AUSTRALIAN GRAIN

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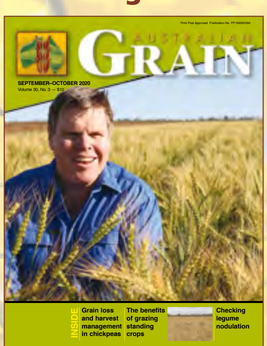
FRONT COVER

Flowering window



DAF (Qld) research agronomist Darren Aisthorpe, says growers could reap a significant yield benefit by identifying the ideal target flowering window for a region and adapting sowing date accordingly.

Contents

Focus Sections

Southern Australia Focus

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

Northern Focus

Covering Northern NSW and Queensland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Editorial… Lloyd O'Connell

GOOD rain in September generally makes-or-breaks the Australian winter crop. And for anxious growers across the country, this saying has rarely had more potency than in this season. Favourable conditions in September will be the difference between a good and a really good Australian harvest and a very welcome – much needed – income boost after last year's dismal national production figures.

Western Australian farmers have generally had a hand to mouth season. Most of the WA grainbelt is now very low on stored soil moisture and with the weather warming up, widespread September rain will very easily raise current winter crop production estimates to well beyond 15 million tonnes (mt).

It's a similar story in the south and south east of the country with winter crops in South Australia and Victoria poised for excellent yields as long as 'Hughie' plays along in September.

At the risk of putting the mockers on NSW growers, after a pretty much ideal autumn and winter, harvest prospects in that state are the best in years. There was above average rainfall from March to August in nearly all winter cropping regions. The very good autumn rainfall encouraged the planting of over 6 million hectares to winter crops which is around 15 per cent more than the 10-year average – and about twice the area that was planted last season.

With good soil moisture and a favourable rainfall outlook for spring, record NSW winter crop yields are on the cards for many areas. ABARES is forecasting statewide winter crop production at around 15 mt which is almost 50 per cent bigger than the average of the past 10 years.

The national 2020 winter crop forecast is for around 48 mt to tip the scales – which is more than 60 per cent better than last season and 20 per cent above the 10-year average of 40 mt.

Stand-out production figures

A stand-out figure is that about 60 per cent of our expected increase in national winter crop production this year is from NSW alone. The other stand-out number is a forecast 90 per cent increase on last season in national wheat production. Given average spring conditions, wheat growers across the country will be harvesting around 29 mt – or more than 20 per cent above our 10-year average.

This will not only put a smile on the face of growers but also our grain exporters who will have plenty of product to sell.

Here's hoping for a soft finish to the winter season to help fill those heads and to bolster soil moisture reserves for summer.

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In this issue…

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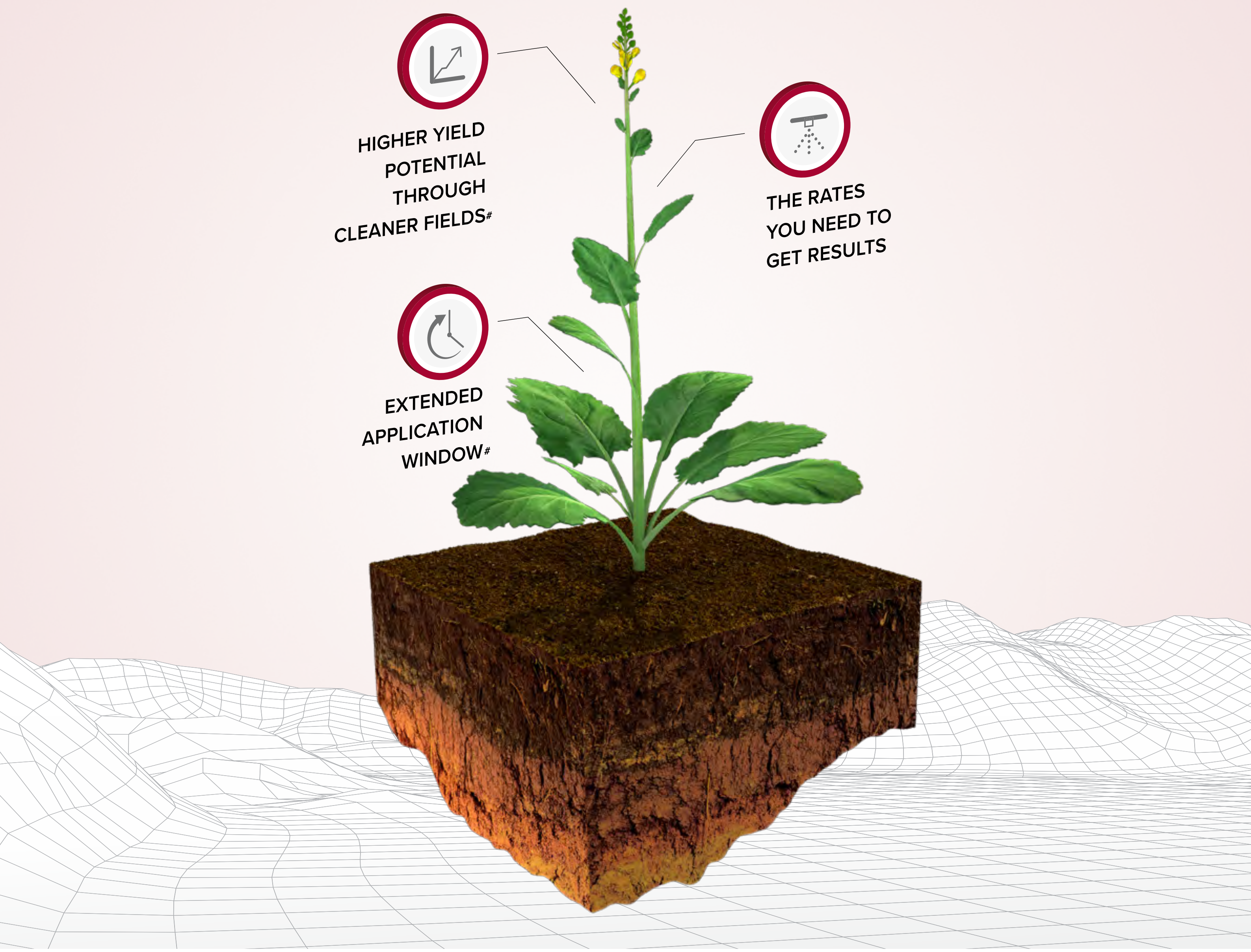

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Brown manures, cover crops and long fallows to increase profit

By Chris Minehan, RMS Farm Business Consultants

AT A GLANCE...

- Reducing crop intensity can reduce variable costs and risk, while increasing profit.
- Use a long-term, systems approach when considering a brown manure, cover crop or long fallow. Many of the benefits from this appear two to three years later.
- 'Problem' paddocks with weed or soil fertility issues are the best place to start, as these are often unprofitable when cropped, so opportunity cost is minimal.

LONG term continuous cropping systems can be very profitable when managed well. But continuous cropping is prone to the emergence of a number of issues which ultimately decrease profitability and increase risk. These include:

- Soil fertility decline;
- Increasing grass weed pressure and herbicide resistance; and,
- Soil and foliar disease build up in single crop systems.

Many of these issues cannot be adequately addressed in a single year break cropping situation. A trend of declining spring rainfall in southern NSW is also expected to increase the risk of all-crop systems.

To improve the sustainability and profitability of cropping systems in southern NSW, many growers have chosen to replace their usual grain crop in lower performing crop paddocks with an alternative 'non-grain' crop, forage or pasture for one year.

The choice between brown manure, long fallow, sacrifice crop, mixed-species cover crop or other alternative is based on variables including financial considerations, location, climate, soil type, access to livestock and suitable livestock infrastructure.

The factors common to each of the mentioned cropping tactics are:

- Crop is terminated in spring, to ensure complete weed control, often incorporating double knock applications or non-herbicide control measures; and,
- Timing of termination is aimed at maximising accumulation of plant available water (PAW) and organic nitrogen for the following crop.

For more sustainable and profitable cropping systems many growers are introducing non-grain crops into their rotation.

The benefits of non-crops

There are benefits of replacing a grain cash crop with a non-grain crop accrue, both at the paddock level and at the broader farm business level, especially when a system is adopted across a portion of farm area each year.

Benefits may compound by following a brown manure or non-grain crop option with another break crop, such as canola. This 'double-break' is extremely effective at managing grass weeds and cereal root diseases. Positioning canola after a brown manure or long fallow also decreases risk for canola by providing additional nitrogen and PAW, ensuring canola is more likely to be established at the correct time.

Potential benefits at the paddock level:

- Improved weed control;
- PAW accumulation;
- Increased soil fertility (with legumes); and,
- Increased diversity (when multiple plant species are used together).

Follow on benefits identified for the farm business:

- Reduced input costs, especially grass herbicides in cereals and urea following legumes;
- Increased productivity from planted area – Similar crop income, from less area, with less cost;
- Reduction in risk, resulting from lower spend on input costs;
- Ability to effectively manage herbicide resistance, through multiple and varied weed control tactics; and,
- Improvements in labour and machinery efficiency:
  - Wider sowing window;
  - Less paddocks require urea; and,
  - Less pre-emergent herbicides used.

Limitations

There can be logistical issues involved with 'non grain' options, including sourcing of seed, or trouble sowing through heavy pulse stubbles. These will vary between farms based on location, machinery and management priorities. History suggests that once growers are convinced a practice is worthwhile, a solution will soon be found to the technical and logistical issues.

Many of the cited limitations to adopting a brown manure (or similar) system are associated with FOMO (the fear of missing out). The most commonly cited reasons not to brown manure a paddock are cash flow constraints or the opportunity cost of not cropping that paddock in the current year.

Cashflow implications

Cash is critical to business. While it may seem that a paddock not producing grain is negative to cashflow, brown manure crops tend to have much lower input costs compared to cash crops, especially when those crops require expensive grass herbicides or urea to achieve their yield potential. A typical brown manure crop might cost $100 per hectare from sowing until termination,

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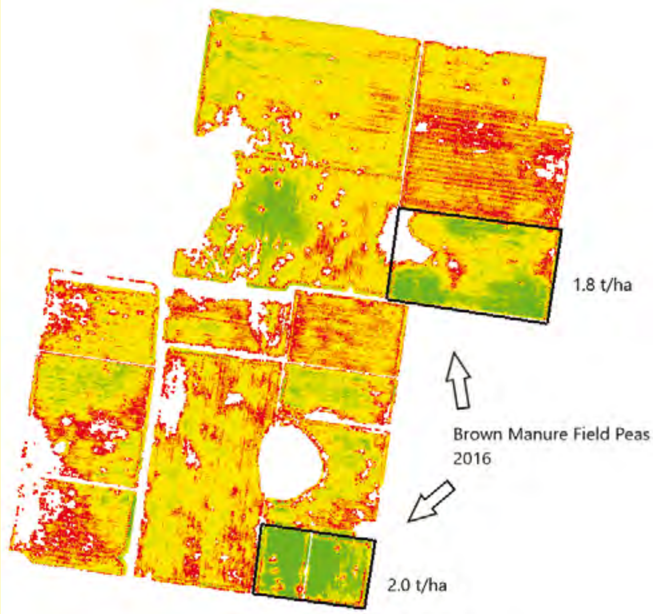
FIGURE 1: Yield map of paddocks highlighting difference in yield between brown manure fields and rest of the property



compared to a cereal crop targeting 2.5 tonnes per hectare which could cost between $200 and $300 per hectare up to harvest.

The first year with decreased grain area is certainly the hardest. From the second year onwards, the benefits from previous brown manure crops generally outweighs initial decreased harvested area resulting in greater returns per hectare over time.

Many vetch growers use hay as a strategic cashflow tool. In dry years, when other grain yields are likely to be lower and cashflow tight, vetch is made into hay, capitalising on higher hay prices in those years.

In better years, when there is adequate income generated from other crops, the vetch is brown manured, reducing nutrient removal, leaving more nitrogen, more PAW and better groundcover.

For those with livestock of their own, or access to agistment, mixed species forage crops can provide many of the same benefits as straight brown manures, with cashflow from livestock.

This is heavily dependant on location and individual situation.

The benefits of brown manure legume crops become more apparent in the second year onwards. (PHOTO: NSW DPI)

Opportunity cost

"I could grow a four-tonne barley crop there". Typically, this argument over-estimates the yield and the price, underestimates the cost of growing a cash crop and does not account for any future yield increases or cost savings associated with the brown manure.

Rather than using a farm average grain yield, or aspirational yield target, the analysis should be done using the worst paddock on the farm. Typically, the lowest performing paddock on any farm will have a very low profit margin in most years and may possibly be costing the business money. By starting with a poor performing paddock first, the opportunity cost is minimised. This allows the brown manure program to commence with less impact on cashflow.

For further information: Chris Minehan, Rural Management Strategies, Wagga Wagga NSWPh: 0427 213 660; Email: chris@rmsag.com.au ■

BROWN MANURE BENEFITS: A CASE STUDY

A group of paddocks in 2016, all sown to barley, except the two least productive paddocks (due to grass weed populations), which were sown to field peas and brown manured ($100 per hectare cost).

BARLEY RESULTS 2016	
3.0 t/ha @ $170/tonne average	
Income	**$510/ha**
Waterlogging, grass weeds and disease Boxer Gold + Axial in-crop, urea spread by plane	
Variable costs	**$280/ha**
Gross margin	**$230/ha**

- All paddocks were sown to canola in 2017:
  - The yield map is shown in Figure 1.
  - Canola in paddocks following barley averaged 0.8 t/ha.
  - Canola in paddocks following brown manure (BM) peas averaged 1.9 t/ha (60% higher yield).

CALCULATING THE BENEFIT OF BROWN MANURE (BM) FIELD PEAS IN 2016	
Extra canola yield 2017 (1.1 t/ha @ 550/tonne)	$605/ha
Less the cost of growing peas in 2016	-$100/ha
Less the opportunity cost of barley in 2016	-$230/ha
Net benefit of BM field peas (over 2 years)	**$275/ha**

- Cumulative rotational benefits identified from 2016 to 2019.

Extra canola yield 2017 (1.1 t/ha @ $550/tonne) due to the benefit of BM field peas in 2016	$605/ha
No Sakura on BM paddocks 2018	+$40/ha
No urea on BM paddocks 2019 (vs 100 kg urea on all others)	+$55/ha
Less the cost of growing peas in 2016	-$100/ha
Less the opportunity cost of barley in 2016	-$230/ha
Net benefit of BM field peas (over 4 years)	**$365/ha**

Integrating livestock into a continuous cropping system

INTEGRATING livestock into a continuous grain cropping enterprise can establish a more robust and resilient farming enterprise, by creating new revenue streams, improving the utilisation of natural water resources on-farm, and producing a healthier soil ecosystem.

That's according to 2018 Nuffield Scholar and NSW farmer, Stuart McDonald, who investigated global practices that incorporate livestock into established continuous cropping systems, with support from Grains Research & Development Corporation (GRDC).

Travelling across France, Ukraine, the United Kingdom, the United States and New Zealand, Stuart met with farmers and visited research centres and universities to identify successful crop rotation and grazing systems that drive profitability and productivity on-farm.

Grain and graze benefits

In the report, Stuart highlighted the benefits of establishing a dual-purpose grain and graze enterprise, focusing on the implications for greater flexibility and risk diversification.

"Travelling to New Zealand, I saw firsthand the benefits driven to growers who integrated winter grazing into their operation.

2018 Nuffield Scholar, Stuart McDonald.

"Many of the large breeding operations in New Zealand operate in an environment where they run out of traditional feed every autumn and winter.

"To supplement feeding during these periods, many farms I visited had a fodder crop worked into their rotation systems to ensure stock are supplied with high-quality finishing feed.

"The grazing crops were planted to suit the period of generally low feed availability experienced on breeding operations, which in New Zealand were the winter months when low temperatures shut down native feed production."

Stuart said diversity in crop rotation establishes a more robust and resilient farming enterprise.

"Rotational crop diversity provides more options for income generation than grain only systems and can alter the focus on winter only grain production, providing greater versatility in planning times and harvest," Stuart said.

"Livestock have the unique ability to turn plant cellulose into high value protein and as a result, can generate income from a resource that otherwise has little monetary value."

Unexpected benefits

Stuart said soil health improvement was one of the more unexpected benefits identified throughout his travels, when livestock were introduced to a continuous cropping enterprise.

"When livestock are integrated with soil health in mind, there is an opportunity to build a system that allows soil to function as a vital living ecosystem that sustains plants, animals and people and generate extra returns," Stuart said.

"Adding fertility to the soil through livestock can occur in various ways. While travelling in Litcham, England, I met with local grower, Nick Doig, who witnessed significant soil health benefits by running pigs on a paddock for two years.

"The pig activity on the soil was extensive and successfully enhanced the fertility of the following crop. This method of extended grazing periods could now be rotated through the farm to boost soil health and productivity across the whole cropping system."

Though there are extensive benefits associated with integrating livestock and continuous cropping, Stuart said grazing can be a damaging tool when not applied in a sympathetic way to the goals of the system.

"Attention must be paid to both animal and plant performance, with high intensity grazing driving the greatest potential for positive crop, soil, and animal performance," Stuart said.

"When applied well, integrating livestock to a continuous cropping system has the ability to cycle nutrients faster in the soil, generate new income streams, and create a more biologically diverse and healthy soil ecosystem.

"To achieve greater production efficiency in an integrated system, more longer-term research must be done to better understand the biological processes in soils and determine how on-farm management influences and drives these processes."

Applications for the 2021 Nuffield Scholarship program are now open, providing a unique opportunity for proactive young farmers to contribute to the advancement of Australia's agricultural sector.

For more information: Stuart McDonald M: +61 427 640 200, E: stuartmc1@me.com ■

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KEY AREAS ENDOFUSE HAS BEEN SHOWN TO IMPACT:

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- Reduce long fallow disorder
- Crop yield
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- N, P, K and trace mineral uptake
- Water uptake during moisture stress
- Soil health
- Re-populate mycorrhizae following cultivation

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Grain loss and harvest management in chickpeas

By Richard Daniel, Linda Bailey, Denielle Kilby, Branko Duric, Richard Black & Lawrie Price. NGA

AT A GLANCE...

- Generally minor impact from desiccant treatments or application timing on yield or grain quality.
- Decisions on harvest management choice should be determined by cost, attitude to Ally plant back restrictions, weed spectrum present at harvest and speed of desiccation required.
- Delayed harvest at low percentage grain moisture caused more damaged and split grain than desiccant treatment or timing.
- Ideally target desiccation at around 85 to 90 per cent pod maturity and schedule harvest seven days later to reduce grain quality issues.
- Large levels of pod and grain losses were measured at the front of the header in four commercial evaluations (around 100–200 kg per hectare).
- Losses reduced by about 50 to 90 kg per hectare when harvested with air assist or when brushes were attached to the reel.
- Impact from the harvest modifications would have improved returns by $34–$67 per hectare.
- In the trials conducted in 2018 and 2019, this represented an additional 5–18 per cent yield.

OVER the past three seasons Northern Grower Alliance has been involved in two important aspects of chickpea harvest management. The first has been to evaluate the impact of desiccant choice and timing on yield and grain quality. The second has focussed on the magnitude of commercial harvester losses and the impact on yield and economics from changes in harvest approach.

Desiccation evaluation

The area of focus has evolved over the three seasons.

2017: Five trials evaluating current and new desiccation tools to assist in refining management programs. Treatments included glyphosate alone, glyphosate + Ally, glyphosate + Sharpen, Reglone, Gramoxone and Gramoxone + Sharpen.

2018: Four trials continuing the original activity. An additional three trials focussed on impact of desiccation timing (application around 3, 2 and 1 week prior to 'planned' commercial harvest). In all three timing trials, treatments were also harvested after a 14 day delay. Treatments repeated from 2017.

2019: Three trials primarily focussed on the impact of desiccation timing (application at around 70, 80 and 90 per cent pods at physiological maturity). Harvest was conducted for all timings at about seven days after application. Similar treatments to 2017 and 2018 but replaced Reglone with glyphosate + Ally + Sharpen.

Pod maturity was assessed at each application on a minimum of 10 main branches. Pods were considered mature when a 'yellow beak' was starting to extend on the enclosed grains. This stage often corresponded with a purplish tinge appearing on the pod coat.

What we found

Leaf discolouration and leaf drop (visual ratings)

- Treatments increased the percentage of leaf discolouration and percentage of leaf drop compared to the Untreated but without consistent differences between treatments across sites.
- Improvements in percentage of leaf discolouration and percentage of leaf drop compared to the Untreated were greatest in 2017 (where high levels of October rainfall encouraged crop regrowth) and generally lowest in 2019 at sites that matured very rapidly under high moisture stress.

Stem dry down (physical rating)

- A 'twist test' was conducted to assess the percentage of plants where all stems snapped at harvest. This was done to provide an indication of stem ropiness or harvest readiness.
- The most consistent treatments in 2017 and 2018 were the mixture of glyphosate + Ally or Gramoxone 250 + Sharpen. In 2019 there was no significant difference, in any trial, between any treatment and the Untreated.
- There was a positive dose response to glyphosate in 2017 and 2018 with increased stem snapping from the 1.8 L/ha rate (540 g ai/L formulation).

Yield

- In 14 of the 15 trials, there was no significant difference in yield between any treatment and the Untreated.
- In 2018, there was a significant reduction in yield from Gramoxone 250 at one site where the application was about four weeks prior to expected commercial harvest and then harvest was delayed by another two weeks. Crop stage at application was only 59 per cent of pods at physiological maturity.

Grain quality (NIR and sievematic)

- Impact on grain quality was generally minor.
- Test weight was significantly reduced in two trials in 2018 by Gramoxone 250 or Reglone when application occurred around 4 weeks prior to expected harvest. Crop stage at application was approximately 50–60 per cent of pods at physiological maturity.
- There was no significant impact on screenings from any desiccant treatment in 2018 (using a 4 mm slotted screen as an indication of defective grain)
- Impact on grain moisture at harvest was minor with no significant difference between desiccant treatments and the Untreated in 12 of 15 trials. All treatments reduced grain moisture by about 1 per cent in a 2017 trial where regrowth was evident and Gramoxone 250 significantly reduced harvest moisture at two of the three sites in 2019.

Grain grading (visual rating)

- Visual grain assessment on all trials from 2019 showed no significant impact from desiccant treatment or timing on the

percentage of green or yellow grain compared to Untreated grain harvested at the same time.

- In one trial, application of glyphosate alone at 70% of pods at physiological maturity reduced the percentage of mature grain by around 2 per cent and increased the percentage of damaged grain by a similar amount. There was no significant impact when glyphosate was applied at 90 per cent pod maturity.

Germination

- Germination tests were conducted on seed samples from application timing trials in 2018 and 2019. Effects were generally minor.
- Significant reductions in germination were observed from glyphosate + Ally applied at 58 per cent pod maturity in one trial in 2018 and glyphosate + Sharpen + Ally applied at 66 per cent pod maturity in 2019. In both cases, application of the same treatment at later crop stages had no effect.
- Reduced germination was observed from all treatments at one site in 2019 when applied at 90 per cent pod maturity where a rain event of 18 mm occurred between application and harvest. There was no consistent impact from treatments on germination from applications at the same site at 70 and 80 per cent pod maturity.
- NB. The use of desiccants is not recommended when the grain is expected to be used for seed.

Summing up the dessication research

Differences between desiccant treatments and timing of application were less obvious than originally expected.

The addition of Ally will generally improve stem dry down compared to other treatments, whilst higher label rates of glyphosate will improve the speed of discolouration and stem dry down.

Impacts on yield and grain quality were relatively minor, even when application occurred up to two or three weeks earlier than currently scheduled.

But in five of the six trials where harvest timing was also compared, it was clear that the earlier harvest of chickpeas had significantly lower levels of damaged grain.

This effect was irrespective of whether the plots had been desiccated or Untreated. Although differences in header setup can't be eliminated, it is likely that the lower levels of damaged or split grain is at least partly due to the higher levels of grain moisture at harvest.

Even the early application treatments had grain moisture lower than 10 per cent – when tested within 24 hours of harvest – in five of the six trials.

Rather than suggesting that the industry desiccate chickpeas at an earlier maturity stage, this data should provide good confidence that desiccation at 85 to 90 per cent pod maturity is highly unlikely to have any negative impact on yield or grain quality.

When combined with harvest scheduled around 7 days after application, this should allow harvest at slightly higher grain moisture and significantly reduce the amount of damaged or split grain in samples.

Commercial harvest losses

Commercial observations have frequently indicated high levels of harvest grain and pod loss in chickpeas, particularly in crops with reduced biomass that 'feed' poorly into the header.

This grain loss is different to grain that passes through the header (processing loss) or grain left on plants (harvest height loss).

Front of header grain loss is made up of pods and grain that are knocked off by the reel, cut off by the knife but fall outside the header front or thrown out from the header by the drum or belt.

In 2018, data was generated at a site near Gurley (northern NSW) where PBA Seamer was harvested with a header fitted with an air front. Replicated strips were established where the only difference was whether the air front was turned on or off during harvest.

Counts were taken of pods or grain on the ground together with the number of grains per pod and grain weight. In 2018, sampling zones were assessed across the harvested width with no pods or grain apparent on the ground prior to harvest.

Results shown in Table 1 are for the pod and grain losses away from the header trail. These are the harvest losses that occurred at the front of the header but exclude any pods that were unharvested but still attached to plants.

In 2019 three sites were evaluated with sampling away from the header trail to identify the pods or grain losses at the front of the header. Again there was no indication of pod or grain loss prior to harvest. Two of the sites had air assist fitted to the header that could be simply turned on or off. The third site (Bellata) evaluated lengths of brushes attached to the reel (see photo).

All results in Table 1 are for sampling away from the header trail. This shows the yield losses occurring at the header front. Assessment of grains/pod and grain weight was conducted to calculate total grain loss.

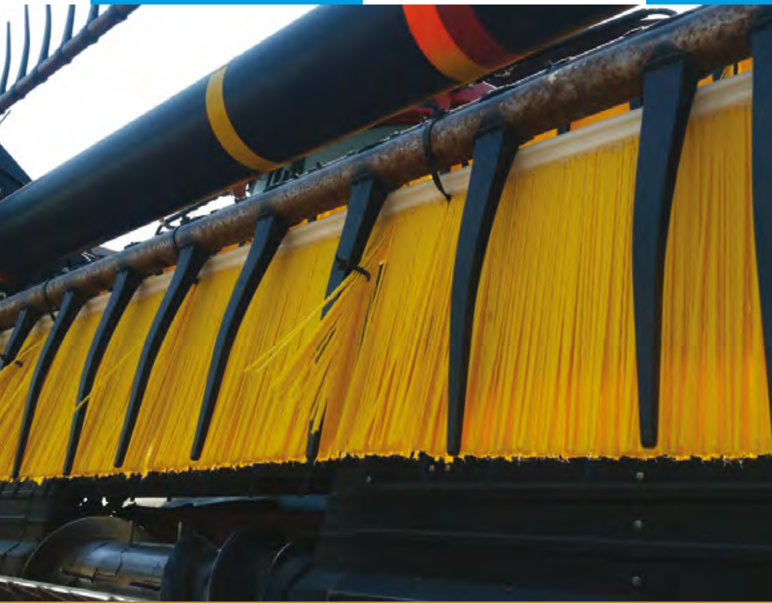
Commercial harvest losses: What we found

- The majority of grain losses were as whole pods rather than individual grains.
- At all four sites between around 100 and 200 kg per

TABLE 1: Impact on chickpea yield losses from air assist or reel brushes

Location and year	Variety and yield	Header set-up	Yield losses on ground			Reduced grain losses kg/ha and ($/ha)
			Pods/m^2	Grain/m^2	Total kg/ha	
Gurley 2018	PBA Seamer ~0.62 t/ha	Air assist OFF	55 a	10	164 a	89 kg/ha ($67/ha)
		Air assist ON	22 b	8	76 b	
Wee Waa 2019	PBA Monarch ~1.0 t/ha	Air assist OFF	33 a	5	115 a	45 kg/ha ($34/ha)
		Air assist ON	21 b	3	70 b	
Bongeen 2019	PBA HatTrick ~0.45 t/ha	Air assist OFF	38 a	1	123 a	80 kg/ha ($60/ha)
		Air assist ON	14 b	0	43 b	
Bellata 2019	PBA HatTrick ~0.40 t/ha	Reel brushes OFF	62 a	11	217 a	63 kg/ha ($47/ha)
		Reel brushes ON	43 b	9	154 b	

Letters of significance show significant differences within each site (2 sample T test, p=0.05)
Economic impact calculated on a $750/t grain price



Brushes attached to the header reel, Bellata 2019.

hectare of grain was lost at the front of the header using a conventional setup.

- Use of air assist or brushes attached to the reel significantly reduced the losses of whole pods and the total grain loss, at all sites.
- There was no significant difference in losses of individual grains.
- The mean reduction in grain loss was 70 kg per hectare (range 45 to 89 kg per hectare).
- The mean reduction in grain loss was $52 per hectare (range $34 to $67 per hectare).
- The reduction in losses would have been equivalent to an extra 5–18 per cent crop yield.

Summing up the commercial harvest research

All four trials highlighted the amount of chickpea grain and income that can be lost at the front of the header at harvest.

The impact of air assist or even the simple approach of attaching brushes to the reel provided benefits of around $50 per hectare.

But some caution is needed as both 2018 and 2019 were low yielding seasons with yields varying between 0.4 and 1.0 tonnes per hectare. The benefits of simple header adaptations may be more substantial in lower yielding years or where crop biomass or planting configuration is likely to result in poor levels of 'feeding in' of harvested material.

Further evaluation is warranted under more normal conditions to provide growers with realistic indications of the benefits of changes in chickpea harvest management.

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, the authors would like to thank them for their continued support.

Northern Grower Alliance would particularly like to acknowledge the assistance from a large number of trial co-operators during this series of trials: Wade Bidstrup, Graham Butler, Jack Williamson, Sam Chaffey, Glen Kendall, Mark Cotter, Drew Penberthy, Nigel Melbourne, Ash Butler and Ross Durham.

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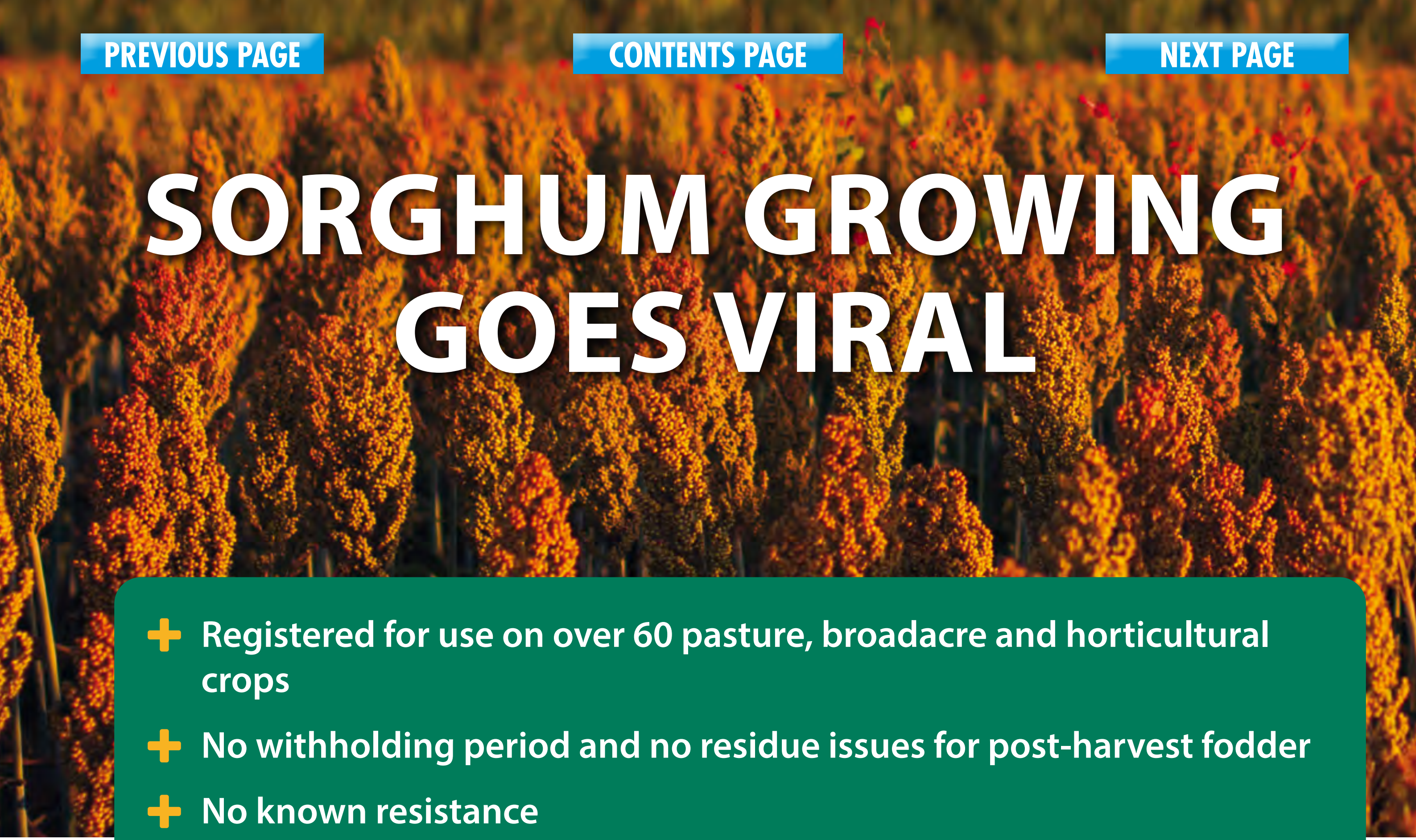

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Instar	Age (days)	Size category	Length (mm)	Actual size	ViVUS Max timing
1st	0 - 2	Very Small	1 - 3		✔✔
2nd	2 -4	Small	4 - 7		✔✔
3rd	4 - 8	Medium (small)	8 - 13		✔
4th	8 - 11	Medium (large)	14 - 23		✖
5th	11 - 14	Large	24 - 28		✖
6th	14 - 18+	Large (snake)	29 - 40+		

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$/tonne	0.1	0.2	0.3	0.5	0.7	1.0	2.0
$200	$5.76	$11.52	$17.28	$28.80	$40.32	$57.60	$115.20
$250	$7.20	$14.40	$21.60	$36.00	$50.40	$72.00	$144.00
$300	$8.64	$17.28	$25.92	$43.20	$60.48	$86.40	$172.80
$350	$10.08	$20.16	$30.24	$50.40	$70.56	$100.80	$201.60

*12 heads/m, 1m row spacing. Source QDAF.

CREATE YOUR OWN THRESHOLD

NUMBER LARVAE/HEAD = $$\frac{(C \times R)}{(V \times N \times 2.4)}$$

WHERE

C = Cost of control ($/ha)
R = Row spacing (cm)
V = Value of crop ($/t)
N = Number of heads/m row
2.4 = weight of sorghum (grams) lost/larvae

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The benefits of grazing standing crops

By Claire Dennerley (PIRSA) for MacKillop Farm Management Group

At a glance…

- Standing crops offer a protective alternative feed base option during times of high grass seed burden for lambs in our region.
- It is important to evaluate your feedbase and understand when to make decisions and take actions that optimise the growth rate of lambs.
- Grazing standing crops allows for flexibility in management of a mixed enterprise farm and offers a reduced labour cost option when growing lambs.
- Standing crops provide groundcover over summer, preventing erosion and are of general benefit to soil health.

Integration of cropping and grazing operations provides flexibility for farm businesses to manage seasonal and market variation, reduce business risk and improve profitability, while enhancing land condition. Managing the feed-base in a mixed enterprise can be problematic or complementary because both enterprises use the same land, and timing of operations can sometimes conflict

In the Upper South East region of South Australia, the winter-dominant rainfall dictates the management of breeding and finishing systems around the growing season months (April through to October). When grain harvest begins in late spring, grass seeds can become a significant burden for lambs grazing in pasture paddocks, so having a seed-free paddock to graze lambs on for the duration of harvest is advantageous.

To this end, MacKillop Farm Management Group (MFMG) has worked on demonstrating the role of standing crops in our local environment.

A standing crop is a cereal crop sown and taken through to flowering or grain fill, and managed as a crop would be for harvest. This means that varieties are chosen to suit the location, and are sown on time with adequate fertiliser and weed management to maximise dry matter production. The crop is then evaluated in spring to determine its most beneficial end-use, whether that be grazing, cutting for hay, or harvesting.

The benefits of standing crops

- Allow for flexibility in management (for example a *Grain & Graze* opportunity in early winter and for finishing lambs then carry through to grain harvest);

Claire Dennerley, PIRSA.

- Can be used as a fodder bank to finish lambs on;
- Offer a reduced labour cost option for growing lambs to achieve their target sale weights for marketing;
- Can meet the higher nutritional demands needed to turn lambs off earlier;
- Promote better soil erosion protection and subsequently facilitate maintenance of groundcover outside of the growing season, by turning lambs off earlier; and,
- Are grown on winter rainfall, therefore reducing the risk of summer cropping options that are dependent on opportunistic summer rainfall events.

How the demonstration was done

This single-season demonstration project aimed to highlight a fodder option that will turn lambs off faster in summer while providing more soil protection outside of the growing season.

We wanted to demonstrate the role standing crops have in the local environment and to have a better understanding of the costs and benefits.

MFMG hosted an initial *Grazing Standing Crops Forum* in Keith in March 2019. San Jolly, a livestock consultant with Productive Nutrition, was invited to introduce the practice to the farmers and advisors in attendance.

Varieties were selected by growers at the forum for the purpose of assessing how they grow in the local environment as a standing crop fodder option.

MFMG collaborated with Birchip Cropping Group to deliver this project through funding from the Australian Government's National Landcare Program.

MFMG managed two demonstration sites in the Upper South East of SA while two sites in the Victorian Mallee were managed by BCG.

The project ran over one season, finishing in March 2020.

There were two parts to the demonstration:

- **Small plot demonstration strips**
  Ten varieties were sown at Keith, and 11 varieties were sown at the Sherwood site.
- **Paddock-scale demonstration sites**
  The Upper South East locations – 'Tolcairn' at Sherwood and 'Tallawong' at Willalooka – were

MFMG

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Executive Officer: Meg Bell

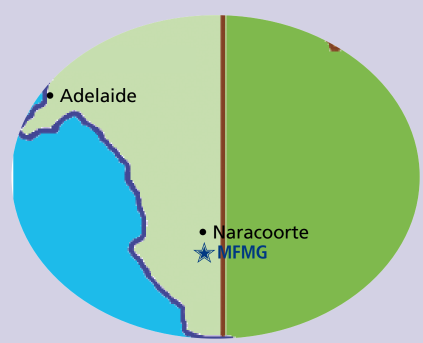
Overview: MacKillop Farm Management Group was formed in 1998 following a bus trip to Geelong to view raised bed cropping systems. In conjunction with a number of farmer groups, MFMG initiated a research and extension program for high rainfall cropping in the South East of South Australia. It was proposed that the cropping area in the South East could be lifted to 50,000 hectares by 2004, with yields being increased by 25 per cent.

In 1999, MFMG applied to Southern Farming Systems for association as a South Australian Branch, with a total of 15 members.

By 2006 the MacKillop Group had become a separate identity and was known as a farming systems group in its own right. By 2014 the membership base had increased to over 250 growers throughout the South East. In 2018 MFMG celebrated its 20th year and by then included members in the Upper South East – or the medium rainfall zone (MRZ) region.

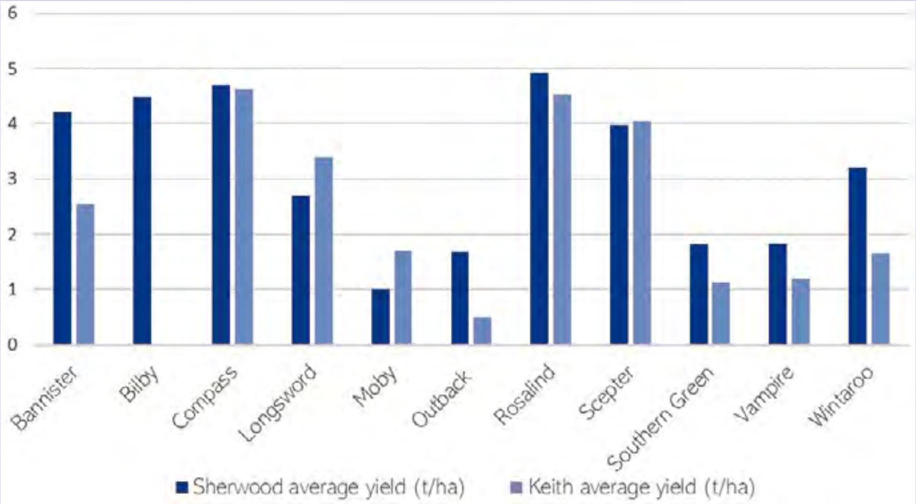
MFMG currently has around 370 members, 30 sponsors and has trial sites spread throughout the South East of SA and into Western Victoria.

MFMG develops and delivers innovative and sustainable farming practices through collaborative research, communication and extension for the benefit of members and the agricultural industry across the South East of South Australia, Western Victoria and beyond.



MFMG is proud to have more than 30 commercial sponsors. See www.mackillopgroup.com.au for more details.

Figure 1: Average grain yield (t/ha) for all varieties at Keith and Sherwood



selected to host a large-scale demonstration of the practice. An economic analysis of the practice was carried out and presented in March 2020.

The small plots in SA

These were located on two Upper South East family farms.

The Makin family are at Keith. Their sheep and cropping farm is predominately a clay loam soil. Sowing date of the small plots was May 23, 2019.

Fertiliser strategy was 140 kg per hectare 18:13:0:10 1 per cent Zn + 400 mL Flutriafol.

The Menz family are at Sherwood and also have a mostly sandy loam soil on their sheep and cropping operation.

Sowing date of the small plots was May 24, 2019 and the fertiliser strategy was 115 kg per hectare 18:13:0:10 1 per cent Zn + 400 mL Flutriafol.

Varieties sown at both sites were:

- Vampire and Southern Green rye corn;
- Outback, Wintaroo and Bannister oats;
- Moby, Compass and Rosalind barley; and,
- Scepter and Longsword wheat.

The Sherwood site had an additional oat variety sown – Bilby.

The sowing rates were as per the variety recommendations. These demonstration strips were exhibited at the MFMG Sherwood and Keith Crop Walks on November 1, 2019.

The paddock demonstrations, SA

The Bartlett and Jackson families provided the demonstration paddocks.

Paul and Rodney Bartlett are at Sherwood and operate a mixed enterprise of annual cropping, lamb finishing and wool. The soil is a sand over clay (delved).

Jamie and Josie Jackson are at Willalooka and run a lamb finishing enterprise. The soil is also predominantly a sand over clay (delved)

Commercial farmer practice was used to at both sites in preparing, sowing and managing the standing crop to fit with their system. At both sites, Scope barley was sown.

At Sherwood on May 11, 2019 Scope was oversown on an 8-year old lucerne stand at a rate of 60 kg per hectare across 40 hectares.

At Willalooka on June 15, 2019 Scope was sown as a pure sward at a rate of 60 kg per hectare across 16 hectares.

Both animal condition and paddock condition were assessed in this project. Animal condition was assessed by collecting empty liveweights and condition scores, as an indicator of animal wellbeing, upon entry to and exit from the standing crop paddock.

At Sherwood, a sample (15 per cent) of the 1000 merino wether lambs were weighed and condition scored (using the Lifetime Ewe Management app) into the paddock on October 21, 2019. A sample (13 per cent) was weighed and condition scored out of the paddock on December 18, 2019 – a total of 58 days grazing.

At Willalooka, a sample (17 per cent) of the 860 Wiltipoll x Aussie White cross wether lambs to go into the standing crop were weighed and condition scored into the paddock on November 4, 2019. An additional sample (11 per cent) of 500 Wiltipoll x Aussie White cross ewe lambs were weighed and condition scored as a parallel mob, to graze for the same period on pasture.

The same samples (15 per cent, 10 per cent) of wether lambs and ewe lambs were weighed and condition scored out of their respective paddocks on January 6, 2020 – a total of 63 days grazing.

The paddock assessment captured information about groundcover, bio-mass, composition and feed quality (via feed tests), every two weeks throughout the project monitoring phase (starting October 21, 2019, concluding January 6, 2020). This was to help understand the nutritional value of the crop, as well as the groundcover and soil protection aspects.

What we found

Small plot demonstration strips

The highest yielding varieties at both sites were Rosalind and Compass barley, yielding 4.93 tonnes per hectare and 4.69 tonnes respectively at Sherwood. At Keith, 4.53 tonnes per hectare and 4.62 tonnes respectively were recorded (Figure 1).

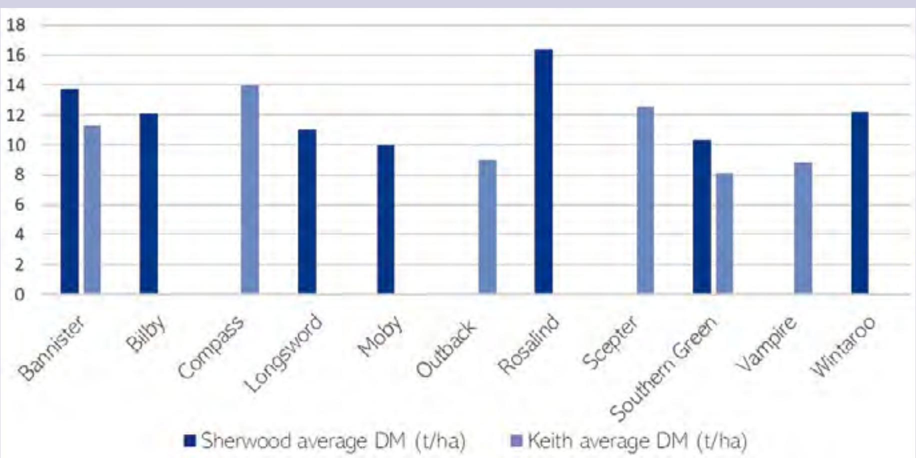
Rosalind produced the highest dry matter of the varieties that were sampled at Sherwood (16.40 tonnes per hectare), while Compass produced the highest dry matter at Keith (14.00 tonnes) (Figure 2).

Paddock-scale demonstration sites

At Sherwood (Table 1), the merino wether lambs improved in condition score by 0.01 on average over 58 grazing days, corresponding with an average total weight gain of 3.5 kg. The average difference between the minimum condition score at entry and exit was -0.25 (the lambs lost 0.25 of a condition score) and the average difference between the maximum condition score at entry and exit was 0.25 (the lambs gained 0.25 of a condition score).

The minimum weight at entry into the standing crop was 22.5 kg and upon exit was 24 kg – an average gain of 1.5 kg over the 58 days.

Figure 2: Average dry matter (t/ha) for all varieties at Keith and Sherwood



Grazing standing crops allows more flexible mixed farming management while reducing soil erosion.

The maximum weight at entry to the standing crop was 44 kg and upon exit was 53 kg – an average of 9 kg over 5.8 days.

At Willalooka (Table 2), the condition score of the Wiltipoll x Aussie White cross wether lambs remained stable at 3.77 on average over 63 grazing days. Their average total weight im-proved by 5 kg over this period.

The average difference between the minimum condition score at entry and exit was -0.25 (the lambs lost 0.25 of a condition score) and the maximum was stable at 4.5 (the lambs maintained condition).

The average difference between the minimum weight at entry and exit was 1.5 kg over the 63 grazing days with a maximum gain of 12 kg.

At Willalooka, a parallel mob of ewe lambs were monitored. They were grazing pasture for the same 63 days as the wether lambs grazed the standing crop. This project acknowledges that numerous previous studies show ram lambs grow faster than wethers, which in turn grow faster than ewe lambs on grass-based swards.

This demonstration project focussed on the feedbase as the main variable, and the class of stock was secondary to the priorities and convenience of the producers.

On average, the Wiltipoll x Aussie White cross ewe lambs in this parallel mob improved in condition score by 0.25, corresponding with an average total weight gain of 11.0 kg. The average difference between the minimum condition score at entry and exit was –0.25 (the lambs lost 0.25 of a condition score) and the average difference between the maximum condition score at entry and exit was 0.25 (the lambs gained 0.25 of a condition score).

The average difference between the minimum weight at entry and exit in the project was 10.5 kg with an average of 24.5 kg upon entry and 35 kg upon exit. The maximum weight among the ewe lambs at entry was 46 kg and at exit was 56 kg – an average weight gain of 10 kg.

Table 1: Animal condition data for the Sherwood site

Wether lambs									
Date In/Out		No. of Animals	Condition score			Weight (kg)			
			Min.	Max.	Average	Min.	Max.	Average	Total
21/10/2019		150	2.5	3.25	2.82	22.5	44.0	33.5	5045
18/12/2019		130	2.25	3.5	2.83	24.0	53.0	37.0	4984
Change	58 days	**–20**	**–0.25**	0.25	0.01	1.5	9.0	3.5	**–61**
Average daily weight gain								60.34 g	

Table 2: Animal condition data for the Willalooka site

Wether lambs									
Date in/out		No. of animals	Condition Score			Weight (kg)			
			Min.	Max.	Average	Min.	Max.	Average	Total
4/11/2019		150	2.5	4.5	3.77	20.5	46.5	36.0	5504
6/01/2020		132	2.25	4.5	3.77	22.0	58.5	41.0	—
Change	63 days	**–18**	**–0.25**	0	**0**	1.5	12	5.0	
Average daily weight gain								79.37g	
Ewe lambs									
Date in/out		No. of animals	Condition score			Weight (kg)			
			Min.	Max.	Average	Min.	Max.	Average	Total
4/11/2019		57	3.0	4.25	3.86	24.5	46.0	33.0	1841
6/01/2020		52	2.75	4.5	3.75	35.0	56.0	44.0	—
Change	63 days	**–5**	**–0.25**	0.25	**–0.11**	10.5	10.0	11.0	
Average daily weight gain								174.6g	

The feed quality at both sites declined after four weeks of grazing as measured in feed tests collected on November 19, 2019 at Sherwood and December 3 at Willalooka. It is important to note that at Sherwood the paddock was sampled in a 'north' section and 'south' section, predominantly reflective of the staggered maturity of the crop at the time the lambs were due to enter the paddock, likely due to the soil type variability and landscape.

Grazing behaviour of the lambs influenced the feed on offer. The lambs grazed out the lucerne plants first, which were more abundant in the north. They grazed the north part of the paddock more heavily at first, particularly closer to the water point (located in the northeast corner of the paddock).

After four weeks, feed testing indicated that the maturity of the crop had evened out and the feed quality was more uniform, so the 'north' and 'south' samples were bulked and the lambs grazed across the paddock on the feed that was left on offer.

An additional sample of hay from Willalooka was feed tested, representative of an alternative feed source. The quality of the hay was slightly better than the standing crop, based on energy, protein and NDF, though poorer quality compared with the pasture.

This feed quality is important to inform management decisions.

Based on rations developed for Sherwood (merino wether lambs, targeting 40 kg liveweight) the energy requirement was 15.0 total megajoules (MJ) per day and total protein requirement was 180 g per day.

The maximum energy the crop could provide without protein supplementation was 13.5 MJ per day and 117 g per day of protein.

In a second scenario where beans were added into the ration, the energy increased to 19.0 MJ per day and 203 g per day of protein, exceeding the requirement for growing lambs.

This highlights the importance of providing appropriate supplementation and managing introduction of that feed effectively to ensure the lambs consume enough feed to achieve their growing potential. Without a protein supplement,

the lambs did not grow as fast as they would have with the supplement.

Based on rations developed for Willalooka (Wiltipoll x Aussie White cross wether lambs, targeting 40 kg) the energy requirement was 15.0 MJ per day and protein was 180 g per day. Lentils were supplementarily fed as a protein source, comprising 19.5 per cent of the diet in this scenario. The ration provided approximately 15.9 MJ per day of energy and 183 g per day of protein, which was adequate to meet the target liveweight gain.

Gross margin analysis

The summarised gross margins for grain production for harvest and for grazing the standing crop at each site are presented in Table 3.

Harvesting grain at Sherwood returns a gross margin of $288.53 per hectare while grazing the standing crop returns a gross margin of $305.36.

At Willalooka, harvesting returned a gross margin of $680.94 per hectare and grazing the standing crop returned $820.70 per hectare.

In both demonstrations, the gross margins for grazing the standing crop were higher than harvesting the crop.

The producers have acknowledged that the grazing standing crop gross margins can be improved in future years with further understanding and refinement of the practice on their own farms, including protein supplementation and crop treatment and preparation.

Host producers noted that in the future, they would draft off the smaller lambs and only place lambs greater than 30 kg in a standing crop to graze. The smaller lambs tended to grow more slowly on the standing crop compared with the larger lambs.

At Sherwood, the hosts producers' future intentions are to introduce lambs to lupins for four or five days prior to weaning, to enhance the success of the practice when supplementing the lambs' diet while grazing the standing crop.

Host producers also recognised the value of the standing crop in reducing grass seed burden in their lambs.

Table 3: Summarised gross margins for harvesting and grazing the crop at each demonstration site

Gross margin	Sherwood (40 ha)	Willalooka (16.5 ha)
Grain production – harvest	$288.53/ha	$680.94/ha
Grazing standing crop	$305.36/ha	$820.70/ha

To sum up

The major benefit as communicated by both site hosts of the grazing standing crops practice is that it offers a protective alternative feed base option during times of high grass seed burden for lambs in the Upper South East.

The data collected in this demonstration shows that it is important to evaluate your feedbase and understand when to make decisions and take actions that optimise the growth rate of lambs, namely when to remove them from the standing crop, supplement their diet or otherwise manage them.

The practice has added versatility to mixed farms, by keeping options open at the end of the season. The standing crops have provided good groundcover and subsequently greater soil erosion protection, benefitting soil health at both sites.

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Thank you to the project team: San Jolly, Meg Bell, Tiffany Bennett, Amanda Pearce, Ian Ludwig, David Robertson and Carolyne Hilton.

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NLP Smart Farms Small Grant project: 4-9GKWTRC ■

Incredible – but true!

■ By Ian M. Johnston

Since the 1892 baptism of America's and indeed the world's first tractor – the formidable Froelich – there have been numerous examples of quite remarkable pieces of ironmongery posing as tractors. Some were simply ludicrous and could never have ploughed a field. Others performed surprisingly well, despite their unorthodox design.

I have endeavoured to highlight a few of these bizarre machines, accompanied by my somewhat unprofessional comments, commencing with the afore mentioned Froelich.

The Froelich

The 1892 Froelich. (Photo IMJ)

The Van Duzen petrol fuelled engine manufactured in Columbus, Ohio, which powered the 1892 Froelich, had a cubic capacity of 35 litres! I invite readers to ponder over that figure. The capacity of the majority of car engines today range from 1.5 to five litres. A large truck diesel might be rated up around 12 litres. The Van Duzen had cubic capacity of a whopping 35 litres!

So an obvious question is – how many cylinders? I mean to say, a five litre engine is normally endowed with eight cylinders. Maybe 12 for the van Duzen? Surprise surprise, it was bequeathed with a mere single cylinder!

Undeniably, the next question must be – how many horses under the bonnet? Well, I regret to have to inform – there was no bonnet. But the power squeezed out of this gargantuan engine was (wait for it) a miniscule 16 horse power! Yes, truly!

Accordingly, the Froelich tractor was a dismal failure when asked to pull a plough. In fact, it was barely able to propel its own significant weight along a flat surface. But it excelled at driving a threshing machine when hooked up to an endless belt attached to the pulley on the end of its crankshaft. So it was not all bad news!

The Grey 18-36

On the first occasion I ever set eyes on a Grey, it occurred to me that a corrugated iron shed had collapsed over the top of the unfortunate tractor. It appeared to be wrapped in the stuff.

The 1920 Grey 18-36 was the world's first orchard tractor. This example was discovered in a museum in Saskatchewan, Canada. (Photo IMJ)

A closer inspection revealed that the corrugated iron was, in fact, a type of low roof attached over the width of the machine, including the driving wheels and the 30 hp Waukesha engine. I was gazing upon the world's first orchard tractor. The only two features extending above the cowling were the steering wheel and the courageous operator's head!

Upon inquiring, a few days later during a visit to the Nebraska Tractor Test Facility, I was informed that the Grey, whilst undergoing its Nebraska Test in July, 1920, proved possibly the most troublesome unit the test engineers had ever experienced.

The cylinders and pistons had to be replaced. Also an errant Bennet carburettor was exchanged for a superior Stromberg M-3 style. Further, the governor lost all control when a load was taken off the engine.

Obviously the lamentable Grey was – lamentable.

The Bailor Two-Row

The 1919 Bailor was not only an absurd tractor, it was downright dangerous! It is no wonder the manufacturers – Bailor Plow Mfg. Co. of Atchison, Kansas – never subjected one to Nebraska for testing!

There were actually two models, made collectively between the years of 1919 and 1929. The larger of the two, named the Two-Row was powered by a Le Roi 6-10 4 cylinder cast en bloc engine. Sliding gear transmission provided 1.25 and 3 mph via an open chain final drive.

Sounds okay – except it wasn't!

The unbelievably flimsy chassis was totally inadequate for the relatively heavy engine. At full power, it twisted and flexed alarmingly. The unfortunate operator was positioned virtually below and behind the transmission housing with no possibility of forward viewing, unless he leaned perilously to either side. By so doing he was in grave danger of being collected by the open chain final drive and dragged into the sprocket.

I refused the offer of a second drive of possibly the sole

The 1919 Bailor. Note the flimsy chassis, the location of the seat and steering wheel, plus the chain and sprocket of the final drive. (Photo IMJ)

The cockpit of the BMB. Note the location of the hand throttle. (Photo IMJ)

example in Australia. The first drive resulted in the alarming increase of my blood pressure!

The BMB President

In case you are unaware, BMB stands for British Motor Boat. It is only a pity that in the early 1950s, the UK firm of Brockhouse Engineering Ltd. did not continue to concentrate on their boats rather than venture into the world of tractors, of which they were profoundly ignorant!

Over the years I have restored, owned and driven countless classic tractors. But the only one that scared me on several occasions was my BMB.

A magnificently restored Brockhouse BMB President seen at The Plough and be Counted held at Cootamundra, 2004. (Photo IMJ)

1924 Fowler Rein Drive, an outstanding exhibit at The Pioneer Park, Parkes. (Photo IMJ)

The meagre power of the little Morris four cylinder side valve engine (that should have been confined to a Morris 8 car) was controlled through a lever, joined to a long rod which was channelled down through the steering shaft via the steering wheel. The problem was – the lengthy lever lay flat just above the steering wheel.

So, for example, if I was slowly and carefully reversing into a confined shed, the action of which required multiple rotations of the steering wheel as I screwed my neck to chart my course, all of a sudden the engine would roar and the tractor would instantly accelerate at an uncontrollable speed. My sleeve or elbow had caught the throttle lever with potentially devastating results.

For the record, I modified the throttle lever system, following some very scary near misses!

Additionally, the stability of the lightweight machine was precarious, the three-point linkage system frustratingly non-standard, plus when one applied the necessary high degree of foot pressure to the clutch, the rotating uncomfortable pan seat rotated and the clutch pedal remained un-pressed!

It is little wonder the manufacturers, desperate to quit unsold stocks of these apologies, accepted a payment in figs from a Turkish agent in return for a shipment to Istanbul.

The Fowler Rein Drive

Back in the 1920s, it is understandable that many farmers were apprehensive about investing in 'one of these new fangled' tractors. Back then they were relatively unreliable. Plus they were technically challenging to the majority of traditional farmers who had grown up with horses and mules. They believed tractors to be 'noisy', 'smelly', 'dangerous' and 'dripped oil everywhere'.

A Melbournian named Cornelius Murnane thought he had hit upon an excellent idea to encourage farmers to discard their bias, which he believed would result in a marked increase in tractor sales.

He presented his vision to one of England's oldest established engineering firms and tractor manufacturers, John Fowler and Company of Leeds. His philosophy was that if a tractor could be operated from the rear with a pair of reins, in the manner of driving a pair of horses yoked to a cart or hitched to a plough, the majority of farmers who had hitherto been hesitant, would rush to place an order, especially for a Fowler!

The Fowler board agreed. In 1924 a Fowler Rein Drive was exhibited at The Royal Agricultural Show at Leicester, where it was awarded a gold medal.

The engine fitted to the unit was a big V twin diesel, virtually half an engine originally designed for powering World War 1 military tanks.

Operating the tractor was simple, providing one of the rope reins did not break! A jerk of the reins set the tractor moving forward. A pull on the reins stopped the tractor and applied the brakes. A further pull back introduced the reverse gear. A light pull on one or other of the reins turned the machine in the desired direction. The operator could be astride a rear jockey seat or onboard a trailer or towed implement.

But alas for Fowler, the anticipated sales failed to materialise. It seems that in fact, farmers were nervous of this big thumping machine, with its noisy diesel engine, the control of which was utterly reliant upon a pair of rope reins!

Some years ago, whilst visiting the farm machinery museum at Parkes in Western NSW I was given the dubious pleasure of driving possibly the only Fowler Rein Drive in Australia. Yes, I could understand why it was a marketing flop!

Tailpiece

Despite my derogatory comments regarding these various unworthy tractors, they each had an important element in their favour. They had character, an ingredient not evident in modern well behaved tractors! ■

IAN'S MYSTERY TRACTOR QUIZ

Question: Can you identify this odd-ball looking tractor?

Degree of difficulty: If you don't recognise it – you must be one of these NEW people. Over 50!

Clue: It is not a Lanz.

Answer: See page 48.

Comparing water use efficiencies and legacies of summer crops

By Lindsay Bell[1], Brook Anderson[1], Darren Aisthorpe[2], Andrew Verrell[3], Jon Baird[3], Andrew Erbacher[2], Jayne Gentry[2] and David Lawrence[2]

AT A GLANCE...

- While summer crops offer rotational options in the farming system, choose the correct crop to match your available soil water and crop history.
- Sorghum is a reliable performer often exceeding other options in terms of $ returned per mm used.
- Cotton and maize require higher water availability and produce less reliable Water Use Efficiency (WUE) measured by $ per mm ($/mm). But cotton has legacy impacts on water availability for subsequent crops that should be considered.
- Mungbean can produce higher $ per mm in low water availability situations (<200 mm of rain + soil water). Repeated sowings of mungbeans are likely to induce yield reductions due to disease.
- Sorghum crops sown with more than 150 mm of plant available water will maximise crop WUE and profitability. Every extra mm at sowing could be worth as much as $35–$70 extra return per hectare.
- Higher density sorghum crops may provide greater crop competition against weeds and potential upside yield benefits in good seasons. We have seen limited legacy benefits (e.g. improved ground cover) or costs (e.g. greater soil water/nutrient extraction) for soil water or nutrient availability.

SUMMER crops are becoming an increasingly important component of cropping systems in the summer-dominant rainfall zone. They are often useful for providing disease or weed management benefits when in rotation with winter crop dominated systems. While it is widely recognised that summer crops are often critical for improving the system sustainability, a key challenge is transitioning between summer and winter crops or phases in the crop sequence.

This requires either double cropping or introducing long-fallows (greater than 10 months) during transitions between the summer and winter crop phases.

So an understanding of how effectively different summer crop options convert available water into grain yield – and ultimately profit – is critical to making better decisions about when summer crops may be used in the crop sequence.

Further, differences in water extraction, subsequent fallow water and nitrogen accumulation are likely to influence how subsequent crops will perform or the period of fallow time required to reach critical sowing moisture levels.

So, it is important to target the right summer crop option to the system.

This article reports on several comparisons of relative water use (WUE) efficiency of different summer crops, and effects of summer crop management practices (e.g. soil water at sowing, sorghum configuration and density) and their legacy impacts in the farming system.

Relative WUE ($ per mm) of summer crop options

Over the past four years of experiments, different summer crop options have been grown in the same season and under common previous fallow length and starting moisture. Using this

TABLE 1: Crop water use efficiencies ($ gross margin per mm water used) comparisons between summer crops when grown in the same season with similar starting conditions

	Pampas 2016–17 (LF)	Pampas 2017–18 (DC)	Pampas 2017–18 (SF)	Pampas 2018–19 (LF)	Pampas 2018–19 (SF)	Pampas 2019–20 (DC)	Pampas 2019–20 (SF)	Billa Billa 2016–17 (LF)	Narrabri 2018–19 (LF)
Sorghum	12.0	2.82	9.4	10.1	6.1			3.4	0.7
Mungbean	7.0		3.8		5.5	2.0	12.5	1.3	0.4
Cotton	6.4			15.8					
Maize	7.3								
Sunflower		11.4							
French millet						2.7	3.00		

LF = Long fallow. SF = Short fallow. DC = Double Crop.

data, we have calculated for these various comparisons the crop water use efficiency as $ of income generated per mm of crop water use. This was done using long-term median crop prices and inputs for each of the crops, but these relative values would shift if prices for individual crops were more/less favourable compared to others.

Across a range of seasons and growing conditions, sorghum always exceeded mungbeans in terms of $ generated per mm. This was even though on several occasions mungbean crops use less water and often left significantly more residual soil water than the sorghum crops grown in the same conditions. Sorghum was only bettered in terms of crop WUE by a cotton crop at Pampas in summer 2018–19 and sunflowers when they were sown as a double crop in 2017–18 (Table 1).

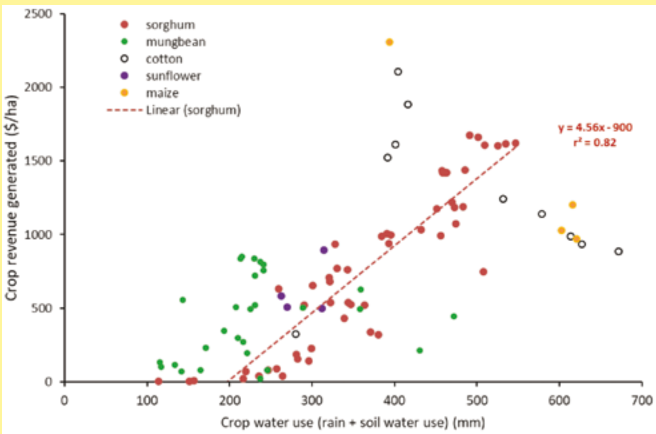
Figure 1 shows the relationships between crop water use and crop income generated for 100 summer crops (sorghum, mungbean, cotton, sunflower and maize) that have been grown in our farming systems research over the past five years. This graph demonstrates that:

- In sorghum, a strong relationship was found between crop revenue and crop water use; on average $4.50 of income generated per mm of crop water use above 200 mm. That is, 200 mm of available water through in-crop rain or soil water at sowing is required before a positive return is generated
- Mungbeans show a higher return per mm at lower crop water use than sorghum, particularly when available crop water is less than 250 mm
- Sunflowers produced a similar return per mm to sorghum in the few seasons when they were grown. This outcome would be greatly influenced by the price obtained for sunflowers which can be highly variable
- In maize and cotton, higher variation in returns per mm were observed. In some seasons, this exceeded sorghum but was lower in others.

Sowing soil water effects

Soil water at sowing is critical for driving the efficiency of summer crops, especially sorghum. Table 2 compares the performance of sorghum crops grown in the same season with common nutrient and crop management but with significantly different soil water at sowing. As expected, crops with higher soil

FIGURE 1: Relationships between crop water use (in-crop rainfall + soil water extraction) and crop revenue generated amongst 100 summer crops grown in farming systems experiments 2015–19



Sorghum N = 51; Mungbean N = 28, Cotton N = 10; Sunflower N = 4; and, Maize N = 5.

TABLE 2: Starting soil water effects on sorghum crop performance and the marginal water use efficiency i.e. extra $ generated per mm of extra water available at sowing

Site/year (in crop rain)	PAW prior to sowing	Crop yield (t/ha)	Crop WUE (kg grain/mm)	Crop WUE ($/mm)	Marginal $/mm water at sowing
Billa Billa 2016 (118 mm)	98	0.88	3.1	2.2	7.5
	194	1.52	4.1	3.6	
Pampas 2016 (345 mm)	153	6.12	13.4	12.5	7.2
	245	7.42	13.6	12.0	
Pampas 2017 (230 mm)	108	0.91	3.1	3.0	70.0
	163	4.52	9.4	9.8	
Pampas 2018 (277 mm)	62	2.7	7.9	6.1	32.4
	120	4.03	10.2	10.1	

Mungbeans can produce higher $ per mm in low water availability situations (less than 200 mm).

water at sowing had higher grain yields. But, perhaps something less obvious was that the crops with more starting water regularly converted the available soil water more efficiently into grain and accordingly into profit. This effect was larger in seasons with limited in-crop rain, while the effect was diminished in the wetter growing season (i.e. Pampas 2016–17).

This phenomenon occurs because it takes a critical amount of water to grow crop biomass, and hence when there is less available water at sowing there is less water left to efficiently convert any residual water into grain during grain filling. Hence, in wetter seasons this is less pronounced because the crop may still have enough available water to minimise this effect.

Across these studies we calculated the increase in crop return that was obtained for each extra mm of soil water available at sowing. While there was some variation in some seasons, this could be as high as $70 extra return per extra mm at sowing. These effects were largest where crops were sown on marginal soil water (<100 mm) and had limited in-crop rain (e.g. <300 mm). These data clearly suggest that for sorghum to maximise its return per mm of water used, higher soil water at sowing is critical.

Crop WUE and legacy effects of growing higher density sorghum crops

There is an increasing interest in integrated weed management practices involving greater in-crop competition with summer grass weeds by increasing sorghum density and narrowing row spacing. In addition to this weed benefit this is likely to have impacts on water and nutrient use efficiency of the crop and legacy impacts on subsequent water and nitrogen accumulation in fallows.

It was hypothesised that the higher density sorghum would grow additional biomass which may or may not be converted into grain yield depending on the season. But, this greater biomass would contribute to greater and more even ground cover and improved fallow efficiency. Similarly, this may have impacts on nutrient cycling due to increased immobilisation of soil N from the higher residue with a high C:N ratio.

Across the three experimental comparisons we have implemented in our farming systems research, we found that consistently the higher density sorghum increased biomass production, but this was only translated into additional yield at Emerald in 2017–18. At the other sites there was no significant yield penalty from growing this additional biomass and grain yields were comparable. Soil water extraction and crop water use was the same amongst the high and low density crops.

The higher biomass production in the higher density sorghum crops has required higher soil N extraction without an increase in grain yield and N. So the nutrient use efficiency of these crops is lower. That is, such higher density crops will require a different nutrient strategy to ensure sufficient N is provided to maximise their yield potential.

While we anticipated there may be some benefits for improved soil water accumulation over the subsequent fallow following the higher density sorghum crops, this was not clear cut.

In one season (Pampas 2017–18) we did observe an extra 33 mm was accumulated in the subsequent fallow after the higher density sorghum crop than the standard management. But, this was largely due to a drier soil profile at crop harvest and there was no significant difference in soil water at the end of the subsequent fallow in any of these cases.

But, observations suggested there was greater uniformity of the soil water where more evenly distributed cover occurred following the narrower sorghum rows compared to wider row crops.

Legacy impacts of summer crop choices

We also compared the impacts of summer crops on residual soil water, accumulation during the subsequent fallow and effects on subsequent crop productivity in the sequence.

From these comparisons the legacy impacts of cotton in the farming system are clear, with lower soil water available for subsequent crops due to higher extraction and also lower fallow efficiencies. This has translated into reductions in yield of 0.5 tonnes per hectare in sorghum and 0.3 tonnes per hectare in mungbeans when sown following cotton compared to maize.

Comparisons of sorghum with mungbean show little differences in residual soil water or soil water in the following crops.

But, mungbean performance was affected by the preceding crop. ‘Mungbean after mungbean’ yield was 0.5 tonnes per hectare lower than ‘mungbean after sorghum’, despite starting with similar moisture after a long fallow.

In contrast, mungbean yields were similar following short fallows out of sorghum and mungbean, even though the sorghum left less residual water. These effects are likely to be related to disease reductions rather than soil water or nutrient impacts.

A comparison between sorghum and sunflower legacy effects found little or any effects on subsequent fallow water accumulation or crop yields.

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, the author would like to thank them for their continued support. We would like to thank the project teams and collaborators contributing to the management and implementation of the farming systems experiments across the northern region.

GRDCcodes: CSA00050 PAQ00192.

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Key words: sorghum, maize, cotton, mungbeans, water-use-efficiency, soil, yield, systems ■

Valuable learnings from wheat phenology research

PRODUCTIVITY gains of up to $400 per hectare in winter cereal crops are possible if growers can successfully target an optimum flowering window.

Recently completed wheat phenology research has found a staggering difference in yield potential between crops that flowered at optimum and non-optimum times.

DAF senior research agronomist Darren Aisthorpe, says growers could reap a significant yield benefit by identifying the ideal target flowering window for a region and adapting sowing date accordingly.

Central Queensland trial coordinator, Department of Agriculture and Fisheries (DAF) senior research agronomist Darren Aisthorpe, said growers could reap a significant yield benefit by identifying the ideal target flowering window for a region and adapting sowing date for particular varieties accordingly.

"Trial data showed that when crops flowered in the optimal window, yields were typically 20–30 per cent higher than the average yields across all four sowing dates," he said.

"In practical terms, if growers can identify when their wheat is likely to flower for a given sowing date and then line that up with the relevant optimal flowering period identified in the trial work, there are some significant yield gains to be made.

"The trial work certainly put this into perspective – based on a wheat price of $250 per tonne, the results showed a $400 per hectare difference in gross margin between crops planted at an optimal and non-optimal time."

The trials involved planting 32 wheat varieties concurrently across eight different regional locations from central Queensland to southern NSW on the same date four times a year – early and late April and early and late May.

A comprehensive set of data has been collected from these trials in a bid to better understand how different varieties respond in terms of biomass and yield across a range of environments on the different sowing dates.

The resulting analysis is starting to draw important

observations about how to optimise key agronomic levers to improve production in specific regions.

Variation in varietal response

According to Darren, one of the greatest differences observed across the sites was the variation in varietal response, particularly with regard to days to flowering.

"A quicker spring wheat variety in Emerald, particularly planted a bit earlier, can go to flowering as quickly as 60 days whereas the same variety planted in central NSW can push out to over 100 days," Darren said.

"Understanding this difference is crucial in terms of identifying time periods when the plant is most sensitive and prone to stress, and then avoiding those periods so that crop yield potential is maximised for the amount of water available."

Darren said growers tended to have a good understanding of the flowering date for specific varieties used on their farms and believes the phenology research can help guide their decisions on sowing date and suitable alternative varieties.

"If their preferred variety flowers in mid-August – but the optimum flowering period for that variety is early August – they could either adjust their sowing date or consider planting a different variety that better suits their planting date."

The CliMate website and app *https://climateapp.net.au/* can provide valuable assistance to growers in seasonal decision making, enabling users to quickly interrogate the past 65 years of weather statistics, forecasts and climate probabilities for their specific location.

This allows growers to determine where the current season sits historically by tracking current season rainfall, temperature or heat sums for any specified period and explore a range of 'what if' scenarios.

"The `how hot/cold' tool in CliMate is an excellent tool to help growers identify the temperature at which they are going to start seeing stress effects in their crop – typically you don't want wheat flowering above 30ºC or below 2ºC," Darren said.

"CliMate data spans a large number of locations so growers can select one that has similar conditions to their farm and use the information as a starting point to identify optimum flowering dates for their crops."

Challenging existing paradigms

Findings from the trial work may challenge some growers' existing paradigms on optimal flowering times, particularly if they have previously experienced losses due to frost.

While the work has identified regionally-specific `sweet spot' flowering periods where yield is maximised, Darren said growers needed to weigh up the risks of frost and heat stress when planning varietal selection and sowing date.

"The trial work showed that yields really began to drop away as evaporative pressure increased and relative humidity decreased. Basically it is a balance of risk versus reward when it comes to sowing date," Darren said.

Darren discussed some of the key findings in a recently released Grains Research and Development Corporation (GRDC) podcast *https://grdc.com.au/news-and-media/podcasts.*

The research project was conducted between 2017 and 2019 as part of a bilateral agreement under the Grains Agronomy and Pathology Partnership between the GRDC and New South Wales Department of Primary Industries (NSW DPI) in conjunction with DAF.

For more information, download a copy of the GRDC Update paper Yield stability across sowing dates – how to pick a winner in variable seasons *https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2020/02/yield-stability-across-sowing-dates-how-to-pick-a-winner-in-variable-seasons* ■

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Growing possibilities

New GRDC Northern Panel

THE interests of grain growers in the northern cropping region will be represented by a new Grains Research and Development Corporation (GRDC) Northern Region Panel which has been appointed for the next two years.

The GRDC Board has announced the new-look Panel, which comprises three new and six returning members, who together will help guide research priorities and deliver enduring profitability to growers in New South Wales and Queensland.

Appointed to the Northern Panel for the first time are Chris Clyne, a grower from Moree; rural banker Adam Tomlinson from Orange; and researcher Georgina Pengilley from Tamworth.

GRDC Chair John Woods says the Panel's new members brought a diversity of insights and backgrounds which would complement the perspectives and skills set of returned members.

Incoming members

In welcoming the incoming members, GRDC Northern Panel Chair John Minogue said it was also timely to recognise the enormous contribution of outgoing members.

"We say farewell to Tony Hamilton formerly of Forbes, Roger Bolte from West Wyalong and Andrew McFadyen from Lake Cargelligo, who have all made outstanding contributions to the grains industry through their involvement with the Panel," John said.

John Minogue.

"These three Panel members are to be congratulated for their tireless commitment, invaluable insights and the enthusiasm they brought to their roles.

"They have represented the northern grains industry with distinction and have devoted significant effort to representing the views, issues and research priorities of growers. They should be extremely proud of their contribution and we wish them all the best in their future endeavours."

The returning panellists are Arthur Gearon, a grower from Chinchilla; research pathologist and private consultant Jo White; Parkes district grower Bruce Watson; Riverina district grower Roy Hamilton; Liverpool Plains senior agronomist Peter McKenzie; central Queensland senior agronomist Graham Spackman; and GRDC's Acting General Manager, Crop Protection, Biosecurity and Regulation, Ken Young; while NSW grower and agricultural consultant John Minogue will continue as Chair.

One of the first commitments of the new Panel will be the annual GRDC spring tour in mid-September. While this tour traditionally involves travelling to meet with regional growers, advisers and researchers, Covid-19 restrictions mean the tour will be held virtually this year with opportunities for stakeholders throughout Queensland and NSW to liaise online with Northern Panel members.

For more information on the Northern Region Panel and GRDC investments, visit *https://www.grdc.com.au* ■

Give sorghum the best start

IN-FURROW application of liquid fertilisers is the effective way to accurately deliver essential nutrients directly to sorghum crops during emergence and establishment. Applying these nutrients at planting reduces the negative effects of early season stresses, allowing plants to develop to their potential.

Yara Australia Sales Agronomist – North Western NSW and the Darling Downs, Jared Snook, says Yara Liquids Flowphos 13Z fertiliser delivers a concentrated band of plant-available nitrogen, phosphorus and zinc directly to where it's needed most.

"Rapid plant establishment has always been important for sorghum," explains Jared.

"Growers generally are aiming to plant sorghum early, with approximate soil temperatures of 15–16ºC. Low levels of AMF, cold, wet or compacted soil conditions can reduce the availability of phosphorus and zinc by slowing down soil biological and chemical reactions," Jared says.

"This is compounded by the fact that young seedlings have a very inefficient root system, limiting their ability to find important nutrients, such as phosphorus and zinc, that are immobile in the soil. This not only reduces phosphorus availability – as shown in Figure 1 – but also reduces plant growth, especially root growth, which plants rely on to find nutrients and water in the soil."

Phosphorus for early crop growth

"Generally, we recommend growers apply 4 to 5 kg P per hectare, or 30 to 40 litres per hectare of Yara Liquids Flowphos 13Z at planting to help boost early crop growth," explains Jared.

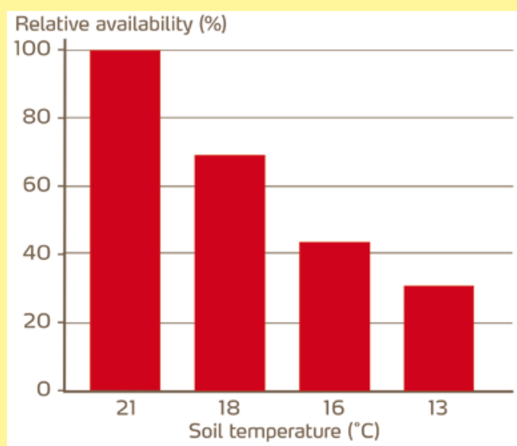
"Applied as a band with the seed at planting, Yara Liquids Flowphos 13Z gives sorghum crops the best start possible.

"All Yara Liquids Flowphos formulations are true liquids, containing 100 per cent water soluble nutrients, which means it delivers exactly the same amount of nutrients during application.

Replacement, or capital rates phosphorus, should be applied at a depth of 20 to 40 cm, when conditions and crop rotations allow.

"A combination of both application strategies will ensure crops are adequately supplied with phosphorus," Jared says. ■

FIGURE 1: Relative availability of phosphorus reduces with decreasing soil temperatures



SOUTHERN AUSTRALIA FOCUS

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

'Seeing is believing': Growers invited to push crop yield limits

GROWERS have a unique opportunity to participate in a new national initiative striving to push crop yield boundaries in high yield potential grain growing environments.

The Grains Research and Development Corporation's (GRDC) new Hyper Yielding Crops initiative is now under way and growers are encouraged to become involved for their own benefit and that of their peers.

The four-year investment spans five states – Victoria, South Australia, Tasmania, New South Wales and Western Australia – and aims to push the economically attainable yield boundaries of wheat, barley and canola.

The Hyper Yielding Crops (HYC) initiative involves five research centres of excellence and attached to each of these are focus farm paddock trials and an innovative grower network charged with taking research and development learnings from small plot to paddock scale.

Hyper Yielding Crops project leader Nick Poole (left) and extension co-ordinator Jon Midwood at Gnarwarre, Victoria. **(PHOTO: Dean Allen-Craig)**

Growers are invited to join the networks and host paddock-scale trials on their properties to enable a 'seeing is believing' participatory approach to the research.

High yield potential cultivars suited to local environments will be identified and the most appropriate agronomic management tactics – including paddock selection and preparation, canopy management, disease, weed and pest control, and crop nutrition strategies – will be explored to assist grower and adviser decision making.

Project leader Nick Poole, from FAR Australia, says HYC builds on the success of the GRDC's four-year Hyper Yielding Cereals

Project in Tasmania, which demonstrated it is possible to more than double yields in some situations through sowing the right cultivars and effective implementation of appropriately tailored management strategies. The Hyper Yielding Cereals Project generated significant attention from mainland growers.

"This initiative is about trying to improve our productivity, increase our yields and close what we believe is a significant yield gap in some high yield potential grain growing environments," Nick says.

"We want to not only lift productivity, but also stabilise productivity. It's no good having varieties that are boom and bust, performing well one year and then not the next. So, our focus is on improving yields and also stabilising them."

Jon says HYC aims to up-scale research to paddock-based trials, providing growers with answers to questions related to their individual farming systems and environments.

Potential turned into reality

"It is really important for people to believe in these yield potentials that we talk about, and then to see that translated into reality in a trial situation at the research centres and, most importantly, on-farm in growers' paddocks," Jon says.

The HYC research centres of excellence are being led and managed by FAR Australia in collaboration with Brill Ag, CSIRO, the Department of Primary Industries and Regional Development in WA, the SA Research and Development Institute (SARDI) and Southern Farming Systems (SFS). The five centres are sited in Tasmania (Hagley), Victoria (Gnarwarre), SA (Millicent), NSW (Wallendbeen), and in WA (Green Range).

"The core data generated from those small plot scale environments will be taken to growers' paddocks where project officers in each state will work with the innovative grower networks to set up paddock trials on growers' properties," Jon says.

To underpin the 'whole community of interest' concept, a HYC awards program is being established.

Project leaders are seeking nominations of 10 wheat paddocks per region – 50 in total – to enable growers to benchmark the agronomic performance of their crops compared with a regional standard.

"The HYC awards aren't about tall poppies or who's got the best yield," Nick says. "This is about trying to build a whole community of interest, not just in what went right but also what can sometimes go wrong. We can learn as a group far more from those situations.

"And while we're keen to look at the profitability of these crops, it's the agronomic benchmarking that we see as being key. It's an opportunity for growers to look, compare and discuss those individual levers to achieving full yield potential."

The HYC focus farm paddock trials, innovative grower network and awards involve TechCrop working with the Centre for eResearch and Digital Innovation (CeRDI) at Federation University Australia and four farming groups across the country. These are Southern Farming Systems (SFS) in Tasmania and Victoria, MacKillop Farm Management Group (MFMG) in SA, Riverine Plains Inc in NSW, and Stirling to Coast Farmers in WA.

Growers, advisers and others wishing to become involved in the HYC initiative can contact their respective state project officers:
Victoria – Ashley Amourgis of SFS, E: aamourgis@sfs.org.au
Tasmania – Ian Herbert of SFS, E: iherbert@sfs.org.au
SA – Jen Lillecrapp of MFMG, E: jen@brackenlea.com
NSW – Kate Coffey of Riverine Plains Inc, E: kate@riverineplains.org.au
WA – Phillip Mackie of Stirling to Coast Farmers,
E: phillip.mackie@scfarmers.org.au.

Nick and John discuss the initiative in a new GRDC podcast available at *https://grdc.com.au/news-and-media/audio/podcast/hyper-yielding-crops-initiative*

Keywords: hyper yielding crops; yield boundaries; whole community of interest.

■


HYOLA GARRISON XC
Pacific Seeds
HYOLA ENFORCER CT
Pacific Seeds
HYOLA BLAZER TT
Pacific Seeds

Research shows Russian wheat aphid can be managed

AT A GLANCE...

- Russian wheat aphid not a major threat if effective management;
- RWA now detected in Western Australia; and,
- Monitoring and thresholds are key

THE more Australian researchers learn about Russian wheat aphid (RWA), the more confident they are that the pest does not pose a major threat to winter cereal crops in this country if growers and advisers understand how to manage it effectively.

This is the message from Grains Research and Development Corporation (GRDC) pests manager Leigh Nelson, following the detection of RWA in wheat crops north of Esperance in Western Australia.

It is the first time the pest has been detected in WA, after being discovered in South Australia in 2016 and subsequently in Victoria, parts of New South Wales and Tasmania.

According to the Department of Primary Industries and Regional Development (DPIRD), which is conducting further surveillance, eradication in WA is unlikely due to the biology of the pest and its ability to spread via the wind and multiple other grass hosts.

Russian wheat aphid. Look for RWA plant damage symptoms on barley and wheat, including white and purple longitudinal streaks on leaves, and curled, rolled or hollow tube leaves. (PHOTO: Tom Heddle PIR-SARDI)

Leigh says scientists have been studying RWA under southern Australian conditions and within local farming systems since it was first detected in 2016.

"Through research investments by the GRDC, a biological and ecological profile of the pest is being built to provide Australian grain growers with scientifically robust management tactics for the future," she says.

"These investments are being led by the research division of the South Australian Department of Primary Industries and Regions – the South Australian Research and Development Institute (SARDI), and cesar."

Leigh says monitoring and making threshold-based decisions remained key to effective long-term management of this aphid.

SARDI entomologist Maarten van Helden says treatment of RWA should only be considered if infestations are at potentially damaging levels.

Spraying thresholds

Maarten, who has helped to lead GRDC-invested RWA thresholds-related research, says thresholds based on Australian conditions will be available soon and show that RWA has less impact than reported in overseas conditions.

"Based on the overseas findings, a spray application is recommended when more than 20 per cent of all seedlings are infested with aphids up to growth stage 30 (early stem elongation) and more than 10 per cent of tillers are infested with aphids from growth stage 30," he says.

Maarten says symptoms of RWA – including striping and rolling of leaves, and sometimes purple discolouration – are always the first sign of presence of RWA and may stay visible even after aphids have disappeared.

"It is important to check for symptoms and suspicious plants need to be checked for the presence of the tiny green aphids inside the youngest leaves," he says.

GRDC-invested research is also investigating how RWA survives over summer. This knowledge is considered pivotal in determining the risk of infestation for winter sown cereals and potential damage ahead of each new cropping season, as well as aiding RWA management planning and development of cultural controls.

Recent research is discussed in a GRDC podcast, 'Just how many Russian wheat aphids is too many' *(http://bit.ly/2TxL2T7)*, and another GRDC video, 'RWA green bridge surveillance' *(http://bit.ly/34h9Nb7)*.

Chemical permits are available to control RWA in grain crops, with more information available from the Australian Pesticides and Veterinary Medicines Authority's website.

WA growers and agronomists are encouraged to report aphids and suspected RWA damage to DPIRD's Pest and Disease Information Service on 08 9368 3080, padis@dpird.wa.gov.au or the MyPestGuide Reporter app.

A RWA resource portal which includes updates on current research efforts and the latest RWA management advice, hosted by cesar, is available at *http://bit.ly/2Px67tu*. The GRDC also has RWA information on its website at *https://bit.ly/31cAxKp*.

Keywords: Russian wheat aphid; spray thresholds

Controlling small pointed snails before they lay eggs

■ By Svetlana Micic, King-Yin Lui, Andrew van Burgel and Sarah Belli – Department of Primary Industries and Regional Development Western Australia

AT A GLANCE...

- Snails will actively feed in summer if there is sufficient moisture, but they will not start to lay eggs until autumn. The albumen gland generally starts to develop in size from March to April indicating that snails are becoming sexually mature and need to be controlled at this time.
- Control measures using baiting alone need to be carefully considered. Small pointed snails feed on baits all year round but, the mortality rate caused by these baits is variable.
- Before baiting entire paddocks, check that baits are effective by 'patch baiting' and then observing dead snails after 24 hours.

BEFORE small pointed snails lay eggs, the albumen gland starts to increase in size. The role of the albumen gland is to secrete a nutritive secretion onto the fertilised egg. Until this gland is developed, snails are not sexually mature and will not lay eggs. If the timing of gland development is known, then control measures such as baiting can be implemented before egg laying occurs. If control measures are put in place before eggs are laid then there will be a reduction in the overall snail population.

The most commonly applied control measure for snails is baiting. Some growers have indicated that they would like to bait after a rain event during summer. Anecdotal reports of the success of baiting after summer rain have been mixed. Some growers report getting good kills with at least one dead snail observed per bait on the ground, whereas other growers have reported no dead snails. To address these varied reports, a Western Australia based trial was done to determine if there was a time of year when snails are more likely to feed on baits.

Small pointed snails.

Albumen gland size and time of egg lay

Snails were collected monthly for about three years. Each month at least 20 snails were collected from a single paddock from each location. In 2017–18 paddocks were located at Woogenellup, Condingup and Munglinup; in 2019 paddocks were located at Mt Barker, Gibson, Scadden and Dalyup.

Using a dissecting microscope, the albumen gland from each snail was removed and its length measured.

Gland size in snails generally increased the most in March or April regardless of whether there was a cumulative summer rainfall event greater than 50 mm. Observations of gut content indicated snails fed on green plant material in summer, but, their albumen glands were not increasing in size and consequently they were not laying eggs during January to March.

The albumen gland reached peak size from May at most sites, indicating that at this time most snails were laying eggs.

Therefore, snail control needs to occur before May (ideally from March to April) to ensure eggs have not been laid.

Generally, by October the albumen gland had decreased in size indicating that the gland was no longer functioning and that snails were not laying eggs. But, at this time of year snails were still observed to be feeding.

Small pointed snails need to be controlled between March and April.

Feeding trial

Small pointed snails were collected monthly for 13 months from Woogenellup. At each collection all snails were placed onto damp paper towel and 7–21 actively moving snails placed into 500 mL round tubs with mesh lids. Each tub had a 10 cm diameter of dampened cotton material placed in the bottom with eight pellets of known weight on top. Tubs had pellets with 50 g/kg of metaldehyde or placebo pellets and there were six replicates of each. The cotton material was re–dampened daily with water.

After three days, pellets were removed, placed into a 40ºC oven for four days and then weighed.

After pellets were removed, snails were placed into the centre of each cotton disc in the tubs. After 48 hours, snails that had moved were scored as alive and those that had not were scored as dead. The humidity and ambient temperatures remained constant in the lab.

We found that snails fed on bait pellets throughout the year. Mortality with placebo was low overall with fewer than 4 per cent deaths except in June when mortality was 12 per cent. Snails feeding on placebo baits between July to October 2018 and in February 2019 consumed almost all the baits, while in February and March 2018 about half were consumed.

While the amount of metaldehyde bait consumed by snails did not significantly differ from month to month (except for a lower amount consumed in March 2018), the mortality caused by the baiting differed from 20–90 per cent between months.

For instance, mortalities in February 2019 were more than four times those recorded for February 2018 (Figure 1).

Similar results have been found in lab feeding trials by SARDI on the round snail, *Cernuella virgata* (Brodie et al. 2020). Round snails collected monthly from two sites in South Australia and exposed to metaldehyde baits were killed more efficiently during periods coinciding with snail reproduction (approximately April to August). It is possible that metabolism is linked with the physiological condition of snails (e.g. reproductive status), but this requires investigation.

To sum up

Snails begin to actively lay eggs about May regardless of whether there has been a rainfall event in summer. To stop snails breeding, control measures such as baiting need to be done between March and April when the albumen gland in snails is beginning to develop.

In the absence of any other food source, snails will feed on baits at any time of year. But, the mortality arising from baiting varies. The increase in placebo bait consumption in April highlights the importance of ensuring that the timing of baiting occurs when snails are more likely to be actively feeding as this will increase the likelihood of snail mortality.

It is recommended that small test areas are baited, and the number of dead snails after 24 hours observed before baiting the whole paddock.

The research presented in this paper from 2017–18 is part of a national GRDC funded project led by the South Australian Research and Development Institute (SARDI). Research from 2019 has been made possible by support from the Snail Mitigation project funded by Trade and Development, DPIRD and GRDC. This work has been made possible by the contributions of growers the authors would like to thank them for their continued support.

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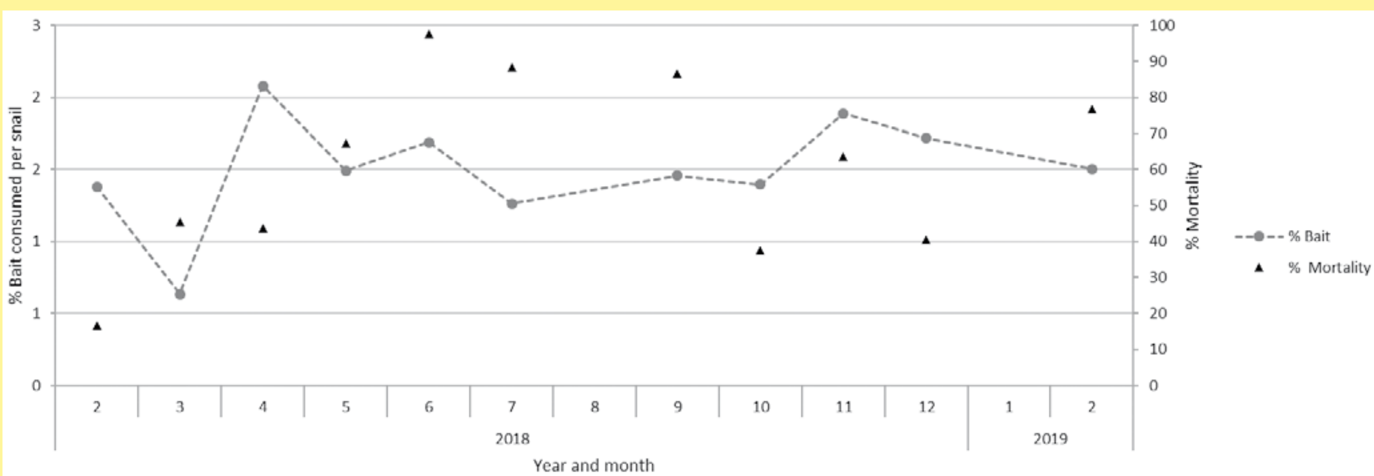
Key words: snail, albumen gland, egg laying

GRDC Project Code Number: DAS00160

■

FIGURE 1: Percentage of baits consumed per small pointed snail and mortality



Least significant differences (LSDs) are 0.6 per cent for baits consumed per snail and 16 per cent for mortality

Cutting edge research award

DIRECTOR of the ARC Centre of Excellence in Plant Energy Biology Professor Harvey Millar from UWA's School of Molecular Sciences and IOA has received a prestigious Australian Research Council (ARC) Laureate Fellowship.

One of 14 Australian Laureate Fellows recognised this year, Harvey was granted $3.3 million to develop new ways to optimise the stability of proteins in crops, in order to increase crop performance and quality.

His project aims to understand the cellular processes and genes that regulate synthesis and degradation of proteins in wheat and barley plants and unveil how to control this for the first time.

Harvey said the research had the potential to increase crop quality through the control of protein abundance in wheat and barley, and that this would be harnessed by biotech industries to create future nutritious crops worldwide.

"Mapping out and developing systems to alter the rates of protein production and degradation inside plants will allow us to hone plant protein production in the future, so that we'll gain the nutritional benefits of higher-protein, plant-based food products," he said.

UWA Deputy Vice-Chancellor (Research) Professor Tim Colmer said the University's new ARC Laureate Fellow is an outstanding researcher and internationally recognised for discoveries in plant proteomics and energy metabolism, who had continued to innovate in a field that could have an enormous impact on future crops and food for global populations.

"The ARC Laureate scheme recognises cutting-edge research in Australia, by our world-leading researchers, and the University congratulates Professor Millar on receiving this recognition," Tim said.

"His research will help boost our biotechnology capacity, as well as broker new collaborations and provide a high-quality training environment for students and mentoring of early-career researchers."

This article was first published in the UWA Institute of Agriculture's August 2020 newsletter.
Professor Harvey Millar e: harvey.millar@uwa.edu.au ■


Plant Biochemist Professor Harvey Millar.

NEW GRDC PANEL MEMBERS…

THE interests of grain growers in the western and southern cropping regions will be represented by new Grains Research and Development Corporation (GRDC) Regional Panels which have been appointed for the next two years. The GRDC Board has announced the composition of each new Panel with each comprising six new members who join returning members re-appointed for another term.

GRDC Chair John Woods says the Panel's new members bring a diversity of insights and backgrounds which will complement the perspectives and skill sets of returned members. "The Board was highly impressed with the quality and volume of Panel member applications received – a reflection of the industry-wide value and respect placed on the GRDC Regional Panel system.

"The Panels play an important role in sourcing feedback from growers and industry about regional production constraints, as well as opportunities, and bringing that information back to the GRDC to help guide investment direction."


John Woods, GRDC Chair.

Western Region

Appointed to the Western Panel for the first time are Calingiri grower Suzanne Woods; Wickepin grower Gary Lang; research and development consultant and adviser John Blake; AgriStart managing director Natasha Ayers; Richard Williams, of CBH Group; and, InterGrain wheat breeder Daniel Mullan.

GRDC Western Panel Chair Darrin Lee welcomed the incoming Panel members and paid tribute to the significant contributions made by outgoing panellists Munglinup grower Gemma Walker; Fiona Dempster, a Mingenew grower and economist; Andy Duncan, partner in a family farm at West River; CSIRO wheat geneticist Greg Rebetzke; and, research agronomist Michael Lamond.

"Outgoing panellists have made a tremendous contribution to the Western Panel, the GRDC and the wider grains industry, and I congratulate them for their ongoing dedication and efforts to best serve the interests of grain growers," Darrin said.

"I thank them for the excellent expertise, passion and commitment they have brought to the Panel and the industry and wish them the very best for their future endeavours."

The returning panellists are Jules Alvaro (Deputy Chair), a Merredin grower, Coorow grower and Summit Fertilizers area manager Juliet McDonald and Binnu grower Rohan Ford.

Mingenew/Dongara grower Darrin Lee is continuing as Chair. GRDC General Manager Applied RD&E Peter Carberry is the GRDC's representative on the Panel.


GRDC Western Panel Chair, Darrin Lee.

Southern Region

First time appointments to the Southern Panel are research agronomist Andrew Ware, from Port Lincoln on SA's Eyre Peninsula; consultant and agricultural extension specialist Pru Cook, from Dimboola in Victoria's Wimmera; Michelle Watt, the Adrienne Clarke Chair of Botany at the University of Melbourne; and, grain grower Michael Treloar, from Cummins on Eyre Peninsula.

Southern Region Panel Chair John Bennett welcomed the appointment of the new Panel members while recognising the valuable contribution of outgoing Panel members: Peter Kuhlmann, a grower from Mudamuckla on SA's west coast; Mike McLaughlin (former Deputy Chair), a researcher with the University of Adelaide; Fiona Marshall, a grower from Mulwala in New South Wales; and, Richard Murdoch, a grower from Warooka on SA's Yorke Peninsula.

Southern Region Panel Chair, John Bennett.

"Peter, Mike, Fiona and Richard have served the Panel with distinction, and we thank them for their dedication, input and commitment," says John, a grower at Lawloit in Victoria's West Wimmera region.

"During their terms on the Panel, they all contributed to informing important GRDC investments in RD&E that have had and will continue to have a positive impact on grower profitability."

The Panel for the coming term features a dynamic blend of grain production, agronomic, extension and scientific expertise, as well as broad geographical representation, according to John, who also announced that Victorian Mallee grower and agronomist Kate Wilson has been appointed Deputy Chair.

The new Panel comprises: Chair John Bennett, grower from Lawloit (Vic); Deputy Chair Kate Wilson, grower/agronomist from Hopetoun (Vic); Michael Chilvers, grower from Nile (Tas); Jon Midwood, consultant from Inverleigh (Vic); Lou Flohr, agronomist/grower from Lameroo (SA); Andrew Russell, grower from Rutherglen (Vic); Pru Cook, consultant from Dimboola (Vic); Andrew Ware, research agronomist from Port Lincoln (SA); Michelle Watt, scientist from Melbourne (Vic); Michael Treloar, grower from Cummins (SA).

GRDC's General Manager, Genetic and Enabling Technologies, Nicole Jensen, is the GRDC executive representative on the Panel.

For more information on the Regional Panels and GRDC investments, visit *https://www.grdc.com.au*. ■

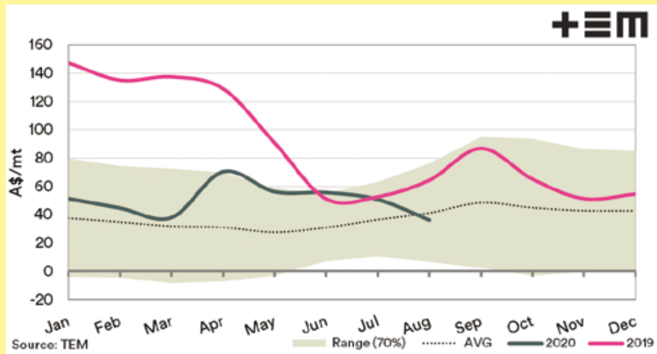
The good news or the bad news?

By Andrew Whitelaw – Thomas Elder Markets

AT A GLANCE...

- Australia is set to rebound and will likely produce a "Top 3 finish" wheat crop;
- Basis levels are generally driven by supply;
- In recent years consumers have paid a handsome premium over futures levels in order to gain access to grain;
- This premium will be heavily discounted compared to previous years;
- Although basis levels are likely to be lower, we will continue to be influenced by moves offshore; and,
- For many, the high basis levels of recent years were irrelevant as they had nothing to sell. At least this year there will be volume.

FIGURE 1: Geelong CBOT basis (A$/mt)



AN analyst of commodity markets must be objective when it comes to providing market intelligence. It is of no use to you – or for us – to tell you what you want to hear. We provide what we view as facts. This sometimes means we have to give you bad news. And we have some bad news about basis.

Australia is on course to rebound from the recent years of drought, with all likelihood of a "Top 3 Finish" for overall wheat production. This comes with a downside. Prices will react to this supply, and it will be felt most on the basis levels received (see accompanying article for a quick explanation of basis).

A large proportion of domestic grain demand is largely inelastic, meaning that consumers cannot, in many cases, immediately reduce their intake. During the drought, consumers had to ensure that they had access to grain. So they paid

premiums to avoid having the grain they needed exported to overseas markets.

This caused basis to rise dramatically. The rise in basis – or put another way – the Australian premium, was felt throughout the nation as a flow-on effect of the drought.

Figure 1 shows the seasonality of basis in Geelong. On average basis throughout the year is about A$37 per tonne over Chicago.

Seasonally, the basis level tends to increase during the latter half of the year. This makes logical sense. If there are supply issues, these will generally be evident to the market from August onwards. In recent years we saw basis levels rise to extraordinary levels.

At TEM, we take data and examine it from many angles, to see what additional insights we can glean. One way to examine basis is through the lens of A$ per tonne.

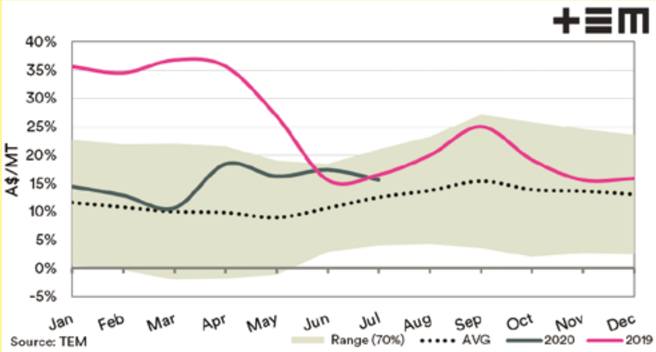
But another is by looking at what percentage of the overall price is comprised of basis.

Figure 2 displays the percentage which basis makes up of the overall price. The basis level rose to close to 40 per cent of the overall price in 2018–19.

As supply increases the basis will become a less critical component of the price received. The Australian premiums of recent years will likely be gone and what happens overseas, will influence our price more heavily.

Although prices are likely to be lower – unless we see significant movements offshore – we will at least have more volume to sell.

FIGURE 2: Geelong CBOT basis (as a percentage of overall price)



Thomas Elder Markets (TEM) is an independent, data-driven market analysis service that provides premium agricultural market insights and reports. Through robust analytical assessment, TEM assists agricultural stakeholders to make better, more informed decisions that drive profitability.
For more information see: *www.thomaseldermarkets.com.au*
Key words: Basis, basis level, wheat production, commodity markets. ■

WHAT IS BASIS?

AT A GLANCE...

- The term basis confuses many but it is merely the difference (positive or negative) between the physical and futures price.
- The basis generally refers to CBOT and local, however, it could be with any other futures exchange.
- The biggest driver of basis is the local supply of grains.
- If supplies are low, then basis rises. Conversely, a large crop tends to lead to lower basis levels.

One of the most common questions which I am asked is 'what is basis?' It is a jargon word which confuses many. In reality, the term basis is quite simple.

The price offered by your local grain buyer is quoted as a flat price, this is the price for the physical delivery of grain, with all the components of pricing included. An example would be A$310 per tonne delivered Melbourne, and this price includes futures, foreign exchange (fx) and basis.

The term 'basis' is exchangeable with 'difference'. When someone is talking about basis, they are discussing the difference between two different prices, generally between physical and futures.

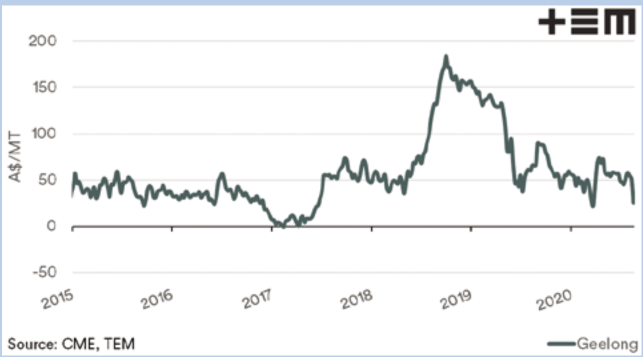
In general, in Australia, basis is a comparison of against CBOT soft red winter wheat (in A$ per tonne). Although whether CBOT is the relevant indicator is a discussion for another day.

The basis level can be either positive (premium) or negative (discount) to CBOT futures. Australian basis levels tend to be positive, with very minimal time at neutral or negative levels (Figure 1).

What drives basis?

The largest driver of basis levels is the local supply of grain. Recent years have seen basis levels rise to record levels. The premium was due to the drought-induced deficit of grain on the east coast. When supply is low, the basis level tends to rise rapidly, providing producers with a very strong premium over international values.

FIGURE 1: CBOT Basis APW



The converse occurs when Australia has a good year. When the local supply of grain is at a large surplus, the basis level declines, as the domestic market does not have to pay up to cover requirements.

The production of grain in Australia is rebounding after a run of miserable years, with forecasts between 25 to 30 million tonnes plus this season.

The larger the production, the more pressure that will be placed on basis levels, and our premium versus the rest of the world will decline.

Over time a lower basis level tends to mean that production has been strong.

In contrast, high basis levels generally mean that the majority of farmers don't have much to sell to capitalise on higher levels.

As we move forward to this season with hopefully good crops, and an uncertain market, it will be worthwhile examining basis levels.

Corn clouds the global grain picture

By Peter McMeekin


Peter McMeekin.

GLOBAL grain markets spent early September pre-empting the thoughts of the number crunchers at the United States Department of Agriculture, and when the latest World Agricultural Supply and Demand Estimates (WASDE) report was released on September 11, the contents were largely as the trade had anticipated.

The wheat news was bearish with US Secretary of Agriculture Sonny Perdue's team increasing global production by 4.5 to 770.5 million tonne (mt). The big movers were Australia, up 2.5 to 28.5 mt, Canada up 2 to 36 mt, The European Union up 0.7 to 136.2 mt, India up 0.4 to 107.6 mt and Argentina down 1 to 19.5 mt.

But the big surprise was forgetting to change Russian wheat production. At 78 mt, it is well below most industry estimates with Russian agriculture consultancy SovEcon raising their forecast by another 0.7 mt last week to 83.3 mt on the back of better than expected spring wheat yields in Siberia.

The larger crops in Australia and Canada led to increases in export projections of 1.5 and 0.5 mt to 19 and 25 mt, respectively. Argentina's export expectations were lowered by 0.5 to 13.5 mt. The majority of the net increase was absorbed by China – import projections increased by 1 mt. A minor increase in global wheat demand has pushed projected ending stocks 2.6 mt higher, primarily in major export origins.

World barley production was also increased with the USDA pegging global output at 157 mt, up 4.2 mt compared to the previous month's report. Russia caught most of the change following a big jump in yield, adding 3 mt to production, which is now forecast at 20.3 mt. The other changes were a 0.3 mt increase Down Under to 10.5 mt and a rise of 0.8 mt in the EU harvest to 63.3 mt.

The global sorghum picture was very similar to that of July, with production unchanged at 60.3 mt. The US crop was decreased by 0.3 to 9.1 mt, but this was entirely offset by an identical increase in Australian output to 1.7 mt. World export forecasts are unchanged at 8.1 mt, 6.7 mt of which is out of the US with 0.5 mt expected to be shipped from each of Argentina and Australia. China is the biggest importer at 6.1 mt.

There were no real surprises in the soybean numbers with the world crop down 0.7 to 369.7 mt. US production was decreased by 3 to 117.4 mt on the back of lower yields and the Brazil crop, which is yet to be planted, was increased by 2 mt to a record 133 mt. The decrease in US soybean yields from 3.58 to 3.49 tonnes per hectare was in line with industry expectations.

But with a number of global production issues and demand uncertainty, particularly from China, most eyes went straight to the USDA's prognostications on corn when the report hit the screens on September 11. Global output was posted at a record 1162 mt – down 8.6 mt from the USDA's July estimate.

As the US harvest rapidly approaches, the WASDE corn yield came in at 11.2 tonnes per hectare, against the July estimate of 11.4 tonnes per hectare. This may seem a small decrease, but when coupled with a 0.5 million hectare reduction in the harvested area due to the storm that lashed Iowa last month, it lops 9.6 mt off US production to 378.5 mt.

Elsewhere, the Brazilian corn crop is forecast at a record 110 mt, up 3 mt compared to August, the Russian crop was cut by 0.3 to 15 mt, and EU output was 1.5 mt lower at 66.3 mt. The harvest of major Black Sea exporter Ukraine was trimmed by 1 to 38.5 mt.

Corn consumption conundrum

On the demand side of the equation, the global corn picture came in unchanged. But, drilling down into the supply and demand matrix, there were some fundamental changes. US corn consumption was cut by 5.1 mt as lower ethanol demand projections due to Covid-19 are realised. On the other hand, Brazilian demand was increased by 2 mt.

But, the trade was left baffled by the China corn numbers. Many think that Sonny's merry men are asleep at the wheel when it comes to the Middle Kingdom. They did increase Chinese corn consumption by 2 to 279 mt but left production and imports unchanged at 260 mt and 7 mt respectively.

This is despite concerns mounting over new crop Chinese corn production this month after three typhoons hit the country's primary corn region in quick succession over a 20-day period, levelling crops, flooding low-lying warehouses and pushing domestic corn prices to their highest level in five years.

The full extent of the storm damage is not yet known, but analysts are expecting corn output in the key producing provinces to be severely affected. And the massive corn auction program over the past four months has almost exhausted China's corn reserves forcing consumers to substitute corn with up to 20 mt of feed wheat and rice ahead of their harvest.

When it comes to China's corn imports in the 2020–21 marketing year, it seems that the right hand doesn't know what the left hand is doing along the hallowed corridors of the USDA at the moment. Leaving import projections at 7 mt, when Beijing already has 8.8 mt of confirmed new crop US corn purchases on their books, was very strange. And sales of new crop Ukraine corn to China already exceed 3 mt.

Global marketers are expecting corn shipments to China to be at least double the USDA projection, the majority are probably closer to triple, and some are even suggesting more than four times the WASDE number at 30 mt.

The global corn balance sheet is littered with questions and uncertainty at the moment, and this will be a crucial driver of international grain markets as we move into the northern hemisphere autumn and the row crop harvest season.

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

Trends in global wheat use

By Australian Export Grains Innovations Centre

DESIGNING a flexible wheat classification system to cater for the increasingly diverse needs of wheat buyers at home and abroad is among several key recommendations in a new AEGIC report examining global wheat consumption out to 2030. *Wheat 2030: Anticipated Trends in Global Consumption* forecasts major trends over the next decade and presents a set of recommendations to help the Australian wheat industry maximise value for growers.

AEGIC Chief Economist Professor Ross Kingwell said by 2030 global wheat imports are expected to increase from 92 million tonnes (mt) to 116 mt for human consumption, and 17.1 mt to 25.7 mt for animal feed (Figure 1).

"Wheat will remain a significant component of the world's daily food intake," he said. "Towards 2030 Australian wheat exports would increasingly come from Western Australia and South Australia, with the domestic food and feed market largely supplied by the eastern states (Figure 2).

"Australia's classification system needs to cater for the increasingly divergent needs of the domestic and export markets," he said.

"Over the next decade the bulk of Australian wheat must be functionally flexible, and support use in multiple products within multiple markets.

"While Australian wheat is currently well regarded for noodle applications, the growth in bread products within international markets provides ongoing opportunity.

"Australia also has strong capacity to develop new varieties for specific end products, for example udon noodles and biscuits."

Ross said South East Asia will remain a key exporting region for Australian wheat. The report makes specific recommendations for individual South East Asian markets.

Other potential opportunistic markets will include the Middle East and North Africa, Sub Saharan Africa, and South Asia.

The report, and a companion barley report, have already been circulated to Australian industry stakeholders and have been well received.

AEGIC is an initiative of the Western Australian State Government and Australia's Grains Research & Development Corporation. For more information: See *www.aegic.org.au*

Keywords: wheat classification, AEGIC, value chains, bread wheat, biscuit wheat

PRIMARY RECOMMENDATIONS AND SUGGESTED ACTIONS

Create an Australian wheat quality classification system that meets the increasingly divergent needs of the domestic and export markets

ACTION: Design an increasingly flexible classification system that caters for differences between domestic and export market requirements.

Australian growers should continue to supply versatile wheat that performs well in multiple applications.

ACTION: Maintain engagement to understand customers' current and future needs in the different markets that use Australian wheat for a range of applications

ACTION: Integrate new information on customers' wheat quality requirements into classification standards.

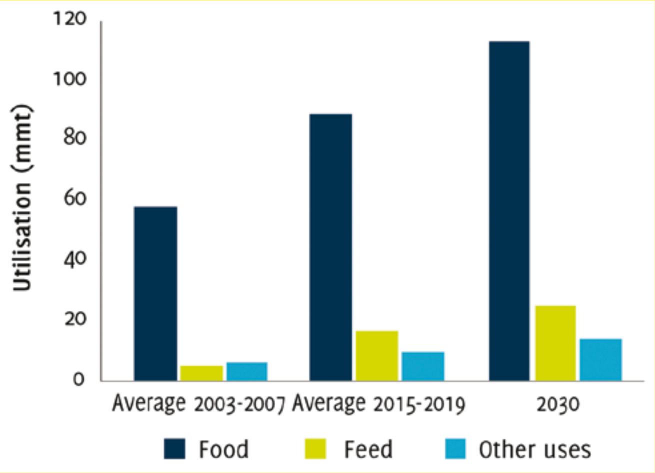
Stimulate demand for Australian wheat in South East Asian noodles

ACTION: Promote and demonstrate the quality and value of Australian wheat in the manufacture of noodles, particularly to consumers to stimulate pull through demand.

Support demand for specialist Australian wheat in key markets

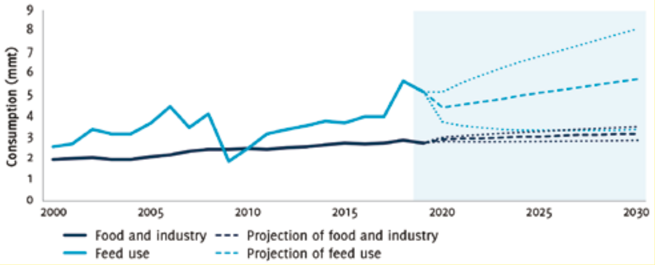
ACTION: Identify emerging opportunities and viable path-to-market value chains for specialist Australian wheat, for example bread wheat and wheat for biscuits and cake.

FIGURE 1: Expected use of wheat imports within the top 40 wheat importing countries



Source: OECD, USDA.

FIGURE 2: Australian domestic consumption of wheat as food and feed with projections to 2030



Source: OECD, AEGIC.

Record land prices... but slowing

WHILE prices of Australian agricultural land are at record highs in many regions, the market is entering a new phase, with low – to no – growth in median prices forecast over the next 18 months, according to a new industry report. In its annual *Australian Agricultural Land Price Outlook* (supported by Digital Agriculture Services), agribusiness banking specialist Rabobank says the robust growth in agricultural property prices witnessed over the past five years has slowed, with 2020 signalling "the beginning of a new phase in land markets across the country".

Report author, Rabobank agricultural analyst Wes Lefroy said already there had been lower agricultural land price growth in 2019 than in the previous two years.

"For the time being, the aggressive rise in land prices is behind us, and we are expecting a period of low, if any, growth in 2020. Ultimately though, this will vary by quality, region and production type," he said.

While there will likely still be a number of "marquee" sales in some locations – especially for high-rainfall properties with scale – median agricultural property prices in some regions may even see a contraction over the coming 18 months, the report says. However, macro-economic factors, such as low interest rates and a forecast weakening in the Australian dollar – along with the overall healthy state of farm balance sheets across the country – will prevent a major downward correction.

"And if agricultural land prices can hold the significant gains they have made over the past five years in the year ahead – through the worst economic crisis we are facing in decades due to the coronavirus pandemic – this will be a great result for landholders," Wes said.

For buyers of agricultural land, he said, "the story is a very complicated one", with different market segments in different locations moving at varying speeds – driven by factors other than just agricultural productivity – so that prices are often not reflective of the productive potential of the land.

"The median price in some regions can be double, or even triple, that of other regions with similar productivity and seasonal variability," Wes said. "We believe using productivity as a basis for identifying opportunities will help prospective buyers discover potential purchases."

With the support of rural intelligence company Digital Agriculture Services (DAS), the report had undertaken analysis to incorporate this land productivity data in its findings.

Factors 'putting on the brake'

The report says a number of factors are contributing to the slowing rate of growth in the agricultural land market.

Chief among these is the trailing effect of recent years of drought, with the impact on land prices often delayed – bringing periods of very low, if any, land price growth, even when rainfall returns.

"It may seem paradoxical, but a key factor weighing on land price growth is the return to better seasonal conditions and drought recovery that is occurring particularly on the east coast," Wes said. "In drought-affected regions, there has been a shortage of properties on the market with many potential sellers choosing to hold off until conditions improved, and this reduced supply had been supportive of price growth. But as seasonal conditions have improved, we will see an increased stream of lower-quality properties come to the market, with sellers trying to take advantage of the high price environment.

"In addition, as part of the recovery from drought, we are likely to see farmers shift their focus to consolidation and direct their business investment towards building resilience in their operations rather than looking to expansion."

And, outside of drought-affected regions, he said, "grain prices that were swollen by the drought have now softened, which will impact farmers' profits, particularly in South and Western Australia".

Land price growth rates, and why

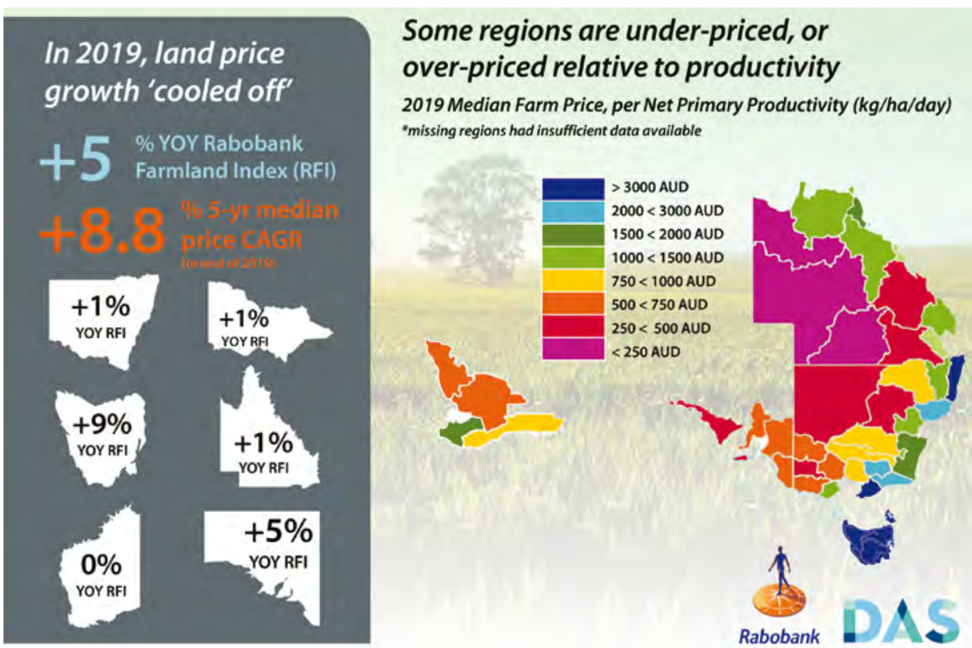
Nationally, median agricultural land prices were shown to have risen at 8.8 per cent per year compound annual growth rate (CAGR) over the five years to December 2019, according to the Rabobank Farmland Index (see chart below).

Most of this growth was concentrated in 2017 and 2018, with growth slowing in 2019. For the past year (to December 2019) national ag property prices rose five per cent year on year (YOY).

The report found agricultural land had appreciated at a faster rate than most other asset classes over the past 10 years.

"So far, ag land has largely avoided the economic fallout of COVID-19," Wes said. "This has highlighted the fact that the primary drivers of agricultural land value are different from any other asset classes and, in fact, aspects of a weak macro-economic environment will actually support investor demand for agricultural property.

"These include a relatively weak Australian dollar, which increases the purchasing power of offshore buyers. Also, low returns on risk-free assets (such as government bonds), along with extreme price volatility and significant downside risk in other asset classes, have also incentivised investment in farm land." ■



Chris (left) and Broden Holland are investing time, energy and dollars in new PA tools to improve farm efficiency.

In collaboration with SPAA, Australian Grain presents a series of articles on a wide range of precision agriculture technologies and how best to put PA to Work on your farm.

Protein map simplifies nitrogen decisions

Written for SPAA by Sue Knights

Like many farming families, the Hollands have expanded their property and paddock size over generations. For them, the result on their farm at Thuddungra, north-west of Young in NSW, is a patchwork of variability across 4500 hectares.

Two decades of yield maps were showing variation in wheat and canola across paddocks – up to 40 per cent in wheat and 30 per cent in canola, mainly due to inherent variation as paddocks were expanded.

Broden Holland, who farms with his parents and grandparents, says that although they were interested in what the maps where showing them, they also left them somewhat confused.

"We suspected there was something to be gained from this information, but we were a little perplexed as to how to use the yield map data. There appeared to be a lot of 'noise' in them, which could be attributed to factors other than nitrogen."

This changed when Broden returned from Charles Sturt University in 2016 with a degree in Agricultural Business Management and an additional full-time employee was recruited. The family decided to invest more time researching and adopting new PA tools to improve efficiency and extract greater returns from the enterprise.

At a glance…

- PA tools are the last 10 percenters. Timing, and general farming practices are still the most important.
- Adopting PA technologies and practices will most likely create more questions than answers.
- Identify your biggest constraint and see if it can be overcome applying PA.
- Adopting PA takes time, make sure it is not to the detriment of other farming practices.
- Be prepared to make incremental improvements with PA.
- Purchase a protein monitor for your harvester and make sure you actively use the data.

Farm details

Location: Thuddungra, 30 km north west of Young, NSW.

Farm size: 4500 hectares.

Rainfall: Annual 600 mm
GSR 350mm – winter dominant.

Soil: Sandy, clay, loam pH 4.6–6.0

Enterprises: 70 per cent cropping, 30 per cent self replacing merinos.

Personnel: Broden Holland, his parents Chris (manager) and Kelly and grandparents Nevin and Marie Holland, 2 full time employees.

Yield: Average wheat yield 3.5 t/ha, average canola yield 1.7 t/ha.

Starting point

Around the same time – and at a SPAA event – the family came across grid soil sampling. It determines a baseline of pH and phosphorus variability.

The family decided to use service provider Precision Agriculture to map its variability for these nutrients. This was done on two-hectare samples across every paddock. From that information, variable rate (VR) application maps were processed.

Broden says the type of mapping chosen was

PA applications	
Technology	**Year started using**
Yield monitoring (sporadically)	2002
Guidance Trimble Ez-guide	2006
Trimble RTK 2010	2010
Yield data (using maps and consistent data collection)	2015
Modified Marshall Multispreader and Wallaby spreader (VR lime and manure)	2016
CropScan 3000H On Combine Analyser	2016

based on cost and effectiveness. "Essentially, the maximum amount of information we could obtain with minimum investment," he says.

The results showed that pH ranged from 4.2 to 6.0 in calcium chloride. The aim was to lift this level to 5.5 across the property. Although the family did not expect to see a yield response from this goal, they knew it was going to be a significant risk to crop production if pH levels dropped any further.

Lime was applied using a Marshall Multispread with rates controlled via the Marshall app and rate controller retrofitted to a 810T machine. This approach was selected for ease of use and low cost. Using the application map, lime was spread at VRs, from 500 kg to 3500 kg per hectare.

The grid soil samples showed phosphorus varied from a Colwell P of 20 to 80 and a target of 55 was established. To achieve this, rates of 1000 kg to 7000 kg per hectare of chicken manure were spread at 25 km per hour using a Marshall Multispread hydraulic rate control kit retrofitted to a Wallaby Manure Spreader.

Manure was chosen based on numbers: The family was able to obtain manure economically, initially from their own on-farm poultry operation and then from a nearby business.

The farm has now been progressively treated during the past three years for both pH and phosphorus. In 2021 some paddocks will be retested to determine the effect of the VR applications and then maintenance levels of manure applied every three to five years.

Broden says that at $17 per hectare, the soil grid mapping exercise was not cheap, but the family will consider re-mapping some paddocks every five years to monitor changes.

Nitrogen challenge

But the nutrient still to be addressed was nitrogen (N). It was proving to be more of a challenge as it can be cost prohibitive to map any variation. This is partly because N mapping needs to be done more frequently than pH and phosphorus, and also the Hollands felt it was difficult to attribute variation solely to N levels.

Following advice from their local dealer and agronomist and installing a 3000H protein meter on their Case 7240 harvester, they had a significant breakthrough. It led to blending benefits and eventually N-prescription maps.

The 3000H protein meter is a near infrared (NIR) analyser designed to measure protein, oil and moisture content in grains and oilseeds as the crops are harvested. This data is presented in real-time paddock maps, trend plots or bin by bin. Maps can be sent to a website for viewing on a tablet, computer or mobile phone.

"We are able to collect protein, oil and moisture data every 5–10 seconds or at approximately 15–20 metre intervals across every cropped paddock. Initially this gave us insights into how to blend our crops for protein and moisture during harvest using mother bins and achieve greater returns," Broden says.

The Hollands estimate that using the data from the 3000H to blend grain to a higher specification returns a minimum of $15,000 a year. Additional gains can be achieved when the protein data is used to establish N prescriptions.

VR urea application

The Holland's N strategy aims to maintain a protein level of 11.5–12 per cent in wheat, with VR maps changed depending on the season to reduce protein variability across paddocks. The same method is applied to canola in the following year. The method needs to be further tested but is showing very convincing data trends across both crop types.

Figure 1 shows the 2016 harvest protein map, the matched variable rate urea map and resulting protein map in 2017 for wheat. Broden used a simple calculation shown in Table 1 to determine the VRs for urea.

TABLE 1: Formula used for variable rate of urea applied according to previous crops' protein level

Protein %	Rate of urea applied (kg/ha)
>13.5	30
>12.5	60
>11.5	90
>10.5	120
>9.5	150
<8.5	180

"Initially, we chose to keep our VR approach simple by separating protein from yield to avoid the noise that we saw in the yield maps," he says.

With a complete paddock protein map, it takes around 10 minutes to make a VR urea map regardless of size of paddock.

"This is much more time efficient than using yield maps or tissue testing and so far, we have been pleased with the results," Broden says.

Variable rates of urea were applied using an Amazone Profis Spreader and Amatron-3 with VR controlled by serial rate control through Trimble FMX. Figure 2 shows the 40 per cent reduction in yield variability for a wheat paddock across two seasons.

FIGURE 1: 2016 harvest protein map for wheat, matched variable rate urea map and resulting protein map for 2017 wheat

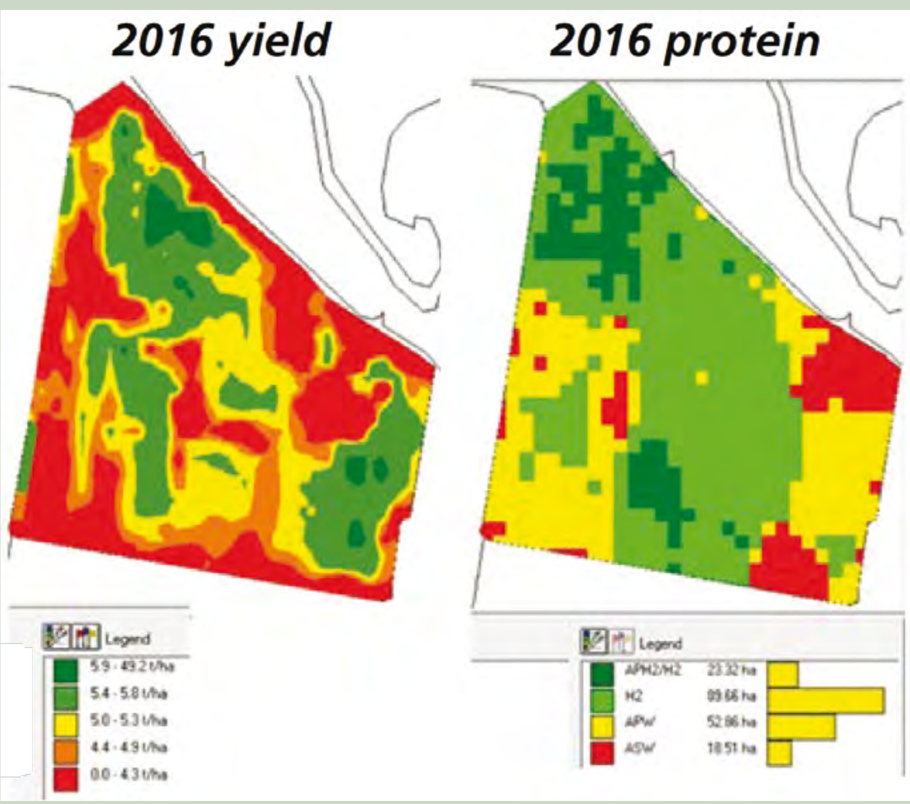
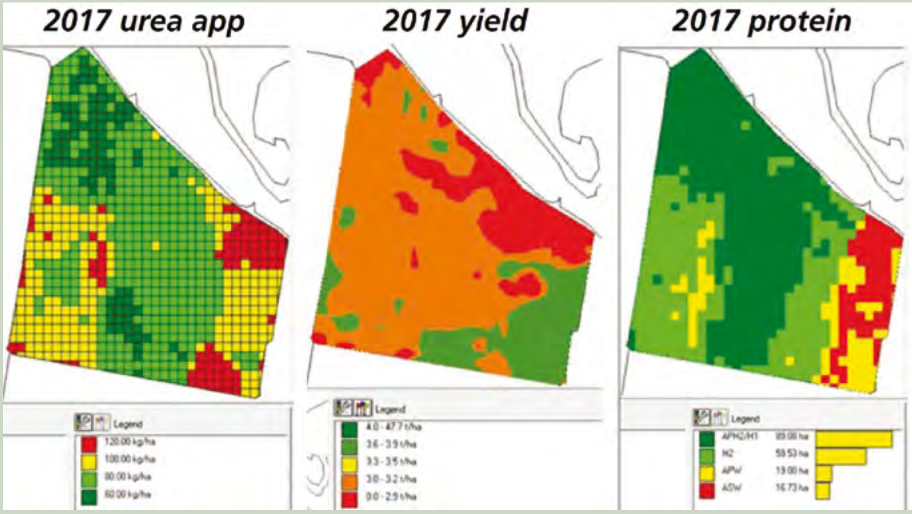


FIGURE 2: Yield maps showed a 40 per cent reduction in variability in 2017 compared to 2016. This was a paddock with wheat on wheat rotation using the 2017 VR urea application map.



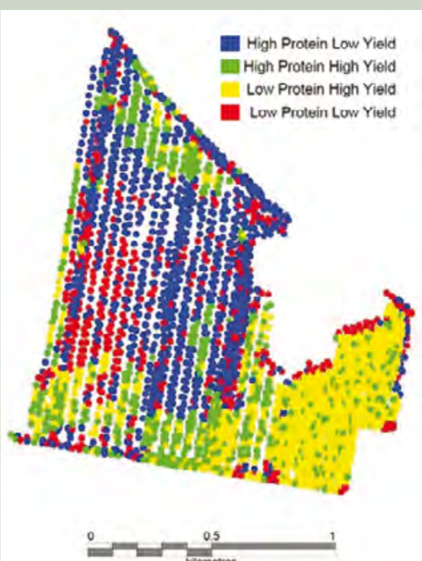
Further investigation

Calculating N rates based on protein is a simple and less time-consuming way of applying N. But yield may still be variable so further investigation is needed.

Figure 3 shows a correlation map of yield and protein dividing the paddock into four performance areas. This enables strategic placement of soil tests or provides defined areas for ground truthing and further investigation of the crop's performance.

Strategic ground truthing over the past three years has been carried out using deep N soil sampling on high and low performing paddock areas guided by maps such as the one shown in Figure 3. So far the deep N data has correlated well with the protein monitor and tests will continue each year until adequate information has been gathered and the method is fully tested

FIGURE 3: Correlation map combining 2017 yield and 2017 protein data



Generations of insights

All generations of the Holland family have learnt from their venture into PA.

"Although a bit unorthodox, our initial foray into PA – driven primarily by time and cost savings – is proving beneficial. We can measure that it's working," Broden says.

Broden's grandfather Nevin Holland has seen many on-farm developments in his life – from the introduction of no till to the use of chemicals – but now believes technology or PA is farming's biggest advance.

The 3000H protein meter has saved the Hollands at least $15,000 a year through load blending as well as enabling a cost-effective means of nitrogen mapping.

"We started with 'seat-of-our-pants' agriculture, didn't know how many or where to put our bags of super (fertiliser) per acre. Now we have variable rate applications for just about everything and our management is more precise within the paddock as the paddocks become larger," Nevin says.

"Increasingly Australian agriculture needs to be more sustainable and competitive. This means more precise application of inputs and growing more from less, and only technology and precision agriculture can aid in that."

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Know the limits and risks of pre-harvest herbicides

By GRDC

AT A GLANCE...

- Pre-harvest herbicide applications, when carefully managed, can be a useful tool in weed control and crop desiccation.
- Always follow the product label and withholding periods.
- Seek advice from grain buyers concerning any specific market requirements prior to use.
- Pre-harvest herbicide use should be considered as a part of a wider integrated weed management plan.

GROWERS planning pre-harvest herbicide applications are being urged to arm themselves with the required knowledge to avoid grain rejection from domestic or international markets.

The risks associated with pre-harvest herbicide use for late season weed management or crop desiccation need to be weighed against potential grain market requirements. By adhering to the product label Directions for Use, growers will ensure that any detectable residues will meet Australian Maximum Residue Limits (MRLs).

But importing country MRLs may differ to the Australian MRL. Growers are encouraged to seek advice from their grain buyers regarding any additional market requirements that might impact on their management choices prior to herbicide application.

Late-season application

Application of herbicides close to harvest comes with the risk of detectable residues being present on harvested grain. Herbicides can be used late in the season to manage weeds, prevent weed seed set or to desiccate crops to accelerate or even-up ripening.

It is the responsibility of growers to adhere to herbicide label recommendations and withholding periods to avoid the presence of unacceptable chemical residues in delivered cereal, pulse and oilseed grains. The GRDC's *Pre-Harvest Herbicide Use Fact Sheet* contains basic information regarding chemical registration by crop type (Table 1), but it is recommended to always check chemical labels before use.

MRLs exist for each crop and market. It is important to take into account MRLs for Australia and the country importing the grain, as these restrictions can often vary.

TABLE 1: Summary of registrations for pre-harvest herbicide use by selected crop type. Always check product labels before application.

	Paraquat	Diquat	Glyphosate	Sharpen
Wheat	×	✓	✓	✓
Barley	×	✓	#	✓
Canola	×	✓	✓	×
Chickpea	✓	✓	✓	✓
Lentil	✓	✓	✓	✓
Faba bean	✓	✓	✓	✓
Field pea	✓	✓	✓	✓
Lupin	✓	✓	×	✓

✓ = registered for pre-harvest use; ×=not registered for use
= Roundup Ultra Max is registered for use in barley crops (except malting barley)
Source: GRDC Pre-harvest Herbicide Use Fact Sheet

Pulses and pastures

In-crop spray topping with paraquat or glyphosate is often used as a control for a range of annual grasses in pulse crops and pastures.

Chemical use should be considered as a part of a wider integrated weed management (IWM) plan, allowing for alternative weed control techniques. The GRDC's *Integrated Weed Management Manual* provides information on the latest tools and techniques for weed management, including cutting crops for hay, break crops and green and brown manuring.

Cereals and canola

Pre-harvest herbicide use in cereals varies by crop type and product label. Individual labels should be checked before application as withholding periods and maximum application rates do vary.

Product acceptance can vary between grain buyers' policies, and growers should consult with their buyer before any application. This is particularly the case for malt barley crops.

Harvest weed seed control methods such as the use of chaff carts and seed impact mills can be employed as long-term options for control of weeds such as ryegrass. Baling a particularly infested crop can also assist in cost recovery and weed seed control.

Windrowing is also an alternative for growers planning on using desiccation techniques to prepare a canola crop for harvest.

Determining MRLs

In Australia, the Australian Pesticides and Veterinary Medicines Authority (APVMA) determines MRLs as part of the registration process. The MRL is set based on the application of the pesticide under Australian use patterns (label directions). Not following label directions is illegal and can result in MRL violations. This includes using higher rates or not following timing of application directions and withholding periods.

It is important to remember, the importing country MRLs may differ to the Australian MRL.

Breaches of MRLs can result in grain being rejected by both domestic and export markets.

Grain handlers and marketers regularly conduct testing on grain receivals for residues. The National Residue Survey also conducts ongoing residue testing of grain.

Further information
To guide growers through their decisions, the GRDC has published the Pre-Harvest Herbicide Use Fact Sheet.
Other resources include: GRDC Integrated Weed Management Manual; GRDC Pre-harvest Herbicide Use Fact Sheet; Grain market access and chemical residues factsheet ■

Taking a *Single Shot* at weeds

By Cindy Benjamin, WeedSmart

AS farmers get their hands on fast and accurate weed mapping technology, the frequency of blanket herbicide spraying can be greatly reduced. With an accurate digital map that shows where the weeds are right now, most boomspray rigs can become low–cost spot sprayers.

For the past two years John Single and his son Tony have been using the air-borne weed sensor, *Single Shot*, developed by John's other son Ben, to rapidly detect and map weeds on their dryland cropping property, Narratigah, near Coonamble, NSW.

Ben saw the benefits of separating the weed detection and weed spraying tasks and set about building the platform and working with Robotic Systems to bring the idea to reality.

"The main aim is to stay ahead of herbicide resistance," says John. "Ten years ago we started work on developing drone-mounted sensors that could take over the task of detecting weeds in a green-on-brown situation. Many sprayers, particularly later models, do not require any modifications and there are many benefits in having the weed mapping done separately rather than on-the-go."

Not just for fallow weed control

Weed maps enable growers to take a planned approach to their weed management throughout the year and to build a historical record of weeds in a paddock. The *Single Shot* sensor maps green-on-brown but are not limited to fallow situations. The sensors can be used in newly sown crops to map weeds that emerged on the planting rain or were missed in a previous application.

These patches, or individual weeds, can be treated in-crop or a pre-emergent can be applied to the patches at the end of the season. The sensor can also be used in-crop to identify high biomass areas within a paddock where high weed density requires more drastic action, such as cutting for hay, and in wide-row crops where the canopy does not fully close and weeds can be detected between the rows.

The Singles have used the *Single Shot* technology in several different management scenarios already and the possibilities seem endless.

John says they have used the sensor to identify survivor marshmallow and milk thistle plants in fallow and then spot spray them with a high rate of Starane to prevent seed set. They have mapped feathertop Rhodes grass in wheat to generate a map for applying pre–emergent herbicide post-harvest and have filtered data to segregate weeds based on size, giving them the option to apply a blanket spray on smaller weeds and a herbicide spike to treat larger weeds, or to use a second boom to apply two different products or rates.

Where pre-emergent herbicides are used, a perimeter determined by the user can be added to cover the seed distribution area of the mother plant.

Scouting for survivor weeds

Another important role for *Single Shot* at Narratigah is to scout for survivor weeds after herbicide applications.

The Singles crop 4500 hectares and can map the farm at a rate of up to 300 hectares per hour. This is one of the most important tasks in a herbicide program and yet it is generally not done effectively due to the time required. Having 'eyes in the sky' makes routine and accurate scouting practical after every spray treatment.

The sensor is capable of covering 300 hectares per hour under continuous flight or targeting weeds greater than five cm diameter. Under normal operating conditions, and including battery changes, the Singles achieve a work rate of around 200 hectares per hour. Critically, data processing can be done in the field, if the internet is available at the site, and is done at a speed 1.7 times faster than flight time.

Once a weed map has been created, the drone can be sent out again to take high resolution imagery of plants in specific locations in the paddock for identification purposes, allowing John and Tony to plan a herbicide program with their agronomist, based on exactly what's in the paddock.

When it comes to spraying, having the weeds mapped before the spray operator gets in the cab means that the job can be done when conditions are suitable, including at night.

The real power of the *Single Shot* system is the ability to run simulations and to re–process the data to fine-tune a herbicide

John Single with a drone carrying the *Single Shot* weed sensor. By separating the weed mapping and weed spraying tasks the Singles can take a planned approach to their weed management throughout the year.

Screen shot of the Trimble guidance screen in operation with a Single Shot spray map.

program based on weed size or density. The sensor requires just a one cm 'brown' perimeter around a weed to be able to detect the weed size.

The weed maps are built from images that are 10,000 times higher resolution than satellite images, giving a one cm sampling size. Every part of the paddock is photographed twice so obstacles such as stubble occlusion can be significantly reduced. The drone flies at a height of 75 metres, following a pre-determined path, and can also be flown lower and or slower if necessary to collect specific data. The sensor also accurately identifies stressed weeds.

"Information is power and this has really put us back in control of our weed management," says John. "We know how much chemical to buy to do the job at hand, we know the costs and can alter the chemistry to suit a budget if necessary, we can choose to blanket spray or spot spray, and our ability to apply the double knock tactic is greatly improved."

Ready for unmanned aerial vehicle spraying

In a bid to be one step ahead of the game, the *Single Shot* software will also calculate the shortest path for the sprayer, which is most useful when doing spot spraying on an ATV, or in the future, to deliver herbicide via a drone-mounted sprayer (unmanned aerial vehicle) or autonomous vehicles.

"We ran a scenario for treating about 2000 survivor weeds in a 125 hectare paddock using a spray drone," says Ben. "To apply a blanket spray to the paddock, the spray drone would need to travel about 310 km. Using the *Single Shot* software we determined the shortest path to reach all the weeds, which cut down the time required to do the job to just two and a half hours. The sprayer would only be applying herbicide for 16 km of the 54 km flight, and just five per cent of the paddock would have herbicide applied."

Weed mapping using tools and systems like *Single Shot* are putting growers back in the driving seat to cost-effectively and consistently implement the WeedSmart Big 6 tactics that underpin sustainable herbicide use and maintain productivity gains through no–till farming systems.

For more information about managing herbicide resistance visit the WeedSmart website: *www.weedsmart.org.au*

Keywords: Single Shot, WeedSmart, weed mapping, spray drone, spray map, herbicide resistance ■

Feathertop Rhodes grass: What strategies are working best?

By Richard Daniel[1], Hanwen Wu[2] and Mark Congreve[3]

AT A GLANCE...

- Feathertop Rhodes grass is well adapted to colonise bare ground (fallows, roadsides).
- Commitment to two summers of 100 per cent control of feathertop Rhodes grass should deplete the seed bank in the soil.
- Control strategies require an integrated approach that includes tillage, crop selection, maximising crop competition, residual herbicides and selective use of double knock applications in fallow.

FEATHERTOP Rhodes grass (*Chloris virgata*) (FTR) continues to be a major problem weed in zero till farming systems in the northern grains region, with populations continuing to expand further into southern and western Australia, particularly along road corridors.

Biological factors that influence control

Feathertop Rhodes grass is a prolific seed producer which can produce up to 40,000 seeds per plant under optimal conditions. But, when plants are under moisture stress, they will quickly begin setting viable seed, even when the plant is small/young.

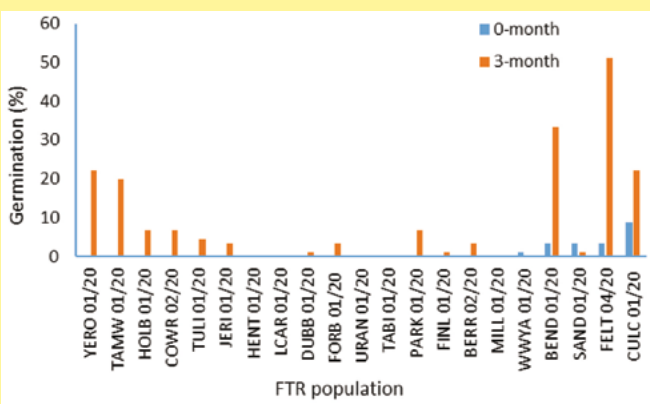
It appears to have a short dormancy period, with poor germination for the first few months after shedding (Figure 1).

FTR is often the first weed to establish on bare ground following a rainfall event in spring/summer, although it can germinate at all times of the year (including winter).

Glasshouse studies by Queensland Department of Agriculture and Fisheries showed that FTR will emerge following as little as a 10 mm simulated rainfall event (Figure 2) but larger rainfall events resulted in increased emergence.

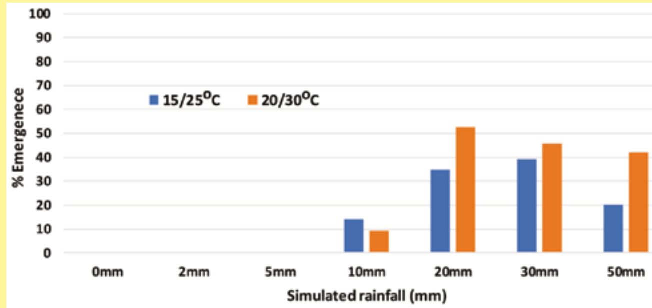
Awnless barnyard grass, common sowthistle and flaxleaf fleabane were also included in this study (data not shown). The rainfall requirement for emergence of FTR was less than for awnless barnyard grass, especially at the lower temperature tested, while rainfall over 20 mm was required to provide significant emergence of sowthistle and fleabane.

FIGURE 1: Germination percentage of different FTR collections soon after shedding



(Hanwen Wu. NSW DPI)

FIGURE 2: Percentage FTR emergence with respect to temperature and rainfall



This ability for FTR to establish on lower rainfall highlights one of the reasons that FTR is often the first weed to establish following spring rainfall.

In a second trial in the same study, different amounts of rainfall were simulated over consecutive days (Figure 3). Keeping the soil surface moist for a longer period typically increased the percentage emergence compared to a single application of the same total amount of rainfall.

Feathertop Rhodes grass is predominantly a surface germinator, with minimal germination occurring from seed below the top two cm in the soil (Figure 4).

The combination of surface germination and germinating on less rainfall than competitor weeds means that FTR is well adapted to zero till fallows and other bare areas (such as roadsides sprayed with glyphosate).

Seed persistence: FTR's 'glass jaw'

Seed persistence is short. Viability of seed declines rapidly and almost no seed remains viable 12–18 months after shedding (Figure 5). Unlike most other weeds, studies have shown that burying seed does not significantly increase persistence.

This lack of seedbank persistence can be utilised as the proverbial

FIGURE 3: Percentage FTR emergence with multiple rainfall events

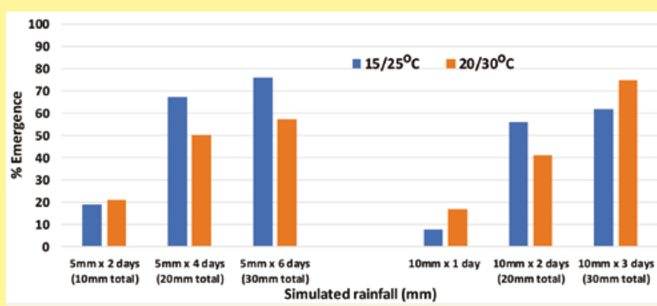
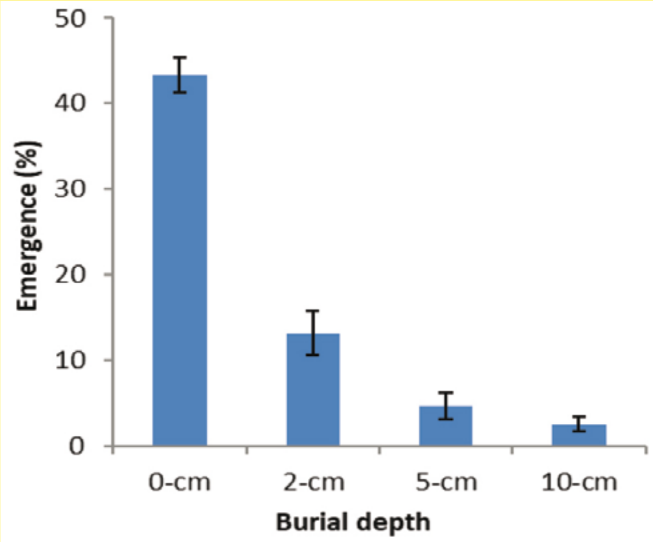


FIGURE 4: Effect on emergence of FTR seed burial



(Hanwen Wu, NSW DPI)
Pot trial – duplex red Kandosol soil, pH 5.4 and organic carbon 0.6 per cent.

boxer's 'glass jaw' in management of FTR – a concerted effort over two consecutive summers to completely stop seed set and any further recruitment into the paddock can see paddocks rapidly go from infested to effectively clear of FTR in a couple of years.

Feathertop Rhodes grass does not compete well with existing crops or pasture. But, it often is the dominant species in any bare areas (e.g. roads, fallow) right up against the edge of the crop or pasture paddocks.

These factors see FTR quickly dominate bare earth roadsides or zero till paddocks, especially following wet summers where control programs have not been able to stop seed set and recruitment into the seed bank.

Outside of the cropping paddock, residual control can be achieved by the use of imazapyr based herbicides (e.g. Arsenal) in non-crop areas. The flumioxazin based herbicides Terrain and Valor have recently obtained registrations for residual control along fencelines and irrigation channels respectively.

The first punch – prevention is better than cure

Control of established populations of large FTR is difficult, extremely costly and most likely to be incompatible with zero till farming. Therefore, growers should aim to keep FTR out of farming paddocks wherever possible, and urgently seek to remove individual plants before they have a chance to set seed.

Where glyphosate has been used on roadways and fence lines and FTR has then become established, seed can be blown into adjacent paddocks. Alternatively, seeds may be deposited in the paddock via livestock and kangaroos; from machinery or in flood water.

Typically, a single plant in year one will result in a small clump covering maybe two to three square metres in year two. Over coming years these patches will continue to expand, potentially seeing the whole paddock infested if nothing is done to stop seed set.

Growers should be continually on the lookout for individual plants and act quickly to manually remove or spot spray these before they are allowed to set seed. Small patches should be chipped, burnt or cultivated to prevent spread. Ideally these should be GPS mapped for future monitoring with a residual herbicide applied prior to the commencement of spring rainfall events.

The second punch – knockdown herbicides

Glyphosate alone is not registered for control of FTR and cannot be expected to achieve control. Even when using a double knock of glyphosate followed by paraquat under ideal conditions and targeting seedlings before they start tillering, control is variable and rarely provides a commercially acceptable result.

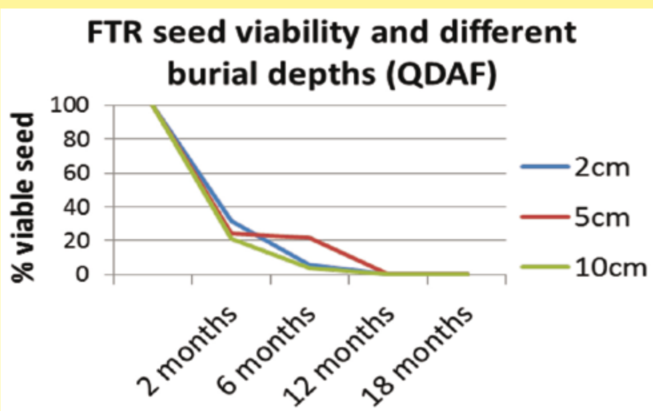
Targeting larger weeds that have commenced tillering, or are under any stress, will typically achieve less than 50 per cent control as a double knock, and often not significantly better than using paraquat alone as a single application.

Research trials and commercial experience have shown that Group A herbicides can be effective in providing useful control.

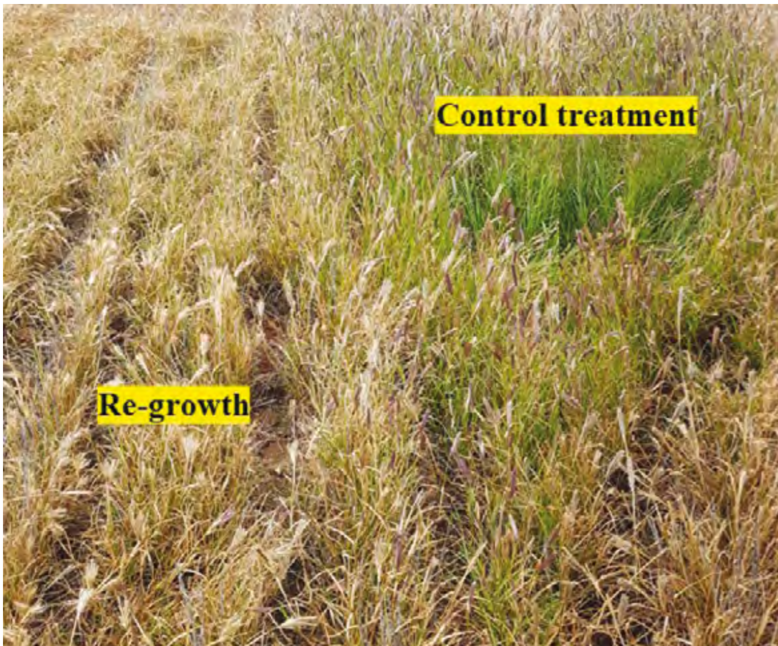
Shogun (propaquizafop) is registered for the control of feathertop Rhodes grass in fallow and in cotton, peanuts and sunflower. In fallow, Shogun must be applied to weeds at the 3-leaf to early tillering growth stage and followed with an application of paraquat within 7–14 days (double knock).

Firepower 900 (haloxyfop) has recently been registered for control of FTR in fallow. (Note: This is the only haloxyfop formulation approved for use on FTR in NSW). Weed size is

FIGURE 5: FTR persistence over time



Adapted from QDAF (2014) Integrated weed management of FTR.



Re-growth (left) with single knock of glyphosate (540g ai/L) at 1.44 L/ha (not registered for FTR). (PHOTO: Hanwen Wu)

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restricted to 2-leaf to early tillering (Z12 to Z22) and for FTR, this should always be followed by a paraquat double knock.

The APVMA has also recently approved an emergency permit that supports the use of clethodim formulations for control of FTR in fallow (PER89322 – Expires August 31, 2021, for NSW and Queensland only). This must also be followed by a paraquat double knock application within 7–14 days. While there is no weed size recommended on the permit, it should be noted that trial work has consistently shown that clethodim is generally slightly less effective than 'fops' on FTR, so limiting application to seedlings or very early tillering is strongly advised.

The importance of weed growth stage is critical for the performance of Group A herbicides (Figure 6 and 7). As weed size increases, translocation of the herbicide reduces throughout the plant. Once plants move from vegetative production to reproductive growth, production of the enzyme targeted by the Group A herbicide reduces in the plant. Further information explaining this can be found in the GRDC Fact Sheet '*Group A Herbicides in Fallow*'. *http://www.grdc.com.au/GRDC-FS-GroupAinFallow*

When applying Group A herbicides, ensure the correct adjuvant is used and application set up is optimised for coverage. Typically, this will be a medium-coarse spray quality, with water rates of 80 to 100 litres per hectare.

Avoid tank-mixing other herbicides which may reduce the performance of Group A herbicides (Figure 8).

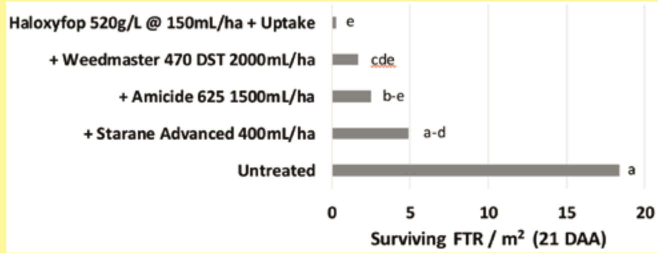
Experience in other grass weed species has shown that Group A herbicides are one of the quickest modes of action to select for resistance as there is typically a high frequency of resistant individuals in the natural population.

For this reason, all Group A applications in fallow must be:

- Followed by a double knock;
- They should only be targeted at small weeds; and,
- Should not be used more than once per season.

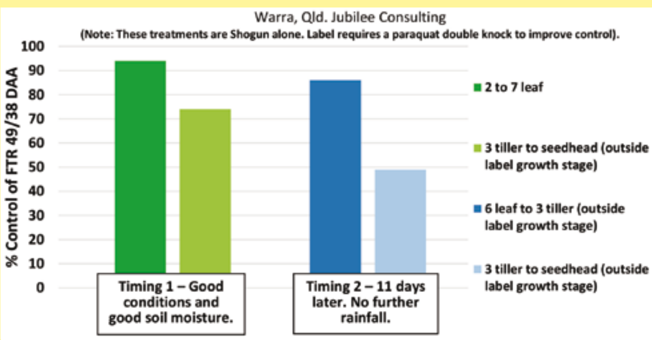
It is essential that this mode of action is protected from resistance selection. Group A herbicides are the mainstay of post-emergent grass weed control in summer broadleaf crops.

FIGURE 8: Haloxyfop tank mixes against FTR



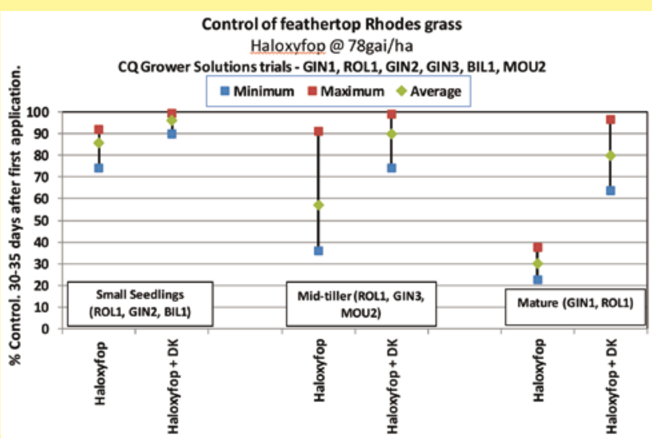
(NGA, Crooble 2014. RN1433)

FIGURE 6: Effect of weed size and timing of Shogun on FTR



(Adama, unpublished)

FIGURE 7: Effect of weed size +/- double knock of haloxyfop on FTR



(Central Queensland Grower Solutions Project 2011–15)

The third punch – tactical cultivation

Where FTR has got out of hand and established plants are present, it is likely that tillage will be needed to remove existing weeds.

It is unlikely that any herbicide treatment will provide consistent cost-effective control of mature plants. Where old, established plants remain from last summer they can frequently shade herbicide application, thus leading to unsatisfactory results from subsequent knockdown or residual herbicide applications.

Removing mature plants via cultivation can be very effective. Burial of seed below 5 cm can also reduce emergence and this seed will lose viability within about 12 months (providing it is not subsequently returned to the soil surface by further tillage).

While an effective cultivation may bury the vast majority of seed, there is always a small percentage of seed remaining at the soil surface in the preferred germination zone. If something is not done to prevent these seeds from germinating and establishing, then the cycle recommences.

A plan should be in place to manage these subsequent germinations via either tillage, knockdown or residual herbicides.

The knockout blow – residual herbicides

The most successful strategies employed by growers for managing FTR have included the use of residual herbicides. these are either directly targeted at known FTR problem paddocks, or more broadly, by keeping FTR at bay when targeting other grass weed problems on the farm. The viability of most other grass weed seeds in the soil is much longer than for FTR, so where growers are incorporating residual herbicides into their program to manage grass weeds such as awnless barnyard grass, FTR is often also controlled or suppressed.

Balance can be a particularly effective option for fallow management. In addition to residual control of FTR, it will also control flaxleaf fleabane and common sowthistle with suppression of awnless barnyard grass. But significant plantback periods apply for many summer crop options.

Dual Gold is registered for residual control of FTR prior to planting a wide range of summer crops and also in fallow situations, with minimal plantback constraints. A new use pattern also allows for a top–up application in sorghum after crop emergence.

Valor, applied at rates for residual control, is also an option

prior to planting selected summer crops. Plantback periods apply for some summer crops when using Valor, so always check the label. In addition to control of FTR, Valor can also provide residual control of a range of difficult to control broadleaf weeds such as fleabane, sowthistle, red pigweed, caltrop, bladder ketmia and the Ipomea species such as bell vine and morning glory.

Most residual 'grass' herbicides are active on FTR but the length of residual control is a function of environment at the site; the soil type and stubble; and the individual properties of the herbicides. Choose the 'grass' residual herbicide that fits the farming system within that paddock.

Screening of residual herbicides registered for use in winter cereal or pulses is showing a promising range of options that can suppress FTR emergence for periods of three to four months. These may be options to consider in areas where spring temperatures are warmer and FTR is establishing in-crop during spring.

Going the full 10 rounds – pulling it all together

Where there has been a 'blow out' and a paddock has become infested with FTR, it is likely that a management strategy will look something like the following:

- Cultivation of established plants (before seed has been shed).
- Residual herbicide applied if there is still the possibility of further germination before winter.
- Aggressive crop competition (and pre-emergent herbicides) in the winter crop.
- Decide on your strategy for summer before the first spring rainfall event, and potential weed germination:
  - If fallowing over summer, apply a residual herbicide before spring rainfall. Monitor frequently for any escapes or breakdown of the residual herbicide. Once the residual treatment has broken down, a double knock application will be required, with consideration given to including another residual application with the second knock; and,
  - Where soil moisture is adequate, consider a summer broadleaf crop (or cotton where suitable). Use a pre-emergent herbicide effective on grass weeds; keep row spacing narrow and plant population high to increase the benefit of crop competition; and utilise a selective Group A 'fop' herbicide in-crop to control any escapes.
- Do not plant sorghum or maize into paddocks with a high FTR seed bank population. Pre-emergent herbicide options such as Dual Gold are unlikely to provide full season residual control, even at the highest application rate.
- If FTR is not allowed to set seed, then seed bank viability should be low the following year. Continue vigilant management for another season to deplete the seed bank.

Unfortunately, the best management strategies for this difficult to manage weed place great reliance on herbicides – and therefore – selection of resistant individuals.

Glyphosate is ineffective and Group A herbicides are known to be of significant risk of rapid selection for resistance.

While there is currently negligible resistance to many of the pre-emergent herbicides with efficacy on this weed, one thing we have learnt from history is that if we over-rely on a particular herbicide or herbicide group and don't stop weed seed set of survivors, then we will break it.

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Key words feathertop Rhodes grass, Chloris virgata, ecology, management
GRDC code: NGA00003 and NGA00004, DAN1912-034RTX, ICN1912-002SAX ■

New fungicide resistance in WA

GROWERS are urged to be on alert following the discovery of succinate dehydrogenase (SDHI, Group 7) resistance in spot form of net blotch (SFNB) in barley crops in the Western Australian grainbelt. The fungicide resistance was uncovered in samples collected from the Cunderdin region and marks the first time SDHI resistance in barley SFNB has been confirmed in Australia.

Researchers from the Centre for Crop and Disease Management (CCDM) confirmed the presence of SDHI resistance in a sample sent to them by local agronomist Dan Taylor, after he became concerned about disease levels in a barley paddock.

CCDM researcher Wesley Mair said genetic analysis of the SFNB pathogen isolated from the initial sample also showed multiple mutations in the target of the SDHI fungicides, suggesting resistance may have been developing over a significant period of time.

"Initial testing identified the presence of SFNB resistant to SDHIs, so we followed up with a more comprehensive ground survey from areas around the Cunderdin region," Wesley said.

A total of 124 samples from five paddocks within a 10 KM radius of Cunderdin were collected, in partnership with Dan, and then analysed by CCDM researchers in the laboratory.

"While the results confirmed the presence of low frequencies of SDHI resistance in three of the surveyed paddocks, more than 40 per cent of disease lesions tested positive for reduced sensitivity."

CCDM's fungicide resistance expert Fran Lopez-Ruiz says researchers have run a monitoring program for SDHI resistance in WA since 2014, but this is the first time it has been detected in SFNB of barley.

"SFNB is a prevalent foliar fungal disease in Australian barley so being able to detect early signs of SDHI resistance is very important for the industry," Fran said.

The barley samples were from a barley-on-barley rotation with fluxapyroxad (Group 7) used over consecutive years.

Changing disease patterns

According to CCDM director, Professor Mark Gibberd, this latest discovery is indicative of changing patterns in the significance of the net blotches to barley production in the Australian grains industry.

"Net blotches are a major limitation to the yield of barley in Australia and, while closely related, there are two main types – spot form net blotch (SFNB) and net form net blotch (NFNB).

"In WA we have seen a changing pattern in the distribution of impact of the two types due to an increasing barley area, reliance on SFNB susceptible varieties and a considerable reduction in the rotation time for this crop in all rainfall areas," Mark said.

"Importantly, efforts to enable the development of new crop varieties with high levels of disease resistance to the net blotches are advancing at the CCDM.

"But, fungicide control currently remains the primary crop protection mechanism to counteract disease impacts."

The Cunderdin discovery follows the detection last year of cases of resistance to SDHIs in NFNB in Australia's southern growing region.

"We have already seen examples in South Australia of how selection pressure, due to limited crop and chemical rotation, has sped up the evolution of net blotch fungicide resistance and it appears to be the same drivers here," CCDM's Fran said.

"Good integrated disease management plans for next season should now be a priority for growers in the Cunderdin region by limiting resistance spread through stubble management and protecting their seed with a formulation that does not contain a SDHI."

GRDC senior manager crop protection, Emma Colson, said the first-time discovery of SDHI resistance in barley in WA reinforces the importance of investment in research and development in the Australian grains industry.

"It's critical that any signs of resistance are confirmed as quickly as possible so management strategies can be updated and acted upon. The more effectively we can identify the risk, the more efficiently we can help growers deal with it," Emma said.

If you suspect SDHI resistance contact the CCDM's fungicide resistance team at frg@curtin.edu.au or ccdm@curtin.edu.au ■

Symptoms of SDHI spot form of net blotch. (PHOTO: CCDM)

INTEGRATED RESISTANCE MANAGEMENT

This latest SDHI resistance discovery is a timely reminder to growers and advisers of the need to be vigilant in monitoring for disease and to implement an integrated resistance management strategy.

- Avoid growing consecutive barley crops – look for suitable alternate break crops;
- Choose fungicide mixtures with different modes of action;
- Do not use Group 7 fungicides for net blotch control in the areas where resistance to this group of fungicides has been reported. Growers and agronomists in the Cunderdin region should avoid using Group 7 fungicides and consider stubble management heading into next season;
- Group 7 fungicides (seed dressing and foliar) should not be used more than once per season in any crop rotation – alternate them instead with other fungicides with different modes of action;
- Do not apply the same Group 3 fungicides twice in a row – look at alternate sprays;
- To prevent indirect fungicide resistance selection, avoid using Group 3 fungicides as a stand-alone product in barley for any disease;
- Use fungicides as early as possible after symptoms develop if conditions are highly conducive for disease development; and,
- Do not spray below label rates.

Do I or don't I, and how much? Pondering the N equation

HOW much nitrogen fertiliser should I apply to my crops to achieve grain yield potential? Is it too late now to be applying nitrogen? These are among the burning questions being pondered by grain growers in some regions as the window for top dressing crops begins to close.

The many questions growers have around in-season nitrogen application are raised and discussed in a new GRDC podcast and nitrogen reference manual (see details in footnote) to assist growers with their fertiliser strategies.

Ag Consulting Co agronomist Bill Long, who had input into the new manual, says in the podcast that good nitrogen decision making, at this point in the season, is essentially about making sure the crop has satisfactory nitrogen to reach yield potential, which is set by soil water availability and the expected rainfall for the remainder of the season.

"A lot of growers are sitting on a fair bit of soil water and some of the seasonal forecasts are looking promising – these are two crucial factors that underpin a fairly aggressive nitrogen program," says Bill, who is also a South Australian grower.

Find out your yield potential

He suggests growers interrogate the new manual to help them understand what their yield potential might be and therefore how much nitrogen is needed to achieve that potential.

"Crops currently range in growth stage from mid tillering through to flag leaf emergence across the southern region of Australia. Growers will be asking: is it too late to apply nitrogen; how late can I put it on; how effective will it be if I don't have a decent follow-up rain; how much mineralisation might I expect to get for the remainder of the season; how much nitrogen am I already sitting on; how much nitrogen did that bean crop fix last year that I've sown this wheat crop on?" Bill says.

"There are specific questions that growers need to be thinking about in that complex nitrogen decision matrix which is dealt with in the manual."

Bill says the economics of nitrogen decision making can be challenging, especially where variability between paddocks can be significant: "When you're considering your nitrogen inputs, should you target that maximum yield or should you consider targeting a yield that is a little less risky, such as 80 per cent of yield potential," he says.

"There's a component of risk that's being considered in that decision you have to make in the next couple of weeks that reflects the fact that you may not get the favourable outcome you're looking for. And there is a risk associated with applying too much nitrogen and then having a 'haying off' event, which can be potentially detrimental to the return."

The new reference manual is a comprehensive guide to understanding, managing and estimating nitrogen requirements from paddock to paddock and season to season, and includes information about the various nitrogen decision support tools available to growers and advisers.

Bill says it is important that growers explore these tools rather than relying on someone else's rules of thumb which may not be applicable to their particular situation.

"It's important to recognise that these tools are there to use, and from there growers and advisers can develop their own knowledge and sophistication in their thinking. The manual provides useful equations to help you understand some of the vital aspects around nitrogen decision making," he says.

Top-up opportunities

North east Victoria soil scientist Cassie Schefe, of AgriSci, says in the podcast that opportunities do exist for growers to top up nitrogen in favourable circumstances.

"If there is any doubt about whether growers have enough nitrogen in the system to meet yield potential, now is basically the last chance to have a rethink of nutrition programs and to decide if it's worth putting on some more," Cassie says.

Cassie says nitrogen profiles in cropped paddocks vary according to soil types and rainfall, as well as crop rotation history (i.e. cereals following nitrogen-fixing pulses).

"Under a higher rainfall system, we're going to get more nitrogen movement through the soil, but on the flip side you're more likely to be putting more nitrogen on because you're going to get a bigger yield response. It's that interaction of rain with soil type.

"In zones with higher rainfall but a lighter soil type, I wouldn't be expecting or assuming that there's still a lot of nitrogen in the system. Whereas, in a high rainfall area with a clay soil, there's a higher expectation that the nitrogen would still be there.

"And in our low rainfall systems, we're likely to get less movement of nitrogen to depth."

Andrew Russell.

Rutherglen (Victoria) grower Andrew Russell says in the podcast that matching nutrients to potential is vital in maximising his production this year, to take advantage of forecast spring rainfall and positive commodity prices.

"It's all about making the best educated decision we can at the time," says Andrew, who is also a GRDC Southern Region Panel member.

"We'll keep going back and re-evaluating every fortnight until we get to a point where any nitrogen that we put on, after a certain growth stage, is not going to realise a return on investment.

"The other important factor is the potential for a premium for higher protein wheats – that could also be a part of that decision-making process as to whether we do some late applications of nitrogen."

A Nitrogen Reference Manual For The Southern Cropping Region* was collated by a team from the University of Adelaide, University of New England, the University of Melbourne and advisers as part of a GRDC-invested project *https://grdc.com.au/a-nitrogen-reference-manual-for-the-southern-cropping-region

The podcast is available at *https://bit.ly/2EQtoGZ,* draws insights, advice and tips from Bill Long who also contributed to development of the GRDC's new *A Nitrogen Reference Manual For The Southern Cropping Region*. ■

Remember the four Cs when checking legume nodulation

GRAIN growers are encouraged to follow four simple steps when checking the status of legume nodulation over winter and early spring – collect, clean, count and calculate.

Grain legume crops and pasture legumes initiate a symbiotic relationship with rhizobia bacteria to form nitrogen-fixing root nodules. This nitrogen fixation process has a national benefit of close to $4 billion annually in Australian cropping systems.

Researchers working on a Grains Research and Development Corporation (GRDC) investment, which aims to improve nitrogen fixation in pulses, believe growers could be missing out on the full benefits of correctly inoculated pulses.

University of Adelaide University Research Associate Maarten Ryder says the optimal time for nodulation checks is 10–12 weeks after emergence.

Maarten says successful legume nodulation indicates adequate nitrogen fixation will occur, benefiting the legume, the soil and future crops.

"If growers have gone to the trouble of inoculating legumes at seeding, it is worthwhile to find out if the inoculant has actually worked," he says.

"For those who haven't inoculated, it is also worthwhile checking nodulation to observe whether there is adequate nodulation from the rhizobia in the soil, or if inoculation is required in the future."

The four Cs of legume nodulation checks

- **Collect samples:** Plan to conduct nodulation checks at about 10–12 weeks after emergence. Collect approximately 10 plants at three sample sites from a paddock and place them in separate buckets. Dig up roots and soil carefully to at least 10 cm deep.
- **Clean samples:** Clean the root system of each plant carefully with water in a bucket and rinse a couple of times. For heavy soils, soak in water 30 minutes. Float the root systems in water in a tray, preferably white plastic, for easy observation.
- **Count the nodules:** Count the nodules on the plants (to the nearest five or 10) and also cut a few nodules open to look for a healthy red/pink colour for indications of effective nitrogen fixation. White or green nodules indicate ineffective fixation. Desirable nodule numbers vary by legume type. Look for around 50 or more nodules per plant for vetch, field pea, faba bean and lentil and 10–30 nodules per plant for chickpea. For more information on desirable nodule numbers and what to look for visit GRDC Tips and Tactics: Legume and Nitrogen Fixation at *https://grdc.com.au/tt-legume-n-fixation*.
- **Calculate the nodulation rating:** Work out the percentage of plants adequately nodulated from each sample site. Good nodulation is at least 70 per cent plants adequately nodulated across the three samples. A poor rating is when less than 50 per cent of plants have adequate nodulation for the crop type. If any particular part of the paddock is poorly nodulated, consider possible causes, such as soil type, and plan for future remedies including higher inoculation rates.

Further information on conducting nodulation checks, consult the 10 Dos and Don'ts of legume nodulation checks Paddock Practices article at *https://bit.ly/3gapl6m*.

The GRDC's Inoculating legumes: A practical guide, available at *https://grdc.com.au/GRDC-Booklet-InoculatingLegumes*, provides further comprehensive information. ■

Nodulation checks are best done around 10–12 weeks after legume emergence. "It's worthwhile finding out if the inoculant has actually worked."

New agronomy initiative

LEADING seed provider Pacific Seeds has announced a new initiative which promises to deliver new technological solutions and help farmers navigate the emerging technological revolution in agriculture.

Foundation Farm is an innovation hub for ag-tech that will provide a trial site for emerging technological and data-based solutions to increasingly complex farming challenges.

Pacific Seeds Summer Grains Agronomist Trevor Philp said that this program will not only assess new technologies but will also act as a foundation for innovative research that will significantly benefit the whole community.

"We are excited about the potential benefits this project will deliver to the current farming community, but also to many future farmers as well," said Trevor. "With new technologies and start-up businesses emerging every day, deciding on the best solutions for your farm can be a confusing and challenging decision.

"Growers and agronomists need somewhere these technologies can be tested, and their value proven.

"While this hub will be used to test and demonstrate the value of new technologies and management techniques prior to implementation on farms, Pacific Seeds also identified a real demand for every day practical solutions and the need for a centre to educate young farmers and agronomists.

"As new data-driven systems for sustainable and efficient farming emerge, the need to bring together innovative likeminded businesses, researchers and farmers has never been more apparent."

The Foundation Farm site is situated on the outskirts of the Southern Queensland town of Allora and consists of approximately 32 hectares of black clay loam soil and provides capability for both irrigated and dryland farming systems.

Pacific Seeds have established Foundation Farm on five core pillars, comprising of new technology, crop protection, crop agronomy, sustainable farming systems, and training. ■

Trevor Philp, Pacific Seeds grain agronomist.

Good practice in grain protection

WITH the promise of a big harvest in many regions this year, and the trend to more on-farm storage, Bayer considers it timely to remind growers of good stored grain protection practices. This reminder is especially relevant for those growers with unsealed silos and who rely on grain protectants for weevil control.

According to Daryle Swarz – Market Manager (Pest) at Bayer – in the past four or five years the major suppliers of grain protectants are now recommending a combination of protectants be used and that these be rotated on an annual basis to help manage the build-up of resistance to the chemistry.

"Bayer recommends that its grain protectant, K-Obiol, is used in combination with an organophosphate (OP) insecticide – either fenitrothion or chlorpyrifos-methyl," says Daryle. "K-Obiol is a Group 3A pesticide and the OPs are Group 1B."

"There are six or seven insect pests – generically known as weevils – commonly found in stored grain in Australia. We know that some weevils are resistant, or are developing resistance, to one or more of the insecticide groups. It's very difficult to predict which type of insect pest is going to occur so by using a combination of chemistries you will ensure protection from all the potential insect pests of stored grain.

"It is important to select grain protectant products from different insecticide groups so that weevils which may be resistant to one protectant will be controlled by the protectant from another group," Daryle says.

"That's why on an annual basis we also recommend using K-Obiol and its OP mixing partner in rotation with Group 5 and 7A pesticides. This reduces the risk of resistance developing and prolongs the effective life of all the grain protectants from various manufacturers. Bulk handlers use a similar strategy."

New this season to help chemical rotation

To assist growers rotate their grain protectants, Bayer has released a one litre pack of K-Obiol. "The one litre pack size treats 50 tonnes of grain," says Daryle "which is a convenient size for growers storing grain for seed or feed on-farm. We are also changing some of the requirements of our product stewardship program.

"In addition, farmers buying K-Obiol no longer have to do the online training before purchasing the product. In previous years, some growers would go to buy K-Obiol but not be able to if they hadn't done the online training. Instead, they would buy the same product they used the season before which adds to resistance pressure.

"Growers who haven't previously done the online K-Obiol training (which we still encourage), can now watch a nine minute video in the store, then read and sign an end-user declaration." ■

District Reports…

September–October 2020

National summary

Winter crop prospects in Australia are generally average to above average in early spring. Crop prospects are strongest in New South Wales where favourable winter rainfall and a strong start to the winter cropping season are expected to result in well above average production.

Crop prospects are average to above average in Victoria, South Australia, Western Australia and southern Queensland, despite warmer than average temperatures and below average rainfall in June and July.

Soil moisture levels and timely rainfall were sufficient to sustain established crops through this period. Timely August rainfall provided a boost to yield prospects in these regions.

But it is expected that August rainfall was generally insufficient for crops in central and northern cropping regions in Queensland to achieve average yields.

Outlook for spring

Favourable climatic conditions during spring are expected to support the ongoing development of winter crops and provide a good foundation for summer crops.

The Bureau of Meteorology's latest three-month climate outlook (September to November), issued at the start of September, indicates spring rainfall is likely to be above average in most cropping regions. But there are roughly equal chances of higher or lower than average spring rainfall in most cropping regions in Western Australia and below average spring rainfall is most likely in the Geraldton zone and part of the Kwinana zone.

Crop production forecasts

Winter crop production in Australia is forecast to increase by 64 per cent in 2020–21 to 47.9 million tonnes – 20 per cent above the 10-year average (40 mt) to 2019–20.

Around 60 per cent of the forecast increase in production is from New South Wales.

Area planted to winter crops this season is estimated to have increased by 23 per cent from the drought affected 2019 season.

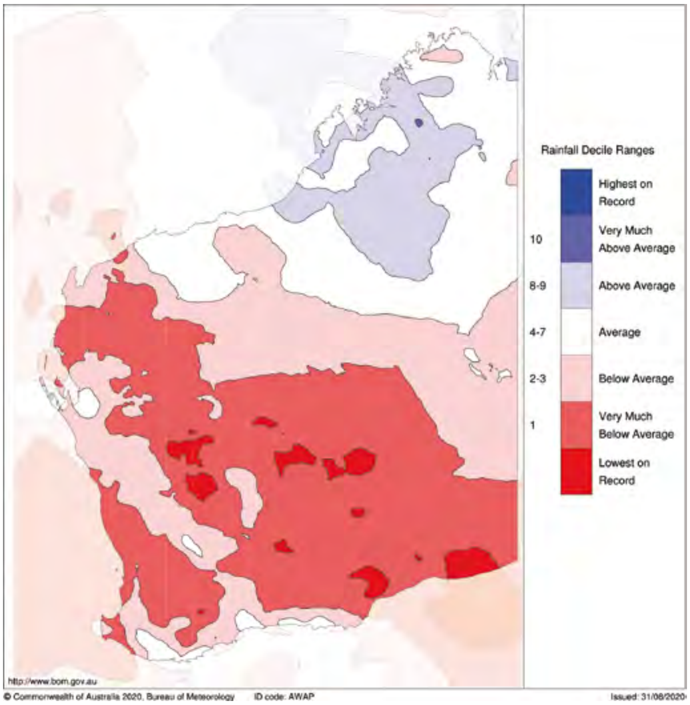
Production forecasts for the major winter crops:

- Wheat 28.9 mt, (22% above the 10-year average)
- Barley 11.2 mt (23% above average)
- Canola 3.4 mt (4% above average)
- Chickpeas 708,000 tonnes
- Oats 1.7 mt

ABARES, *Australian Crop Report* September 2020 edition

Western region

Western Australia 2020 rainfall deciles – April 1 to August 31
Australian Bureau of Meteorology



WESTERN AUSTRALIA SUMMARY

Recent unexpected early spring rainfall in Western Australia has helped with crop grain-fill, although for most regions of the WA grainbelt it will only buy another week or two until more rain is needed to avoid a sharp drop in grain yield potential.

The bulk of the grainbelt has run out of – or will soon run out of – stored moisture. With the weather warming up and crops at peak water use, more rain is urgently needed to avoid crops crashing and not achieving current grain yield potential.

The next two weeks will largely determine the final outcome for the year. Crops on heavier soils and in the lower rainfall regions are showing signs of moisture stress now, whilst the majority of the grainbelt could hang on for a week or two before grain yield potential falls away.

Total grain production for the state is estimated at around 14.5 million tonnes – a drop of 2.5 per cent on the August forecast.

If no significant rain falls in the next two weeks, the decrease in tonnage could exceed 10 per cent from current estimates.

Some areas doing very well

In contrast to the majority of the grainbelt, the western rim of the region out to the western Great Southern is in very good shape. Most of these areas are on track for average to above average grain yields. The area west of the Albany Highway is in particularly good shape and barring major frosts events in the next month, will pull in large tonnages.

The season is looking like an early finish for most of the state, with canola and barley harvesting projected to start a week or two earlier than normal in the low rainfall regions.

In an early start to the hay harvest, hay crops are being knocked down now to avoid colour loss due to moisture stress in the lower rainfall regions.

It has been a low disease and insect pressure year except for budworm in the north of the state.

It is too early to make a call on grain quality although without

some decent falls of rain in September, cereal screenings could be up around 2019 levels in regions with lower than average growing season rainfall.

Grain Industry Association of WA – *Crop Report*
September 11, 2020

SOUTH COAST

Seasonal conditions over the past two months have been favourable. The August rain enjoyed by the majority of the South Coast region has significantly improved the yield prospects. But the Northern Mallee – about 70 km from the coast – is still quite dry and with no rain in September to date, yield potential is slipping quickly.

For those closer to the coast, whilst still dry for September, the stored moisture is holding up quite well and average yields are still achievable.

Steve Pettenon and Brian Staines (FMC) with Nicky Tesoriero (Agronomy Focus) in a Planet barley crop at Gibson. The crop had been treated with the new FMC pre-emergent herbicide, Overwatch. (PHOTO: Quenten Knight)

The first Russian wheat aphids to be ever detected in WA were on a property near Gibson, in the WA South Coast region. (PHOTO: Quenten Knight)

With the August rain, there was a lot of action around nitrogen applications to ensure crops were fed adequately given the improvement in yield potential. Other than that activity growers have been busy applying fungicides, attending a range of spring field days and keeping a watchful eye on Russian wheat aphid.

In late August, this exotic pest was detected for the first time in WA in an Illabo wheat crop near Gibson (see photo).

The main wish for the remainder of the season is some timely September rainfall and mild temperatures – I suspect this is a common hope for the majority of Australia.

Quenten Knight
Agronomist, Agronomy Focus, Esperance
September 11, 2020

Southern region

SOUTH AUSTRALIA SUMMARY

The total area sown to winter crops in South Australia is estimated to have increased to 4.0 million hectares – which is significantly higher than the five-year average of 3.75 million hectares.

Seeding was completed earlier than usual in some districts and close to normal in the remainder of the state. There were very minimal delays to seeding although farmers in several areas on Eastern Eyre Peninsula delayed sowing of non-wetting sands due to insufficient soil moisture. Some of these areas had still not emerged 4 to 5 weeks after sowing.

The area sown to barley has been reduced by 5 to 10 per cent in many districts although the increase in Chinese tariffs and reduction in barley prices was too late to enable many farmers to make significant changes.

Most of the reduced barley area was sown to either wheat, canola, or pulse crops.

Early sown crops emerged rapidly with good crop establishment. Growth of later sown crops was much slower, due to cold conditions in late May and June.

Crop growth slowed in early June following numerous frosts in most districts but following rain in mid to late June, crops recovered.

Weed and pest control

Most farmers achieved good early control of weeds with a combination of knockdown and pre-emergent herbicides.

A wide range of insect pests damaged emerging crops in many districts, including red-legged earth mite, lucerne flea, pasture web worm, cut worms and snails. In general, these were effectively controlled using insecticides resulting in minimal crop damage.

Russian wheat aphid numbers increased to damaging levels in some districts, particularly where grasses were not controlled over summer or where the seed was not treated with an insecticide.

On the back of moderate to high levels of stored soil moisture, many farmers have applied additional nitrogen fertiliser to growing crops.

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District Reports…

September–October 2020

Early in the season, disease levels were generally low in most crops. Some farmers applied preventative fungicides with post-emergent herbicides to ensure disease levels remained low.

From PIRSA *Crop and Pasture Report South Australia* 2020–21 Seeding and Crop Establishment July 9, 2020

Hay-making under way in the southern Mallee. (PHOTO: Rob Pickles)

VICTORIA SUMMARY

Below average rainfall during winter is not expected to have substantially reduced crop prospects in Victoria. Above average levels of lower layer soil moisture present at the beginning of winter are expected to have sustained crops. In addition, timely August rainfall in western districts was sufficient to support crops in average to above average condition at the beginning of spring.

Spring rainfall is likely to be above average in most cropping regions in Victoria, according to the latest three-month rainfall outlook (September to November) issued by BOM.

Winter crop production in Victoria is forecast to increase by 6 per cent in 2020–21 to around 7.9 million tonnes. This mostly reflects an expected increase in yields, driven by favourable seasonal conditions in autumn and the favourable spring outlook.

The forecast increase in production also reflects an estimated 8 per cent increase in planted area to 3.4 million hectares as a result of favourable seasonal conditions in autumn, particularly in marginal cropping regions.

Significant area of wheat and barley crops is not expected to be cut for hay and fodder because of the favourable seasonal conditions expected during spring as well as low hay prices.

2019–20 winter crop production forecasts

- Wheat 4.1 mt (14% increase on last season).
- Barley 2.3 mt (6% decrease on last season).
- Canola 765,000 tonnes (18% increase on last season).

ABARES, *Australian Crop Report* September 2020 edition

VICTORIAN WIMMERA & MALLEE

After a very dry winter, growers were relieved to receive decent rainfall over August. The Southern and Northern Mallee is sitting at around a decile 5 growing season rainfall. The Bureau of Meteorology's ENSO outlook remains at La Nina alert so many growers are hopeful for more rain soon as some areas in the Mallee are starting to look for rain with soil moisture levels low and warm and windy weather forecast.

Growers are continuing to monitor weeds, pests and disease in crops. With timely rain during sowing, many pre-emergent herbicides have successfully controlled weeds this season so there hasn't been as much pressure for in-season spraying until the recent germination event following the August rainfall.

Pests are active in crops but not all necessarily warranting control with many beneficial insects also being observed. Growers are monitoring for armyworm, red legged earth mites and moth flights. Some mouse activity is causing damage in crops across the southern Mallee with reports of mice targeting canola.

There are reports of some disease present across the Wimmera and Mallee with stripe rust being observed in wheat and some ascochyta blight being seen in pulses. Decisions around control will be dependent on the crops end purpose and rain forecasts over the coming weeks.

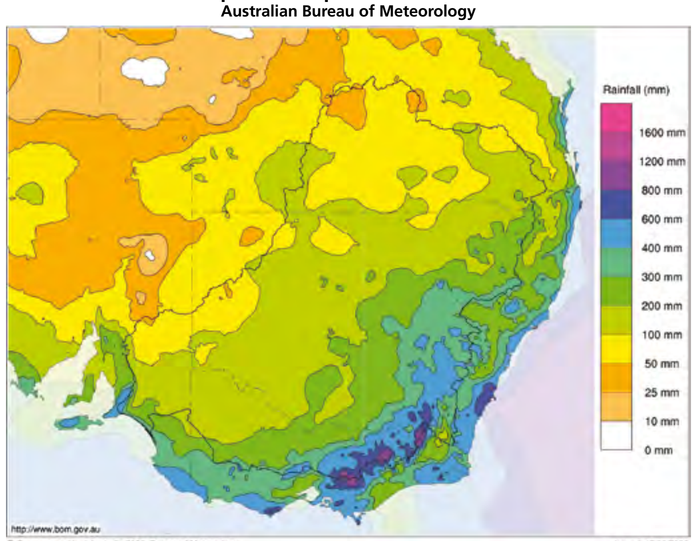
Vetch hay is being cut across the northern and some parts of the southern Mallee with oats not far off either.

Shearing is keeping mixed growers busy with decisions needing to be made around what to do with the clip as wool prices are at their lowest since 2002.

Growers are starting to turn their attention to preparing for harvest with the usual jobs underway including organising grain storage, ensuring harvest equipment is ready to go and hiring labour. All these decisions are being made with increased uncertainty due to Covid-19 and its impacts on border crossings and the changes to working conditions that need to be made to ensure that harvest is carried out in a Covid-safe manner.

**Brooke Bennett
Research and Extension Officer, Birchip Cropping Group
September 11, 2020**

Murray–Darling Basin rainfall totals (mm) – April 1 to September 17, 2020
Australian Bureau of Meteorology



Northern region

NSW SUMMARY

Growing conditions in NSW have been excellent this season with above to very much above average rainfall from March to August in nearly all winter cropping regions. Area planted to winter crops in central and northern cropping regions in New

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South Wales is well above average reflecting timely rainfall leading into the planting window. With above average levels of soil moisture at the end of winter – particularly in central and northern cropping regions – favourable spring rainfall will likely result in significantly above average winter crop yields.

According to the latest three-month rainfall outlook (September to November), issued by the Bureau of Meteorology in early September 2020, spring rainfall is very likely to be above average in all cropping regions in the state.

Winter crop production is forecast to rise to 14.8 million tonnes in 2020–21, which is almost 50 per cent above the 10-year average to 2019–20.

Winter crop area in NSW is estimated to be just over 6 million hectares or 14 per cent above the 10-year average to 2019–20. This is almost double the winter crop area planted last season.

2019–20 NSW winter crop production forecasts

- Wheat 10.3 mt (58% above the 10-year average to 2019–20).
- Barley 2.5 mt (52% above the average).
- Canola 869,000 tonnes (2% below the average).

ABARES, *Australian Crop Report* September 2020 edition

QUEENSLAND SUMMARY

Winter crop production prospects in Queensland are mixed at the beginning of spring because of variable seasonal conditions over winter. Rainfall in southern Queensland in June and July was average to below average but timely rainfall in early and mid-August generally boosted crop prospects in this region.

But August rainfall in central and northern cropping regions in Queensland was average and insufficient to boost crop prospects in these regions.

The latest three-monthly climate outlook (September to November) released by the Bureau of Meteorology, in early September 2020, indicates that rainfall in most Queensland cropping regions is likely to be above average.

The rainfall forecast for spring in Queensland cropping regions, if realised, will sustain average yield prospects in southern cropping regions in Queensland but is expected to arrive too late and be largely insufficient to improve yield prospects in central and northern cropping regions.

Winter crop production in Queensland is forecast to be around 1.7 million tonnes, which is 4 per cent below the 10-year average to 2019–20. Forecast production is 147 per cent higher than drought affected production in 2019 –20, driven by an estimated 75 per cent increase in planted area and an expected 41 per cent improvement in state wide average yields.

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)	2020 rainfall to date (mm)	Summer		Autumn		Winter		Spring	
			25yr Annual Average (mm)	2019–20	25yr Annual Average (mm)	2020	25yr Annual Average (mm)	2020	25yr Annual Average (mm)	2020 to date
Emerald Qld	560	390	256	287	105	69	67	42	123	0
Toowoomba Qld	678	425	271	304	143	53	87	92	179	1
Roma Qld	567	481	245	385	118	49	74	52	131	4
Goondiwindi Qld	609	436	242	256	124	117	98	93	145	4
Narrabri NSW	617	498	213	272	121	152	122	63	161	17
Gunnedah NSW	622	485	206	220	110	150	125	104	182	13
Dubbo NSW	583	570	183	120	125	280	127	154	150	18
West Wyalong NSW	433	512	114	112	79	239	121	165	120	1
Wagga Wagga NSW	524	399	130	39	110	201	146	155	141	12
Swan Hill Vic	307	209	68	44	65	109	87	57	88	5
Bendigo Vic	491	432	96	74	107	233	159	119	129	10
Horsham Vic	365	282	73	67	72	110	121	88	98	22
Lake Bolac Vic	507	430	105	102	107	140	155	148	141	48
Murray Bridge SA	356	256	64	38	81	108	120	84	93	9
Kadina SA	328	149	59	41	79	40	108	77	82	4
Cummins SA	394	286	50	43	92	100	176	142	76	9
Esperance WA	620	375	91	36	137	31	253	309	138	3
Wagin WA	392	248	50	49	89	60	168	105	85	35
Northam WA	407	225	51	44	84	55	192	116	80	12
Mingenew WA	347	336	32	87	84	46	174	188	57	15
Moora WA	385	235	46	46	79	41	191	134	69	15
Mullewa WA	310	274	48	66	89	49	130	155	43	8

Last rainfall reading September 14, 2020.

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District Reports…

September–October 2020

2019–20 Qld winter crop production forecasts

- Wheat 1.1 million tonnes (4% below the 10-year average).
- Barley 270,000 tonnes (27% above average).
- Chickpea 275,000 tonnes (21% below average).

ABARES, *Australian Crop Report*
September 2020 edition

DARLING DOWNS

Good rainfall across most of the Downs in mid-August has really set up the winter crops, and given hope for the summer by improving the stored soil moisture. This past winter did not have too much cold weather, but a series of consecutive frosts in late August caused some head damage to early planted cereals, and burnt the leaves of some chickpeas.

Winter crops 2020

Cereals are now in the flag leaf to late grain fill stages and looking very handy. The earliest barley crops west of Dalby have started to be harvested with good yields and quality, but most crops will not be ready until into October. Growing conditions have been good, but there has been some disease in the barley, predominantly powdery mildew, which has been successfully controlled.

Chickpeas are moving into the podding stage, and we are seeing moderate to high numbers of helicoverpa larvae in the late flowering stages. But to this stage there have been no outbreaks of ascochyta or botrytis grey mould.

The main issue for winter crops at present is mouse damage. Numbers have been increasing over the past month with damage occurring to the cereal crop's stems with the pests then moving up to attack the grain as it fills. This has prompted some widespread treatment applied by ground and air. The mice were controlled earlier in the season but chickpeas are again at risk during the podding period.

Summer crops 2020–21

There has been a significant early planting of corn by irrigators for both the silage and the gritting markets, and some dryland early sown sorghum. Conditions are still cool but despite taking up to 20 days to emerge, these crops have established successfully. The traditional planting time for sorghum is October so the August/September planting is much earlier than normal.

Cotton is expected to be planted from mid-September onwards with most going in during October. The irrigation area will return to its usual average this summer, but the dryland area is well back on normal.

The main early summer crop to be grown will be sorghum, which has improved in price over the last few weeks. The positive *La Nina* type outlook for this summer will encourage farmers to look at double cropping options from the winter crops. We also expect a large area of mungbeans to go in during December/January, along with some sunflowers.

At this stage growers are just glad that there are some planting opportunities in the pipeline.

Hugh Reardon-Smith
Senior Sales Agronomist – Nutrien Ag Solutions, Pittsworth
September 11, 2020

"Everyone is just enjoying being in green, good looking crops," said Hugh as he checked on this flowering and podding chickpea crop south of Pittsworth on the eastern Darling Downs in early October.

By early October on the eastern Darling Downs, barley was in head and looking pretty good. The headers were already rolling into cereal crops to the west of Dalby with reports of good yields and quality.

ANSWER TO IAN'S MYSTERY TRACTOR QUIZ

A Hungarian 1950 HSC G35 single cylinder, two stroke Steel Horse, awaiting restoration in the IMJ collection. (Photo IMJ)

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