off to below average for areas around Lake Grace to well below in the border regions of the Esperance and Southern Albany zones. The areas around Ravensthorpe west and north are going to produce well below average grain yields. Some of these areas have suffered from frost in recent days to further add to the very poor year for those growers.

This area of very low rainfall – and now frost – will have a significant effect on the total state grain production. While this is mostly a lower yielding region of the state, the area is now quite large and many growers will produce very little grain.

The wheat is just starting to reach head emergence and barley the start of grain fill.

The lupins and canola crops are very late and not expected to yield well unless the region has a very soft finish.

Esperance

The Esperance Port Zone will be down on its record of three million tonnes of total grain from 2017 by up to one third. Most areas of the zone look to be about average with areas on the coast washed out and areas in the north very dry with some crops being cut for hay. In contrast, some areas in the central region are looking well above average.

The whole zone was impacted from a late and difficult start with light rainfall events and repeat heavy wind events. In

general, the cereals are performing adequately, whilst the canola is poor.

Most growers took a wait and see approach to the season coming off record tonnages produced in 2017. With the season starting poorly and patchy emergence with many crops, inputs have been held back and crops in general lack top end potential yield except for the central strip away from the coast.

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

GIWA Crop Report – September 14, 2018

SOUTH COAST

Seasonal conditions in Western Australia's South Coast region changed for the better during August. The majority of the district received some very good rainfall – in fact some areas went from being very dry to water-logged with close to 200 mm falling during the month. But September has been very dry to date and most crops will need a good rain in early October to ensure good grain fill.

Crop yields are now looking quite good for most areas particularly for cereals and pulse crops. Unfortunately most canola crops are likely to yield below average with the combination of a dry start, staggered late germinations and high insect pressure – namely green peach aphid and diamond back moth.

There has been some frost damage to the west and north of Esperance, with the more severe frost being north of Salmon Gums and West River. These frost events occurred during mid August and mid September.

Growers are now preparing for harvest. The first canola crops

Machinery operator Linus Schueler from Warakirri Cropping – located to the east of Condingup on WA's South Coast – in an impressive crop of Scepter wheat.

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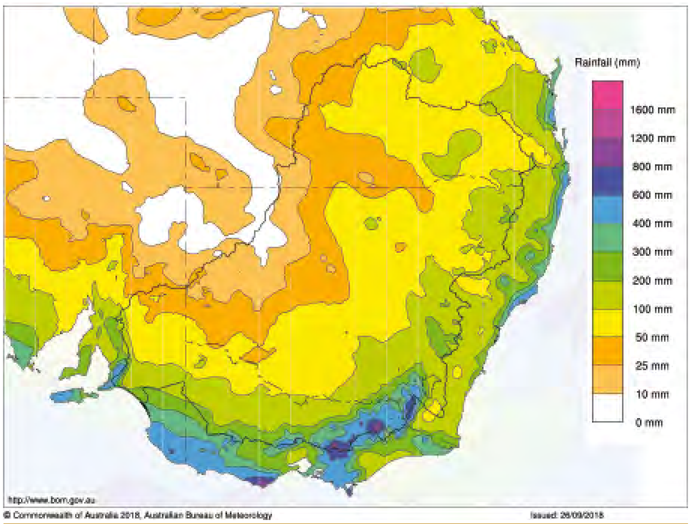
should be desiccated or swathed by mid October and harvest likely to commence on early sown crops at the end of October.

Quenten Knight
Agronomist, Agronomy Focus, Esperance
September 24, 2018

Southern region

Murray–Darling Basin rainfall totals (mm) April 1 to September 26, 2018
Australian Bureau of Meteorology



Cropping areas west of the Great Divide have endured a very dry growing season.

SOUTH AUSTRALIA SUMMARY

Weather

Growing season rainfall from April to the end of August was below to very much below average across most agricultural districts of South Australia.

By the end of Augusr only areas on Lower Eyre Peninsula, the Far West Coast and South East had received average growing season rainfall. Only parts of the Lower South East had received above average rain.

July rainfall was below average to very much below average in most districts. But August rainfall was very much above average on Western and Lower Eyre Peninsula, Southern Yorke Peninsula, Western Kangaroo Island and the Mid South East. Parts of Eastern Eyre Peninsula, Upper and Mid North and Southern Mallee received below average rainfall. An area around Cummins on Lower Eyre Peninsula received the highest August rainfall on record.

Maximum temperatures for August were average in the South East and most of Eyre Peninsula and above average in all other agricultural districts.

Frequent strong winds and several frosts in inland districts occurred during this period.

Crop condition

Despite average to above average rainfall in most areas during August, crop yields in most districts will be below average and well below average in a number of districts. Only crops on Lower Eyre Peninsula, Kangaroo Island and the South East are likely to be average or above.

Estimated total state crop production, although below average at 5.8 million tonnes (from an area of 3.7 million hectares), has not fallen to levels seen in previous drought years, due to the average to above average growing conditions in some districts.

Soil moisture reserves are highly variable across the state with good levels on Lower Eyre Peninsula, Southern Yorke Peninsula and most of the South East, but low in the eastern part of Eastern Eyre Peninsula, northern part of the Upper North and most of the Murray Mallee.

On sandy soils on Upper Eyre Peninsula and the Murray Mallee, strong winds caused soil erosion and sandblasting damage to crops and pastures, further reducing yield potential.

Even with above average August rainfall across Western Eyre Peninsula the tops of sandy rises remain bare and subject to wind erosion, but non-dune areas of most paddocks now have adequate surface cover to protect against wind erosion. Significant areas of the Franklin Harbour district remain bare and at risk of wind erosion.

Many farmers have tried re-sowing eroding sand dunes a number of times this season, with emerging crops being severely damaged by sandblasting during recurring strong wind events.

Crop maturity and vigour is highly variable across the state with early sown cereal crops on Western Eyre Peninsula and coastal areas of the Upper North at grain fill, while later sown or emerged crops in a number of districts are at late tillering to stem elongation.

Cereal crops in many districts suffered moisture stress during July, reducing tiller formation and hastening crop development. Many crops are thin, much shorter than normal and two to three weeks more advanced in their growth stage, with significantly reduced yield potential.

Crops on Lower Eyre Peninsula, Southern Yorke Peninsula and most of the South East, did not suffer moisture stress and have grown well during this period with average to above average yield potential.

Later sown crops on Western and Central Eyre Peninsula that had low yield potential in early August have benefited from the above average August rainfall and now show significantly improved yield potential.

Crops on Lower Eyre Peninsula, Southern Yorke Peninsula, Kangaroo Island and the South East are at early flower and show average to above average yield potential. Crops in other areas of the state are at early to full flower and although many have low plant numbers per unit area the plants have branched well, and show 50 to 80 per cent of average yield.

Pulse crops are highly variable across the state. Where they have suffered moisture stress, growth has been slow, and crops are very short, showing reduced yield potential.

Pulse crops on Lower Eyre Peninsula, Southern Yorke Peninsula and the South East have grown well and show average to above average yield potential.

Foliar disease is generally low with worst affected crops confined to districts with the higher production potential.

In many areas of the state, bean crops are short, flowering and setting pods close to the ground.

Peas have tolerated the dry conditions better than other pulse crops and are growing well with low disease levels. Early sown crops are beginning to flower.

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District Reports…

September–October 2018

Hay and fodder

Both pastures and cereal crops were cut for hay in early September in areas of the Upper Eyre Peninsula, Upper North and Southern Mallee. Most hay in these districts will be kept on-farm but small quantities should be available for sale by late September.

Frost in late August into September has damaged some cereal crops in a number of districts, with the worst affected areas likely to be cut for hay.

The majority of hay will be cut from mid to late September with good supplies available by mid-October.

Pastoral areas

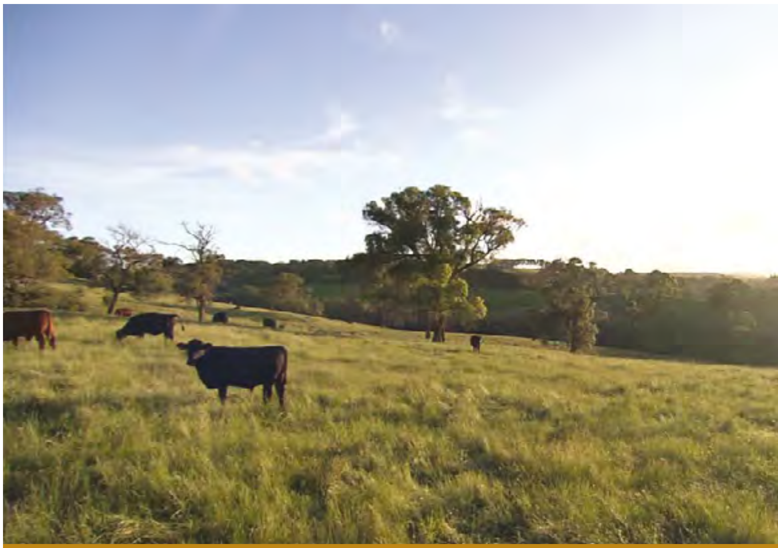
Pastoralists have continued to reduce stock numbers because feed supplies and/or water supplies are depleted. Some pastoralists have totally destocked, while most have reduced numbers by 40 to 50 per cent.

Lambing percentages have been very low with high ewe losses due to lack of available feed in most pastoral areas, with minimal lambs available for sale or replacement. This will further reduce breeding stock.

Most stock have continued to lose weight.

New season hay supplies will be available from the Mid-North by mid-October.

Rural Solutions SA for PIRSA
Crop & Pasture Report
September, 2018



Pastoralists have continued to reduce stock numbers because feed supplies

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)	2018 rainfall to date (mm)	Summer 25yr Annual Average (mm)	Summer 2017–18	Autumn 25yr Annual Average (mm)	Autumn 2018	Winter 25yr Annual Average (mm)	Winter 2018	Spring 25yr Annual Average (mm)	Spring 2018 to date
Emerald Qld	561	298	251	330	105	21	69	29	127	0
Toowoomba Qld	675	324	269	302	138	82	88	36	179	8
Roma Qld	581	260	251	208	116	94	78	34	135	7
Goondiwindi Qld	623	181	254	113	122	62	102	45	145	11
Narrabri NSW	631	181	220	95	118	67	130	47	164	9
Gunnedah NSW	634	155	217	118	108	35	129	42	183	27
Dubbo NSW	604	118	190	85	127	24	133	57	157	7
West Wyalong NSW	454	141	119	156	80	40	124	60	131	3
Wagga Wagga NSW	540	230	133	177	111	47	150	77	146	31
Swan Hill Vic	317	104	71	69	65	28	87	59	95	2
Bendigo Vic	504	237	109	60	106	70	159	128	135	17
Horsham Vic	374	185	79	43	71	54	122	109	104	5
Lake Bolac Vic	515	303	114	66	101	103	153	165	148	15
Murray Bridge SA	364	143	70	64	79	39	121	83	97	6
Kadina SA	336	139	63	60	78	18	112	51	85	51
Cummins SA	388	331	55	49	88	55	170	241	78	11
Esperance WA	614	458	88	75	141	68	248	285	138	38
Wagin WA	397	317	50	62	97	50	163	213	87	8
Northam WA	401	390	47	97	88	40	185	262	80	5
Mingenew WA	347	256	30	75	89	50	170	134	58	0
Moora WA	382	422	43	88	85	51	185	281	69	13
Mullewa WA	321	278	53	88	93	47	130	165	45	4

Last rainfall reading September 25, 2018.

District Reports…

September–October 2018

VICTORIA SUMMARY

Seasonal conditions in Victorian cropping regions during winter were mixed for crop establishment and development. In the Mallee, below average winter rainfall and low soil moisture levels reduced yield prospects. Average to above average winter rainfall in the Wimmera and western districts resulted in crops in these regions being in good condition at the end of winter with good yield prospects.

Crops in these regions are expected to boost Victorian winter crop production but not offset the expected production falls in the Mallee. Dry and cool conditions have delayed crop development in some cropping regions, which reduces the risk of damage from frost events but increases the risk of heat stress during spring in the event of warmer and drier than average seasonal conditions.

WINTER CROP FORECASTS, VICTORIA, 2018–19

Crop	Area '000 ha	Yield t/ha	Production kt	Area change %	Production change %
Wheat	1570	1.72	2700	1	–33
Barley	880	1.88	1650	10	–21
Canola	430	1.28	550	–4	–27

Note: Yields are based on area planted. Source: ABARES September 2018 Crop Report.

VICTORIAN MALLEE

Crops in the Mallee have been dealt very tough conditions throughout most of the 2018 season with a late/poor break and patchy germination, frosts, warm temperatures, wind and a Decile 1 growing season rainfall.

As a result, crops are suffering throughout much of the region and yield potential has reduced significantly since the previous edition of *Australian Grain*. Some areas in the northern Mallee have received only 50 mm of rainfall for the year (as at September 24).

Surprisingly, wheat crops are holding on better than barley crops – there doesn't seem to be an explanation for this but there are significant observations as a result of soil type differences and stubble retention practices – with crops performing better on the latter. Additionally, the value of chemical fallow has been highlighted as seen by the only remaining paddocks in some areas with green crops.

There hasn't been a great need for disease control and weed and pest issues have been relatively easy to manage this season,


Manangatang NVT barley on September 13 doing well despite only around 65 mm of rainfall.


Canola on fallow in the Southern Mallee in early September.


Canola on fallow in the Southern Mallee with cracking soil showing signs of moisture stress.


The sun sets on the BCG Main Field Day on September 12.

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although those in the Southern Mallee are keeping an eye out for precautionary disease control in high value pulse crops.

There has been a surge in crop hectares being cut for hay throughout the region to salvage crops that will not make it to grain, or that will provide a better return as hay than grain.

The additional benefit of cutting hay is an alternative weed management tool, so growers are focusing on paddocks with weed issues and/or the greatest biomass.

Fortunately, grain, sheep and wool prices remain excellent so mixed farming enterprises will be in a good position as well as those with grain in storage to help manage cash flow and spread income.

It has been noted there is a long time between now and April next year, so with little groundcover in some areas, there is going to be a greater risk of paddocks blowing during windy conditions.

Ciara Cullen
BCG Extension Manager, Birchip
September 25, 2018

Northern region

NSW SUMMARY

Seasonal conditions during winter were hotter and drier than average in cropping regions in New South Wales. Total winter rainfall was 54 per cent below average. In parts of the western districts there was the lowest winter rainfall on record.

The well below average rainfall during the planting window resulted in much less area planted to winter crops than was initially intended. The majority of planted area, and crops with reasonable prospects, are in southern New South Wales where June rainfall facilitated winter crop planting and subsequent seasonal conditions were more favourable than further north.

But timely spring rainfall will be important for the ongoing development of these crops.

WINTER CROP FORECASTS, NSW, 2018–19

Crop	Area '000 ha	Yield t/ha	Production kt	Area change %	Production change %
Wheat	2100	1.20	2520	–32	–44
Barley	600	1.27	762	–24	–36
Canola	400	0.75	300	–38	–51

Note: Yields are based on area planted Source: ABARES September 2018 Crop Report..

The area to be planted to summer crops in New South Wales in 2018–19 is forecast to decrease by 27 per cent to 449,000 hectares. This forecast assumes that spring and early summer rainfall will be adequate for planting grain sorghum and dryland cotton. Soil moisture levels are currently well below average and not ideal for summer crop planting.

Total NSW summer crop production is forecast to fall by 20 per cent in 2018–19 to around 1.9 million tonnes.

SUMMER CROP ESTIMATES, NSW, 2018–19

Crop	Area '000 ha	Yield t/ha	Prod. kt	Area change %	Prod. change %
Sorghum	156	3.12	488	4	14
Cotton lint	161	2.42	389	–48	–44
Cottonseed	161	3.42	550	–48	–44
Rice	54	10.25	554	–10	–12

Note: Yields are based on area planted, except cotton which is based on area harvested.

QUEENSLAND SUMMARY

Winter rainfall in most cropping regions in Queensland was average to very much below average, which decreased crop prospects. The dry conditions and low levels of soil moisture limited opportunities for late planting in southern Queensland and reduced potential yields across the state.

Winter crop production in Queensland is forecast to fall by 38 per cent in 2018–19 to around 900,000 tonnes, which would be the lowest winter crop production in over 10 years and is similar to production in 2006–07. The small crop forecast reflects a large fall in planted area, with below average autumn rainfall limiting the ability to plant crops.

WINTER CROP FORECASTS, QUEENSLAND, 2018–19

Crop	Area '000 ha	Yield t/ha	Prod. kt	Area change %	Prod. change %
Wheat	460	1.14	525	–25	–23
Barley	75	1.39	104	–15	–14
Chickpeas	220	1.11	245	–62	–62

Note: Yields are based on area planted. Source: ABARES September 2018 Crop Report.

Area planted to summer crops in Queensland is forecast to fall by 14 per cent in 2018–19 to around 615,000 hectares. This reflects a large forecast fall in area planted to irrigated cotton.

Summer crop production is forecast to fall by 12 per cent to 1.6 million tonnes.

In its latest three-month rainfall outlook (September to November 2018), issued on August 30, 2018, the Bureau of Meteorology forecast the chance of spring rainfall exceeding the median at between 50 per cent and 35 per cent in Queensland's cropping region.

SUMMER CROP ESTIMATES, QLD, 2018–19

Crop	Area '000 ha	Yield t/ha	Prod. kt	Area change %	Prod. change %
Grain sorghum	410	2.60	1067	8	6
Cotton lint	89	2.20	191	–53	–45
Cottonseed	89	3.03	270	–53	–45

Note: Yields are based on area planted, except cotton which is based on area harvested. Source: ABARES September 2018 Crop Report.

DARLING DOWNS

Weather conditions

There have been a few paddocks that have received up to 40 mm over the past two months, but most farms have only had about 10–15 mm of rain, and the drought rages on. The dry conditions are being compared to the mid 1960s, and on ridges on the eastern Downs, swathes of trees are dying.

One eastern Downs farmer says this is the first time in over 60 years that no winter crop was able to be planted on his farm.

District Reports…

September–October 2018

Winter crop

The only crops looking reasonable are the irrigated crops, and these are still limited by water restrictions. Grain fill is underway, but many paddocks are being cut for silage and hay, due to the high prices – and with water shortages – heads are not filling to the tip. It really is a direct correlation between mm of irrigation water and kg of grain, but without rainfall this winter and with plenty of frosts, crop height is short.

Early sown dryland crops on the western Downs are looking at fair yields, but later sown crops are failing. There has been some frost damage as well leading to more forage harvesting.

Chickpea crops on good subsoil moisture will have some yield, but with small plants and some frost damage, yields will be on the low side.

Summer outlook

Every farmer is hoping to get the rain for a big summer plant to compensate for the major lack of a winter plant. But the soil moisture levels are generally average to very poor, with only a few paddocks showing good profiles.

There has been some forage and grain sorghum already planted on isolated falls with soil temperatures warm enough to bring the crop up. The main crop in area this summer will be grain sorghum, along with increased interest in forage sorghum and the millets.

Exceptional prices for gritting maize has encouraged some farmers to bring corn back into their plans at the expense of sorghum, whilst others are considering allocating some irrigation water from cotton to corn to spread their risk.

The irrigated cotton area will be well back due to reduced availability of water, and the dryland cotton area could be similar to last summer if there is enough planting rain. Growers are keeping all their options open, and if a later summer plant is possible, sorghum, maize and mungbeans will be popular.

One issue already causing difficulties is seed supply, with some varieties of forage sorghum and corn already sold out, and pressure expected on grain sorghum seed.

Hugh Reardon-Smith
Agronomist – Landmark, Pittsworth
September 20, 2018

ANSWER TO IAN'S MYSTERY TRACTOR QUIZ

The tractor is a rare Oliver Diesel Super 55, restored by the author. (Photo IMJ)

ADVERTISERS' DIRECTORY

Grazing failed cereal crops on the eastern Darling Downs.