2020

HART FIELD DAY GUIDE

HART FIELD DAY 2020

WE'RE DOING IT A ~~LITTLE~~ lot DIFFERENTLY...

The health & safety of everyone in attendance at the Hart Field Day is our top priority and let's be honest, a global pandemic and large crowds from diverse areas don't really go hand in hand.

Despite our previous optimism, the management of COVID-19 risks and ever-changing restrictions forced the Hart board to announce that the 2020 Hart Field Day would not be held. (We were devastated.)

BUT… thanks to the wonders of technology, we can share our research with you in other ways. Our alternative Hart Field Day package includes mini events, small group or self-guided tours (with supporting site & trial information easily accessible), this publication, plus online video and audio presentations for those who can't get to Hart.

Check out our website for new resources as they become available: www.hartfieldsite.org.au

DISCLAIMER

While all due care has been taken in compiling the information within this manual the Hart Field-Site Group Inc and researchers involved take no liability resulting from the interpretation or use of this information. We do not endorse or recommend the products of any manufacturers referred to. Other products may perform as well or better than those specifically referred to. Any research with unregistered pesticides or unregistered products and rates in the manual does not constitute a recommendation for that particular use by the researchers or the Hart Field-Site Group Inc.

WELCOME TO HART

2020 HART FIELD DAY GUIDE

OUR VALUES

INDEPENDENCE | RELEVANCE | INTEGRITY
CREDIBILITY | PROFESSIONALISM |
VALUE FOR MONEY | GENEROSITY |

OUR PURPOSE

To deliver value to growers and make agriculture better (in productivity, sustainability and community)

OUR VISION

To be Australia's premier cropping field site, providing independent information and enhancing the skills of the agricultural community

PHOTO AND DESIGN ACKNOWLEDGMENTS
Front cover photo - Sandy Kimber
Design and layout - Alli Elliott, *by the way designs*
Other photos - Sandy Kimber and Gabrielle Jones

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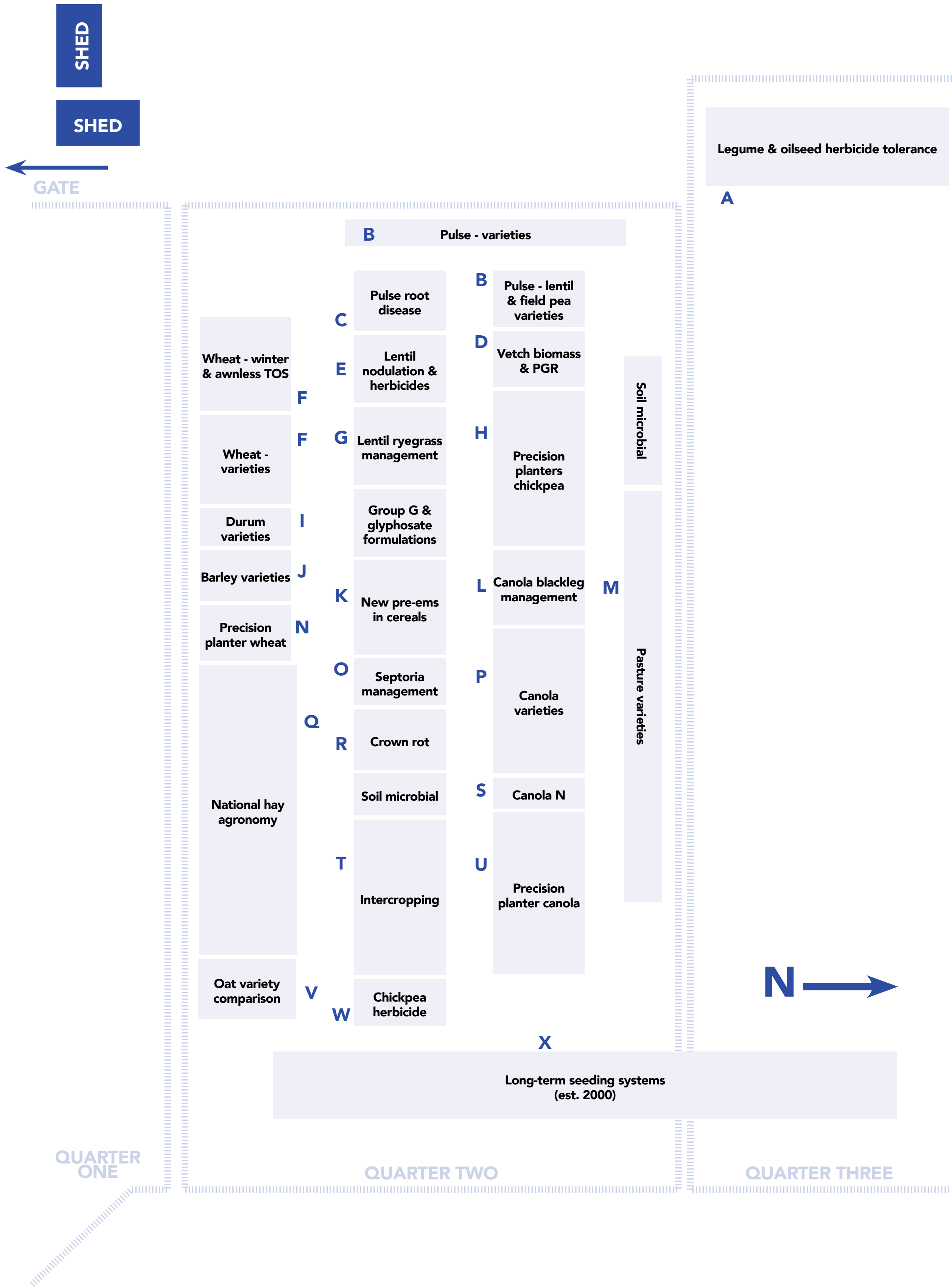
A NOTES PAGE HAS BEEN INCLUDED ON PAGE 94 FOR YOUR USE

SITE MAP



SHED
SHED
GATE
Legume & oilseed herbicide tolerance
A
B Pulse - varieties
Pulse root disease
C
B
Pulse - lentil & field pea varieties
D
Vetch biomass & PGR
Wheat - winter & awnless TOS
E
Lentil nodulation & herbicides
F
Soil microbial
F
Wheat - varieties
G
Lentil ryegrass management
H
Precision planters chickpea
Durum varieties
I
Group G & glyphosate formulations
Barley varieties
J
K
New pre-ems in cereals
L
Canola blackleg management
M
Precision planter wheat
N
O
Septoria management
P
Canola varieties
Pasture varieties
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Crown rot
National hay agronomy
Soil microbial
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Long-term seeding systems (est. 2000)
QUARTER ONE
QUARTER TWO
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CHAIRMAN'S WELCOME

This is where I would usually write 'welcome to the 38th annual Hart Field Day', but with a global pandemic (COVID-19) and government restrictions on large group gatherings, it's not to be.

This was a difficult decision for our board to make as we know farmers and industry really value the opportunity to be on site and hear from the experts face-to-face. We are aware this is the best environment to learn and share so you can be assured it was not made without considerable debate and review of our options.

It also has a flow on effect to our local suppliers and community groups that provide huge support in the running of this event, but we're very much looking forward to working with them all again in 2021.

Having said that, we are confident we have found a range of alternative ways to share our trial site and research with you.

This publication, the annual Hart Field Day Guide, will still provide you with written information to support each trial featured, as well as a site map and trial layouts.

In addition, we're conducting two mini events; 'Managing Weeds' on September 15, and 'Managing Varieties' on October 20. While limited in the number of growers that can attend, we'll have a film crew on- site so presentations can be shared online for all those that can't be there in person. We'll also be sharing some additional presentations via podcast.

The Hart site will be open (by appointment only) for small group and individual visitors. Our trial layouts will still be signed and will feature a QR code – simply scan it and information specific to that trial will pop straight up on your device. We'll have hard copies available as well. Please make sure you book before visiting.

After a very dry July, but excellent rainfall in August (please refer to 'The 2020 Season at Hart' on page 16 for more details), the Hart site is looking fantastic. Rainfall isn't the only influencing factor though; it also takes an incredible amount of planning and work to present the large number of trials we have on-site to a high standard and I'd like to especially thank our research staff; Rebekah Allen, Brianna Guidera and Sarah Noack, and Patrick Thomas and the team from SARDI Clare, for their efforts in a particularly difficult year.

I'd like to say thank you to all our researchers and presenters who have happily shared their knowledge, experience and time by providing a detailed report. A number of them are also presenting at either our mini events or via virtual delivery – their contribution provides you with the professional and independent analysis you've come to expect.

Harts' sponsors continue to amaze us with their commitment to supporting our group. Even in these particularly difficult times they have remained loyal and continue to back us despite the Hart Field Day not going ahead this year. Partnerships between growers and industry are vital to the ongoing profitability and sustainability of farming enterprises and their financial contribution also

allows us to offer our resources and Hart events at no or very low cost to growers. They're all very approachable and keen to support you, so please make sure you give them the opportunity to help sustain and grow your business too.

I'd also like to thank Hart's funding partners and collaborators. Working with such well respected partners allows us to provide you with access to a wider range of high quality research that would not otherwise be possible and we look forward to continuing those relationships.

As many of you will know, our Research & Extension Manager, Sarah Noack, took maternity leave at the end of February before she and husband Kym welcomed baby Ella to their family at the end of March. I'd like to thank Sarah for her meticulous preparation in making sure the transition for our new R&E Manager, Rebekah Allen, was as seamless as possible. Bek was the perfect candidate and came to us after working with Kalyx in the South East. She quickly gained an understanding of the on and off-site field trials and our relationships with collaborating researchers, growers and other partners which is no mean feat. Bek remains with us full time, while Sarah has returned in a part-time capacity and we're looking forward to working with both into the future.

We continue to offer our Regional Internship in Applied Grains Research to an outstanding Ag Science graduate; our fifth intern, Brianna Guidera, also joined us in February and has proved herself to be more than capable of meeting the demands of the role. While Bri is involved in all trial work at Hart, her two focus projects, Soil and Plant Testing and National Hay Agronomy, provide her with the chance to work more independently and she's certainly grabbed that opportunity with both hands. We'd like to thank SAGIT & SARDI for their ongoing commitment to supporting this program.

Both Bek and Bri have fit in to the Hart team exceptionally well and we're really pleased to have them on our team. I'd also like to acknowledge their resilience - imagine moving to a new town, starting a new job, then heading into lockdown!

Our board remains stable, with only one change following our AGM in April. Justin Wundke retired after seventeen years with the group. He has volunteered an enormous number of hours over that time, including as a past chairman and member of our sponsorship committee. We would usually make a special presentation at the Field Day for someone who has provided this level of contribution and service, but obviously that can't happen this year. So on behalf of our membership and past and present board members, thank you for your absolute dedication to Hart, Justin.

Our newest board member, Glen Wilkinson, is no stranger to Hart and was elected at our AGM in April. He farms at Snowtown and provides a valuable new perspective as we continue to plan for both the short and longer term. We're really pleased to have him on the board and thank him for nominating.

I'd like to close out the list of thanks (last but definitely not least) by acknowledging the dedication and professionalism of the Hart board. This year has presented its fair share of challenges and they have willingly committed the extra time required. I am proud to be a part of this group look forward to a (hopefully) smoother road next year!

As always, we welcome your feedback so please get in touch if there's anything you'd like to suggest.

And finally, thank you all for your continued support of Hart. Your membership is usually renewed when you register at the Field Day, but despite that not going ahead this year, we encourage you to maintain it (or re-join) so please watch out for that invitation very soon.

Have a great harvest!

Ryan Wood
Chairman
Hart Field-Site Group
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ABOUT US

HART FIELD-SITE GROUP BOARD

Ryan Wood (Clare)	Chairman
Damien Sommerville (Spalding)	Vice Chairman, Sponsorship
Sandy Kimber (Clare)	Executive officer
Deb Purvis (Farrell Flat)	Finance officer
Matt Dare (Marola)	Commercial crop, Sponsorship
Leigh Fuller (Koolunga)	Community engagement, Sponsorship
Andre Sabeeney (Clare)	Board member
Peter Baker (Clare)	Board member
Simon Honner (Blyth)	Board member
Alex Thomas (Torrens Park)	Board member
Rob Dall (Kybunga)	Board member
Glen Wilkinson (Snowtown)	Sponsorship

Sarah Noack	Research & extension manager
Rebekah Allen	Research & extension manager
Brianna Guidera	Regional intern
Gabrielle Hall	Media

SITE MANAGEMENT

SARDI, Agronomy Clare	Patrick Thomas, John Nairn, Phil Rundle, Sarah Day, Dili Mao, Richie Mould, Navneet Aggarwal, Penny Roberts, Dylan Bruce, Greg Walkley, Amber Spronk & Trevor Lock
Hart Field-Site Group	Rebekah Allen, Sarah Noack & Brianna Guidera

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Sarah Noack	0420 218 420
Research & Extension Manager	rebekah@hartfieldsite.org.au
Rebekah Allen	0428 782 470
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Office	155 Main North Road - CLARE SA 5453
Postal	PO BOX 939 - CLARE SA 5453

COMMUNICATIONS

Website	http://www.hartfieldsite.org.au/
Hart Beat Newsletter	
Trial Results	
Live Weather	
Grower Resources	
Events and more...	
Facebook and Twitter	@HartFieldDay
YouTube	Hart Field-Site Group

COMMERCIAL SPONSORS

RESEARCH SUPPORTERS

We also receive project funding support provided by the Australian Government

COLLABORATORS

ACKNOWLEDGMENTS

SUPPORTERS

We thank the numerous growers and consultants who provide various contributions, from knowledge and experience through to land and equipment for conducting trials.

Peter Baker	Peter Hooper	Damien & Ben Sommerville
Shawn Cadzow	Michael Jaeschke	Kelvin Tiller
Chris Clarke	Brendan Johns	Sam Trengove
Andrew Cootes	Jim Maitland	Tom & Ashley Robinson
Robert & Dennis Dall	Mid North High Rainfall Zone Group	Robert & Glenn Wandel
Matt Dare	Daniel Neil	Andre Sabeeney
Mick Faulkner	Reuben & Gareth Ottens	Anthony Williams
Leigh Fuller	Anthony Pfitzner	Justin, Bradley & Dennis Wundke
Wayne Heading	Stefan Schmitt	
Simon Honner	Stuart Sherriff	

We would also like to thank various organisations for the provision of seed and/or products that were trialled in the 2020 research program.

ADAMA	Durum Breeding Australia	Nutrien
Advanta Seeds	FMC	Pioneer Seeds
Australian Grain Export	Global Grain Genetics	Pulse Breeding Australia
Australian Grain Technologies	Imtrade	S & W Seeds
Barenbrug	Incitec Pivot	SARDI, Vetch Breeding Program
BASF	InterGrain	Seednet
Bayer Crop Science	Longreach Plant Breeders	Seed Force
Clare Metal Fabrication	Marcroft Grains Pathology	Sumitomo
Corteva Agriscience	Nufarm	Syngenta
Crop Care	Nuseed	UPL

RESEARCH SUPPORTERS

Grains Research & Development (GRDC)	South Australian Grains Industry Trust (SAGIT)
Australian Government	Department of Agriculture & Water Resources
Soil CRC	Natural Resources Northern & Yorke
AgriFutures Australia	Primary Industries and Regions South Australia (PIRSA)

UPCOMING EVENTS

2021 EVENTS

Getting The Crop In seminar

Wednesday March 10, 2021
(tbc) - Clare, SA

Industry guest speakers from across the country cover a wide range of topics, all relevant to broad-acre cropping. We always treat you to breakfast first!

Winter Walk

Tuesday July 20, 2021
9am - Hart, SA

An informal guided walk around the trial site; your first opportunity to inspect the site post seeding, with guest speakers presenting their observations on current trials. They are on hand to answer your questions and will also share their knowledge on all the latest cropping systems and agronomic updates.

Hart Field Day

Tuesday September 21, 2021
9am - 3:30pm - Hart, SA

Our main Field Day attracts hundreds of visitors from all over the Mid-North, South Australia and interstate. With a rolling program of half-hour sessions conducted simultaneously throughout the day, highly regarded specialists speak at each trial, backed up by a comprehensive take-home Field Day Guide included in your entry fee.

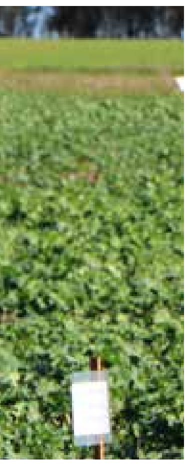
Tailor your own program for the day to hear about the trials that interest you. Plenty of parking; buses and group bookings welcome.

Spring Twilight Walk

Tuesday October 19, 2021
5pm - Hart, SA

Another informal opportunity to inspect the trial site, this time just prior to harvest, again with industry researchers and representatives presenting in the field.

This event is followed by drinks and a BBQ in the shed - a great opportunity to chat more about how your season is unfolding and to catch up with other farmers in our district and beyond.



HART FACILITIES

The Hart field site, located between Blyth and Brinkworth in South Australia's Mid-North has been the home of substantial trials research since the land was purchased by the Hart Field-Site Group in 2000.

Known as SA's premier field cropping trials site, the 40 hectares of land featuring sandy clay loam soils and an average annual rainfall of 400 mm is the home of the annual Hart Field Day (est. 1982), now in its 38th year.

Infrastructure developments include two sheds; a new field lab (2018) used to process and analyse research samples onsite, and an events shed used as a learning facility for high school and university students visiting the site. It is also utilised by specialist speakers presenting at the Hart Field Day and also by the Hart Board as they host workshops, lectures, crop walks and BBQ's. Both sheds are powered by solar with battery storage.

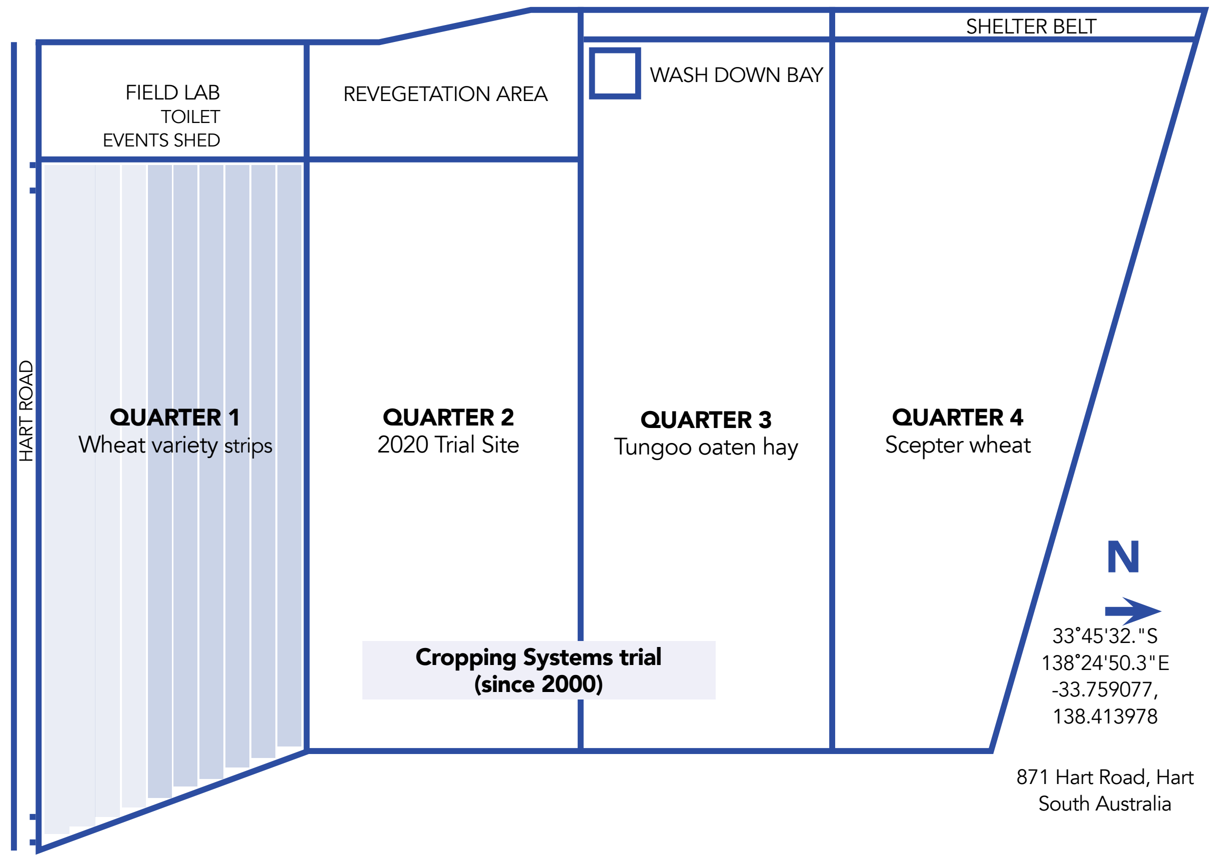
The site also features a separate toilet, a permanent wash down bay allowing contractors and trial collaborators to manage chemical and seed contamination and mobile power via a portable generator.

A fully fenced re-vegetation area featuring a 20 x 25 m native grasses demonstration site is maintained in an area to the north of the sheds.

Signage on both the Blyth to Brinkworth Road and within the Hart site provides significant exposure to visitors for Hart's valuable sponsors.

Yield Prophet® signs at the site are updated throughout the growing season giving growers in the area a guide to yield potential.

If you would like to hire the shed please contact us on 0427 423 154 or email admin@hartfieldsite.org.au



The Hart field site is managed as four quarters and rotated each year. In 2020, Quarter 2 hosts our trials, Quarter 3 has been sown to Tungoo oats and will be cut for hay to tidy the site in preparation for next years' trials, and Quarters 1 & 4 are sown to wheat for our commercial crop.

COMMERCIAL CROP REPORT

This season's commercial crop was sown to Scepter wheat in Quarters 1 & 4 on May 29. In addition to Scepter and a strip of Vixen several other wheat variety strips were sown in Quarter 1 on the April 27 (see the trial plan below). They are not a replicated trial but were sown as a broad acre demonstration of a range of newer and current longer season wheat varieties better suited to earlier (April) sowing in terms of maturity and flowering time. Early sown variety strips established well in adequate available soil moisture. The later sown Scepter did experience some moisture stress prior to August rain. Russian wheat aphid has been present in the commercial crop and a selective insecticide was applied recently with the broadleaf herbicide.

Thanks to seed company reps Josh Reichstein (Inter Grain), Dan Vater (AGT) and Col Edmondson (Pac-Seeds) for organising seed for the variety strips in Quarter 1.

Quarter 3 of the site and the car park (8ha) was sown to Tungoo oats for hay on the May 29 in preparation for the 2021 trial site. Seed was kindly donated by local grower Jim Maitland. Also thanks to Rob Wandel for rolling the hay.

Nitrogen was applied to Quarter 1 as 100 kg/ha urea on Jult 10 and was applied to Quarter 4 at 70 kg/ha on August 10. Thanks to Jim Maitland for spreading Quarter 1.

It's been great to see the whole site respond to the August rain, and I look forward with some optimism to a kinder finish to the season than the last couple of years.

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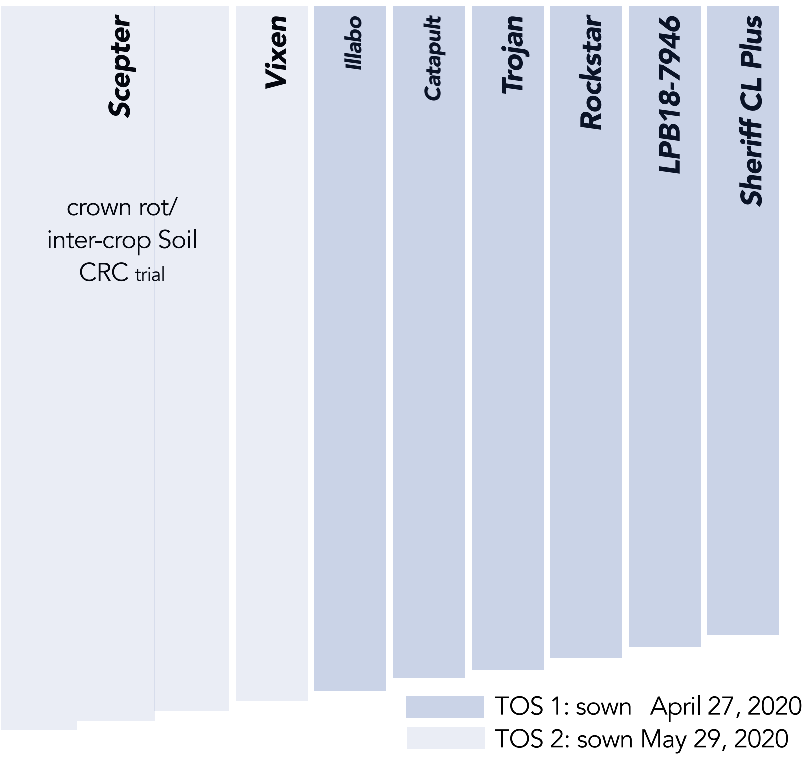
Quarter 1 layout



Quarter 1 - 8ha Commercial wheat crop - wheat variety strips x 2 TOS		
	TOS1	**TOS2**
Spray:	April 27, 2020 1.5 L/ha Glyphosate 520 g/L + 100 ml/ha Striker + 210 ml/ha SakuraFlow + 1% AmmSulfate v/v +0.25% LI700 v/v @ 100 L/ha	May 27, 2020 2 L/ha Glyphosate 520 g/L + 100 ml/ha Striker + 160 ml/ha Dicamba750 + 3 L/ha Prosulfocarb + 2% AmmSulfate v/v +0.4% LI700 v/v @ 100 L/ha
Seeding date:	April 27, 2020	May 29, 2020
Crop & Variety:	wheat variety strips *(see opposite page)	
Seeding rate:	75 kg/ha	100 kg/ha
Fertiliser:	75 kg/ha DAP	
Post Em Spray: June 26, 2020	Spray ~ 5 ha early sown wheat varieties in Q1. 25 g Paradigm + 470 ml MCPA LVE 570 g/L + 75 ml Dicamba 750 g/L + 0.5% Uptake Oil @ 85 L/ha	
Post Em Nitrogen spread: July 10, 2020	100 kg/ha Urea spread on Q1 (7.43ha) by Jim Maitland	
Post Em Spray: August 26, 2020	Spray ~ 3 ha late sown wheat varieties in Q1. 25 g Paradigm + 500 ml MCPA LVE 570 g/L + 200 g Pirimicarb + 500 ml Epoxiconazole + 0.5% Uptake Oil @ 85 L/Ha	
	Spray ~5 ha early sown wheat varieties in Q1. 200 g Pirimicarb + 500 ml Epoxiconazole	

Quarter 2 - 8 ha 2020 trial site

Quarter 3 - 8 ha Oaten hay (2021 trial site & carpark)

Spray: May 27, 2020
2.0 L/ha Glyphosate 520 g/L + 100 ml/ha Striker + 2% AmmSulfate v/v + 0.4% LI700 v/v @100 L/ha

Seeding date: May 29, 2020 **Crop & Variety:** Tungoo oats (donated by Jim Maitland)

Seeding rate: 100 kg/ha **Fertiliser:** 50 kg/ha DAP

Quarter 4 - (incl. east of Crop systems trial) 10 ha Scepter wheat

Spray: May 27, 2020 - 2 L/ha Glyphosate 520 g/L + 100 ml/ha Striker + 160 ml/ha Dicamba 750 + 3L/ha Prosulfocarb + 2% AmmSulfate v/v +0.4% LI700 v/v @ 100 L/ha

Seeding date: May 29, 2020 **Crop & Variety:** Scepter wheat **Seeding rate:** 100 kg/ha

Fertiliser: 70 kg/ha DAP **Post Em Nitrogen spread:** August 10, 2020
70 kg/ha Urea spread

Post Em Spray: August 26, 2020 25 g Paradigm + 500 ml MCPA LVE 570 g/L + 200 g Pirimicarb + 500 ml Epoxiconazole + 0.5% Uptake Oil @ 85 L/ha

THE 2020 SEASON AT HART

PREPARED AUGUST 28, 2020

The Mid-North had a promising start to the season receiving above average summer rainfall. This meant there was stored soil moisture available leading into the growing season (Figure 2).

Seeding at Hart commenced on the April 20, utilising an optimal sowing window for early sown wheats. Majority of Hart's trial program was sown early to mid May, with the final plots sown May 29.

The site received above average rainfall during April, with 60 mm. Although there was an optimistic start to the seeding program, well below average rainfall of 19 mm was received for May (Figure 1) affecting early crop establishment in some trials.

Rainfall received on site for both June and July was well under average, with a combined total of 38.4 mm.

For August to date, we have received 67.5 mm rainfall, relieving crops from both moisture and nitrogen stress (Figure 3).

Currently, Hart has received 281 mm annual rainfall (average 400 mm) and 183 mm of growing season rainfall (GSR average 300 mm). This is significantly higher compared to this time in 2019, with 154 mm annual rainfall and 144 mm of growing season rainfall. Current plant available water is 77 mm, up from 40 mm in August last year.

Yield prophet® is currently predicting above average yields of 3.7 t/ha for Scepter wheat sown on May 1. The traditional French & Schultz model is estimating similarly at 3.5 t/ha. For the remaining growing season, spring rainfall will continue to play an important role in determining crop yield potential for 2020.

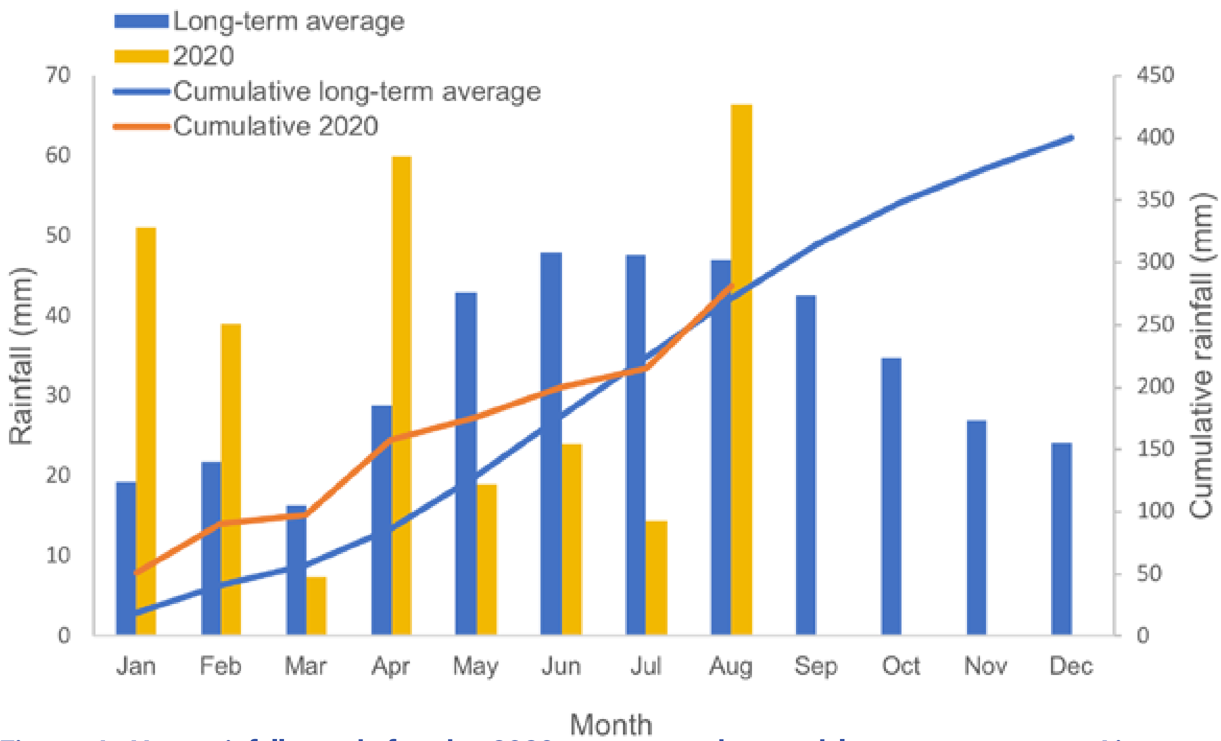


Figure 1. Hart rainfall graph for the 2020 season to date and long-term average. Lines are displayed to present cumulative rainfall for long-term average (blue) and 2020 (orange).

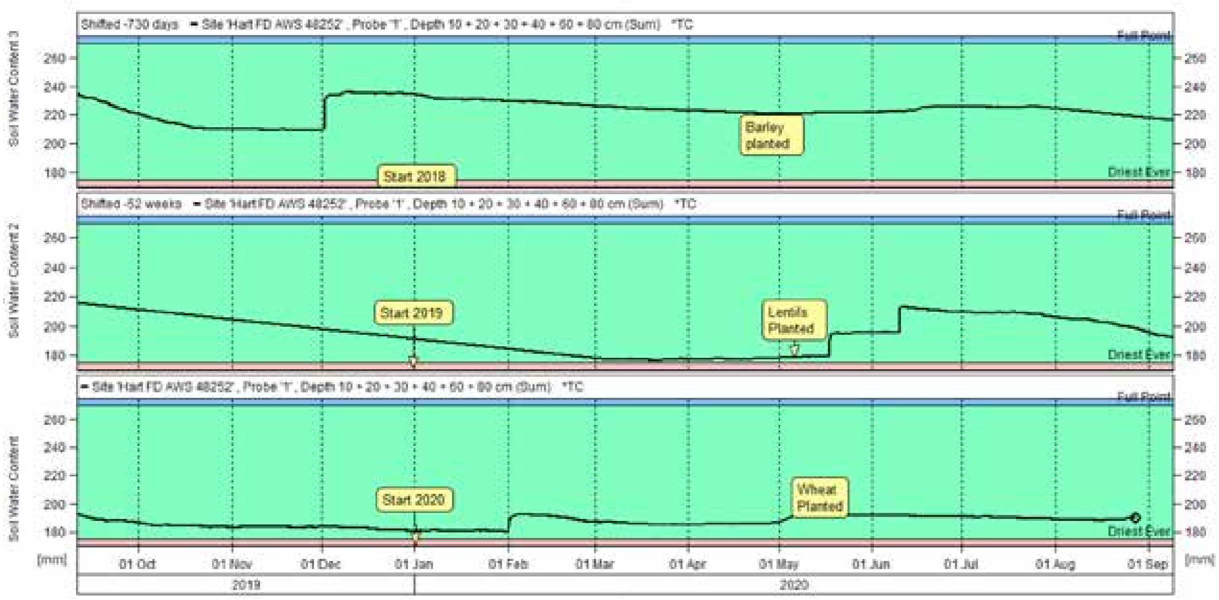


Figure 2. Soil moisture probe summed comparison (80 cm) for 2018 (top), 2019 (middle) and 2020 (bottom) at the Hart field site. Hart soil moisture data is free to view via Agbyte http://www.hartfieldsite.org.au/pages/live-weather/soil-moisture-probe.php

Figure 3. Image of the Hart field site, August 18, 2020.

A – LEGUME AND OILSEED HERBICIDE TOLERANCE

Photo taken on August 27 (12 weeks after sowing).

Atlantis OD + Hasten	50
Rexade + Wetter 1000	49
Pixxaro + Uptake	48
Frequency	47
Quadrant	46
Triathlon	45
Flight EC	44
NIL	43
Paradigm + MCPA LVE + Uptake	42
Talinor + Hasten	41
Velocity + Uptake	40
Carfentrazone + MCPA Amine 750	39
Ecopar + MCPA Amine 750	38
Lontrel Advanced	37
Atrazine + Hasten	36
Ally + Wetter 1000	35
NIL	34
Saracen + Banjo	33
Intercept	32
Ecopar + Wetter 1000	31
Raptor + Wetter 1000	30
Spinnaker + Wetter 1000	29
Brodal Options + MCPA Amine 750	28
Brodal Options	27
Thistrol Gold + Banjo	26
Broadstrike + Wetter 1000	25
Metribuzin (750 g/kg)	24
Simazine (900 g/kg)	23
NIL	22
Palmero TX	21
Balance + Simazine	20
Terbyne (750 g/kg)	19
Metribuzin (750 g/kg)	18
Simazine (900 g/kg)	17
Diuron (900 g/kg)	16
NIL	15
Terrain	14
Sentry	13
Callisto	12
Overwatch	11
Luximax	10
Reflex	9
Ultro	8
Devrinol C	7
Butisan	6
Propyzamide	5
Boxer Gold	4
Sakura	3
Trifluralin	2
NIL	1

Legume and oilseed herbicide tolerance trial plan

No.	Application timing	Treatment	Rate (ml or kg/ha)	Canola				Bean		Pea		C/pea	Lentil			Vetch		Medic	Clover
				Nuseed Quartz	HyTTec Trophy	Pioneer 44Y90	CT90008	PBA Bendoc	PBA Samira	Wharton	Ourstar	Genesis090	Jumbo 2	PBA Hallmark XT	GIA1703L	RM4	Timok	Sultan SU	Zulu II
1		NIL																	
2		Trifluralin	1500 ml																
3		Sakura	118 g																
4		Boxer Gold	2500 mL																
5		Propyzamide	560 g																
6		Butisan	1800 ml																
7	IBS 29th May	Devrinol C	2000 g																
8		Ultro	1700 g																
9		Reflex	1000 ml																
10		Luximax	500 ml																
11		Overwatch	1250 ml																
12		Callisto	200ml																
13		Sentry	50g																
14		Terrain	180g																
15		NIL																	
16		Diuron (900 g/kg)	825 g																
17		Simazine (900 g/kg)	825 g																
18	PSPE 29th May	Metribuzin (750 g/kg)	280g																
19		Terbyne (750 g/kg)	1000 g																
20		Balance + Simazine	99 g + 830 g																
21		Palmero TX	1000 g																
22		NIL																	
23		Simazine (900 g/kg)	850 g																
24		Metribuzin (750 g/kg)	280 g																
25		Broadstrike + Wetter 1000	25 g + 0.2%																
26		Thistrol Gold + Banjo	2000 mL + 0.5%																
27	3-4 Node 8th July	Brodal Options	150 mL																
28		Brodal Options + MCPA Amine 750	150 mL + 100 mL																
29		Spinnaker + Wetter 1000	70 g + 0.2%																
30		Raptor + Wetter 1000	45 g + 0.2%																
31		Ecopar + Wetter 1000	800 mL + 0.2%																
32		intercept	750ml + 1.0%																
33		Saracen + Banjo	100 mL + 1.0%																
34		NIL																	
35		Ally + Wetter 1000	7 g + 0.1%																
36		Atrazine + Hasten	1000 g + 1%																
37		Lontrel Advanced	150 mL																
38		Ecopar + MCPA Amine 750	400 mL + 330 mL																
39		Carfentrazone + MCPA Amine 750	100 mL + 330 mL																
40		Velocity + Uptake	670 mL + 0.5%																
41		Talinor + Hasten	750 mL + 1 %																
42	5 - 6 node 24th July	Paradigm + MCPA LVE + Uptake	25 g + 500 mL + 0.5%																
43		NIL																	
44		Flight EC	720 mL																
45		Triathlon	1000 mL																
46		Quadrant	1000 mL																
47		Frequency	200 mL + 1.0%																
48		Pixxaro + Uptake	300 mL + 0.5%																
49		Rexade + Wetter 1000	100 g + 0.25%																
50		Atlantis OD + Hasten	330 mL + 0.5%																

B – LENTIL, FIELD PEA AND CHICKPEA VARIETY UPDATE 2020

AUTHOR: Sarah Day, SARDI Agronomy, Clare

TAKE HOME MESSAGES

- 2019 saw the release of two new pulse varieties suitable for production in South Australia:
  - PBA Royal – a medium sized kabuli chickpea with a yield advantage over Genesis090 and PBA Monarch in mid to high yielding environments (greater than 1.5 t/ha).
  - PBA Highland XT – a medium sized red lentil with similar herbicide tolerance characteristics to PBA Hurricane XT and PBA Hallmark XT. PBA Highland XT is well adapted to lower rainfall and Mallee type environments.
- GIA Ourstar and GIA Kastar are two new field pea varieties with improved herbicide tolerance that have recently been developed by Grains Innovation Australia (GIA) and commercialised by AG Schilling & Co.
- PBA Kelpie XT, a large size red lentil with improved tolerance to imidazolinone herbicides, will be released this spring through commercial partner Seednet.

Table 1. Disease ratings of pulses

S	susceptible
MS	moderately susceptible
MR	moderately resistant
R	resistant

FIELD PEAS

Kaspa⦷ is a semi-leafless, late-flowering variety with resistance to shattering. It has good early-season vigour and moderate resistance to lodging. Kaspa is susceptible to powdery mildew, blackspot and the Kaspa strain of downy mildew. The seed of Kaspa is distinct from traditional dun types (Parafield) in that it is red-brown in colour and almost spherical in shape. Kaspa needs to be considered carefully before use in low-rainfall areas or areas prone to early periods of high temperature and drought stress due to its late and condensed flowering period. Kaspa should be considered carefully in areas prone to frequently severe vegetative frosts due to the yield loss potential of bacterial blight. Kaspa is licensed to Seednet.

PBA Gunyah⦷ is a kaspa seed type field pea with earlier and longer flowering than Kaspa and higher yield in shorter or dry seasons (yield potential below 2.25 t/ha) than this variety. PBA Gunyah is an early to mid-flowering variety with early maturity making it more suitable than Kaspa to the practice of crop topping and better suited to delayed sowing for blackspot disease management. Its disease resistance profile is similar to Kaspa and therefore not well suited to bacterial blight prone environments. Despite being susceptible to powdery mildew it is likely that PBA Gunyah will incur reduced yield loss from this disease than Kaspa, due to earlier maturity. PBA Gunyah is licensed to Seednet.

PBA Oura⦷ is a high yielding early to mid flowering semi-dwarf dun dimpled type field pea with high yields and improved resistance (MR-MS) to bacterial blight (pv syringae) over Kaspa, PBA Gunyah and PBA Wharton. This line has broad adaptation and high yield potential in short growing seasons. It produces non sugar-type pods and has fair to good lodging resistance at maturity. PBA Oura has improved resistance (MR-MS) to the kaspa strain of downy mildew and improved tolerance to metribuzin herbicide over Kaspa. Seed is licensed to Seednet.

PBA Percy⦶ is a conventional dun dimpled type field pea with improved resistance (MR) to bacterial blight over all other varieties, making it a preferred option in areas prone to this disease. Its early flowering and early maturity make it well suited to delayed sowing for disease management and crop-topping. It is moderately tolerant to salinity and produces non sugar-type pods similar to PBA Oura. PBA Percy generally produces yields similar to PBA Oura but in low rainfall environments it can be the highest yielding Dun variety in trials. Seed is licensed to Seednet.

PBA Pearl⦶ is a semi-leafless white field pea variety that is broadly adapted and the highest yielding field pea in long-term evaluation trials across all areas of SA. It has an erect growth habit, often with excellent lodging resistance at maturity. It is early to mid flowering and produces non sugar-type pods similar to PBA Oura. It has a favourable disease-resistance profile, with good resistance to bean leaf roll virus and is MS to bacterial blight. Seed is available through Seednet and growers are advised to secure markets before deciding to grow white peas as they cannot be delivered to bulk dun or kaspa type export markets.

PBA Wharton⦶ is a kaspa seed type field pea offering improved resistance to powdery mildew and various viruses (bean leaf roll and pea seed borne mosaic virus). It provides the same agronomic benefits as Kaspa (lodging and shattering resistance) and has some tolerance to boron toxicity. It is moderately tolerant to salinity and will provide a reliable alternative in those areas where powdery mildew and viruses are regular problems. PBA Wharton is an early to mid flowering and early maturing variety, making it well suited to crop-topping and delayed sowing for blackspot management. Seed is licensed to Seednet.

PBA Butler⦶ is a kaspa seed type field pea with high yields and improved resistance to bacterial blight over Kaspa. It is mid to late flowering, early to mid-maturing and offers the same agronomic benefits of lodging and shattering resistance as Kaspa. PBA Butler has a medium seed size with a yellow split and a uniform tan seed coat colour that is similar to Kaspa. It has a semi-leafless plant type with vigorous plant growth and is rated MS to blackspot and the 'Kaspa strain' of downy mildew. PBA Butler has wide adaptation across southern Australia and performs particularly well in medium to long-growing seasons in SA and may reduce yield losses in regions where bacterial blight is a significant disease. Seed is available from the commercial partner Seednet.

OZP1408 is a kaspa seed type semi-leafless field pea with wide adaptation. It has resistance to viruses including pea seed borne mosaic and bean leaf roll, and is moderately tolerant to salinity. This variety is currently expected to be released in 2022.

OZB1308 is a semi-leafless blue field pea with broad adaptation and grain yield exceeding Excell by 25%, with similar yield to kaspa seed type varieties. OZB1308 has a good level of resistance to downy mildew, resistance to bean leaf roll virus and is moderately tolerant to salinity. This variety is currently expected to be released in 2022.

GIA Ourstar (tested as GIA2002P)⦶ is the first dun dimpled type field pea offering improved tolerance to common in-crop and residual Group B herbicides. GIA Ourstar has improved herbicide tolerance to post-emergent imazamox, imazethapyr and flumetsulam applications as well as improved tolerance to commonly used Group B imidazolinone and sulfonylurea herbicides. GIA Ourstar is an early to mid-flowering variety with a relatively long flowering window, and early to mid-maturity suitable for crop topping. It has a semi-leafless plant type with a semi-erect growth habit and moderate resistance to pod shatter at maturity. GIA Ourstar has a disease resistance profile similar to PBA Oura and is rated MS to blackspot and susceptible to bacterial blight. GIA Ourstar was developed by Grains Innovation Australia (GIA) using conventional breeding techniques and commercialised by AG Schilling & Co.

GIA Kastar⊕ **(tested as GIA2001P)** is the first kaspa seed type field pea with improved tolerance to common in-crop and residual IMI herbicides. GIA Kastar has improved tolerance to post-emergent imazamox and imazethapyr applications as well as improved tolerance to commonly used residual Group B imidazolinone herbicides. GIA Kastar response to residual sulfonylurea and post-emergent flumetsulam is similar to that of PBA Wharton. GIA Kastar is a mid- flowering variety with early to mid-maturity suitable for crop topping. It has a semi-leafless plant type, an erect growth habit and is resistant to pod shatter at maturity. GIA Kastar has a disease resistance profile similar to PBA Wharton and is rated R to powdery mildew, MS to blackspot and S to bacterial blight. GIA Kastar was developed by Grains Innovation Australia (GIA) using conventional breeding techniques and commercialised by AG Schilling & Co.

CHICKPEAS

Genesis090⊕ is a small to medium seeded kabuli (7 to 8mm). The ascochyta blight (AB) rating for Genesis090 is MS and crops will now require three to four strategic fungicide sprays during the season ahead of rain fronts, the sprays offering two to three weeks protection against infection. Genesis090 has medium height with erect branches and yields similar to PBA Monarch but lower than PBA Slasher and PBA Striker. For seed distribution contact PB Seeds.

Genesis™ Kalkee⊕ is a medium to large-seeded kabuli type, with mid-late flowering and late maturity. It is rated MS to AB and will require three to four strategic fungicide sprays during the season ahead of rain fronts. The sprays offer two to three weeks protection against infection. It has the largest seed size of all commercial kabuli types, hence is more able to meet the size requirements of premium high-valued markets. However, yield is inferior to the small kabuli types and PBA Monarch but generally similar to Almaz in SA. For seed distribution contact PB Seeds.

PBA Monarch⊕ is a high-yielding medium-sized kabuli chickpea with adaptation to all kabuli growing areas of Australia. The AB rating for PBA Monarch is S and crops will require regular vegetative and reproductive foliar fungicide sprays every two to three weeks. It is particularly well suited to the shorter seasoned medium rainfall environments of south-eastern Australia due to improved adaptation through earlier flowering and maturity compared to Genesis090, Almaz and Genesis™ Kalkee. It is adapted to the traditional kabuli chickpea-growing regions and has shown a consistent and significant yield advantage over all current medium and large-seeded kabuli varieties, providing AB can be managed. It has similar yields and larger seed size than Genesis090 although is higher yielding than this variety in low-yielding (<1 t/ha) situations. In shorter growing seasons, PBA Monarch may have larger and more consistent seed size than other medium-sized varieties due to its earlier pod filling timing. Seed is licensed to Seednet.

PBA Royal⊕ is a high yielding medium seed size (predominantly 8 mm) kabuli chickpea. It is well adapted to medium rainfall chickpea growing regions of south eastern Australia and has a yield advantage in mid to high yielding environments (greater than 1.5 t/ha) compared to Genesis090 and PBA Monarch. PBA Royal has early to mid-flowering and maturity characteristics and has a semi spreading plant type similar to Genesis090. PBA Royal is rated MS to foliar AB infections in the southern region and will require three to four strategic fungicide sprays during the season ahead of rain fronts. Sprays offer two to three weeks protection against infection. Seed is licensed to Seednet.

PBA Slasher⊕ is rated MS to AB and will require three to four strategic fungicide sprays during the season ahead of rain fronts, with sprays offering two to three weeks protection against infection. PBA Slasher is high yielding in all chickpea-growing areas of SA, providing AB can be managed. It has a semi-spreading plant type with mid flowering and mid maturity. PBA Slasher is suitable for both the split and whole seed markets. Seed is licensed to Seednet.

PBA Striker⊕ is susceptible to AB and will require regular vegetative and reproductive foliar fungicide sprays every two to three weeks. PBA Striker is a high-yielding desi chickpea with very good early vigour. It is an early-flowering and maturing variety which provides a high-yielding alternative to all chickpea varieties in the medium to low-rainfall environments of western and southern Australia, providing AB can be managed. PBA Striker has a similar plant type to PBA Slasher but with larger seed size than all other southern desi varieties. Seed of PBA Striker is also light in colour and has good milling characteristics. Due to its early maturity and AB susceptibility, PBA Striker is not recommended for high-rainfall and long-growing season districts. Seed is licensed to Seednet.

PBA Maiden⫯ is rated as S to foliar AB infection and will require regular vegetative and reproductive foliar fungicide sprays every two to three weeks. PBA Maiden is a large-seeded high-quality desi chickpea for the medium to low-rainfall environments of southern Australia. It is broadly adapted to these regions and has shown similar yields to PBA Slasher. PBA Maiden has a semi-spreading plant type and height similar to PBA Slasher. It has a seed size greater than current southern desi varieties (approximately 30 per cent larger than PBA Slasher) with a yellow-tan seed coat. This variety is targeted for whole-seed markets where its large, angular shaped and bright yellow-tan coloured seed coat are well suited to the specific requirements of these markets. Growers are advised to investigate delivery and marketing options for PBA Maiden prior to growing this variety, due to its unique and favourable seed characteristics. Larger uniform seed size is more likely in medium rainfall regions. Seed is licensed to Seednet.

CICA1521 is a desi type chickpea with broad adaptation and a medium seed size. It has good grain yields in South Australia, in particular in the Mid-North region. CICA1521 has excellent harvestability with improved plant height and height to the lowest pod compared to all other desi varieties adapted to the southern region. It is a mid-flowering and mid-maturing variety, similar to Genesis090. CICA1521 is rated as S to ascochyta blight and will require regular vegetative and reproductive foliar fungicide sprays every two to three weeks. This variety is expected to be commercially released in spring 2020.

Note: All chickpea seed should be treated with a thiram-based fungicide to prevent seed transmission of AB on to the emerging seedlings.

LENTILS

PBA Blitz is suited to all current lentil growing areas, with particular adaptation to shorter season areas. The combination of early to mid-flowering, early maturity, moderate disease-resistance to ascochyta blight (AB) and botrytis grey mould (BGM) and medium seed size will improve lentil reliability and economics of production. PBA Blitz is the earliest maturing lentil variety and the best option where crop-topping or delayed sowing are practised. It has a good level of early vigour and is an erect plant type. PBA Blitz is a medium-sized red lentil (larger than PBA Flash and Nugget) with a grey-coloured seed coat. PBA Blitz has a low level of 'pale coat Blitz' seeds that still have red cotyledons and are a natural part of the genetic make-up of the variety. These do not affect the splitting or cooking characteristics of this variety. These 'pale coat Blitz' seeds are classified at receival point as seeds of contrasting colour with a limit of one per cent allowed. PBA Blitz is commercialised by PB Seeds.

PBA Bolt is a mid-flowering but early to mid-maturing lentil with excellent lodging resistance at maturity and high yield in drought years and dry areas. It provides an alternative to PBA Flash in all areas, particularly in areas where AB, harvestability and drought tolerance are major issues. Like PBA Flash, it has improved tolerance to boron and salt over most other varieties. PBA Bolt is rated MR to AB but is susceptible to BGM, and this disease will need to be carefully managed in disease prone areas. It has a grey seed coat colour and is licensed to PB Seeds.

PBA Jumbo2⫯ is the highest yielding red lentil available for SA. PBA Jumbo2 was released as a direct replacement for PBA Jumbo although grain size is almost the only similarity. It has improved agronomic characteristics over PBA Jumbo, including greater early vigour, improved lodging, shattering and disease resistance. PBA Jumbo2 is rated R for AB and R-MR for BGM, but disease monitoring and a fungicide application prior to canopy closure are still recommended for BGM.

PBA Jumbo2 has a large seed size and a grey seed coat. As with other large-seeded varieties PBA Jumbo2 is well suited to the post-harvest removal of small broadleaf weed seeds. PBA Jumbo2 is licensed to PB Seeds.

PBA Hurricane XT⫯ was the second lentil variety to be released with improved tolerance to the herbicides imazethapyr and flumetsulam, including reduced sensitivity to some sulfonylurea and imidazolinone herbicide residues. However, it is important to note that product label rates, plant-back periods and directions for use must still be adhered to. It is a mid-flowering, mid-maturing variety with small red seed and a grey seed coat. PBA Hurricane XT has a MR-MS rating for foliar AB in South Australia, and severe lesions have occurred in seedling crops in 2018, so may require a podding spray to prevent seed and pod infection. PBA Hurricane XT has a MR-MS rating for BGM and in disease-prone areas a strategic fungicide programme for BGM will be required and early sowing should be avoided. Plant height and early vigour are improved over Nipper and PBA Herald XT, improving weed competition and harvestability. Like PBA Herald XT and Nipper, PBA Hurricane XT has been found to be more sensitive to Group C herbicides such as metribuzin and simazine than other lentil varieties; however, label rates of these herbicides have been used on most evaluation trials. It is important to be cautious when applying these herbicides on variable soil types, especially if weather conditions conducive to crop damage are forecast. PBA Hurricane XT is the highest yielding small red lentil and is commercialised by PB Seeds.

PBA Hallmark XT⫯ was the third lentil variety to be released with improved tolerance to the herbicides imazethapyr and flumetsulam, plus reduced sensitivity to some sulfonylurea and imidazolinone herbicide residues. However, it is important to note that product label rates, plant-back periods and directions for use must still be adhered to. PBA Hallmark XT builds on PBA Herald XT and PBA Hurricane XT, with higher grain yields and a different size market class. It is a mid-flowering, mid-maturing variety with medium red seed and a grey seed coat. The seed size is slightly larger than PBA Ace and PBA Bolt but less than PBA Flash and PBA Blitz. PBA Hallmark XT has a high resistance rating for BGM, and is rated MR-MS for AB in South Australia where it may require a podding spray to prevent seed and pod infection. Like PBA Herald XT, Nipper and PBA Hurricane XT, PBA Hallmark XT has been found to be more sensitive to Group C herbicides such as metribuzin and simazine than other lentil varieties; however, label rates of these herbicides have been used on most evaluation trials. It is important to be cautious when applying these herbicides on variable soil types, especially if weather conditions conducive to crop damage are forecast. Vigour and plant height are slightly improved over PBA Hurricane XT. PBA Hallmark XT is a high-yielding medium red lentil and is commercialised by PB Seeds.

GIA Leader⫯ **(tested as GIA1701L)** is a new imidazolinone tolerant red lentil developed for favourable lentil growing areas with good soil types in medium to higher rainfall zones. This variety has similar IMI herbicide tolerance and tolerance to residual levels of sulfonylurea (SU) herbicide from prior crops to current XT lentil varieties (e.g. PBA Hurricane XT). GIA Leader has good disease resistance and mid to late flowering and maturity, making it well suited to early sowing. GIA Leader has a medium seed size with a grey seed coat. GIA Leader was developed by Grains Innovation Australia and is planned for commercial release in early 2021 with seed available through commercial partner PB Seeds.

PBA Kelpie⫯ **XT (tested as CIPAL1721)** is a large seeded red lentil with improved tolerance to the herbicides imazethapyr and flumetsulam. It also has reduced sensitivity to some sulfonylurea and imidazolinone herbicide residues. PBA Kelpie XT is an early to mid-flowering and maturing variety with moderate to good vigour. PBA Kelpie is MR to pod drop and resistant to shattering at maturity. Provisional data shows that PBA Kelpie XT is MR to AB infection and is it moderately resistant to BGM.

These disease ratings are subject to change when more data becomes available. PBA Kelpie XT has a large seed size (slightly smaller than PBA Jumbo2) and a grey seed coat. This variety is expected to be released in spring 2020 through the commercial partner Seednet.

PBA Highland XT (tested as CIPAL1621)ⓟ was the fourth lentil variety to be released with improved tolerance to the herbicides imazethapyr and flumetsulam, plus reduced sensitivity to some sulfonylurea and imidazolinone herbicide residues. PBA Highland XT offers an improved herbicide-tolerant lentil that is showing adaptation to drier lentil growing regions of the Victorian Mallee and South Australia. It has medium seed size, high early vigour with early flowering and early to mid-maturity features. PBA Highland XT has a provisional disease rating for AB of MR and MR-MS to BGM. These disease ratings are subjected to changes when more data become available. Seed is licensed to PB Seeds.

Note: It is important to note that product label rates, plant-back periods and directions for use must still be adhered to.

Refer to the South Australian Crop Sowing Guide for further detailed yield and agronomic information on all varieties: https://grdc.com.au/resources-and-publications/all-publications/publications/2020/2020-south-australian-crop-sowing-guide

For seed enquiries please contact the commercial seed distributer.

Contact details:
Sarah Day
08 8841 2404
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Pulse variety demonstration trial plan

Plots	Crop	Variety
1, 2	Faba Bean	Nura
3, 4	Faba Bean	PBA Zahra
5, 6	Faba Bean	PBA Samira
7, 8	Faba Bean	PBA Bendoc
9, 10	Faba Bean	PBA Marne
11, 12	Faba Bean	AF11023
13, 14	Field pea	Parafield
15, 16	Field pea	Kaspa
17, 18	Field pea	PBA Gunyah
19, 20	Field pea	PBA Oura
21, 22	Field pea	PBA Percy
23, 24	Field pea	PBA Pearl
25, 26	Field pea	PBA Wharton
27, 28	Field pea	PBA Butler
29, 30	Field pea	OZP1408
31, 32	Field pea	OZP1308
33, 34	Chickpea	Genesis090
35, 36	Chickpea	Genesis™ Kalkee
37, 38	Chickpea	PBA Monarch
39, 40	Chickpea	CICA1156
41, 42	Chickpea	PBA Slasher
43, 44	Chickpea	PBA Striker
45, 46	Chickpea	PBA Maiden
47, 48	Chickpea	CICA1521
49, 50	Lentil	PBA Blitz
51, 52	Lentil	PBA Bolt
53, 54	Lentil	PBA Jumbo 2
55, 56	Lentil	PBA Hurricane XT
57, 58	Lentil	PBA Hallmark XT
59, 60	Lentil	GIA Leader
61, 62	Lentil	CIPAL1721
63, 64	Lentil	CIPAL 1621

N ↓

Seeding date: May 18, 2020
Fertiliser: MAP
Fertiliser rate: 80 kg/ha

Lentil and field pea variety trial plan

1	buffer	buffer	buffer
2	Kaspa	PBA Butler	Kaspa
3	GIA Ourstar	PBA Wharton	Oura
4	Oura	GIA Kastar	GIA Kastar
5	PBA Butler	Oura	PBA Butler
6	PBA Wharton	GIA Ourstar	GIA Ourstar
7	GIA Kastar	Kaspa	PBA Wharton
8	buffer	buffer	buffer
9	buffer	buffer	buffer
10	PBA Kelpie XT	Hurricane	Hallmark
11	Hallmark	GIA LeaderL	Jumbo 2
12	Hurricane	PBA Kelpie XT	GIA Leader
13	Highland XT	Highland XT	Highland XT
14	Jumbo 2	Hallmark	Hurricane
15	GIA Leader	Jumbo 2	PBA Kelpie XT
16	buffer	buffer	buffer

Key:

Field pea = 2m

Lentil = 1.75m

N →

Seeding date: May 18, 2020
Fertiliser: MAP
Fertiliser rate: 80 kg/ha

C – EMERGING PULSE ROOT DISEASES

AUTHORS: Blake Gontar, Tara Garrard, Kelly Hill, Alan McKay, SARDI

TAKE HOME MESSAGES

- Pulse and canola crops are affected by root diseases.
- Next generation sequencing technology and PREDICTA®B tests have been used to survey SA, and now national, pulse samples from industry, revealing multiple potentially important soilborne pathogens.
- Field trials have been established with the aim of quantifying the benefit from controlling root diseases in pulses.

Background

International experience indicates that soilborne pathogens can be important constraints to production in pulse crops when cropping frequency increases (Gossen et al. 2016). In 2017, the loss of three chickpea crops to suspected Phytophthora root rot and a faba bean crop to Aphanomyces root rot, prompted the South Australian Grains Industry Trust (SAGIT) to fund a root disease survey of pulse and oilseed crops in South Australia (S218).

Phytophthora root rot, caused by Phytophthora medicaginis, is an important root disease of chickpeas in northern NSW. However, P. medicaginis was eliminated as the cause of loss of the three chickpea crops in South Australia (SA), using an existing PREDICTA®B (Northern Region) test.

New diagnostic research technology being developed by the GRDC-SARDI bilateral investments; DAS1907-001BLX and DAS1802-011BLX was used to test DNA extracted from the diseased chickpea roots and identified a different Phytophthora species, P. megasperma as the likely cause. A PREDICTA®B test was developed for this pathogen to support the survey.

In 2019, GRDC extended the survey nationally as part of DJP1907-002RMX. Department of Agriculture pathologists in each state coordinated sample collection and provided samples to SARDI for testing. A panel of 23 tests was assembled to survey the pulse and oilseed root systems collected from across Australia (Table 1 and Table 2). DNA extracted from these samples was also tested using next generation sequencing (NGS), to detect pathogens for which no PREDICTA®B-style test had been developed.

Although the presence of pathogens in symptomatic roots is concerning, it does not define any effect on yield. In 2020, SAGIT have funded a series of 39 pulse root disease field trials which have been sown at 20 GRDC-funded 'Southern Pulse Agronomy' sites around SA. Two crop species at each site were treated with a range of active fungicides/nematicides targeting various pathogens. Field trials will be evaluated to determine the effect of pathogen control on yield.

Methods

Survey

Pulse root samples were sent by agronomists and growers to Department of Agriculture pathologists in each state. Excess soil was washed from the roots and any plant material above the basal stem was removed. Roots were scored for disease, photographed and then dried and sent to SARDI. Samples were then processed through the PREDICTA®B laboratory and DNA was extracted. The Pulse Research test panel was run on the extracted DNA to quantify targeted pulse pathogens in the samples.

Table 1. Locations, sowing dates and crop types for each of the pulse root disease yield loss trials.

Region	Site	Sowing date	Crop type					
			Chick-pea	Faba bean	Field pea	Lentil	Lupin	Vetch
Mid North	Booleroo	12 May		X		X		
	Eudunda	4 May		X				X
	Farrell Flat	6 May		X		X		
	Hart	18 May				X		
	Maitland	25 May		X		X		
	Pinery	15 May	X			X		
	Port Broughton	13 May	X			X		
	Riverton	26 May	X	X				
	Tarlee	26 May		X		X		
	Turretfield	5 June	X		X			
	Warnertown	5 May		X		X		
South East	Bool Lagoon	18 May	X	X				
	Coomandook	11 May		X			X	
	Sherwood	11 May		X			X	
Eyre Peninsula	Kimba	26 May			X			X
	Stokes	27 May						
	Tooligie (1)	14 May	X		X			
	Toolige (2)	13 May				X	X	
	Wudinna	13 May				X		X
	Yeelanna	27 May		X		X		

DNA samples were also assessed using NGS to identify potentially important pathogens not detected by the Pulse Research test panel. Three Illumina® MiSeq® libraries were prepared for each sample using primer pairs that target the ITS1, ITS2 and elongation factor gene regions to aid identification of oomycetes (for example, Phytophthora) and fungal species (for example, Phoma and Fusarium species).

Where root samples showed distinctive/diagnostic symptoms, or where DNA tests indicated the presence of a potential pathogen, samples were plated on a variety of selective agar media in an attempt to culture the suspected pathogen(s). Selected isolates were tested for pathogenicity on host pulses, with more currently being tested.

Field Trials

At each of 20 southern pulse agronomy sites across SA (low, medium and high rainfall), replicated (n = 3) field trials have been sown for two crop types suited to the region. Sites, crop types & sowing dates are given in Table 1.

At each site, three soil samples were collected, with one for each bay of the combined two species trials. Soil samples were submitted to PREDICTA®B testing to determine which pathogens were present at levels likely to cause root disease.

Treatments were applied at seeding. Various pesticides, including fungicides, a fungicide/ nematicide and a biological nematicide/bio-stimulant were applied as seed treatments and in-furrow liquid bands targeting fungi, oomycetes and nematodes, as well as the combination of these. An untreated control was also sown.

Field trials were sown using standard plot trial narrow-point/press wheel seeders. Fertiliser (no fungicide) was applied at seeding per district practice. Trials have been managed since as per district practice including foliar fungicides. At each site, plots will be sampled by digging plants, washing and visually scoring root disease. Roots will then be tested using PREDICTA®B to determine the causal pathogens involved in any root disease and to confirm any treatments effects. Plots will be harvested for yield comparison.

Results and discussion

Survey

To date, 400 samples have been processed from across all cropping regions in Australia, including 97 collected in 2018 from SA and western Victoria (Vic). Crops tested include chickpea, lentil, faba bean, field pea, lupin, canola, vetch, clover and lucerne. Over 150 fungal and oomycete isolates have now been isolated, sequenced to confirm their identity and stored for future work.

Pulse research test panel

The results for the Pulse Research test panel for the 2019 national survey are summarised in Figure 1; results from SA in 2018 were very similar (data not shown). Rhizoctonia AG8, Pratylenchus spp., Pythium clade F and Phoma pinodella (this test also detects Didymella pinodes) were all common across crop types and regions.

P. neglectus (root lesion nematode) was detected at substantial levels in many crops including some that were considered to be poor hosts (for example, faba bean and field peas); these crops are known to limit multiplication (hence used as 'break crops') however the nematodes are clearly able to invade and cause damage. Their effect on yield of pulses has not been reported.

P. pinodella appears to have a broader host range amongst pulse crops and pasture legumes than generally expected. As part of a species complex involving other closely related fungi, P. pinodella is known to cause blackspot leaf and stem blight, as well as foot rot. However, its importance as a root rot pathogen has not been well-documented in pea, nor in any other pulses where it appears common.

Aphanomyces euteiches was found in 18% of samples in 2018 and 1% in 2019, all were from faba bean crops exhibiting moderate to severe root disease. In 2019, a test for Aphanomyces trifolii was added to the panel, with six samples (faba bean, lentil, and vetch) found to be infected. The pathogen was particularly prevalent in vetch (27% of vetch samples infected). This pathogen is typically associated with sub-clover (O'Rourke et al., 2010). The effect of A. trifolii on lentil and vetch has not been described, while the effect on faba bean has only been briefly described (O'Rourke et al., 2010).

Rhizoctonia solani AG8 and AG2.1, Pythium clade I and Macrophomina phaseolina (charcoal rot) were also present at substantial levels. Rhizoctonia AG8, the cause of Rhizoctonia root rot in cereal crops, also causes substantial root damage in pulses, despite pulses generally reducing paddock inoculum over the course of the season.

P. medicaginis was not detected in either year, probably due to drought in northern Australia. Conditions were conducive for Phytophthora in the GRDC Southern and Western Regions of Australia and P. megasperma and P. clandestina were detected in SA and Western Australia (WA) (lentil and lupin). Both species are known to have a wide host range, however their importance in southern Australian pulse crops is yet to be quantified.

Next Generation Sequencing (NGS)
DNA from each root sample was analysed with NGS and a broad range of fungal organisms were detected (Figure 2); some of which have been reported to cause root disease of pulses.

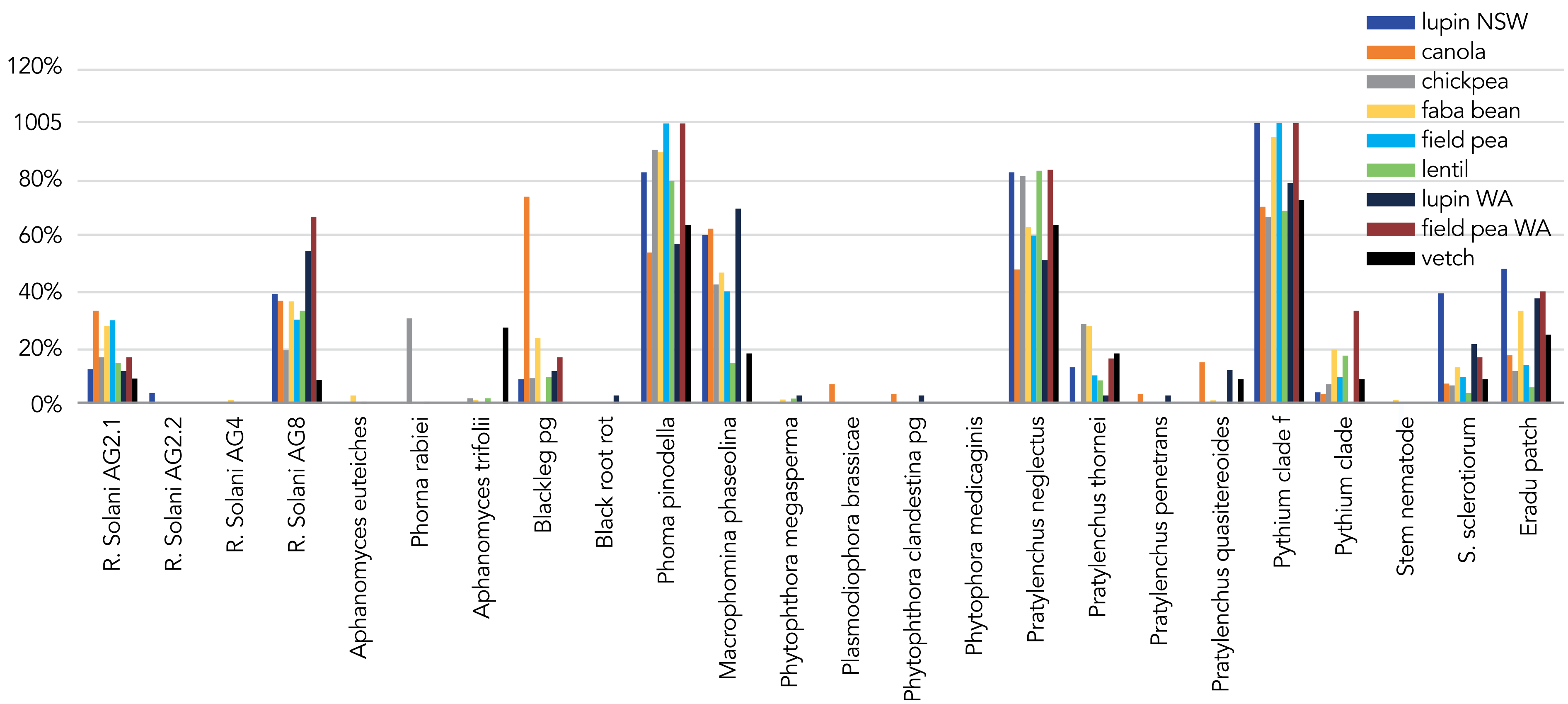

Figure 1. Frequency of detection of known pulse pathogens from national pulse and canola root samples in 2019.

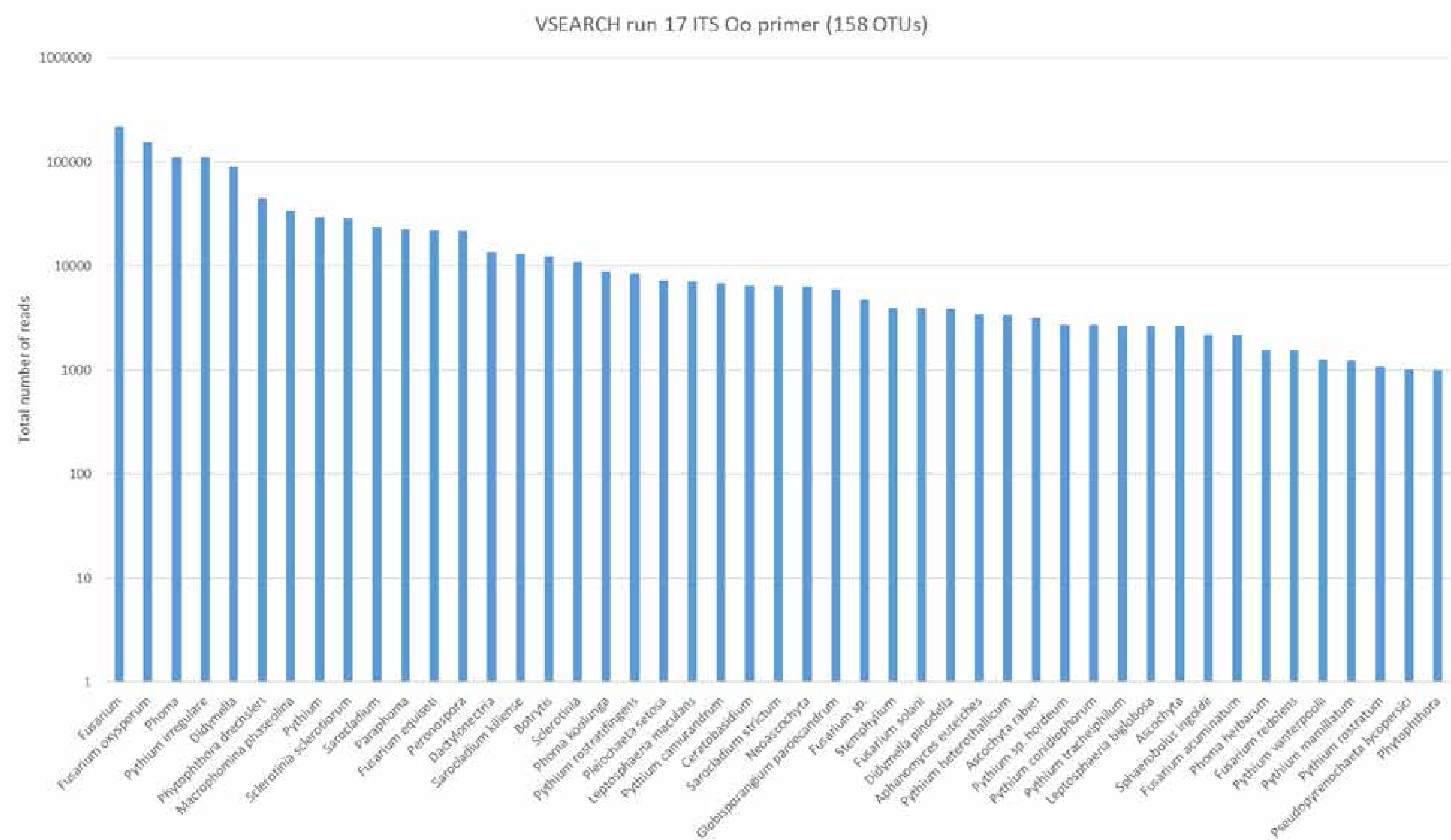

Figure 2. NGS detections of DNA of possible pathogen species in all 2019 pulse samples combined using primers aimed at oomycetes (Pythium, Phytophthora). Other primers are being used to better detect true fungi.

Organisms were identified as pathogens of interest based on international research and observed symptoms in plant samples. A number of pathogens of interest identified in this survey are summarised as follows:

Phytophthora spp. - sequence data identified several Phytophthora species present including P. megasperma, P. trifolii, and P. clandestina. All three species were detected in chickpea roots with symptoms of Phytophthora root rot in 2018. P. megasperma was also found on faba bean and lucerne roots. These Phytophthora species could have been the pathogens responsible for crop failures in the chickpea paddocks from 2017 and crop and root symptoms in 2018.

The potential of P. megasperma to also infect faba bean roots could have implications for the South East region and requires further investigation to confirm and quantify its extent and severity. Phytophthora root rot in the Northern Region is estimated to cost chickpea growers up to $8.2 million annually (Murray & Brennan, 2012).

Fusarium spp. - globally, Fusarium spp. feature frequently in research on pulse root diseases (Gossen et al., 2016, Li et al., 2017, Wong et al., 1985, Banniza et al., 2015). Species reported in the literature and tentatively identified as detected by the survey, include F. solani, F. redolens, F. oxysporum, F. equiseti, F. avenaceum and F. acuminatum. Internationally, research groups are currently investigating the role of these species as potentially important components of disease complexes with A. eutiches and Phytophthora spp. (Banniza, 2016).

There are constraints on the resolution of the NGS, however Fusarium spp. are amongst the most common NGS detections in survey samples. The Illumina® MiSeq® sequences cannot differentiate Fusarium species to form a specialis. This limits our current ability to identify some of the most important root pathogens of chickpea (F. oxysporum f. sp. ciceris) and lentil (f. sp. lentis). Both however, are not currently known to occur in Australia (Cunnington et al., 2016, Pouralibaba et al., 2016).

Further investigation is needed to determine which, if any, of the above species play an important role in causing pulse root disease in Australia. Currently, Fusarium spp. are being isolated from the samples, their DNA sequenced using Sanger Sequencing to confirm identity, then tested in pot assays to determine pathogenicity (Figure 3).

Figure 3. Pot assays for pathogenicity of Fusarium spp. From left: F. avenaceum on faba bean, F. oxysporum + F. avenaceum on faba bean and faba bean control with no disease inoculum.

Field Trials

Pre-sowing PREDICTA®B results for all field trials are summarised in Table 2. Field trials have established well and are showing possible symptoms of root disease. However cold, dry conditions have limited yield potential at many sites, while the dry conditions may also have limited soil fungicide distribution and efficacy. Sites are currently being assessed for disease.

Conclusion

The survey has identified some important trends, although the National data is limited to only a single year. Phytophthora and Aphanomyces have been associated with crop failures in the high rainfall zones, but their distribution seems to be limited. Other potential root pathogens such as Fusarium spp., Rhizoctonia solani, Pythium spp., Pratylenchus spp. and Phoma spp. are much more common, within and across regions.

It is likely that pulse root diseases are contributing to poor water use efficiency and unexpected yield losses, and the risk is likely to increase with increased frequency of pulses in cropping sequences. Legume pastures may also be a significant source of infection. Their effect on yield is currently being evaluate through the SAGIT Pulse Yield Loss trials. These potential pathogens being widespread suggests they have greater potential for impact across the industry.

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Table 2. Pre-sowing PREDICTA®B soil test results for Pulse Root Disease Yield Loss trial sites in 2020.

Notes	R. solani AG2.1 pgDNA/g Sample*	R. solani AG8 pgDNA/g Sample*	Aphanomyces trifolii kDNA copies/g Sample*	Didymella pinodes/ Phoma pinodella pgDNA/g Sample*	Macrophomina phaseolina kDNA copies/g Sample*	Phytophthora megasperma clade kDNA copies/g Sample*	Phytophthora clandestina pg DNA / g soil	Phytophthora medicaginis kDNA copies/g Sample*	Pratylenchus neglectus nematodes /g soil	Pratylenchus thornei nematodes/g soil	Pythium clade f pgDNA/g Sample*	Pythium clade I pgDNA/g Sample*	Stem nematode nematodes/100 g soil	S. sclerotiorum kDNA copies/g Sample*	Eradu pgDNA/g Sample*
Booleroo	657	307	1	85	6	0	0	0	4	3	28	1	0	0	142
Eudunda	0	330	1	426	10	0	0	0	6	0	5	7	0	0	0
Farrell Flat	349	76	1	79	6	0	0	0	0	0	9	3	0	0	186
Hart	22	85	0	633	7	0	0	0	2	1	17	6	0	0	0
Maitland	0	13	5	18	6	0	0	0	233	0	129	20	0	1	1
Pinery	0	1284	0	0	0	0	0	0	37	0	54	3	0	0	0
Port Broughton	0	140	0	10	13	0	0	0	20	0	6	1	0	0	70
Riverton	0	887	4	158	8	0	0	0	12	1	6	4	0	0	13
Tarlee	0	361	0	306	3	0	0	0	6	24	24	2	0	0	0
Turretfield	86	0	0	106	43	0	0	0	6	0	52	1	16	0	12
Warnertown	0	150	0	152	9	0	0	0	3	2	39	3	0	0	0
Bool Lagoon	1	0	4	891	67	0	0	0	5	0	152	11	0	0	0
Coomandook	12	26	2	12	9	0	0	0	107	0	36	2	0	0	0
Sherwood	0	0	0	2134	27	0	0	0	0	0	36	0	0	0	23
Kimba	11	151	0	59	10	0	0	0	20	0	11	8	0	0	13
Stokes	3	177	2	279	1	0	0	0	7	0	40	0	0	0	13
Tooligie 1	0	0	0	323	7	0	0	0	27	0	23	0	0	0	0
Tooligie 2	6	150	0	53	12	0	0	0	2	0	15	1	0	0	0
Wudinna	399	24	0	65	16	0	0	0	30	3	13	7	0	270	0
Yeelanna	0	5	3	117	10	0	0	0	130	0	17	15	0	0	0

Pulse root disease trial plan

Row	Bay 1	Bay 2	Bay 3
	Buffer	Buffer	Buffer
1	Treatment 2	Treatment 4	Treatment 3
2	Treatment 2	Treatment 4	Treatment 3
3	Nil	Treatment 2	Treatment 2
4	Nil	Treatment 2	Treatment 2
5	Treatment 7	Treatment 7	Nil
6	Treatment 7	Treatment 7	Nil
7	Treatment 6	Treatment 6	Treatment 7
8	Treatment 6	Treatment 6	Treatment 7
9	Treatment 3	Nil	Treatment 4
10	Treatment 3	Nil	Treatment 4
11	Treatment 4	Treatment 5	Treatment 5
12	Treatment 4	Treatment 5	Treatment 5
13	Treatment 5	Treatment 3	Treatment 6
14	Treatment 5	Treatment 3	Treatment 6
	Buffer	Buffer	Buffer
	Rep 1	Rep 2	Rep 3

Key:

Treatment 1	Nil
Treatment 2	Fungi (Fusarium spp.) active
Treatment 3	Fungi + oomycete active (Rhizo spp. etc. + Pythium spp. etc.)
Treatment 4	Oomycete active (Pythium spp. etc.)
Treatment 5	Nematode bioactive + root stimulant
Treatment 6	2 + 3 + 5
Treatment 7	3 + 5

Inoculated at seeding with mixed Rhizoctonia solani AG8, Phoma pinodella and Fusarium avenaceum

Not inoculated - background disease inoculum only

N →

Seeding date: May 18, 2020
Fertiliser: MAP
Fertiliser rate: 80 kg/ha

D – VETCH VARIETY UPDATE

AUTHOR: Stuart Nagel, SARDI

SARDI's National Vetch Breeding Program is supported by the GRDC. It focuses on the breeding and assessment of common vetch (Vicia sativa) and woolly pod vetch (*Vicia villosa*) with the aim of producing high yielding grain and hay lines with disease resistance, soft seeds and tolerance to drought/heat stress. All common vetch varieties released by this program are rust resistant.

CURRENT VARIETIES

Common Vetch

Morava - the first common vetch variety bred in Australia, it is highly rust resistant and very high in grain and dry matter production in areas with an average annual rainfall > 400 mm. It is a late flowering (115+ days to full flower), soft seeded, non-shattering multi-purpose variety, with beige cotyledons. It is palatable as fresh or dry plant and the grain is extremely palatable for ruminants with a grain toxin level of 0.5-0.6%.

Rasina - this variety is characterised by maturing 15-20 days earlier than Morava, (95 - 105 days to flowering), it is a small plant, with less shooting than Morava, but form pods on lower nodes (starts from 5-7node) and produce good grain yield in areas with annual rainfall less than 380 mm. Rasina is resistant to rust but not resistant to Ascochyta and Botrytis, but is less infected by these diseases because the canopy is more open than Morava's.

Volga - this variety is highly rust resistant has very good early establishment, earlier in maturity by 7-12 days than Rasina (from seeding to full flowering 95-100 days). It is well adapted to grain and hay production in low to medium rainfall areas; such as the SA Mallee, Mid North, Eyre Peninsula, Vic Mallee (Walpeup), Wimmera, NSW Central West (Ranking Springs). Volga is available from Heritage Seeds.

Timok - this variety matures between Rasina and Morava (from seeding to full flowering 100-105 days) is high yielding and highly rust resistant but is only moderately resistant to ascochyta blight, susceptible to botrytis. Timok is ideally suited to grain production in areas with annual rainfall > 380 mm. Timok dry matter production is similar to Morava in high rainfall regions (> 400 mm), but 19% higher than Morava in low to medium rainfall regions (330-380 mm). Timok is available from Pasture genetics/S&W Seeds.

Studenica is a new white flower variety of common vetch that will be commercially available for sowing for the first time in 2021. This variety has the earliest flowering and maturity of the common vetches, flowering in approx 85- 90 days. It is rust resistant but susceptible to botrytis like other common vetch varieties. The advantage Studenica has over other varieties is its winter growth and vigour combined with good frost tolerance which enables it to put on more bulk throughout the cold parts of winter, providing fodder earlier in the season. This variety is particularly well suited to low rainfall and marginal cropping/mixed farming systems requiring early feed to fill the winter feed gap, or a more reliable legume option in mixed enterprises. Studenica was developed and trialled by the SARDI national vetch breeding program in conjunction with GRDC and SAGIT, it will be available from Pasture genetics/S&W Seeds.

Woolly pod vetch

Capello (*Vicia villosa subsp.*) has high dry matter yields, similar to Haymaker. It has late maturity and is best suited to areas receiving greater than 450 mm annual rainfall. It is worth noting that Capello has a high level of high seeds.

RM4 (*Vicia villosa subsp.*) - this variety is characterised by good early establishment for a woolly pod vetch (> 10 nodes in 3 months) with earlier maturity than other woolly pod varieties, it is 10-20 days earlier than Capello and Namoi, respectively. It is soft seeded (emerged > 90% in Australian soil conditions), non-shattering (< 5% by full maturity/harvesting), palatable as both green plants and hay/silage with good leaf retention at baling.

ACKNOWLEDGMENT

The National Vetch Breeding Program would like to thank GRDC and SARDI for funding this program and acknowledge the ongoing support and interest provided by Australian farmers. Farmers and not for profit farmer groups and organisations provide trial sites, feedback, advice, recommendations and their wish lists for future varieties to the program, all of which are gratefully received and appreciated.

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Table 1. Characteristics of selected vetch varieties

Variety	Maturity	Yield potential		Flower colour	% of pod shattering	% of hard seeds	Disease reaction*		
		Grain	Dry matter				Rust	Ascochyta	Botrytis
Common vetch varieties (Vicia sativa).									
Blanchefleur	Mid	High	Mod	White	5-10	5-10	VS	MR	S
Studenica	Very early	High	High	White	0-2	0	R	MS	S
Morava	Late	High	High	Purple	0	0	R	MS	VS
Rasina	Early-mid	High	Mod	Purple	0-2	0	R	MR	S
Volga	Early	V. high	High	Purple	0-2	2-5	R	MR	MS
Timok	Mid	High	V. high	Purple	0-2	0-2	R	MR	MS
Purple vetch (Vicia benghalensis subsp. benghalensis)									
Popany	Very late	Low	High	Purple	20-30	5-10	R	S	VS
Woolly pod vetches (Vicia villosa subsp.)									
Haymaker	Late	Low	V. high	Purple	5-10	20-30	R	S	VS
Capello	Late	Low	V. high	Purple	5-10	15-20	R	S	VS
RM4	Mid	Mod.	V. high	Purple	2-5	2-5	R	MS	VS

VS: very susceptible
S: susceptible
MS: moderately susceptible
MR: moderately resistant
R: resistant

Aim: To increase vetch biomass using growth regulants.

Vetch biomass trial plan

Buffer	Buffer	Buffer
Morava (untreated)	Morava (untreated)	Timok (+ 20 g)
Timok (+ 10 g)	Studenica (untreated)	Morava (untreated)
Studenica (untreated)	Studenica (untreated)	Morava (+ 20 g)
Timok (untreated)	Morava (untreated)	Timok (untreated)
Studenica (+ 20 g)	Studenica (+ 10 g)	Studenica (+ 10 g)
Studenica (untreated)	Morava (+ 20 g)	Studenica (untreated)
Timok (+ 20 g)	Studenica (+ 20 g)	Timok (+ 10 g)
Morava (untreated)	Timok (untreated)	Studenica (untreated)
Timok (untreated)	Timok (+ 10 g)	Studenica (+ 20 g)
Morava (+ 20 g)	Timok (+ 20 g)	Timok (untreated)
Morava (+ 10 g)	Morava (+ 10 g)	Morava (untreated)
Studenica (+ 10 g)	Timok (untreated)	Morava (+ 10 g)
Buffer	Buffer	Buffer

N →

Seeding date: May 20, 2020
Fertiliser: MAP
Fertiliser rate: 80 kg/ha

Note: Applications of ProGibb (Gibberellic acid) were made to vetch on June 11, 2020 at either 10 or 20 g/ha, four weeks prior to grazing. Biomass cuts were taken July 4. Flowering and podding dates will be monitored.

E – PULSE NODULATION AND HERBICIDES

Pulse nodulation and herbicides trial plan

Buffer	Buffer	Buffer
Canola plot	Canola plot	Canola plot
Treatment 1	Treatment 4	Treatment 11
Treatment 2	Treatment 13	Treatment 14
Treatment 3	Treatment 7	
Treatment 4		Treatment 9
Treatment 5	Treatment 8	Treatment 3
Treatment 6	Treatment 10	Treatment 4
Treatment 7	Treatment 14	Treatment 13
Treatment 8	Treatment 12	Treatment 5
Treatment 9	Treatment 6	Treatment 1
Treatment 10	Treatment 2	Treatment 10
Treatment 11	Treatment 9	Treatment 8
Treatment 12	Treatment 1	Treatment 7
Treatment 13	Treatment 3	Treatment 12
Treatment 14	Treatment 11	Treatment 6
Canola plot	Canola plot	Canola plot
Buffer	Buffer	Buffer

Key:

1	Hallmark + Boxer Gold (IBS)
2	Hallmark + Clethodim - low rate (5-6 node)
3	Hallmark + Ultro (IBS)
4	Hallmark + Sakura (IBS)
5	Jumbo 2 + Sakura (IBS)
6	Jumbo 2 + Ultro (IBS)
7	Hallmark + Clethodim - high rate (5-6 node)
8	Jumbo 2 + Boxer Gold
9	Hallmark + Propyzamide (IBS)
10	Jumbo 2 + Propyzamide (IBS)
11	Jumbo 2 + Clethodim - low rate (5-6 node)
12	Jumbo 2 + Clethodim - high rate (5-6 node)
13	Jumbo 2 - Nil
14	Hallmark - Nil

N →

Seeding date: May 19, 2020
Fertiliser: MAP
Fertiliser rate: 80 kg/ha

F – WHEAT VARIETY UPDATE

NOTES ON NEWER RELEASES AND NUMBERED LINES

LPB18-7946 appears in Hart's winter and awnless wheat time of sowing trial. It is an awnless Scout type variety, likely to be released with AH classification. Hay quality of LPB18-7946 is similar to Mulgara.

LPB18-7982 is derived from a Scout and Yitpi cross. This awnless variety is showing maturity and phenology traits similar to Scepter. LPB18-7982 could be suitable for release soon with yields expected to be greater than LPB18-7946. This variety appears in Hart's winter and awnless wheat time of sowing trial.

Hammer CL Plus⦹ **(OAGT0016)** will be an imidazolinone herbicide tolerant (Clearfield®) variety. It is a Mace type with similar maturity and yield. Hammer CL Plus has AH classification in the Southern Zone with low screenings and high test weight.

Ballista⦹ **(RAC2598)** Is a high yielding variety with maturity similar to Corack. It is earlier than Mace but longer than Vixen with CCN resistance comparable to Scepter and Mace. Evaluation of Ballista in 2019 has shown improved yield over Scepter and has AH quality classification.

Denison⦹ **(WAGT734)** appears in Hart's winter and awnless wheat time of sowing trial. Denison is an early sowing spring Mace cross with maturity similar to Pascal, maturing earlier than Longswood and later than Catapult. Expected AH classification in Southern Zone SA/Vic.

Catapult⦹ **(RAC2484)** was released by AGT in August 2019 and may be viewed as a longer season Scepter, with a mid-late maturity allowing growers to achieve Scepter-like yields when sown in late April. Catapult offers a unique combination of features to growers, combining this maturity type with yellow leaf spot resistance, CCN resistance and AH quality (in SA/Vic/sNSW). Seed available for the 2020 growing season.

Devil⦹ is a high yielding, early-mid maturing wheat with similar phenology to Mace, distinctly earlier than Scepter. Devil was released by InterGrain in 2018 and has an AH and APWN classification. Devil offers strong yellow spot resistance (MRMS) and good stripe rust (MR) resistance.

LRPB Nighthawk⦹ is a slow maturing spring wheat with a unique set of maturity holds that allows planting in earlier systems that don't suit traditional winter wheat types. It has demonstrated high yields throughout the April sowing window across early sowing and time of seeding trials. High tiller number and semi prostrate early growth habit that becomes more erect than the traditional winter types in early spring with medium tall in height and good standability. LRPB Nighthawk has APW Classification in the Southern Zone for SA/Vic.

Razor CL Plus⦹ is an imidazolinone herbicide tolerant (Clearfield® Plus) ASW wheat released by AGT. Razor CL Plus is an early developing variety slightly quicker than Mace. The long-term performance of Razor CL Plus suggests it is the highest yielding Clearfield variety and on average is 3% higher than Mace. Razor CL Plus is rated S to leaf rust, MRMS to stem and MS to stripe rust, MSS to yellow leaf spot, and MR to CCN.

RockStar⦹ **(IGW4341)** is an exceptionally high-yielding, mid-late flowering AH variety. It has a similar flowering time to Trojan. RockStar provides exceptional yields and sets a new yield benchmark for this flowering class. It offers very good powdery mildew (Rp), yellow spot (MRMSp) and stripe rust (MRMSp) resistance. RockStar is well suited to earlier sowing opportunities, performing best in longer growing seasons. It has a good grain size, good test weight and has a moderate plant height, similar to Mace. RockStar is available for planting in 2020 from local resellers and Seedclub members.

Sheriff CL Plus⑴ is an imidazolinone herbicide tolerant (Clearfield® Plus) APW wheat released by Intergrain in 2018. Sheriff CL Plus is a mid – late developing variety similar to Trojan in developmental speed and can be sown slightly earlier than the other Clearfield options. The long-term performance of Sherriff CL Plus suggests it yields similar to Mace. Sheriff CL Plus is rated SVS to leaf rust, MSS to stem and stripe rust, MRMS to yellow leaf spot, and MS to CCN.

Vixen⑴ is an early – mid season variety that develops slightly quicker than Scepter. Vixen was released by InterGrain in 2018 and has an AH Classification in SA. Vixen has not been widely evaluated in some regions for more than one year. Long term data suggested performance is similar to Scepter, however it performed slightly above Scepter in 2016 evaluation. Vixen is rated SVS to leaf rust, MRMS to stem and stripe rust, MRMS to yellow leaf spot, and MSS to CCN.

LPB15-2485 is a higher tillering Trojan type with slightly later maturity and stronger maturity holds that suits the front end of the main season planting window and has shown stable yields across a wide range of sowing times. Premium quality classification is expected for this line as it has shown excellent data over a number of years. Good agronomy with medium height canopy with erect growth habit and solid disease package.

Table 1. Wheat variety performance at Hart by year (expressed as % of trial average).

		% of trial average					Grain yield (t/ha)
Quality	**Variety**	**2015**	**2016**	**2017**	**2018**	**2019**	**2019**
	Arrow	105	98	103	102	90	1.36
	Beckom			112	104	110	1.65
	Catapult (RAC2484)					97	1.46
	Cobra	104	105	100	96	99	1.49
	Cosmick	105	101	97	98	105	1.58
	Devil					104	1.56
	Emu Rock	100	99	98	104	104	1.57
AH	Grenade CLPlus	102	96	95	110	93	1.40
	Hatchet CLPlus	51	88	86	106		
	Havoc			97	85	96	1.44
	Kord CLPlus	97	90	97	100	91	1.37
	Mace	100	94	102	95	95	1.43
	Rockstar (IGW4341)					104	1.56
	Scepter	110	106	111	113	106	1.59
	Scout	110	103	107	107	107	1.61
	Vixen					111	1.67
	Corack	95	96	86	86		
	Chief CL Plus				87	85	1.27
	Cutlass	104	119	104	117	98	1.47
APW	DS Pascal			90	86		
	Estoc	104	108	96	100		
	Sheriff CL Plus					96	1.44
	Trojan	113	121	113	106	102	1.53
ASW	Razor CLPlus			103	104	109	1.64
Unclass	LPB15-2485					98	1.47
	Trial mean yield (t/ha)	4.27	3.87	3.83	2.13	1.50	
	Sowing date	May 6	May 10	May 8	May 14	May 15	
	Apr-Oct rain (mm)	230	356	191	160	162	
	Annual rain (mm)	353	485	331	224	189	

Awnless and winter wheat variety trial plan

Buffer	Buffer	Buffer
TOS_1_Orion	TOS_1_DS Bennett	TOS_1_Catapult
TOS_1_Nighthawk	TOS_1_LPB18-7982	TOS_1_Denison
TOS_1_Scepter	TOS_1_LPB18-7946	TOS_1_Illabo
Buffer	Buffer	Buffer
TOS_2_LPB18-7982	TOS_2_LPB18-7982	TOS_2_Illabo
TOS_2_Orion	TOS_2_LPB18-7946	TOS_2_Denison
TOS_2_Scepter	TOS_2_Nighthawk	TOS_2_DS Bennett
TOS_2_Nighthawk	TOS_2_LPB18-7982	TOS_2_Orion
TOS_2_Illabo	TOS_2_Catapult	TOS_2_Scepter
TOS_2_DS Bennett	TOS_2_Denison	TOS_2_LPB18-7946
Buffer	Buffer	Buffer
TOS_1_Catapult	TOS_1_LPB18-7982	TOS_1_DS Bennett
TOS_1_Orion	TOS_1_Denison	TOS_1_Scepter
TOS_1_LPB18-7946	TOS_1_Illabo	TOS_1_Nighthawk
TOS_1_Denison	TOS_1_Nighthawk	TOS_1_Illabo
TOS_1_Scepter	TOS_1_LPB18-7946	TOS_1_Catapult
TOS_1_LPB18-7982	TOS_1_Orion	TOS_1_DS Bennett
Buffer	Buffer	Buffer
TOS_2_DS Bennett	TOS_2_LPB18-7982	TOS_2_Nighthawk
TOS_2_Scepter	TOS_2_Catapult	TOS_2_LPB18-7946
TOS_2_Denison	TOS_2_Orion	TOS_2_Illabo
Buffer	Buffer	Buffer

N →

Seeding date: TOS 1: 20 April, TOS 2: 6 May
Fertiliser: DAP
Fertiliser rate: 80 kg/ha

Wheat variety trial plan

Buffer	Buffer	Buffer
Razor CL Plus	Grenade CL	Catapult
Ballista	Mace	Devil
Vixen	Rockstar	Emu Rock
Hammer CL Plus	Sheriff CL Plus	Nighthawk
Cutlass	Trojan	Chief CL Plus
Scout	Scepter	LPB15-2485
Trojan	Devil	Scepter
Chief CL Plus	Catapult	Cutlass
RockStar	Nighthawk	Ballista
LPB15-2485	Emu Rock	Mace
Grenade CL	Razor CL Plus	Scout
Sheriff CL Plus	Hammer CL Plus	Vixen
Nighthawk	Chief CL Plus	Sheriff CL Plus
Scepter	Vixen	Trojan
Mace	LPB15-2485	Hammer CL Plus
Emu Rock	Scout	Grenade CL
Catapult	Cutlass	RockStar
Devil	Ballista	Razor CL Plus
Buffer	Buffer	Buffer

N →

Seeding date: 6 May
Fertiliser: DAP
Fertiliser rate: 80 kg/ha

G – SUSTAINABLE USE OF IMI-TOLERANT TECHNOLOGY IN HIGH BREAK CROP INTENSITY (HBCI) FARMING SYSTEMS

AUTHORS: Navneet Aggarwal and Penny Roberts SARDI, Larn McMurray, formerly SARDI.

KEY FINDINGS

- Use of imidazolinone (IMI) herbicides in two consecutive years, i.e. in the break crop phase and the subsequent cereal crop, did not provide additional benefit for broadleaf weed control.
- The greatest benefit from using IMI herbicides to manage broadleaf weeds was in the break crop phase, with benefits of carryover in the following cereal phase.
- Rotating herbicides with alternative modes of action in the cereal phase {such as LVE MCPA (Group I), clopyralid (Group I), bromoxynil + dicamba (Group C and I), MCPA Amine (Group I), Affinity (Group G), and Paradigm (Group I + B)} improved bifora, bedstraw and vetch control in high break crop intensity systems.
- Use of chlorsulfuron in wheat (on label) instead of lentil (off-label industry practice) provided extra benefits for bifora control in the lentil-wheat sequence.

Background

The introduction of herbicide tolerant break crop options including XT lentil, Clearfield® canola, TT canola, and PBA Bendoc have broadened the weed control options in these crops and have resulted in better management of hard to control grass weeds like brome grass and multiple broadleaf weeds (Boutsalis et al. 2016). This, coupled with better economic returns, has increased their adoption by South Australian growers. Traditionally, break crops were included once every three to six years in the crop rotation. However, the frequency has now increased and, in some regions, has become equal to cereal crops or even greater in some cases.

The increased adoption of herbicide tolerant break crops has resulted in over-reliance on a few modes of action, especially Group B herbicides. Moreover, availability of multiple Clearfield® resistant cereal crops (wheat and barley), and now an IMI-tolerant oaten hay crop, has provided multiple IMI tolerant crop options across both cereal and break crop phases of the cropping rotation. The increased reliance on Group B herbicide tolerant crops and recurrent use of imidazolinone herbicides for broadleaf weed control has increased the risk of shifting the weed flora, and the development of resistant weeds to these herbicides. Recent random surveys (Boutsalis et al. 2016) conducted in different regions of SA that recorded 33% of surveyed paddocks with resistant wild turnip in the SA-Mallee region and 13-14% paddocks with Indian Hedge Mustard resistant to the IMI herbicide Intervix®. Similarly, common sowthistle has been reported to develop resistance to Intervix and Imazapic in 65 and 88% respectively of the high break crop intensity (HBCI) paddocks

(paddocks with at least two break crops in last 5-6 years), in SA (Aggarwal et al. 2019).

Another issue is the development of cross-resistance within a group of herbicides having the same mode of action. A weed population that is resistant to sulfonylureas can be cross-resistant to IMI herbicides even if the population has never been exposed to IMIs (Boutsalis and Powles 1995), and 50% of the common sowthistle populations resistant to sulfonylureas were found to be cross-resistant to IMI herbicides from the paddocks where IMI herbicides were not used in last 5-6 years (Aggarwal et al. 2019). This suggests a need to develop sustainable methods for use of IMI-crops in HBCI systems that involve the regular use of different IMI herbicides with the same mode of action. The inclusion of diverse mode of action herbicides along with reduced use of AHAS chemistries in crop rotations has the potential to increase the heterogeneity of the selection pressure and thereby reduce or delay the build-up of IMI-herbicide resistant weeds (Boutsalis et al. 2016).

In the GRDC-SARDI funded project 'DAS00168 BA', research work was undertaken at the Hart Field site and at a farmer's paddock in Bute in 2018 and 2019 to investigate strategies for sustainable use of IMI chemistries in HBCI systems. The research investigated whether to use IMI herbicides in the break crop phase or cereal phase, the frequency of IMI use in a crop rotation, and the carryover effect on following cereal or break crops with respect to impact on broadleaf weeds.

How was it done?

A canola-wheat-barley-lentil trial was established at the Hart field site (Mid-North) in 2017, to investigate sustainable use of IMI herbicides in HBCI rotations. Vetch and bedstraw seeds were sown in 2017 to build up the weed population at the trial site, with treatments initiated from 2018.

Another lentil-wheat-lentil-wheat trial was established in 2018 within a farmer's paddock at Bute (Yorke Peninsula) having a background population of bifora.

Location: Hart

Plot size	3.5 m × 10 m (12 crop rows)	
Seeding date	June 5, 2018	May 30, 2019
Crop season rainfall	129 mm	132 mm
Design	Split-plot design	

Herbicides used in 2018 and 2019:
Canola: Lontrel (Group I) POST ± OnDuty (Group B) POST
Wheat: Eclipse (Group B) POST + LVE MCPA (Group I) POST + clopyralid (Group I) POST ± OnDuty (Group B) POST
Barley: Bromoxynil + dicamba (Group C and I) POST ± imazamox + imazapyr (Group B) POST
Lentil: Metribuzin (Group C) PSPE + Broadstrike (Group B) or imazamox + imazapyr (Group B) POST

Location: Bute

Plot size	3.5 m × 10 m (12 crop rows)	
Seeding date	June 19, 2018	May 8, 2019
Crop season rainfall	142 mm	182 mm
Design	Split-plot design	

Herbicides used in 2018:
Wheat: {MCPA Amine (I) POST + Affinity (G) POST} ± {Paradigm (I + B) + LVE-MCPA (I)} ± OnDuty (B) POST
Lentil: Metribuzin (C) PSPE + Broadstrike (B) or imazamox + imazapyr (B) POST ± chlorsulfuron (IBS)

Herbicides used in 2019:
Wheat: {MCPA Amine (I) POST + Affinity (G) POST} ± chlorsulfuron ± OnDuty (B) POST
Lentil: Metribuzin (C) PSPE + Broadstrike (B) or imazamox + imazapyr (B) POST ± chlorsulfuron (IBS)

Results and discussion

At Hart, the use of non-IMI herbicides LVE MCPA (Group I) POST + clopyralid (Group I) POST + Eclipse (Group B) POST in wheat, and bromoxynil + dicamba (Group C and I) POST in the barley phase resulted in similar levels of vetch and bedstraw bifora control as achieved with both non-IMI + IMI herbicides (OnDuty POST in wheat, and imazamox + imazapyr POST in barley) in the lentil-canola-wheat-barley system in 2018 and 2019 (Tables 1 and 2). Furthermore, non-IMI herbicides alone provided a similar level of vetch control in canola, and bedstraw in the lentil phase, compared to the use of both non-IMI + IMI herbicides. The use of IMI-herbicides was essential for control of vetch in the lentil phase and bedstraw in the canola phase in 2018. The results were similar in 2019, with the exception that non-IMI herbicides provided effective control of vetch in lentil and bedstraw in canola (Table 2). Very low rainfall (35 mm) following the POST herbicide application until harvest in 2019 may have resulted in lower seed set on stressed vetch and bedstraw plants in non-IMI treatments as well. When an IMI herbicide was used in the 2018 break crop phase, there was no additional benefit in controlling vetch and bedstraw with the additional use of an IMI herbicide in the 2019 cereal crop that followed.

Table 1. Vetch and bedstraw seed set as affected by different herbicide treatments in lentil-canola-wheat-barley system at Hart in 2018.

Crop	Vetch seed set/m²		Bedstraw seed set/m²	
	IMI frequency			
	Only non-IMI herbicides	IMI herbicides + non-IMI herbicides	Only non-IMI herbicides	IMI herbicides + non-IMI herbicides
Canola	0[b]	0[b]	78[a]	0[b]
Wheat	0[b]	0[b]	0[b]	0[b]
Barley	0[b]	0[b]	0[b]	0[b]
Lentil	122[a]	11[b]	0[b]	0[b]

Table 2. Vetch and bedstraw seed set as affected by different herbicide treatments in lentil-canola-wheat-barley system at Hart in 2019.

Crop	Vetch seed set/m²			Bedstraw seed set/m²		
	Only non-IMI herbicides in two years	IMI herbicides only in 2018 + non-IMI herbicides (2018 and 2019)	IMI herbicides twice in two years (2018, 2019) + non-IMI herbicides (2018 and 2019)	Only non-IMI herbicides in two years	IMI herbicides only in 2018 + non-IMI herbicides (2018 and 2019)	IMI herbicides twice in two years (2018, 2019) + non-IMI herbicides (2018 and 2019)
Canola	0	0	0	0	0	0
Wheat	1.4	0	0	0.5	2.5	0
Barley	0.1	0.7	0	0	0.1	1.0
Lentil	0	0.3	0	0	0	0
LSD 5%		NS			NS	

In a lentil-wheat-lentil-wheat system trial at Bute in 2018, the use of non-IMI herbicides (MCPA Amine (I) POST + Affinity (G) POST, and Paradigm (I + B) + LVE-MCPA (I)) in wheat was the best option for controlling bifora, and provided a similar level of weed control to the use of both non-IMI + IMI herbicides (OnDuty POST) (Figure 1). Further, MCPA Amine POST + Affinity POST combination proved equally effective for bifora control (8 bifora seeds/m²) in wheat as the same treatment with additional sprays of Paradigm + LVE-MCPA POST (17 bifora seeds/m²). On the other hand, IMI herbicide was essential for bifora control in lentil. Further, use of imazamox + imazapyr (POST) achieved a similar level of bifora control (107 bifora seeds/m²) compared to the common off-label industry practice of chlorsulfuron (IBS) + imazamox + imazapyr (POST) (158 bifora seeds/m²).

In 2019, again non-IMI herbicides alone were as effective as non-IMI + IMI herbicides in wheat (Table 3). Additional application of chlorsulfuron along with MCPA Amine + Affinity proved a more effective broadleaf weed control strategy in wheat that followed the IMI lentil phase compared to wheat that followed a non-IMI lentil phase. Similarly, there was improved bifora control in lentil that followed a wheat crop with IMI herbicide used in the previous season compared to lentil that followed a wheat crop without IMI herbicide, although overall level of bifora control was higher in wheat plots.

Further, in a lentil-wheat sequence, use of IMI herbicides once in two years in the lentil phase and no-IMI herbicides in succeeding wheat proved as effective as IMI herbicides used both in lentil and wheat crops consecutively (Table 3). Therefore, using IMI herbicides in the break crop phase and saving it in cereal phase proved a better strategy, and using chlorsulfuron in wheat (on label) instead of lentil (off-label industry practice) provided extra benefits for bifora control in the lentil-wheat sequence.

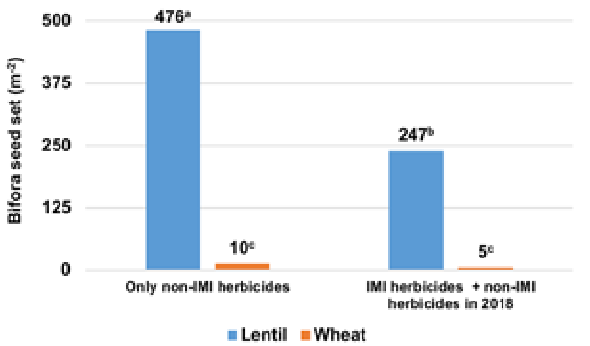

Figure 1. Bifora seed set in wheat and lentil as affected by IMI and non-IMI herbicides at Bute in 2018.

Table 3. Effect of herbicides on bifora management in wheat and lentil at Bute in 2019.

Crop	Strategy	Bifora seed set/m^2		
		IMI frequency		
		Twice in two years (2018 and 2019)	Used only in 2018	No IMI use
Lentil	S1 (without chlorsulfuron)	362[c]	940[b]	2458[a]
	S2 (with chlorsulfuron)	1[e]	0[e]	0[e]
Wheat	S1 (with chlorsulfuron)	0[e]	2[e]	23[de]
	S2 (without chlorsulfuron)	16[de]	47[de]	122[cd]

Summary/implications

Broadleaf weeds developing resistance to IMI herbicides is an emerging challenge. The selection pressure imposed by frequent use of IMI herbicides for broadleaf weed control in HBCI systems, has made the current weed management systems unsustainable in the long term. A holistic approach using multiple IMI tolerant crops (wheat, barley, oaten hay, canola, lentil, faba bean) in a sustainable manner in the cropping rotation is essential to maintain this herbicide tolerance technology as a valuable broadleaf management tool. Adopting improved weed management practices by rotating IMI herbicides with other modes of action in a systems approach will reduce the selection pressure on broadleaf weeds, especially for Group B herbicides.

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Acknowledgements

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AIM: To investigate the management of group A, J & K resistant annual ryegrass in lentils.

Ryegrass management in lentils trial plan

	Bay 1	Bay 2	Bay 3
	Canola	Canola	Canola
	Buffer	Buffer	Buffer
R1	Group C: Propyzamide 1000 (IBS) + Metribuzin (post-emergent)	XT Lentil: Crop topping at RG embryo development stage	Group C: Ultro (IBS) + Metribuzin (PSPE)
R2	XT Lentil: Clipping at reproductive stage	Group C: Ultro (IBS) + Metribuzin (post-emergent)	Group C: Propyzamide 1000 (IBS)
R3	Group C: Propyzamide 1000 (IBS) + Metribuzin (post-emergent)	Group C: Untreated	Group C: Intercept 750 (post-emergent)
R4	Group C: Metribuzin (post-emergent)	XT Lentil: Wick wiping at reproductive stage	Group C: Metribuzin (PSPE)
R5	XT Lentil: Untreated	Group C: Ultro (IBS)	Group C: Ultro (IBS) + Ultro (PSPE)
R6	XT Lentil: Crop topping at RG embryo development stage	Group C: Metribuzin (PSPE)	XT Lentil: Untreated
R7	Group C: Ultro (IBS) + Ultro (PSPE)	Group C: Propyzamide 1000 (IBS) + Metribuzin (PSPE)	Group C: Ultro (IBS) + Metribuzin (post-emergent)
R8	Group C: Propyzamide 1000 (IBS)	Group C: Propyzamide 1000 (IBS) + Metribuzin (post-emergent)	Group C: Ultro (IBS)
R9	XT Lentil: Wick wiping at reproductive stage	Group C: Intercept 750 (post-emergent)	Group C: Metribuzin (post-emergent)
R10	Group C: Ultro (IBS) + Metribuzin (PSPE)	XT Lentil: Clipping at reproductive stage	Group C: Untreated
R11	Group C: Ultro (IBS)	Group C: Propyzamide 1000 (IBS)	Group C: Propyzamide 1000 (IBS) + Metribuzin (PSPE)
R12	Group C: Untreated	XT Lentil: Untreated	XT Lentil: Wick wiping at reproductive stage
R13	Group C: Metribuzin (PSPE)	Group C: Ultro (IBS) + Metribuzin (PSPE)	Group C: Propyzamide 1000 (IBS) + Metribuzin (post-emergent)
R14	Group C: Ultro (IBS) + Metribuzin (post-emergent)	Group C: Metribuz in (post-emergent)	XT Lentil: Crop topping at RG embryo development stage
R15	Group C: Intercept (post-emergent)	Group C: Ultro (IBS) + Ultro (PSPE)	XT Lentil: Clipping at reproductive stage
	Buffer	Buffer	Buffer
	Canola	Canola	Canola

Varieties: PBA Hurricane XT & Group C.

H – PRECISION PLANTER CHICKPEA TRIAL

Aim: to compare plant establishment, growth and yield of chickpeas

Precision planter chickpea trial plan

	Buffer	Buffer	Buffer	
	Treatment 2	Treatment 2	Treatment 2	Precision
	Treatment 1	Treatment 1	Treatment 1	Precision
	Treatment 3	Treatment 3	Treatment 3	Precision
	Treatment 2	Treatment 2	Treatment 2	Perfect placement
Rep 1	Treatment 3	Treatment 3	Treatment 3	Perfect placement
	Treatment 1	Treatment 1	Treatment 1	Perfect placement
	Treatment 1	Treatment 1	Treatment 1	Conventional
	Treatment 2	Treatment 2	Treatment 2	Conventional
	Treatment 3	Treatment 3	Treatment 3	Conventional
	Treatment 1	Treatment 1	Treatment 1	Precision
	Treatment 2	Treatment 2	Treatment 2	Precision
	Treatment 3	Treatment 3	Treatment 3	Precision
	Treatment 2	Treatment 2	Treatment 2	Perfect placement
Rep 2	Treatment 3	Treatment 3	Treatment 3	Perfect placement
	Treatment 1	Treatment 1	Treatment 1	Perfect placement
	Treatment 1	Treatment 1	Treatment 1	Conventional
	Treatment 2	Treatment 2	Treatment 2	Conventional
	Treatment 3	Treatment 3	Treatment 3	Conventional
	Treatment 2	Treatment 2	Treatment 2	Perfect placement
	Treatment 3	Treatment 3	Treatment 3	Perfect placement
	Treatment 1	Treatment 1	Treatment 1	Perfect placement
	Treatment 3	Treatment 3	Treatment 3	Precision
Rep 3	Treatment 2	Treatment 2	Treatment 2	Precision
	Treatment 1	Treatment 1	Treatment 1	Precision
	Treatment 1	Treatment 1	Treatment 1	Conventional
	Treatment 2	Treatment 2	Treatment 2	Conventional
	Treatment 3	Treatment 3	Treatment 3	Conventional
	Treatment 3	Treatment 3	Treatment 3	Conventional
	Treatment 2	Treatment 2	Treatment 2	Conventional
	Treatment 1	Treatment 1	Treatment 1	Conventional
	Treatment 3	Treatment 3	Treatment 3	Perfect placement
Rep 4	Treatment 1	Treatment 1	Treatment 1	Perfect placement
	Treatment 2	Treatment 2	Treatment 2	Perfect placement
	Treatment 1	Treatment 1	Treatment 1	Precision
	Treatment 3	Treatment 3	Treatment 3	Precision
	Treatment 2	Treatment 2	Treatment 2	Precision
	Buffer	Buffer	Buffer	

Note: perfect placement plots used to capture ideal target density and seed placement.

Treatment 1 - high target plant density
Treatment 2 - medium target plant density
Treatment 3 - low target plant density

Seeding date: May 14

N ⟶ **Fertiliser:** APP (N 160 g/L, P 250 g/L)

Fertiliser rate: 50 L/ha

I – DURUM VARIETIES ON DISPLAY AT HART IN 2020

DBA Vittaroiⓟ was released in 2017 by NSW DPI and is eligible for ADR grade in SA. DBA Vittaroi is a shorter durum variety with good straw strength and lodging tolerance. It has good resistance to all rusts with good grain size and lower screenings compared to other durum varieties. Maturity is similar to Saintly.

DBA Artemisⓟ was released from the Durum Breeding Australia's Southern Node (University of Adelaide) in 2019, DBA Artemis is a slower developing durum variety with a disease profile similar to DBA-Aurora. It is eligible for ADR upgrade in SA with grain yield and screening similar to both DBA-Aurora and DBA Spes.

Bitalliⓟ is well suited to a range of environments with good grain quality, high test weights and improved straw strength. It has yielded extremely well in the NVT across the southern durum growing region over the last two seasons. Bitalli is derived from a Saintly cross, maturing 1-2 days later, but earlier than DBA Aurora. Unlike Saintly, Bitalli is a fully awned variety. It also has an ADR quality classification in the Southern Zone (SA/Vic).

DBA Spesⓟ has a similar maturity to DBA-Aurora with a good disease resistance profile, similar to other durum varieties, with improved stem rust resistance (R). It has good grain size and lower screenings compared to the majority of other durum varieties. DBA Spes is eligible for APDR grade in SA and was released from the Durum Breeding Australia's Southern Node (University of Adelaide) in 2018.

Westcourtⓟ was released by AGT in 2019. This variety has mid-season maturity similar to DBA-Aurora. Westcourt has ADR quality classification in SA/Vic with good physical grain characteristics and low screenings.

DBA-Auroraⓟ was released by University of Adelaide in 2014 with seed currently available from the Southern Australia Durum Growers Association (SADGA). DBA Aurora has a good disease resistance profile, similar to that of currently available varieties. DBA-Aurora performs well in NVT trials consistently achieving high yields across all sites with improved grain size and lower screenings. DBA-Aurora shows good early vigour and grass weed competitiveness.

Table 1. Durum variety performance at Hart by year (expressed as % of trial average).

	% of trial average at Hart					Grain yield (t/ha)
Variety	**2015**	**2016**	**2017**	**2018**	**2019**	**2019**
Bitalli (AGTD088)					99	2.62
DB^{A} Aurora	102	102	100	102	103	2.72
DB^{A} Vittaroi				104	96	2.53
Hyperno	98	101	96	95	95	2.50
Saintly	97	85	100	90	97	2.54
DB^{A} Spes				102	105	2.76
Westcourt (AGTD090)					107	2.81
WID802				101	103	2.71
DBA Artemis					95	2.50
Trial mean yield (t/ha)	3.07	4.08	4.24	2.31	2.63	
Sowing date	May 6	May 10	May 9	May 15	May 15	
Apr-Oct rain (mm)	230	356	191	160	162	
Annual rain (mm)	353	485	331	224	189	

Durum variety trial plan

Buffer	Buffer	Buffer
DBA Artemis	Westcourt	DBA Vittaroi
DBA Aurora	DBA Vittaroi	DBA Artemis
Westcourt	DBA Spes	Bitalli
Bitalli	DBA Artemis	DBA Spes
DBA Vittaroi	DBA Aurora	Westcourt
DBA Spes	Bitalli	DBA Aurora
Buffer	Buffer	Buffer

N →

Seeding date: May 6
Fertiliser: DAP + Impact
Fertiliser rate: 80 kg/ha

J – BARLEY VARIETY UPDATE

NOTES ON NEWER RELEASES AND NUMBERED LINES

Leabrook⁽ᵇ⁾ variety was released in 2020 as a malting-accredited variety and was initially developed by the University of Adelaide. Leabrook is closely related to Compass, with evaluation indicating yield improvement. Maturity and straw strength are comparable to Compass with a similar disease profile, it also has good physical grain quality with high retention and low screenings.

AGTB0113 is a variety developed by AGT and is currently undergoing evaluation for release as a feed quality variety. It is derived from a Compass and Hindmarsh cross and although similar in appearance to Compass, AGTB0113 develops slightly quicker and offers greater yield potential. AGTB0113 is currently undergoing evaluation for malt accreditation.

Laperouse (WI4952) is a new barley variety bred by the University of Adelaide and will be available to growers in 2021. It is a longer season variety with maturity similar to Commander and RGT Planet. Laperouse has good straw strength and standability with improved resistance to net form net blotch. Laperouse is currently undergoing evaluation for malt accreditation.

Table 1. Barley variety performance at Hart by year (expressed as % of trial average).

		% of trial average					Grain yield (t/ha)
Quality	**Variety**	**2015**	**2016**	**2017**	**2018**	**2019**	**2019**
Feed	Banks				103	99	2.24
	Fathom	112	104	94	109	104	2.33
	Fleet	107	100	104	106	100	2.25
	Hindmarsh	108	92	98	100	103	2.32
	Keel	112	97	102	105	101	2.28
	Rosalind		104	91	102	107	2.42
Malt	Commander	100	92	102	104	93	2.11
	Compass	111	86	106	105	106	2.38
	GrangeR	93	103	108	89	93	2.11
	La Trobe	107	94	104	99	107	2.41
	Navigator	92	113	111	96	93	2.10
	RGT Planet			134	97	101	2.28
	Scope	99	94	89	89	91	2.04
	Spartacus CL	106	95	98	98	100	2.25
Pending malt accreditation	Maximus CL (IGB1705T)					102	2.30
	Mean yield (t/ha)	**4.38**	**4.62**	**4.36**	**2.86**	**2.25**	
	Sowing date	**May 6**	**May 10**	**May 8**	**May 14**	**May 15**	
	April - Oct (mm)	**230**	**356**	**191**	**160**	**162**	
	Annual rainfall (mm)	**353**	**485**	**331**	**224**	**189**	

Barley variety trial plan

Buffer	Buffer	Buffer
AGTB0113	Maximus CL	RGT Planet
Fathom	Scope CL	Leabrook
RGT Planet	Commander	Laperouse
Compass	Rosalind	Spartacus CL
LaTrobe	compass	Commander
Scope CL	Fathom	Rosalind
Laperouse	AGTB0113	Maximus CL
Spartacus CL	Leabrook	LaTrobe
Leabrook	RGT Planet	AGTB0113
Maximus CL	Laperouse	Scope CL
Commander	LaTrobe	Fathom
Rosalind	Spartacus CL	Compass
Buffer	Buffer	Buffer

N →

Seeding date: May 6, 2020
Fertiliser: DAP + Impact
Fertiliser rate: 80 kg/ha

Note: Compass was resown by hand on May 21 due to poor crop establishment.

K – ANNUAL RYEGRASS CONTROL WITH NEW PRE-EMERGENT HERBICIDES AND MIXTURES

AUTHORS: Chris Preston, University of Adelaide and Rebekah Allen, Hart Field-Site Group

BACKGROUND

Herbicide resistance in grass weeds is a major constraint to crop production. Due to resistance to post-emergent herbicides, the main control tactics used in wheat for annual ryegrass control are now pre-emergent herbicides. It is important that pre-emergent herbicides are used as effectively as possible. New mode of action herbicides are being developed for annual ryegrass; however, there is limited information about the efficacy of mixtures of these new herbicides with existing herbicides to obtain higher levels of annual ryegrass control in wheat.

Trial aim: to evaluate the effects of new pre-emergent herbicides Luximax (active ingredient cinmethylin) and Overwatch (active ingredient bixlozone) alone or in mixtures with existing pre-emergent herbicides on annual ryegrass control.

TRIAL DETAILS

Location – Hart field site, SA

Ryegrass seed was broadcast at 5 kg/ha on May 19. Herbicides were applied IBS on May 20 prior to Scepter wheat sown with a standard knife-point press wheel system 22.5 cm (9") row spacing with 80 kg/ha DAP. Herbicides used are listed in Table 1.

Table 1. Pre-emergent herbicide treatments applied for the management of ryegrass in wheat at Hart in 2020.

Herbicide treatment	Rate of product (xx/ha)
1. Nil	-
2. Arcade	3 L
3. Avadex Xtra	2 L
4. Sakura	118 g
5. Sakura Flow	210 mL
6. Sakura + Avadex Xtra	118 g + 2 L
7. Arcade + TriflurX	3 L + 1.5 L
8. Luximax	500 mL
9. Luximax + Sakura	500 mL + 118 g
10. Luximax + Avadex Xtra	500 mL + 2 L
11. Luximax + Arcade	500 mL + 3 L
12. Overwatch	1.25 L
13. Overwatch +Sakura	1.25 L + 118 g
14. Overwatch + Avadex Xtra	1.25 L + 2 L
15. Overwatch + Arcade	1.25 L + 3 L

Excellent rains occurred in early autumn leading to a moist soil profile at sowing (Figure 1). However, rainfall during May and June was below average. This likely influenced the ability of Sakura to be activated and control annual ryegrass.

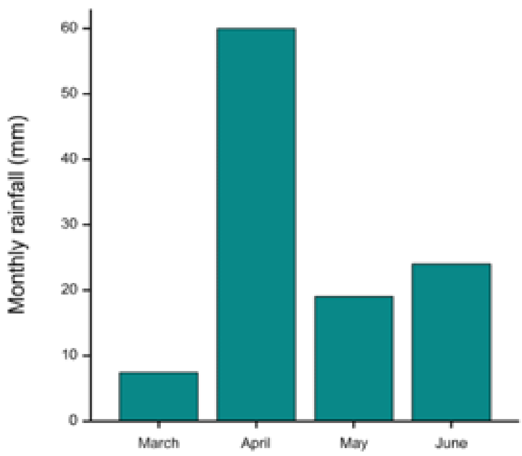

Figure 1. Monthly rainfall at Hart in 2020.

There was no significant effect of herbicide treatment on crop emergence in 2020 (Table 2). Most pre-emergent herbicides are safe on wheat when used with a knife-point press wheel seeding configuration. However, damage can occur with some pre-emergent herbicides if the furrow wall collapses or herbicide-treated soil is moved into the crop row.

Overwatch often produces crop effect on wheat as bleaching of young leaves. Crops grow out of this effect and in our trials, there has been no effect on crop yield to date. Mixtures of Group K herbicides with Luximax can result in crop yield loss and are not recommended. The mixture with Sakura used here can be particularly problematic. While the crop establishes normally, growth is affected leading to yield loss.

Both Luximax and Overwatch provided good control of annual ryegrass. Control was improved with these herbicides when compared to existing pre-emergent herbicides. The rate of Avadex Xtra used in this trial is too low when used as a stand-alone product for the control of annual ryegrass.

Luximax is the most soluble of the herbicides used in this trial and would have been least affected by the relatively dry conditions after sowing. Overwatch is a little more soluble than both Sakura or Arcade and this would have helped its performance in the drier conditions after sowing in 2020. While pre-emergent herbicides have generally worked well in 2020, situations with low rainfall after sowing, such as at Hart, have seen reduced performance of Sakura, while Overwatch and Luximax have performed well.

Table 2. Effect of different pre-emergent herbicides on wheat establishment and annual ryegrass plant numbers 4 WAS at Hart in 2020.

Herbicide treatment	Crop establishment (plants/m²)	Annual ryegrass (plants/m²)
1. Nil	164	183 f
2. Arcade	174	123 e
3. Avadex Xtra	165	120 e
4. Sakura	158	85 de
5. Sakura Flow	168	70 bcde
6. Sakura + Avadex Xtra	165	48 abcd
7. Arcade + TriflurX	174	82 cde
8. Luximax	144	10 a
9. Luximax + Sakura	160	11 a
10. Luximax + Avadex Xtra	145	11 a
11. Luximax + Arcade	161	16 ab
12. Overwatch	188	26 abc
13. Overwatch +Sakura	156	20 ab
14. Overwatch + Avadex Xtra	171	20 ab
15. Overwatch + Arcade	158	12 a

Mean values within column followed by different letters are significantly different.

ACKNOWLEDGEMENTS

Funding for this work was provided through GRDC project UQ00080.

New pre-emergent herbicides for grass and broadleaf weed control trial plan

B	Buffer	Buffer	Buffer
1	Untreated control	Avadex Xtra (triallate) 2.0L/ha	Luximax 500 ml/ha
2	Sakura 118 g/ha	Sakura 118 g/ha	Luximax 500 ml/ha + Sakura 118 g/ha
3	Sakura Flow 210 ml/ha	Luximax 500 ml/ha + Arcade (prosulfocarb) 3.0 L/ha	Avadex Xtra (triallate) 2.0L/ha
4	Sakura 118 g/ha + Avadex Xtra (triallate) 2.0 L/ha	Luximax 500 ml/ha + Avadex Xtra (triallate) 2.0 L/ha	Sakura 118 g/ha + Avadex Xtra (triallate) 2.0 L/ha
5	Arcade (prosulfocarb) 3.0 L/ha	Overwatch 1250 ml/ha	Overwatch 1250 ml/ha + Sakura 118 g/ha
6	Avadex Xtra (triallate) 2.0L/ha	Luximax 500 ml/ha + Sakura 118 g/ha	Arcade (prosulfocarb) 3.0 L/ha
7	Luximax 500 ml/ha	Sakura Flow 210 ml/ha	Untreated control
8	Luximax 500 ml/ha + Avadex Xtra (triallate) 2.0 L/ha	Overwatch 1250 ml/ha + Sakura 118 g/ha	Sakura 118 g/ha
9	Luximax 500 ml/ha + Arcade (prosulfocarb) 3.0 L/ha	Arcade 3.0 L/ha + 1.5L Trifluralin	Luximax 500 ml/ha + Avadex Xtra (triallate) 2.0 L/ha
10	Luximax 500 ml/ha + Sakura 118 g/ha	Overwatch 1250 ml/ha + Avadex Xtra (triallate) 2.0 L/ha	Overwatch 1250 ml/ha
11	Overwatch 1250 ml/ha	Arcade (prosulfocarb) 3.0 L/ha	Overwatch 1250 ml/ha + Avadex Xtra (triallate) 2.0 L/ha
12	Overwatch 1250 ml/ha + Avadex Xtra (triallate) 2.0 L/ha	Overwatch 1250 ml/ha + Arcade (prosulfocarb) 3.0 L/ha	Arcade 3.0 L/ha + 1.5L Trifluralin
13	Overwatch 1250 ml/ha + Arcade (prosulfocarb) 3.0 L/ha	Luximax 500 ml/ha	Overwatch 1250 ml/ha + Arcade (prosulfocarb) 3.0 L/ha
14	Overwatch 1250 ml/ha + Sakura 118 g/ha	Untreated control	Luximax 500 ml/ha + Arcade (prosulfocarb) 3.0 L/ha
15	Arcade 3.0 L/ha + 1.5L Trifluralin	Sakura 118 g/ha + Avadex Xtra (triallate) 2.0 L/ha	Sakura Flow 210 ml/ha
16	Untreated control	Voraxor @ 200 mL/ha + Luximax @ 500 mL/ha	Voraxor @ 200 mL/ha
17	Callisto @ 200 mL/ha	Voraxor @ 200 mL/ha	Callisto @ 200 mL/ha + Boxer Gold @ 2.5 L/ha
18	Callisto @ 200 mL/ha + Boxer Gold @ 2.5 L/ha	Callisto @ 200 mL/ha	Voraxor @ 200 mL/ha + Luximax @ 500 mL/ha
19	Voraxor @ 200 mL/ha	Callisto @ 200 mL/ha + Boxer Gold @ 2.5 L/ha	Untreated control
20	Voraxor @ 200 mL/ha + Luximax @ 500 mL/ha	Untreated control	Callisto @ 200 mL/ha
B	Buffer	Buffer	Buffer

N →

Seeding date: Weeds hand spread May 19. Treatments and wheat sown May 20.

Fertiliser: DAP + Impact **Fertiliser rate:** 80 kg/ha

Treatment list:

Grass herbicides	
1	Untreated control
2	Sakura 118 g/ha
3	Sakura Flow 210 ml/ha
4	Sakura 118 g/ha + Avadex Xtra (triallate) 2.0 L/ha
5	Arcade (prosulfocarb) 3.0 L/ha
6	Avadex Xtra (triallate) 2.0L/ha
7	Luximax 500 ml/ha
8	Luximax 500 ml/ha + Avadex Xtra (triallate) 2.0 L/ha
9	Luximax 500 ml/ha + Arcade (prosulfocarb) 3.0 L/ha
10	Luximax 500 ml/ha + Sakura 118 g/ha
11	Overwatch 1250 ml/ha
12	Overwatch 1250 ml/ha + Avadex Xtra (triallate) 2.0 L/ha
13	Overwatch 1250 ml/ha + Arcade (prosulfocarb) 3.0 L/ha
14	Overwatch 1250 ml/ha + Sakura 118 g/ha
15	Arcade 3.0 L/ha + 1.5L Trifluralin

Broadleaf Herbicides	
1	Untreated control
2	Callisto @ 200 mL/ha
3	Callisto @ 200 mL/ha + Boxer Gold @ 2.5 L/ha
4	Voraxor @ 200 mL/ha
5	Voraxor @ 200 mL/ha + Luximax @ 500 mL/ha

L – CANOLA BLACKLEG TRIAL

AIMS:

- To confirm that resistant (R) groups and blackleg ratings are working
- Determine the timing of flowering severity, fungicide effects and yield response
- Determine crown canker yield loss from fungicide options
- Provide seasonal advice on regional crown canker and Upper canopy infection (UCI)

Note: No fungicide treatments have been applied to intensive site plots. Site was inoculated with infected canola stubble prior to seeding, however, disease levels have remained very low due to dry seasonal conditions. There has been no movement of infection into the upper canopy to date.

Variety (fungicide site): ATR Mako

Canola blackleg trial plan

Buffer	Buffer	Buffer	
SDHI + 8-10L	SDHI + 8-10 L + 30% bloom + pod	SDHI + 30 % bloom	Fungicide site
Untreated	SDHI (seed only)	SDHI + 8-10L	
SDHI + 8-10 L + 30% bloom + pod	SDHI + 8-10L	Untreated	
SDHI (seed only)	SDHI + 30 % bloom	SDHI + 8-10 L + 30% bloom + pod	
SDHI + 30% bloom	Untreated	SDHI (seed only)	
Hyola 350TT	Pioneer Sturt	Hyola 559TT	Intensive Site
ATR-Bonito	HyTTec Trophy	DG560	
DG560	Hyola 350TT	Group H	
SFR65-017TT	ATR-Bonito	SF Turbine TT	
ATR-Stingray	Group H	SFR65-017TT	
Hyola559TT	SFR65-017TT	Hyola 350TT	
Group H	Hyola 559TT	HyTTec Trophy	
HyTTec Trophy	SF Turbine TT	ATR-Stingray	
SF Turbine TT	DG560	Pioneer Sturt	
Pioneer Sturt	ATR-Stingray	ATR-Bonito	
Buffer	Buffer	Buffer	

N →

Seeding date: May 5, 2020
Fertiliser: DAP (untreated)
Fertiliser rate: 80 kg/ha

M – PASTURE DEMONSTRATION

VETCH BLENDS	VETCH/OATS	1
	VETCH/OATS	2
	VETCH/BARLEY	3
	VETCH/BARLEY	4
	VETCH/CANOLA	5
	VETCH/CANOLA	6
VETCH	TIMOK	7
	TIMOK	8
	POPPANY	9
	POPPANY	10
	BUFFER	
LUCERNE	SARDI 7 SERIES 2	11
	SARDI 7 SERIES 2	12
	SARDI GRAZER	13
	SARDI GRAZER	14
	SW9720	15
	SW9720	16
	L71	17
	L71	18
	TITAN 5	19
	TITAN 5	20
	TITAN 7	21
	TITAN 7	22
	SW20	23
	SW20	24
	SW03	25
	SW03	26
	BUFFER	
SUB CLOVER	DALSA	27
	DALSA	28
	MAWSON	29
	MAWSON	30
	IZMIR	31
	IZMIR	32
	URANA	33
	URANA	34
	BUFFER	
OTHER CLOVER	COBRA BALANSA	35
	COBRA BALANSA	36
	NITRO PERSIAN	37
	NITRO PERSIAN	38
	ZULU II	39
	ZULU II	40
MEDIC	PM 250 MEDIC	41
	PM 250 MEDIC	42
	SULTAN SU MEDIC	43
	SULTAN SU MEDIC	44
	BUFFER	

N →

Seeding date: May 6
Fertiliser: MAP
Fertiliser rate: 80 kg/ha

Vetch/oats - Poppany/Mulgara
Vetch/barley - Timok/Fathom
Vetch/canola - Timok/StingrayTT

N – 2020 PRECISION PLANTER WHEAT

Aim: to compare plant establishment, growth and yield of wheat with conventional air-seeder and precision planter.

Precision planter wheat trial plan

	Buffer	Buffer	Buffer	
Rep 1	90 plants/m^2	90 plants/m^2	90 plants/m^2	Precision
	180 plants/m^2	180 plants/m^2	180 plants/m^2	Precision
	90 plants/m^2	90 plants/m^2	90 plants/m^2	Conventional
	180 plants/m^2	180 plants/m^2	180 plants/m^2	Conventional
Rep 2	90 plants/m^2	90 plants/m^2	90 plants/m^2	Precision
	180 plants/m^2	180 plants/m^2	180 plants/m^2	Precision
	180 plants/m^2	180 plants/m^2	180 plants/m^2	Conventional
	90 plants/m^2	90 plants/m^2	90 plants/m^2	Conventional
Rep 3	180 plants/m^2	180 plants/m^2	180 plants/m^2	Precision
	90 plants/m^2	90 plants/m^2	90 plants/m^2	Precision
	90 plants/m^2	90 plants/m^2	90 plants/m^2	Conventional
	180 plants/m^2	180 plants/m^2	180 plants/m^2	Conventional
	Buffer	Buffer	Buffer	

N →

Seeding date: May 14
Fertiliser: APP (N 160g/L, P 250g/L)
Fertiliser rate: 50 L/ha
Variety: Scepter

Note: treatments are target densities not actuals.

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O – WHEAT SEPTORIA TRIAL

AIMS:

- To compare various application timings of foliar fungicide to assess the control of Septoria tritici.
- Assess whether or not the use of seed treatment (fluquinconazole) gives any additional control and/or suppression of Septoria tritici.
- Determine which timing is best suited for the low-moderate rainfall zone.

Wheat septoria trial plan

Note: Due to seasonal conditions, an early target application timing of GS31 (first node) was not applied. Applications at GS39 (Flag leaf) were applied August 13th and again at GS55 (50% head emergence) on September 1. There has been no Septoria tritici observed in this trial to date.

Buffer	Buffer	Buffer	
GS55	Seed+GS39	GS39	Scepter
		GS55	
Untreated	GS55	Seed Trt	
Seed Trt	GS39		
Seed+GS39	Untreated	Seed+GS39	
GS55	Seed Trt	Untreated	
GS55	GS39	GS39	Trojan
Seed Trt	Untreated		
Seed+GS39	Seed+GS39	Seed Trt	
Untreated		Seed+GS39	
	Seed Trt	Untreated	
GS39	GS55	GS55	
Buffer	Buffer	Buffer	

N →

Seeding date: May 6
Fertiliser: DAP + Impact
Fertiliser rate: 80kg
Seed treatment: Jockey Stayer (167 g/L Fluquinconazole)
Rate: 450 ml/100kg seed
Foliar product: Tazer Xpert (80 g/L azoxystrobin + 31.25 g/L Epoxiconazole) + Banjo @ 1%
Rate: 500 ml/ha

D – CANOLA VARIETIES

AUTHOR: Andrew Ware, EPAG Research

There will be several new canola varieties available for production in 2021. These include SF Dynatron TT, Hyola Blazer TT, Hyola Enforcer CT, HyTTec Trifecta, InVigor T 6010 and Pioneer 44Y94CL. Further to this, 2021 brings the first year that South Australian growers may be able to grow genetically modified canola (glyphosate tolerant). There may be further variety releases in the months to follow with seed possibly available for planting in 2021, but these cannot be confirmed at this time.

NOTES ON VARIETIES AT HART 2020 AND NEWLY RELEASED VARIETIES

Disease ratings for cultivars

S	susceptible
MS	moderately susceptible
MR	moderately resistant
R	resistant

TRIAZINE TOLERANT (TT) VARIETIES

ATR Bonito early to mid season maturing open pollinated variety. Short - medium height. Suited to low - medium rainfall areas. Blackleg resistance rating of MS (resistance Group A). Tested in NVT trials 2012-18. Marketed by Nuseed (EPR $5.00/t ex GST).

DG 670TT a mid to late maturity triazine tolerant hybrid. Medium to tall plant height. Suited to medium - high rainfall areas. Blackleg resistance of MR (resistance Group BF). Tested in NVT in 2016-20. Marketed by Nutrien Ag Solutions and Seednet.

Hyola® 350TT an early maturing TT hybrid with. Medium plant height and is suited for low to medium rainfall zones. Blackleg resistance rating of R (resistance Groups ABDF). Tested in NVT trials in 2016-20. Bred and marketed by Pacific Seeds.

Hyola® Blazer TT is a new release. A mid to early maturing TT hybrid. It has medium to short plant height and has a blackleg resistance rating R (resistance groups to be determined). It is suited for low to medium and high rainfall zones. Replacement for Hyola 550TT, 559TT and 650TT. Tested in NVT trials 2019-20. Bred and marketed by Pacific Seeds.

HyTTec Trident an early maturity hybrid canola. It has a medium to tall plant height with blackleg rating of R (resistance Group AD). Tested in NVT trials 2017-20. HyTTec Trident is marketed with an EPR of $10/tonne, but a reduced seed price compared to other hybrid varieties. Bred and marketed by Nuseed.

HyTTec Trifecta a new release. A mid-maturity hybrid canola. Medium to tall plant height with provisional blackleg resistance rating of R (resistance Group ABD). Tested in NVT trials 2019-2020. HyTTec Trifecta is marketed with an EPR of $10/tonne, but a reduced seed price compared to other hybrid varieties. Bred and marketed by Nuseed.

HyTTec Trophy an early to mid-maturity hybrid canola. Medium to tall plant height. Blackleg rating of R-MR (resistance Group AD). In NVT 2017-20. HyTTec Trophy is marketed with an EPR of $10/tonne, but a reduced seed price compared to other hybrid varieties. Bred and marketed by Nuseed.

In Vigor T 4510 a mid- season hybrid variety. Medium plant height and suited to medium rainfall areas. Blackleg resistance rating of MR-MS (resistance Group BF). Tested in NVT trials 2016-19. Marketed by BASF.

In Vigor T 6010 a new release. Mid to late season hybrid variety which is suited to higher rainfall areas. BASF suggest a blackleg resistance rating of MS (resistance Group BC). Tested in NVT trials 2019-20. Marketed by BASF

Monola® 420TT a new release. A new open pollinated early maturing Monola variety. Provisional blackleg rating of MR (resistance group to be determined) with medium plant height. Tested in NVT trials 2019-20. A premium payment will apply to Monola H420TT. Closed loop market and must be delivered to Glencore Grain at Owen and Coomandook.

Monola® H421TT a new release. A new hybrid which is an early maturing Monola variety. Provisional blackleg rating of MR (resistance group to be determined). It has medium plant height and has been tested in NVT trials across 2019-20. A premium payment will apply to Monola H421TT. Closed loop market and must be delivered to Glencore Grain at Owen and Coomandook.

Pioneer 44T02 (TT) an early to mid-maturing hybrid variety. It has medium plant height, suited for low to medium rainfall areas. Blackleg resistance rating of R (resistance Group ABD). Tested in NVT trials in 2015-18. Marketed by Pioneer Brand Seeds.

Pioneer 45T03 (TT) a mid maturing triazine tolerant hybrid. Medium plant height and suited to medium to high rainfall areas. Blackleg resistance rating of R (resistance Group ABD). Tested in NVT trials 2018-20. Marketed by Pioneer Brand Seeds.

SF Dynatron TT a new release. Mid maturing hybrid canola. It is suited to medium to high rainfall areas. Medium-tall height with a high oil content. Blackleg rating of MR-MS (resistance Group BC). NVT tested 2019-20 as SFR65-061TT. Released 2020. Marketed by Seed Force. EPR $10.00.

SF Ignite TT a mid maturing hybrid. Suited to medium to high rainfall zones. Medium plant height. Blackleg resistance rating MR (resistance Group BF). Tested in NVT 2016-20. Marketed by Seed Force.

SF Spark TT an early maturing hybrid. Suited for low to medium rainfall areas. Medium plant height. Blackleg rating R (resistance Group ABDS). Tested in NVT trials 2018-20. Marketed by Seed Force.

SF Turbine TT an early to mid maturing hybrid. Excellent early vigour with a moderate height and oil content. Suited to medium rainfall areas. Blackleg resistance rating MR-MS (resistance Group BF). Tested in NVT 2015-20. Marketed by Seed Force.

DUAL TRIAZINE AND IMIDAZOLINONE TOLERANT

Hyola® 580CT a dual herbicide tolerant, Hyola® 580CT carries tolerance to both triazine and imidazolinone herbicide chemistries. It is a mid-maturing hybrid. Hyola® 580CT is thermal responsive and when sown in early-mid April, will commence flowering at a similar time to other varieties with mid - fast phenology. Medium plant height. Suited to Medium-high through to high rainfall areas. Blackleg resistance rating R (resistance Groups BC). Tested in NVT trials in 2017-20. Bred and Marketed by Pacific Seeds.

Hyola® Enforcer CT a new release. Dual herbicide tolerant, Hyola Enforcer CT carries tolerance to both triazine and imidazolinone herbicide chemistries. Mid-early maturity. Medium plant height. Suited to low-medium through to high rainfall areas. Blackleg resistance rating R (resistance groups to be determined). Tested in NVT trials in 2019-20. Bred and marketed by Pacific Seeds.

IMIDAZOLINONE TOLERANT

Pioneer 43Y92 (CL) an early maturing hybrid with medium plant height. Blackleg resistance rating of R (resistance Group B). Suited for low to medium rainfall areas and short season growing zones. Tested in NVT trials 2016-20. Marketed by Pioneer Brand Seeds.

Pioneer 44Y90 (CL) an early to mid-maturing hybrid. It has medium plant height and suited for low to medium rainfall areas. Blackleg resistance rating of R (resistance Group B). Tested in NVT trials in 2015-20. Marketed by Pioneer Brand Seeds.

Pioneer 44Y94 (CL) a new release. An early to mid maturing hybrid. Blackleg resistance rating of R (resistance Group BC). Tested in NVT trials in 2019-20. Marketed by Pioneer Brand Seeds.

Pioneer 45Y93 (CL) an early flowering, mid maturing hybrid variety. It has medium to tall plant height with a blackleg rating of R (resistance Group BC). Tested in NVT trials in 2017-20. Marketed by Pioneer Brand Seeds.

Saintly CL a mid maturity hybrid, slightly earlier than Banker with high oil content. It has medium plant height with a blackleg rating MR (resistance Group B). Tested in NVT 2016-20. Marketed by Barenbrug.

Victory® V75-03CL a mid maturing specialty (high oleic, low linoleic oil) hybrid. Medium plant height. Blackleg rating R-MR (resistance Group AB). Tested in NVT trials from 2017-2020. Bred by Cargill. Marketed by AWB under contract.

CONVENTIONAL

AV-Garnet a mid-maturing open pollinated variety. It has medium height and is widely adapted. Blackleg resistance rating of MS (resistance Group A). Tested in NVT trials 2006-2019. Bred by DPI Victoria. Marketed by Nuseed Pty Ltd.

Nuseed Diamond a early maturing hybrid. Very fast to flower. Medium plant height. Suited for low to medium rainfall areas. Blackleg resistance rating of MR (resistance Group ABF). Tested in NVT trials in 2012-20. Bred and marketed by Nuseed Pty Ltd.

Nuseed Quartz mid-maturing conventional hybrid. Replacement for AV Garnet with medium height. Blackleg resistance rating of R (resistance Group ABD). Tested in NVT trials 2016-20. Bred and marketed by Nuseed Pty Ltd.

GLYPHOSATE TOLERANT HYBRID VARIETIES

Hyola® 404RR an early, Roundup Ready® hybrid canola. Medium to medium-tall plant height. Suited for low to medium rainfall zones with a blackleg resistance rating of R-MR, (resistance Groups ABD). NVT tested 2010-2020. Bred and marketed by Pacific Seeds.

Hyola® 410XX an early to mid, Truflex® hybrid canola. It has medium to medium-tall plant height and it suited for low to medium-high rainfall zones. Blackleg resistance rating of R-MR, (resistance Groups ABD). NVT tested 2018-2020. Bred and marketed by Pacific Seeds.

Hyola® 506RR a mid maturing hybrid variety. It has medium plant height and is suited for medium to high rainfall zones. Blackleg rating R (resistance Group ABD). NVT tested 2013, 2016-19. Released 2017. Bred and Marketed by Pacific Seeds.

InVigor R 3520 an early maturing Roundup Ready® hybrid variety. Suited to early season areas or later planting. Medium plant height. Blackleg rating R-MR (resistance group unknown). NVT tested 2016-20. Released 2017. Bred and marketed by BASF.

InVigor R 4022P an early to mid-maturing Truflex® hybrid, suited to medium rainfall zones. PodGuard® technology makes it suited to later windrowing timings or direct harvest. BASF indicate a blackleg rating of MR (resistance Group ABC). NVT tested 2019-20. Bred and marketed by BASF.

InVigor R 5520P a mid-maturing Roundup Ready® hybrid variety suited to medium to high rainfall areas. PodGuard™ technology makes it suitable for flexible windrow timing or direct heading with reduced harvest losses. Medium height. Blackleg rating MR (resistance Group ABC). NVT tested 2015-20. Bred and marketed by BASF.

Pioneer® 43Y23 (RR) early maturing Roundup Ready® hybrid best suited to low to medium rainfall districts. Blackleg rating R-MR (resistance Group BC). NVT tested 2011-18. Marketed by Pioneer Brand Seeds.

Pioneer® 43Y29 (RR) early to mid-maturing Roundup Ready® hybrid variety. Suited for early sowing in a wide range of rainfall zones. Blackleg rating of R-MR (resistance Group BC). Medium height. NVT tested 2017-20 Released 2018. Marketed by Pioneer Brand Seeds.

Pioneer® 44Y27 (RR) early to mid-season Roundup Ready® hybrid variety, ideally suited to low to medium rainfall zones. Blackleg rating R-MR (resistance Group B). NVT tested 2016-19. Marketed by Pioneer Brand Seeds.

Pioneer® 45Y28 (RR) mid maturing Roundup Ready hybrid variety. Suited to medium to high rainfall zones and irrigation. Blackleg rating unknown (resistance Group BC). Medium to tall height. NVT tested in 2018-19. Released 2018. Marketed by Pioneer Brand Seeds.

XseedTM Raptor early to mid-maturing Truflex® hybrid. Blackleg rating MR (resistance Group AD). Medium height. NVT tested 2018-20. Marketed by Nuseed.

XseedTM Condor a new release. Mid maturing Truflex® hybrid. Provisional blackleg rating R (Nuseed) (resistance Group ABD). Tall height. NVT tested 2019-20. Marketed by Nuseed.

Victory® V5003RR a mid maturing Roundup Ready® specialty (high oleic, low linoleic oil) hybrid variety. Medium height. Blackleg rating R-MR (resistance Group AB). NVT tested 2013-2020. Bred by Cargill. Marketed by AWB under contract.

DUAL TRIAZINE AND ROUNDUP READY TOLERANT VARIETY

BASF 3000 TR an early maturing Roundup Ready®/ Triazine Tolerant hybrid suited for low to medium rainfall zones. Blackleg rating MS-S (resistance Group B). NVT tested 2015-19. Marketed by BASF.

DUAL IMIDAZOLINONE AND ROUNDUP READY TOLERANT VARIETY

Hyola® 540XC dual herbicide tolerant, early to mid TruFlex® + Imidazolinone hybrid canola. Suited for the medium to high rainfall zones. Hyola® 540XC is thermal responsive and when sown in early-mid-April, will commence flowering at a similar time to other varieties with mid - fast phenology. Blackleg rating R (resistance groups to be determined). NVT tested 2019-2020. Marketed by Pacific Seeds.

Hyola® Garrison XC a new release dual herbicide tolerant, early to mid-maturing Truflex® + Imidazolinone hybrid canola. Medium to medium-tall plant height. Suited for the low to medium and high rainfall zones. Blackleg resistance rating R (resistance groups to be determined). NVT tested 2019-2020. Bred and marketed by Pacific Seeds.

Canola variety trial plan

1	SF Turbine TT	1	
2	SF Ignite TT	2	
3	SF Spark TT	3	
4	Pioneer 44T02 TT	4	
5	Pioneer 45T03 TT	5	
6	ATR Bonito	6	
7	HyTTec Trophy	7	
8	HyTTec Trident	8	
9	HyTTec Trifecta	9	Nuseed Quartz
10	Hyola® 350TT	10	Nuseed Diamond
11	Hyola® 559TT	11	
12	Hyola® 580CT	12	
13	CT 90008	13	
14	InVigor T4510	14	Pioneer 44Y90 (CL)
15	InVigor T3510	15	Pioneer 43Y92 (CL)
16	DG1902TT	16	Pioneer 45Y93 (CL)
17	DG 670TT	17	Banker CL
18	DG 1903TT	18	Saintly CL

N →

Seeding date: May 5, 2020
Fertiliser: DAP + Impact
Fertiliser rate: 80 kg/ha

*2 plots sown for each variety

Table 3. Mid-North mid-season canola

Variety	Year	2015	2016	2017	2018	2019	
	Mean yield (t/ha	1.76 t/ha	2.79 t/ha	2.34 t/ha	1.34 t/ha	1.56 t/ha	
Variety	No. Trials	3	3	3	1	3	
ATR Bonito	9	96	97	96	93		Triazine Tolerant
ATR Mako	9	95	95	96	95		
ATR Stingray	7	97	96	93	87		
ATR Wahoo	5	88	97	96			
DG 670TT	9		112	108	103	108	
Hyola 350TT	6		109	107	111	111	
Hyola 559TT	13	105	103	106	113	104	
Hyola 580CT	5			100	99	96	
Hyola 650TT	8	97	102	104	106		
Hyola Enforcer CT	3					113	
HyTTec Trident	5			119	128	116	
HyTTec Trifecta	3				120	122	
HyTTec Trophy	7			115	118	115	
InVigor T 4510	10		117	113	113	117	
InVigor T 6010	3					116	
Pioneer 44T02 TT	7	108	103	106	113		
Pioneer 45T03 TT	4				97	102	
SF Dynatron TT	3					116	
SF Ignite TT	9		112	108	101	105	
SF Spark TT	3					103	
SF Turbine TT	13	110	108	106	108	108	
	Mean yield (t/ha)	1.76 t/ha	2.80 t/ha	2.34 t/ha	1.34 t/ha	1.56 t/ha	
Variety	No. Trials	3	3	3	1	3	
Banker CL	9	110	111	105	100		Imidazolinone Tolerant
Hyola 575CL	6	90	91	92	91	92	
Pioneer 43Y92 (CL)	3		111	108	111		
Pioneer 44Y90 (CL)	10	114	112	108	107	111	
Pioneer 44Y94 CL						116	
Pioneer 45Y91 (CL)			106	103		104	
Pioneer 45Y93 CL	12			109		110	
Saintly CL	8	120	112	107		115	
VICTORY V7002CL	13			96		95	
VICTORY V75-03CL	2					94	
	Mean yield (t/ha	1.80 t/ha	2.92 t/ha	1.97 t/ha	No Result	1.59 t/ha	
Variety	No. Trials	1	1	1		1	
AV Garnet	4	86	87	86		87	Conventional
Nuseed Diamond	4	108	107	106		111	
Nuseed Quartz	3		114	116		112	

NVT Trials are not designed to allow comparison of varieties between herbicide tolerance groups.

Data source: SARDI/GRDC, NVT 2015-2019 MET data analysis by National Statistics Program.

Q – OAT VARIETIES AND AGRONOMY

AUTHORS: Courtney Peirce, SARDI, Josh Reichstein, Intergrain and Brianna Guidera, Hart Field-Site Group.

Bilby (SV06204-16) tested as 06204-16 is the newest milling oat variety, released in September 2019 by the National Oat Breeding Program led by SARDI. It is a dwarf variety with a high β-glucan content and quick to mid-quick development speed. Bilby has high grain yield potential in South Australia similar to Williams and Bannister with improved grain quality due to lower screenings, a higher groat percentage and greater protein content. Compared to other dwarf varieties Bilby has improved barley yellow dwarf virus resistance and is rated resistant to moderately resistant (R-MR) to red leather leaf. Bilby has been commercialised by Heritage Seeds.

Koorabup (SV05096-32) tested as 05096-32 is a mid-tall oaten hay variety developed for the Western Australian market that was released in 2019 by the National Oat Breeding Program. It is similar in height, grain yield and stem diameter to Yallara but with mid development speed and two to four days later than Yallara to hay cut from a late May sowing date. Compared to other hay varieties, Koorabup has lower hay yield but improved disease resistance rated moderately resistant to Septoria and Bacterial Blight. Koorabup has been commercialised by AEXCO.

Kingbale (GIAO-1701) is a single gene IMI tolerant oaten hay variety with mid-development speed and an improved tolerance to soil residual imidazolinone herbicides. It is an ideal variety for use where there are IMI residue concerns from previous crops. Preliminary data shows KingBale has a similar disease and agronomic profile to Wintaroo and indicates that it is resistant to CCN although, rust (likely susceptible) will require proactive management. The original breeding work was undertaken by Grains Innovation Australia (GIA) and the line will be commercialised by InterGrain. A Sentry® registration has been submitted to APVMA for pre-emergent use only, with earliest potential registration for use in oaten hay production in March 2021. It is important to note that delays may occur and Kingbale may not be released if Sentry® registration is not received. Sentry®, pending successful registration, will be the only imidazolinone herbicide registered for use on Kingbale.

For more information on these varieties and other oat varieties, please check the South Australian Crop Sowing Guide: (https://grdc.com.au/NVT-south-australian-crop-sowing-guide).

NATIONAL HAY AGRONOMY

BACKGROUND

The National Hay Agronomy trial is a four year project supported by AgriFutures, focusing on improving the quality of export hay in Australia. The core trial series located at Hart in SA, Muresk in WA, Birchip in Victoria and Yanco in NSW has a focus on developing updated guidelines for export oaten hay that optimise variety selection, seeding date and in-crop nutrition requirements. The 2020 trial is our second of three seasons at Hart. In these trials, we are investigating the influence and interaction between oaten hay variety, sowing date and nitrogen to provide best practice guidelines for growers to maximise both hay yield and hay quality.

Varieties:

Nine oat varieties: Durack, Brusher, Carrolup, Koorabup, Mulgara, Vasse, Williams, Wintaroo and Yallara. Vasse is a new addition in 2020, replacing Forester which was deemed too slow developing to be relevant for the medium rainfall areas targeted in these core trials.

Management treatments:

- Two times of sowing (TOS), early May and late May/early June.
- Three nitrogen (N) rates (30 kg N/ha, 60 kg N/ha or 90 kg N/ha) for all varieties.
- Yallara, Mulgara and Wintaroo have an additional three N treatments of 10 kg N/ha, 120 kg N/ha and 150 kg N/ha to further validate the N response curve.
- N treatments were split with 2/3 applied at seeding, and 1/3 applied six weeks after seeding when the plants were tillering. This split was according to current best practice for hay to achieve good early vigour, plant establishment and thin stems.
- Plots were sown at a target seeding density of 320 plants/m^2.
- Growth stage of varieties were monitored from heading, and hay cuts were taken for each plot at watery ripe (Zadoks 71). Hay was cut 15 cm height above the ground, before getting dried for two days at 60°C, and hay yield determined. Hay cuts were then ground to < 1mm, and hay quality determined by NIR.

KEY 2019 RESULTS

2019 Season

2019 was defined by spring drought, and increased frost damage in cereal crops. These seasonal conditions coupled with a strong domestic demand for fodder highlighted the benefit of oaten hay as a risk management strategy. Hart received 161 mm of growing season rainfall (GSR) from May to October and 188 mm annual rainfall, resulting in a decile one year and very low hay yields (site mean of 2.9 t/ha) for the season. Responses to applied nitrogen (N) were significant but small. The increase in N from 30 to 60 kg N/ha increased biomass yields when sown in early May (3.0 to 3.6 t/ha,least sig. difference (LSD) 0.4 t/ha), however there was no increased biomass as a result of increasing applied N above 30 kg N/ha when sown in early June. This result is unsurprising as both the availability of applied N, and the plants ability to uptake applied N would have been low in 2019, due to the reduced in-season rainfall, and shortened growing season.

Oat development differences

Due to the dry conditions experienced at Hart, many varieties flowered in the boot which made flowering date observations difficult. This is a problem in some varieties that is likely to influence hay quality. The spread in flowering date between oat varieties with the exception of Forester was about three weeks when sown early May or two weeks when sown early June. Durack was the earliest variety to flower, on average flowering a week before all other varieties. Forester is a very slow developing variety and did not flower at Hart with panicles emerging only in the outside rows from the early May sowing date at Hart. Forester plots sown in early May were cut at the end of October and the early June sown plots were cut at the end of November after observing a halt in biomass growth over the previous two weeks. Forester is unlikely to be a suitable variety for the low-medium rainfall environments of SA.

Yield and quality

In 2019, biomass and grain yields were maximised from early May sowing with differences observed between varieties (Table 1). Forester which struggled to flower did not yield any grain from either sowing date. To meet Grade 1 hay quality requirements, neutral detergent fibre (NDF) should be below 57% and water soluble carbohydrates (WSC) should be greater than 18%. All treatments at Hart achieved this in 2019. Neutral detergent fibre increased with delayed sowing but decreased with increased applied N. These differences were small and not replicated across the other core trial locations. It is generally observed that NDF will increase with earlier sown crops due to taller plants with thicker stems. There was a decrease in WSC with later sowing and as applied N increased (data not shown). Varieties responded differently to management with WSC of Carrolup stable across sowing date whilst all other varieties had lower WSC with the early June sowing date. Stem thickness was thin across all treatments but decreased with delayed sowing (4.0 vs 3.1 mm LSD 0.2 mm). There were differences between varieties with Forester, Carrolup and Koorabup having the thinnest stems and Wintaroo and Mulgara the thickest stems. Increasing applied N also increased stem thickness (data not shown).

Table 1. Hay and grain yield (t/ha) and key hay quality parameters for Hart in 2019.

	Hay yield (t/ha)		Grain yield (t/ha)		Neutral detergent fibre (%)		Water soluble carbohydrates (%)		Stem thickness (mm)
Sowing date	3 May	5 June	3 May	5 June	3 May	5 June	3 May	5 June	
Brusher	3.8 ab	2.4 ef	1.6 c	1.0 fg	42.7 bc	47.5 g	34.6 hi	23.8 b	3.5 cd
Carrolup	3.3 c	2.6 d	1.8 b	1.1 ef	42.3 bc	43.4 cd	32.1 gh	29.6 efg	3.2 e
Durack	3.7 b	2.4 e	1.8 b	1.3 d	45.5 ef	46.5 efg	30.8 fg	26.3 bcd	3.5 cd
Forester	1.9 g	1.1 h	0.0 i	0.0 i	38.7 a	43.1 bc	39.8 j	29.8 efg	3.3 e
Koorabup	3.6 b	2.4 ef	1.8 b	1.1 ef	45.6 efg	46.5 efg	30.1 efg	27.4 cde	3.4 de
Mulgara	3.9 a	2.6 d	1.9 ab	1.3 d	43.3 c	47.4 fg	34.5 hi	25.2 bc	3.8 ab
Williams	3.3 c	2.0 fg	1.8 b	0.8 h	45.1 de	46.1 efg	28.5 def	24.4 b	3.5 cd
Wintaroo	3.9 a	2.5 de	1.6 c	0.9 gh	45.2 de	50.0 h	31.0 fg	20.3 a	4.0 a
Yallara	3.8 ab	2.6 d	2.0 a	1.2 de	41.4 b	42.7 bc	35.6 i	31.2 fg	3.7 bc
LSD ($p \leq 0.05$)	0.4 (0.2 within same TOS)		0.21 (0.16 within same TOS)		1.9 (1.8 within same TOS)		2.8 (2.9 within same TOS)		0.2

Within a trait, varieties that have different letters indicate significant differences ($p \leq 0.05$)

Figure 1 shows how the hay quality of three varieties changes in response to the full range of N treatments. Both Wintaroo and Yallara had relatively stable NDF across N treatments with Wintaroo continuously higher than Yallara. Mulgara however had decreased NDF as the applied N increased suggesting it is more responsive to management than the other two varieties. Likewise for WSC, Yallara was higher than Wintaroo across all N application rates whilst Mulgara varied with N rate.

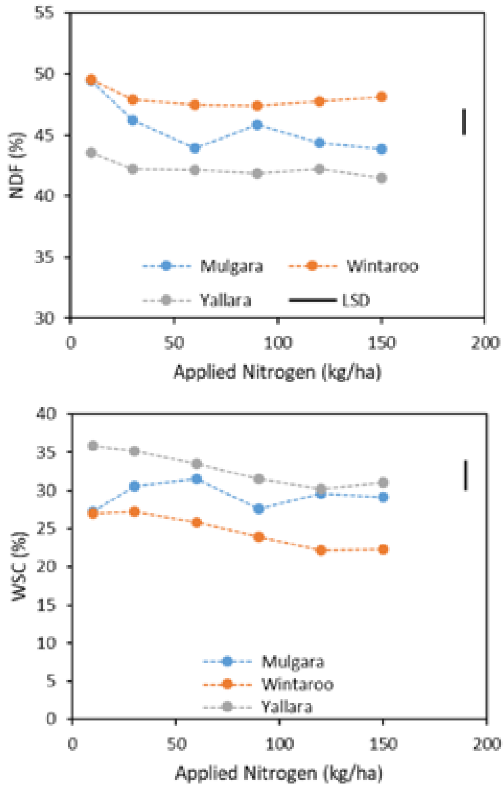

Figure 1. Neutral detergent fibre (NDF%) and water soluble carbohydrate (WSC%) of Mulgara, Wintaroo and Yallara in response to applied Nitrogen from 10 to 150 kg N/ha.

CONCLUSION

Although 2019 was only the first year of trials for the National Hay Agronomy project, we have been able to get some baseline data on the performance of oaten hay. Most oat varieties are of the fast to mid-fast development speed, and will flower from an early May sowing date within a two to three week period in September. Due to the low rainfall experienced in 2019, hay yields were very low at Hart but were maximised from earlier sowing. There were limited differences between varieties, with the exception of Forester which was too slow in its phenology to be suitable for export oaten hay in this environment. With a dry finish and low yields, hay quality across all treatments was good with thin stems, high water soluble carbohydrates (WSC) and low NDF%. There were some differences between varieties in their response to management which will be investigated further over the coming seasons.

2020 SEASON AT HART

Despite a promising start to the season, Hart experienced a disappointing winter with warm and dry conditions. Rainfall for June and July totaled 38 mm and as a result, the trial experienced both water and N stress presenting as red leaf tipping. The increased August rainfall has been a welcome relief with response to N treatments evident throughout both NDVI and visual assessment. With the timing of rainfall coinciding with late tillering to early stem elongation (TOS 2), the 2020 season is shaping up to provide greater yield potential.

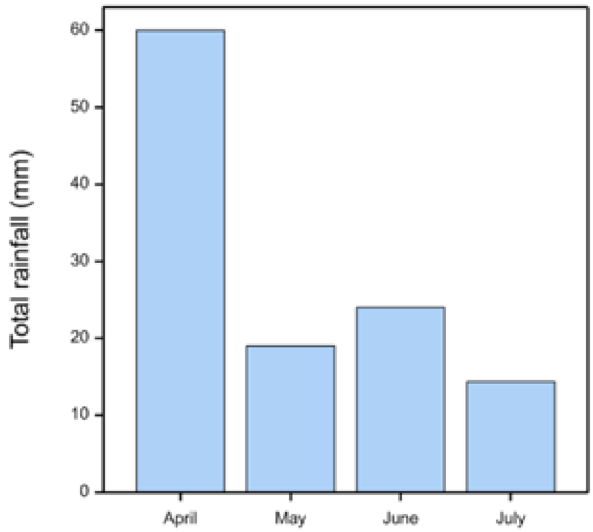

Figure 2. 2020 monthly rainfall at Hart (April to July).

ACKNOWLEDGEMENTS

The National Hay Agronomy trial is a four year project funded by AgriFutures (formerly known as RIRDC). The project is being led by Georgie Troup from the Department of Primary Industries and Regional Development (DPIRD), Western Australia and includes collaborators from SARDI and Hart Field-Site Group in SA, Agriculture Victoria and Birchip Cropping Group in Victoria and Department of Primary Industries NSW in NSW.

Oat variety (national hay program) trial plan

1	Buffer	Buffer	Buffer	
2	TOS2_Vasse_90N	TOS2_Durack_30N	TOS2_Wintaroo_30N	
3	TOS2_Vasse_60N	TOS2_Durack_90N	TOS2_Wintaroo_60N	
4	TOS2_Vasse_30N	TOS2_Durack_60N	TOS2_Wintaroo_90N	
5	TOS2_Yallara_30N	TOS2_Koorabup_90N	TOS2_Wintaroo_120N	
6	TOS2_Yallara_90N	TOS2_Koorabup_60N	TOS2_Wintaroo_150N	
7	TOS2_Yallara_60N	TOS2_Koorabup_30N	TOS2_Wintaroo_10N	
8	TOS2_Yallara_150N	TOS2_Mulgara_30N	TOS2_Williams_90N	
9	TOS2_Yallara_120N	TOS2_Mulgara_90N	TOS2_Williams_30N	
10	TOS2_Yallara_10N	TOS2_Mulgara_60N	TOS2_Williams_60N	
11	TOS2_Brusher_90N	TOS2_Mulgara_120N	TOS2_Carrolup_60N	
12	TOS2_Brusher_30N	TOS2_Mulgara_150N	TOS2_Carrolup_90N	
13	TOS2_Brusher_60N	TOS2_Mulgara_10N	TOS2_Carrolup_30N	
14	Buffer	Buffer	Buffer	Block 1
15	TOS1_Mulgara_120N	TOS1_Durack_60N	TOS1_Koorabup_90N	
16	TOS1_Mulgara_150N	TOS1_Durack_30N	TOS1_Koorabup_60N	
17	TOS1_Mulgara_10N	TOS1_Durack_90N	TOS1_Koorabup_30N	
18	TOS1_Mulgara_30N	TOS1_Brusher_60N	TOS1_Vasse_30N	
19	TOS1_Mulgara_90N	TOS1_Brusher_30N	TOS1_Vasse_60N	
20	TOS1_Mulgara_60N	TOS1_Brusher_90N	TOS1_Vasse_90N	
21	TOS1_Carrolup_60N	TOS1_Wintaroo_90N	TOS1_Yallara_60N	
22	TOS1_Carrolup_90N	TOS1_Wintaroo_30N	TOS1_Yallara_30N	
23	TOS1_Carrolup_30N	TOS1_Wintaroo_60N	TOS1_Yallara_90N	
24	TOS1_Williams_90N	TOS1_Wintaroo_10N	TOS1_Yallara_120N	
25	TOS1_Williams_60N	TOS1_Wintaroo_120N	TOS1_Yallara_150N	
26	TOS1_Williams_30N	TOS1_Wintaroo_150N	TOS1_Yallara_10N	
27	TOS1_Brusher_30N	TOS1_Yallara_90N	TOS1_Durack_30N	
28	TOS1_Brusher_60N	TOS1_Yallara_30N	TOS1_Durack_60N	
29	TOS1_Brusher_90N	TOS1_Yallara_60N	TOS1_Durack_90N	
30	TOS1_Wintaroo_60N	TOS1_Yallara_150N	TOS1_Mulgara_30N	
31	TOS1_Wintaroo_30N	TOS1_Yallara_10N	TOS1_Mulgara_90N	
32	TOS1_Wintaroo_90N	TOS1_Yallara_120N	TOS1_Mulgara_60N	
33	TOS1_Wintaroo_150N	TOS1_Carrolup_90N	TOS1_Mulgara_150N	
34	TOS1_Wintaroo_120N	TOS1_Carrolup_60N	TOS1_Mulgara_10N	
35	TOS1_Wintaroo_10N	TOS1_Carrolup_30N	TOS1_Mulgara_120N	
36	TOS1_Koorabup_30N	TOS1_Vasse_90N	TOS1_Williams_60N	
37	TOS1_Koorabup_60N	TOS1_Vasse_60N	TOS1_Williams_90N	
38	TOS1_Koorabup_90N	TOS1_Vasse_30N	TOS1_Williams_30N	
39	Buffer	Buffer	Buffer	Block 2
40	TOS2_Wintaroo_90N	TOS2_Carrolup_30N	TOS2_Durack_60N	
41	TOS2_Wintaroo_30N	TOS2_Carrolup_60N	TOS2_Durack_30N	
42	TOS2_Wintaroo_60N	TOS2_Carrolup_90N	TOS2_Durack_90N	
43	TOS2_Wintaroo_10N	TOS2_Yallara_90N	TOS2_Brusher_60N	
44	TOS2_Wintaroo_150N	TOS2_Yallara_30N	TOS2_Brusher_90N	
45	TOS2_Wintaroo_120N	TOS2_Yallara_60N	TOS2_Brusher_30N	
46	TOS2_Koorabup_30N	TOS2_Yallara_10N	TOS2_Mulgara_150N	
47	TOS2_Koorabup_60N	TOS2_Yallara_120N	TOS2_Mulgara_120N	
48	TOS2_Koorabup_90N	TOS2_Yallara_150N	TOS2_Mulgara_10N	
49	TOS2_Williams_30N	TOS2_Vasse_60N	TOS2_Mulgara_90N	
50	TOS2_Williams_90N	TOS2_Vasse_30N	TOS2_Mulgara_60N	
51	TOS2_Williams_60N	TOS2_Vasse_90N	TOS2_Mulgara_30N	
52	Buffer	Buffer	Buffer	
53	TOS1_Vasse_60N	TOS1_Williams_30N	TOS1_Wintaroo_150N	
54	TOS1_Vasse_90N	TOS1_Williams_90N	TOS1_Wintaroo_10N	
55	TOS1_Vasse_30N	TOS1_Williams_60N	TOS1_Wintaroo_120N	
56	TOS1_Yallara_120N	TOS1_Mulgara_10N	TOS1_Wintaroo_60N	
57	TOS1_Yallara_150N	TOS1_Mulgara_120N	TOS1_Wintaroo_30N	
58	TOS1_Yallara_10N	TOS1_Mulgara_150N	TOS1_Wintaroo_90N	
59	TOS1_Yallara_60N	TOS1_Mulgara_30N	TOS1_Brusher_30N	
60	TOS1_Yallara_30N	TOS1_Mulgara_90N	TOS1_Brusher_90N	
61	TOS1_Yallara_90N	TOS1_Mulgara_60N	TOS1_Brusher_60N	
62	TOS1_Durack_30N	TOS1_Koorabup_60N	TOS1_Carrolup_90N	
63	TOS1_Durack_60N	TOS1_Koorabup_30N	TOS1_Carrolup_60N	
64	TOS1_Durack_90N	TOS1_Koorabup_90N	TOS1_Carrolup_30N	
65	Buffer	Buffer	Buffer	Block 3
66	TOS2_Carrolup_90N	TOS2_Williams_90N	TOS2_Yallara_90N	
67	TOS2_Carrolup_30N	TOS2_Williams_60N	TOS2_Yallara_30N	
68	TOS2_Carrolup_60N	TOS2_Williams_30N	TOS2_Yallara_60N	
69	TOS2_Durack_60N	TOS2_Brusher_90N	TOS2_Yallara_10N	
70	TOS2_Durack_90N	TOS2_Brusher_60N	TOS2_Yallara_120N	
71	TOS2_Durack_30N	TOS2_Brusher_30N	TOS2_Yallara_150N	
72	TOS2_Mulgara_10N	TOS2_Wintaroo_10N	TOS2_Koorabup_60N	
73	TOS2_Mulgara_150N	TOS2_Wintaroo_150N	TOS2_Koorabup_30N	
74	TOS2_Mulgara_120N	TOS2_Wintaroo_120N	TOS2_Koorabup_90N	
75	TOS2_Mulgara_90N	TOS2_Wintaroo_30N	TOS2_Vasse_60N	
76	TOS2_Mulgara_30N	TOS2_Wintaroo_60N	TOS2_Vasse_90N	
77	TOS2_Mulgara_60N	TOS2_Wintaroo_90N	TOS2_Vasse_30N	
78	Buffer	Buffer	Buffer	

N →

Seeding date:	TOS 1 - May 6, 2020 TOS 2 - May 25
Fertiliser:	DAP + Impact
Fertiliser rate:	60 kg/ha

R – CEREAL ROOT DISEASE UPDATE

AUTHOR: Margaret Evans, SARDI

TAKE HOME MESSAGES

- Rhizoctonia has caused significant damage in cereal crops across South Australia in 2020.
- Soil analysis at the start of 2021 will be particularly important for crown rot and eyespot as it is difficult to predict the risk of yield loss due to these diseases based on paddock history.
- August-October are prime times for root inspection to make management decisions for 2020 and 2021.

Rhizoctonia continues to be a serious issue for 2020 cereal crops, with the dry conditions and low winter soil temperatures slowing root growth and favouring infection and development of this fungal root disease. Early sowing into warm soils generally allows primary roots to grow well with rhizoctonia symptoms only appearing once plants are established and soil temperatures have dropped. This year, a combination of low rainfall and early frost after the break have favoured development of the classic rhizoctonia "bare patches". Now crops are also starting to show general unevenness due to rhizoctonia damaging the secondary root systems and reducing tiller number and growth.

Not all patches and uneven crop growth are caused by rhizoctonia. To check whether rhizoctonia is causing the problem, carefully dig up affected plants and roots. Wash soil out of the roots and float them in water on a white background (e.g. in a white ice-cream container). Rhizoctonia damage appears as honey-brown "spear tips" on roots or thick-and-thin roots characterised by honey-brown discolouration.

Management decisions to consider for affected crops in 2020 include whether or not to apply further inputs, cut for hay and the implications for forward-selling grain. It is also critical to consider long-term management strategies. Options include rotations away from cereals and grass pastures, ensuring summer weed control to remove the green bridge and also early seeding of priority paddocks.

Root lesion nematode (RLN) species Pratylenchus neglectus and P. thornei cause subtle symptoms on cereal roots and plants during winter (e.g. low vigour), but as temperatures warm up in spring these nematodes can multiply rapidly. In 2020, root damage due to RLN has been common. Severely affected roots are chocolate brown, lack root hairs and have limited fine branching. Plant resistance is the most effective management tool currently available. Resistance differs between the two species of nematode, so it is important to correctly identify which RLN is present in each paddock. This will allow correct selection of cereal types and broadleaf break crops which may also host RLN.

Crown rot affects all cereals, with symptoms including brown stem bases and white heads. This is most obvious in seasons with moisture stress during grain filling. Infection occurs when there is good moisture and contact of crown rot infested stubble with the new crop. Infection can occur at any time in the season, however the earlier plants are infected the higher the potential for significant yield losses. Dry conditions at the start of 2020 would not have favoured early infection, but yield losses may still occur if there is moisture stress during grain filling. Significant inoculum carryover into 2021 may also occur.

Crown rot management continues to be problematic, particularly where durum wheat is part of the rotation. In collaboration with the Hart Field-Site Group, Syngenta, Elders and the Southern Australian Durum Growers Association, we are exploring the potential of new bread wheat lines with improved resistance to crown rot, including a new seed treatment with activity against crown rot. Trials are being undertaken at Hart and Pinery to quantify the effectiveness of the seed treatments and also lines with improved resistance to crown rot in durum wheat, bread wheat and barley. We will also assess inoculum carryover after treatments. Results from these trials should allow us to determine the role of the seed treatment and of the lines with improved resistance for managing yield losses due to crown rot in current farming systems.

Eyespot affects all cereals and takes the name from eye-shaped lesions it causes. Good rainfall prior to canopy closure favours this disease, so the dry conditions experienced in early 2019 and 2020 mean eyespot infection and expression has been limited. Even though eyespot inoculum will have decreased in most paddocks for 2019 and 2020, eyespot could still be a problem in 2021. If considering fungicide application, there are now three fungicides registered for managing eyespot in wheat - Aviator®Xpro; Elatus® Ace and Soprano® 500.

PREDICTA® B soil analysis will be particularly useful for identifying the risk of yield loss due to crown rot and eyespot in commercial paddocks for 2021. As conditions across 2019 and 2020 breakdown plant infection and inoculum, it will become difficult to predict disease risk based on paddock history alone. When using resistance as a management tool for RLN, PREDICTA® B analysis will identify the species present, allowing for correct selection of crop types for the following season.

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Crown rot resistance and seed treatment trial plan

Buffer	Buffer	Buffer
Aurora trt	Edge 19 SA 1098 trt	Trojan trt
Aurora	Edge 19 SA 1098	Trojan
Edge 19 SA 0178	Bitalli trt	Aurora trt
Edge 19 SA 0178 trt	Bitalli	Aurora
Scepter trt	Aurora trt	Spartacus
Scepter	Aurora	Spartacus trt
Trojan	Edge 19 SA 0178	Edge 19 SA 1098 trt
Trojan trt	Edge 19 SA 0178 trt	Edge 19 SA 1098
Spartacus trt	Scepter trt	Bitalli trt
Spartacus	Scepter	Bitalli
Bitalli trt	Trojan	Edge 19 SA 0178
Bitalli	Trojan trt	Edge 19 SA 0178 trt
Edge 19 SA 1098 trt	Spartacus	Scepter trt
Edge 19 SA 1098	Spartacus trt	Scepter
Buffer	Buffer	Buffer

*trt = treated with Syngenta seed treatment prior to sowing

Note – this site has been sown with crown rot inoculated grain added to all plots

Paired plots with and without seed treatment to assess effectiveness on cereals with a range of susceptibilities to crown rot

Aurora - very susceptible
Scepter - susceptible
Trojan - moderately susceptible
Edge lines - bread wheat lines bred for improved resistance
Bitalli - included to assess relative resistance and yield losses when compared with Aurora
Spartacus - least likely to exhibit yield losses due to crown rot

N →

Seeding date:	May 25, 2020
Fertiliser:	MAP
Fertiliser rate:	80 kg/ha

S – CANOLA NITROGEN TRIAL

AIM: measure canola yield response to Nitrogen at different rates and application timings.

Buffer	Buffer	Buffer
Nil	50 kg N/ha @ seeding + 50 kg N/ha @ rosette + 100 kg N/ha @ flowering	100 kg N/ha @ seeding
100 kg N/ha @ seeding	50 kg N/ha @ seeding + 50 kg N/ha @ rosette	200 kg N/ha @ flowering
50 kg N/ha @ seeding + 50 kg N/ha @ rosette	Nil	50 kg N/ha @ seeding + 50 kg N/ha @ rosette + 100 kg N/ha @ flowering
50 kg N/ha @ seeding + 50 kg N/ha @ rosette + 100 kg N/ha @ flowering	200 kg N/ha @ flowering	Nil
200 kg N/ha @ flowering	100 kg N/ha @ seeding	50 kg N/ha @ seeding + 50 kg N/ha @ rosette
Buffer	Buffer	Buffer

N →

Seeding date: 5 May
Fertiliser: DAP + Impact
Fertiliser rate: 80kg/ha
Variety: Scepter

Note: seeding options were broadcast immediately post seeding, with rosette applications applied at GS30. Final treatment was applied at flowering (GS60). Prior to a significant rainfall event, dry weather conditions did not permit targeted application at bolting.

T – INTERCROPPING – A TOOL TO IMPROVE PROFITABILITY IN BROADACRE SYSTEMS

AUTHORS: Penny Roberts, SARDI Clare and Alyce Dowling, University of Adelaide

TAKE HOME MESSAGES

- Intercropping two or more crops has potential to increase production while reducing input costs.
- Initial research has shown that intercropping with legumes reduces the need for, and cost of, nitrogen fertiliser.
- As further development of herbicide tolerance traits occurs in crops, more weed management options will become available for intercropping.

Intercropping is the practice of growing two or more crops in the same system, at one given time. The practice of intercropping is not new, it has been a common practice in small-scale subsistence farming systems and while it has not achieved high levels of adoption, intercropping has also been practiced in broad-acre farming systems, both internationally and domestically.

The aim of intercropping is generally to produce greater yields than growing both crops separately. However, there is also interest in these systems for their other documented benefits including reduced input costs, reduced incidence of disease, improved resource-use efficiency, rotation benefits and improved soil health. Trials established at Hart in 2019 and 2020 have focused on using intercropping to improve the cost of production of chickpea through improved harvestability and reduced input costs including weed management, disease management and harvest desiccation. This work investigates the most commonly adopted mixed species crops grown in Canada. Intercrops can be configured in a number of ways with the most common being mixed rows and skip row (or alternate row) arrangements. Both configurations were used in trials at Hart (Figure 1).

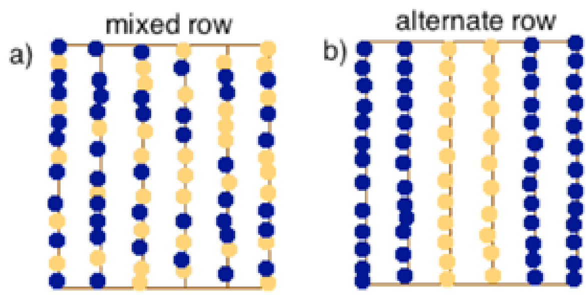

Figure 1. The different types of intercropping showing crops A (blue dot) and B (orange dot). a) Mixed row intercrop – two cash crops seeded together in the same row. b) Alternate row intercrop – two cash crops seeded together in alternate rows. The ratio can vary ie. 1:1 single skip, 2:2 double skip, 1:3 etc.

TRIAL DESIGN

The trial sown in 2019 and 2020 is a split plot design, with intercropping arrangement randomly assigned to the whole plot and management strategy randomly assigned to the sub plot.

Table 1. Trial site details, including treatments and varieties at Hart 2019 and 2020.

	Whole plot:	Sub plot:
Treatments	1. Sole chickpea 2. Sole linseed 3. Sole canola 4. Chickpea + linseed double skip row arrangement 5. Chickpea + canola double skip row arrangement 6. Chickpea + linseed mixed row arrangement 7. Chickpea + canola mixed row arrangement	1. Nil 2. Foliar fungicide 3. Foliar fungicide + desiccation
Varieties	Chickpea	Genesis090
	Linseed	Croxton
	Canola	AV Garnet

PRELIMINARY RESULTS

Disease management

Foliar fungicide applications were included as a sub plot treatment to determine the implications of intercropping arrangements on ascochyta blight disease management in chickpea. Disease was introduced into the trial with infected stubble spread on an adjacent trial following seeding. However, seasonal conditions experienced at Hart in 2019 were not favourable for high levels of disease infection. Temperatures were cold and rainfall was often followed by extremely windy conditions causing humidity to quickly dissipate, which was not favourable to the spread of ascochyta blight. Disease assessments were conducted during flowering growth stages by identifying the percentage of chickpea in each plot infected with ascochyta blight (data not shown). Plots that remained unsprayed (nil) had 11% ascochyta blight infection, while plots that received regular foliar fungicide applications had 2% ascochyta blight infection. There was no grain yield response to sub plot treatments. This suggests that the low level of disease infection seen in 2019, despite the adjacent trial being inoculated with ascochyta blight, was not enough to effect grain production.

Chickpea grain yield

A response to intercropping arrangement was observed for grain yield at Hart in 2019 (Figure 2). Chickpea as a sole crop was at least 160 kg/ha higher yielding than chickpea intercropped with canola or linseed. There was no yield benefit for chickpea when intercropped with a double skip row arrangement compared to a mixed row arrangement. There were no differences in linseed grain yield between intercropped mixed row and double skip row arrangements (data not shown). Desiccation was included as a sub plot treatment to compare the dry down effect of linseed on chickpea compared to chemical desiccation. Due to the dry seasonal conditions experienced in 2019 we experienced a short finish to the season. As a result, there were no grain yield difference between chemically desiccated chickpea and chickpea that was unsprayed to mature naturally. Further work needs to be done in different seasonal conditions to determine any effect of linseed on chickpea maturity and plant material dry down.

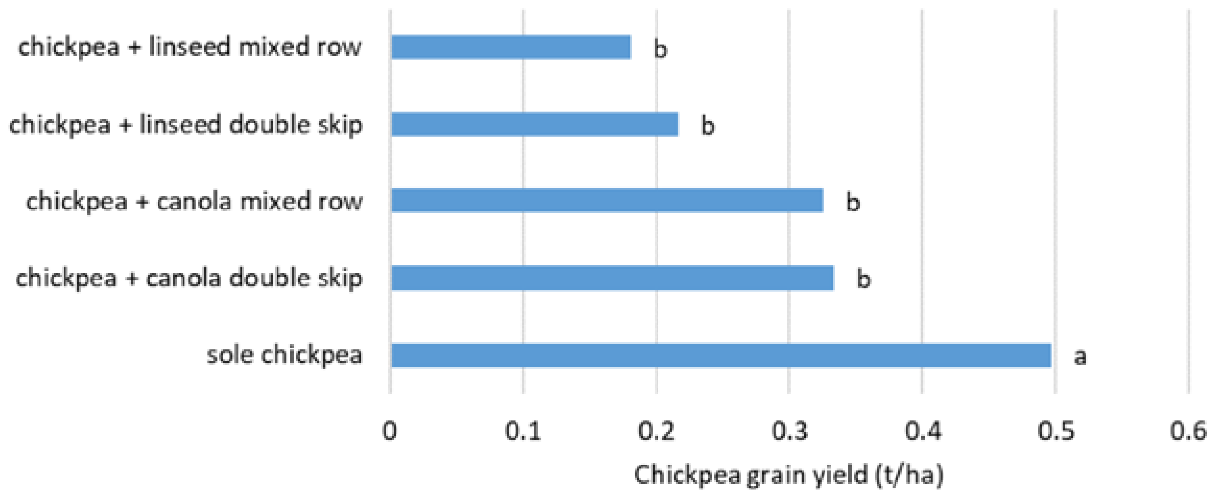

Figure 2. Grain yield of chickpea as a sole crop was increased over chickpea intercropped with canola or linseed, at Hart 2019. Bars labelled with the same letters are not significantly different.

DISCUSSION, BARRIERS AND ADVANTAGES OF CHICKPEA INTERCROPPING

The benefits of intercropping have been demonstrated through previous research. However, there remain barriers to adoption on a broadacre scale. The three main barriers to adoption are: the complexity of mixed species systems, weed management, and yield reductions. The additional complexity of intercropping systems includes logistical challenges at sowing, harvesting, handling and storage of grain. Some types of intercropping lend themselves to a more seamless integration into current farming practices than others. For example, in terms of ease-of-sowing, mixed row intercropping can still be achieved in one pass by putting both seed types into the same box, or by utilising both the seed and fertiliser distribution systems for seed as has been achieved in the mixed row chickpea-linseed and chickpea-canola plots in the Hart trial. More complex arrangements, like single or double skip row, where individual species are sown in a 1:1 or 2:2 alternating row arrangement, can be achieved through modifications to the seeder. Additionally, some seeders are designed to allow for easier adaptation to multispecies sowing.

The second barrier to the adoption of intercropping in broadacre systems is weed management. One of the keys to the success of intercropping is the effective partitioning of resources in time and space due to the different characteristics, such as rooting depth, of the of the intercropped species, most often a legume paired with a cereal or oilseed. However, pairing species from different functional groups makes in-season weed control difficult. Pairing a legume and a cereal limits in-season herbicide options. However, the recent developments in herbicide tolerance technology allow pairings of different species with the same herbicide tolerant trait, broadening in-crop weed management options. Whilst currently this is limited to Group B tolerant crops (with options available in wheat, barley, oats, canola, faba bean, lentil, and field pea, with chickpea under development) more options may become available in time.

The third barrier for intercropping in broadacre systems is yield. While many studies report yield benefits, such as a 2020 study by Fletcher and Kirkegaard from CSIRO, our trial from 2019, as well as similar linseed-chickpea trials at Grace Plains and Roseworthy, showed no significant yield increase in the intercrop compared to single (monoculture) crop. However, this needs to be balanced with any cost savings that are achieved from the intercropping system, the focus of the work being undertaken at Hart.

POTENTIAL BENEFITS OF INTERCROPPING IN BROADACRE SYSTEMS

Intercropping can be used a tool for a number of purposes. While yield gain is certainly important, intercropping can also be used as a cost-saving and market risk reducing, measure. Results from our 2019 trials, and preliminary results from this year, suggest that this is the potential benefit of the chickpea-oilseed intercropping system being studied at Hart.

A challenge for chickpea in the medium rainfall zone of the mid-north is the cost of production. A 3-4 spray fungicide regime is recommended to make sure that Ascochyta Blight (AB) is controlled (all grown chickpea varieties in SA are either moderately susceptible (MS) or susceptible (S) to AB). This can cost at least $50/ha and often more, depending on the product used. This cost does not take into account a thiram-based fungicide seed dressing, which is recommended for all chickpea seed prior to sowing. Further, chickpeas require a dessicant spray to improve the uniformity of ripening prior to harvest. This increases the cost of production per hectare. There was no difference in the yield or quality of the chickpea seed in linseed-chickpea and canola-chickpea intercrops given a full fungicide and dessication regime compared with those that remained untreated. Whilst this is likely to be seasonally dependent, it suggests intercropping may reduce the need for multiple fungicides and dessicants, reducing input costs and increasing profit margin per hectare. It is important to note that the 2019 season at Hart was not conducive to disease (being cold and windy), so more trials are needed under different environmental conditions.

Intercropping with legumes reduces the need for nitrogen fertiliser, again reducing input costs. In a linseed-chickpea trial at Grace Plains and Roseworthy in 2019, there was no significant difference in yield (total intercrop) between the intercrop under a nil fertiliser regime compared with those under a high N high P (50 kg N and 20 kg P per hectare) fertiliser regime. Again, this suggests that intercropping allows a reduction of fertiliser inputs, resulting in reduced input costs and larger profit margin. However, further research is needed under differing environmental conditions.

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Hart intercropping trial plan

Buffer	Buffer	Buffer
Canola	Chickpea	Canola + field pea
Linseed	Field pea	Chickpea + linseed
Chickpea + linseed	Linseed	Field pea
Canola + field pea	Canola	Chickpea
Field pea	Chickpea	Linseed
Canola	Chickpea + linseed	Canola + field pea
Chickpea	Canola	Field pea
Chickpea + linseed	Canola + field pea	Linseed
Buffer	Buffer	Buffer

N →

Seeding date: 25 May
Fertiliser: MAP
Fertiliser rate: 80kg/ha

U – PRECISION PLANTER CANOLA TRIAL

Aim: to compare plant establishment, growth and yield of canola with conventional, air-seeder and precision planter.

	Buffer	Buffer	Buffer	Seeder type
Rep 1	Treatment 1	Treatment 1	Treatment 1	Perfect placement
	Treatment 2	Treatment 2	Treatment 2	Perfect placement
	Treatment 3	Treatment 3	Treatment 3	Perfect placement
	Treatment 2	Treatment 2	Treatment 2	Precision
	Treatment 1	Treatment 1	Treatment 1	Precision
	Treatment 3	Treatment 3	Treatment 3	Precision
	Treatment 1	Treatment 1	Treatment 1	Conventional
	Treatment 3	Treatment 3	Treatment 3	Conventional
	Treatment 2	Treatment 2	Treatment 2	Conventional
Rep 2	Treatment 2	Treatment 2	Treatment 2	Precision
	Treatment 3	Treatment 3	Treatment 3	Precision
	Treatment 1	Treatment 1	Treatment 1	Precision
	Treatment 1	Treatment 1	Treatment 1	Perfect placement
	Treatment 2	Treatment 2	Treatment 2	Perfect placement
	Treatment 3	Treatment 3	Treatment 3	Perfect placement
	Treatment 2	Treatment 2	Treatment 2	Conventional
	Treatment 1	Treatment 1	Treatment 1	Conventional
	Treatment 3	Treatment 3	Treatment 3	Conventional
Rep 3	Treatment 1	Treatment 1	Treatment 1	Perfect placement
	Treatment 2	Treatment 2	Treatment 2	Perfect placement
	Treatment 3	Treatment 3	Treatment 3	Perfect placement
	Treatment 2	Treatment 2	Treatment 2	Conventional
	Treatment 1	Treatment 1	Treatment 1	Conventional
	Treatment 3	Treatment 3	Treatment 3	Conventional
	Treatment 1	Treatment 1	Treatment 1	Precision
	Treatment 3	Treatment 3	Treatment 3	Precision
	Treatment 2	Treatment 2	Treatment 2	Precision
Rep 4	Treatment 3	Treatment 3	Treatment 3	Conventional
	Treatment 2	Treatment 2	Treatment 2	Conventional
	Treatment 1	Treatment 1	Treatment 1	Conventional
	Treatment 1	Treatment 1	Treatment 1	Perfect placement
	Treatment 2	Treatment 2	Treatment 2	Perfect placement
	Treatment 3	Treatment 3	Treatment 3	Perfect placement
	Treatment 3	Treatment 3	Treatment 3	Precision
	Treatment 1	Treatment 1	Treatment 1	Precision
	Treatment 2	Treatment 2	Treatment 2	Precision
	Buffer	Buffer	Buffer	

N →

Seeding date: 5 May

Fertiliser: APP (N 160g/L, P 120g/L)

Fertiliser rate: 50L/ha

Variety: Hyola 350TT

Treatment 1 - high target plant density
Treatment 2 - medium target plant density
Treatment 3 - low target plant density

Note: perfect placement plots used to capture ideal target density and seed placement.

V – OAT VARIETY COMPARISON TRIAL

Aim: to assess the performance of the new oat variety Kingbale compared to common varieties in the Mid-North.

Buffer		
Mulgara	Winteroo	Kingbale
Winteroo	Kingbale	Mulgara
Kingbale	Mulgara	Winteroo
Buffer		

N →

Seeding date: 6 May
Fertiliser: DAP + Impact
Fertiliser rate: 80kg

W – CHICKPEA RYEGRASS MANAGEMENT

Aim: To investigate the management of group A, J & K resistant annual ryegrass in chickpeas.

Ryegrass management in chickpeas trial plan

	Bay 1	Bay 2	Bay 3
	Buffer	Buffer	Buffer
Row 1	Treatment 1	Treatment 6	Treatment 5
Row 2	Treatment 2	Treatment 8	Treatment 9
Row 3	Treatment 3	Treatment 4	Treatment 7
Row 4	Treatment 4	Treatment 7	Treatment 2
Row 5	Treatment 5	Treatment 1	Treatment 8
Row 6	Treatment 6	Treatment 9	Treatment 3
Row 7	Treatment 7	Treatment 3	Treatment 6
Row 8	Treatment 8	Treatment 6	Treatment 1
Row 9	Treatment 9	Treatment 2	Treatment 4
	Buffer	Buffer	Buffer

Variety: Genesis 090

Key:

Treatment	
1	Wick wiping at reproductive stage
2	Ultro (IBS) + clethodim at 500 ml/ha (post-emergent).
3	Crop topping at RG embryo development stage.
4	Protective inter-row spray of weeds before canopy closure
5	Propyzamide at 1 L/ha (IBS) + clethodim at 500 ml/ha (post-emergent)
6	Sakura 118 (IBS) + clethodim at 500 ml/ha (post-emergent)
7	Boxer Gold at 2.5 L/ha (IBS) + Clethodim at 500 ml/ha (post-emergent)
8	Clipping at reproductive stage.
9	Untreated

X – CROPPING SYSTEMS TRIAL

Aim: To demonstrate the long-term effects of various cropping systems and nitrogen fertiliser inputs. The trial still remains one of the only long-term cropping systems trials remaining in the Southern Region.

	Rep 1						Rep 2						Rep 3					
Plot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
System	Disc		Strategic		No-til		Disc		Strategic		No-til		Strategic		No-til		Disc	
Nitrogen	Med	High	Med	High	Med	High	High	Med	High	Med	High	Med	Med	High	High	Med	Med	High

N →

Seeding date: Disc May 27, 2020. Strategic & No-till May 29, 2020.

Fertiliser: MAP

Fertiliser rate: 50 kg/ha

Variety: Scepter

Seeding rate: 100 kg/ha

ASSESSMENT OF THE RATE OF WEED SEED DECAY IN CHAFF-LINING SYSTEMS OF SOUTH AUSTRALIA

AUTHORS: Daniel Petersen[1], Amanda Cook[2], Ben Fleet[1] and Gurjeet Gill[1]
[1]School of Agriculture, Food and Wine, University of Adelaide; [2]SARDI, Minnipa Agriculture Centre.

TAKE HOME MESSAGES

- Investigation of weed seedbank decline in nine chaff-lining systems of South Australia demonstrated that growers are achieving high concentration of weed seeds and crop residue at harvest.
- Assessment of the viable weed seed fraction after crop harvest suggests that large residual annual ryegrass, brome grass and Indian hedge mustard seedbanks have been established in cropping field because these species did not decay over the summer-autumn period in chaff-lines.
- Evaluation of chaff-tramlining systems showed that annual ryegrass seedbank decline is independent of chaff-line configuration and chaff density.
- The stability in the weed seedbanks in chaff-lines were consistent with the dry conditions over the summer-autumn period.
- Growers should be cautious of the magnitude of viable weed seeds in chaff-lines before the cropping season and expect variability in the effectiveness of this tactic between seasons.

Why do the research?

Failure to control annual weed species that persist through cropping phases facilitates replenishment/establishment of weed seedbanks. Consequently, this maintains weed interference in subsequent years of crop production. Harvest weed seed control (HWSC) has been widely adopted in Australia since its inception over three decades ago to prevent redistribution of weed seeds across cropping fields during commercial harvesting operations (Walsh et al. 2017). Implementation of HWSC obstructs fresh seedbank inputs by subjecting the weed seed bearing chaff fraction to a treatment, such as combustion (narrow windrow burning), mechanical pulverisation (impact mills), decomposition (chaff-lining) and removal (chaff cart). Chaff-lining has been readily adopted by growers because of the low cost of modifying a harvester to confine the chaff fraction into a narrow row between stubble, or onto dedicated wheel tracks in controlled traffic farming systems (chaff-tramlining). There is only a small amount of literature examining seedbank decline of important Australian weed species in chaff-lines, however a common conjecture is that a mulching effect is created by a combination of physical and chemical influences (Walsh et al. 2018). Field observations suggest that in the absence of seed decay, control failures of annual weed species and volunteer crop plants may be exacerbated. Therefore, growers urgently need information that substantiates the implications of chaff-lining to weed seedbanks.

How was it done?

Field sites were established at nine different locations with varying rainfall in SA (Figure 1). Sites were selected on the premise of dense annual ryegrass or brome grass infestations. Random sampling was performed at each site across four chaff-lines along a horizontal transect in areas of uniform weed density. Sub-samples were made at 0.5 m intervals so that 1.5 m of the chaff-line was collected. A vacuum was used to ensure complete capture of all weed seeds on the soil surface. In systems with a chaff-deck configuration, both chaff rows were sampled to alleviate distribution bias of the chaff fraction. Sub-samples were bulked and stored in an air-conditioned laboratory. Data on harvest height, and chaff-line depth and width was also obtained. This sampling strategy was repeated at random intervals from December to April.

Chaff was separated from the soil using a sieve and both components were weighed. A 25% sub-sample by mass was taken from each of the components and bulked together. The chaff-line material was spread between a 20 mm base and top layer of potting mix (coco-peat) in germination trays in the first week of May. The trays were then watered close to field capacity. Supplementary irrigation was supplied to trays if there was ten consecutive days without rainfall to ensure the potting mix was moist. Weed seedlings were routinely counted and removed to determine weed seed decay over the summer-autumn period. The data collection ceased in mid-September when no new seedlings emerged after two consecutive counts.

Figure 1. The geographical distribution of six chaff-lining (■) and three chaff-tramlining (▲) sites across the three rainfall zones of the major cropping regions of South Australia, which include the Yorke Peninsula (high), Mid-North (medium) and Eyre Peninsula (low).

There were no consistent trends that demonstrated the susceptibility of annual ryegrass to decay in chaff-lines (Table 2). There was a reduction in annual ryegrass seedbank at three sites (3, 5 and 9), but a repeated measures Analysis of Variance (ANOVA) showed these were non-significant (P=0.361) and associated with the natural variability that exists at these sites. Large variation in the annual ryegrass and brome grass seedbank was identified between sites (P<0.001), but these seedbanks behaved similarly in wheat chaff-lines of different agro-ecological zones. The magnitude of annual ryegrass and brome grass seed capture (93-29831 seeds/m²) demonstrates that HWSC tactics could have an important role in reducing weed seedbanks (Table 1, T able 2). Further research is needed to determine the implications that the large residual annual ryegrass (597-18492 seeds/m²) and brome grass (219-23612 seeds/m²) seedbank in chaff-lines will have to crop production.

Indian hedge mustard control failures at Site 7 (Minnipa, South Australia) enabled investigation of the fate of its seeds in wheat chaff-lines. There was a 43% reduction in the Indian hedge mustard seedbank 125 days after harvest. However, there was no difference (P=0.322) between the initial and final Indian Hedge mustard seedbank (Figure 2). Our previous work in GRDC project UA00156 has shown that Indian hedge mustard has a low level of innate dormancy and readily germinates under favourable soil moisture conditions. The high organic carbon levels of chaff are likely to support microbial biomass, which has been associated with seed decay in statice (Kleemann and Gill 2018). While fatal germination, seedling recruitment and seed decay may contribute to some degradation of the Indian hedge mustard seedbank, spatial variability of this species within the field appears most important to the observed declining trend in the seedbank.

Table 1. Temporal changes in the brome grass seedbank concentrated in wheat chaff-lines at three different sites in South Australia, at Pinery (Sites 3 and 4) and Wharminda (Site 9).

Time of sampling	**Mean brome grass density (seeds/m²)**		
	Site		
	3	4	9
1	14410	240	2363
2	18803	191	2072
3	26049	646	1963
4	23612	219	*

*Not sampled

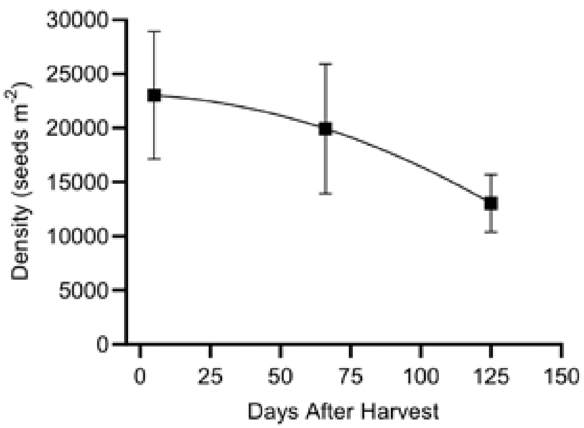

Figure 2. The temporal decline in the Indian hedge mustard seedbank in wheat chaff-lines after crop harvest at Minnipa, South Australia. Each point is the mean of four replicates and vertical bars are the standard error of the mean.

Table 2. Tolerance of the annual ryegrass seedbank to chaff-lining in wheat at nine different sites across the major cropping regions of South Australia; Yorke Peninsula (Sites 1-2), Mid-North (Sites 3-6) and the Eyre Peninsula (Sites 7-9).

Time of sampling	**Mean Annual ryegrass density (seeds/m²)**								
	Site								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	93	5325	1343	3301	22678	8444	25287	513	7134
2	450	11176	982	5467	16969	11464	29831	2399	5443
3	597	7503	1409	7718	26686	12177	29244	1352	4657
4	*	*	1301	4829	18492	8657	*	2143	*

*Not sampled

Chaff density

Chaff-density was calculated by assessing the chaff-line dimensions during sampling and processing. Similar patterns of seedbank decline were observed across the nine different sites in response to chaff density. Variability in the annual ryegrass and brome grass seedbank was not associated with increasing density of chaff-lines at sites across the Yorke Peninsula, Mid-North and Eyre Peninsula (Figure 3). Despite visual differences in chaff-deposition onto dedicated tramlines, a two-sample t-test showed that these were non-significant (P=0.448) and did not contribute to weed seed decay (Figure 3A). The levels of seed decay documented in the present study are consistent with findings in northern Australia by Ruttledge et al. (2018) in GRDC project UQ00084. While weed seed fate was not affected by chaff density, Ruttledge et al. (2018) reported suppression (15-35%) of annual ryegrass emergence in response to burial in chaff-lines under glasshouse conditions.

Climatic implications

Exhaustion of weed seedbanks in chaff-lines occurs through seedling recruitment, seed decay, or a combination of these two factors. Climatic factors are intrinsically linked to regulating the germination behaviour of weed species, while sensitivity of soil microorganisms to temperature and moisture gradients determines rates of substrate depletion.

A HOBO® logger was placed at the bottom of chaff-lines at each site to collect data at hourly intervals on relative humidity, temperature and the number of dew events. The median temperature of chaff-lines ranged from 15.3-28.7°C (Figure 4), while there were no differences detected between sites (P=0.056). Despite the low C: N ratio of wheat residues, the concentration of organic matter in a chaff-line is likely to promote microbial activity.

Microorganisms are known to excrete enzymes which have an important role in mediating weed seed decay. The temperatures recorded in this study are likely to have an increased rate at which these enzymes function, resulting in rapid decay of weed seeds. The stability of the annual ryegrass and brome grass seedbank in chaff-lines demonstrates that low soil moisture may have restricted soil microorganism populations. Even though the median number of dew events at Maitland (11) was more (P=0.011) than other sites (Figure 4), there was no reduction in the annual ryegrass seedbank (Table 2).

Rainfall data was sourced over the duration of the study from the nearest Bureau of Meteorology automatic weather station for all sites. Rainfall across the different regions was well-below average and represented 20-23% of the long-term mean (Figure 5). Intermittent, full hydration of annual ryegrass seeds associated with the summer-autumn rain is known to accelerate dormancy release by altering the seed composition of abscisic acid and gibberellins (Goggin et al. 2012).

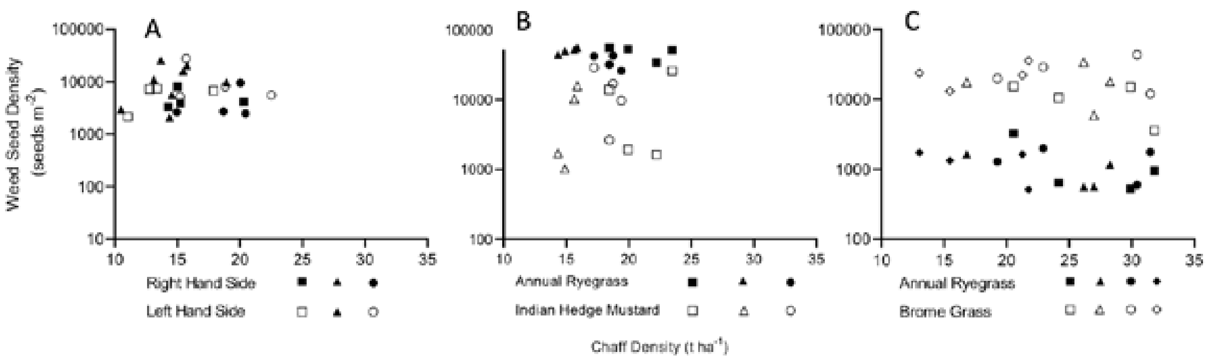

Figure 3.The relationship between seed fate and chaff density for different weed species under chaff-tramlining (A) and chaff-lining systems (B and C) at Maitland, Minnipa and Pinery, South Australia, respectively. Samples were collected at regular intervals over the summer-autumn period: T1 ■ ; T2 ▲; T3 ●; and T4 ◆.

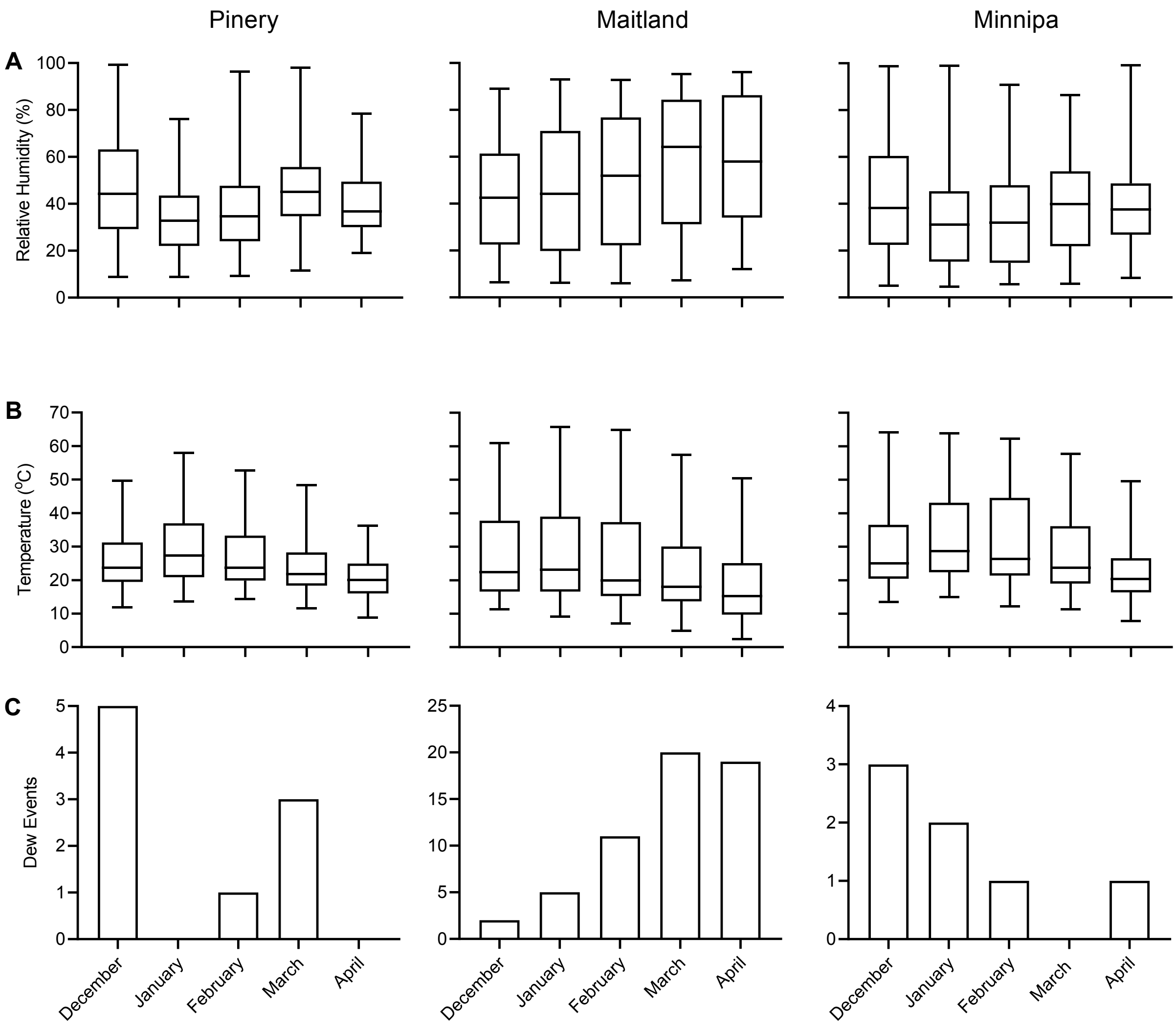

Figure 4. Observations from the Yorke Peninsula (Maitland), Mid-North (Pinery) and Eyre Peninsula (Minnipa) on relative humidity (A), temperature (B) and the number of dew events (C) over the sampling period. This data was collected at hourly intervals using a HOBO® logger that was placed on the soil surface beneath the chaff-line.

Rainfall deficiencies over the summer-autumn period may provide some explanation for weed seedbank stability in chaff-lines. Instead, the small rainfall events that were reported (Figure 5) are likely to have initiated transient hydration, which is known to reduce the time between imbibition and germination in annual ryegrass (Goggin et al. 2012). The temperature of the maternal environment in the year of annual ryegrass seed development has also been found to strongly influence seed dormancy (Steadman et al. 2004).

Brome grass seeds are photosensitive and preferentially germinate with burial, but populations in South Australia have been shown to exhibit a vernalisation requirement to release dormancy (Kleemann and Gill 2013). It is possible that the seed water content of annual ryegrass and brome grass varied in response to changes in relative humidity across the different sites (Figure 4). However, a previous Australian study showed dormancy release rates in annual ryegrass were not modified by natural fluctuations in humidity (Steadman et al. 2004). The proportion of the annual ryegrass and brome grass seedbank that is depleted in chaff-lines by fatal germination or seedling recruitment is difficult to predict because of their complex seed dormancy characteristics.

Investigation of weed seedbank decline in nine chaff-lining systems of South Australia demonstrated that growers are achieving high concentration of weed seeds and crop residue at harvest. Assessment of the viable weed seed fraction after crop harvest suggests that large residual annual ryegrass, brome grass and Indian hedge mustard seedbanks have been established in cropping fields because these species did not decay over the summer-autumn period in chaff-lines. Evaluation of chaff-tramlining systems showed that annual ryegrass seedbank decline is independent of chaff-line configuration and chaff density. The stability in the weed seedbanks in chaff-lines were consistent with the dry conditions over the summer-autumn period; however, infrequent rainfall over this period is not unusual in South Australia. Therefore, growers should be cautious of the magnitude of viable weed seeds in chaff-lines before the cropping season and expect variability in the effectiveness of this tactic between seasons. Implementation of targeted control of these chaff-lines may be necessary to mitigate seedbank replenishment; however, care should be taken to prevent lateral dispersal of weed seeds by vectors, such as livestock and machinery.

Acknowledgments

The research undertaken as part of this project is made possible by the significant contributions of the growers through both trial cooperation, Jerel Fromm, Ian Noble and Ed Hunt on EP, and the support of the GRDC in project UA00156. Thank you to Ian Richter, Katrina Brands, Bradley Hutchings and Steve Jeffs (SARDI) for their technical input to the EP samplings.

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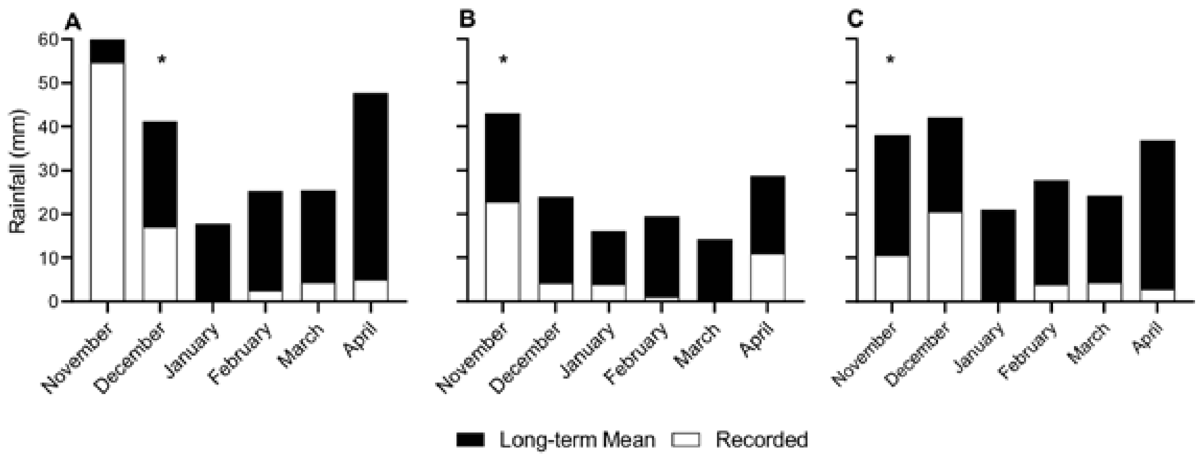

Figure 5. The long-term mean and recorded monthly rainfall for the chaff-lining field sites at Maitland (A), Pinery (B) and Minnipa (C), South Australia, following harvest (*).

SOIL AND PLANT TESTING FOR BETTER FERTILISER DECISIONS

2020 CASE STUDY AND GROWER FEEDBACK: ECONOMIC GAINS THROUGH SOIL TESTING IN THE MID NORTH

AUTHORS: Sean Mason; Agronomy Solutions, Sam Trengove; Trengove Consulting and Brianna Guidera; Hart Field-Site Group.

The following case study is an explanation of the procedure involved with GRDC project: Using soil and plant testing data to better inform nutrient management and optimise fertiliser investments for grain growers in the southern region.

Wheat response to P fertiliser in deficient soils: a 2020 case study

Location: Nantawarra, SA

Crop: Wheat (Scepter)

Standard fertiliser practice at seeding:
23N-18P-0-1 @ 100kg/ha

What was done?

Satellite-based NDVI imagery from previous growing seasons, which indicates biomass density and condition, was used to identify two production zones (1 ha area) within the paddock: a high production zone (Zone 1) and a low production zone (Zone 2) (Figure 1). Soil tests prior to seeding indicated phosphorus (P) deficiency was highlighted in Zone 2 (Table 1). Phosphorus fertiliser test strips were implemented across both production zones at three rates: Nil, grower standard rate and double rate (0P, 18P, 36P). Profile N values were moderate and enough to support early crop growth. The crop was top-dressed with a 50:50 split of urea (42N) and sulfate of ammonia (21N) at 60 kg/ha, providing 25 kg and 12 kg N/ha respectively in early August.

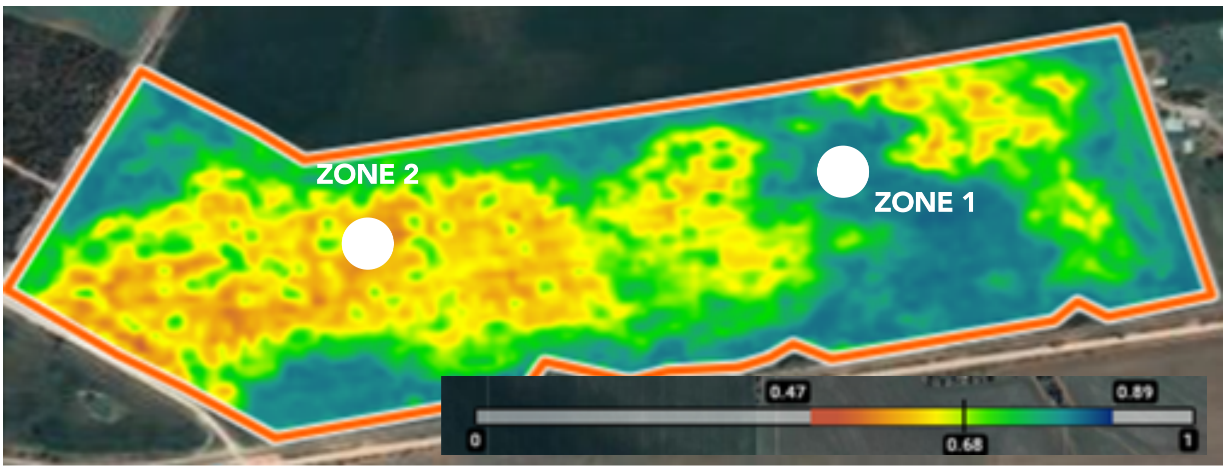

Figure 1. Paddock NDVI imagery with two production zones highlighted.

Table 1. Soil test results from the two different production zones. Zone 1 – target Colwell P = 26, Zone 2 – target Colwell P = 34. Critical value for DGT (wheat = 60).

Zone	Profile mineral N (kg/ha)	Colwell P (mg/kg)	PBI	DGT-P (µg/L)
Zone 1	149	47	85	58
Zone 2	190	30	162	30

Crop tissue tests taken at GS30 (stem elongation) within each treatment and zone, showed that tissue concentrations of P generally increased with fertiliser rate (Figure 3). There is a trend of higher biomass production as fertiliser rate increases (Figure 2) which is clearly visible in the paddock (Figure 5; Figure 6).

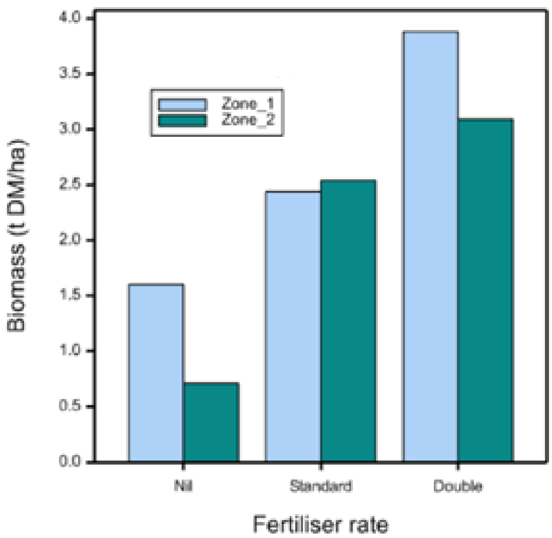

Figure 2. Crop biomass (g DM) within each fertiliser strip in both zones.

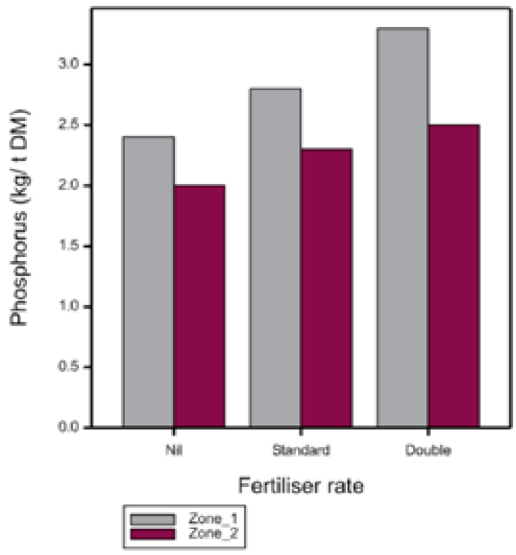

Figure 3. Plant tissue Phosphorus quantities.

What's to come?

Yield data and an economic analysis will determine whether there are significant yield responses between fertiliser rates within each zone, and the profitability of altered fertiliser practices in this paddock.

The aim to the GRDC project is to demonstrate the value of soil and plant testing by placing this value in terms of economic gains with increased yields or improved fertiliser application efficiency. Grower and advisor attitudes to soil and plant testing are a key component and we took time out to interview a participant in the project to quiz them on some key aspects of the project.

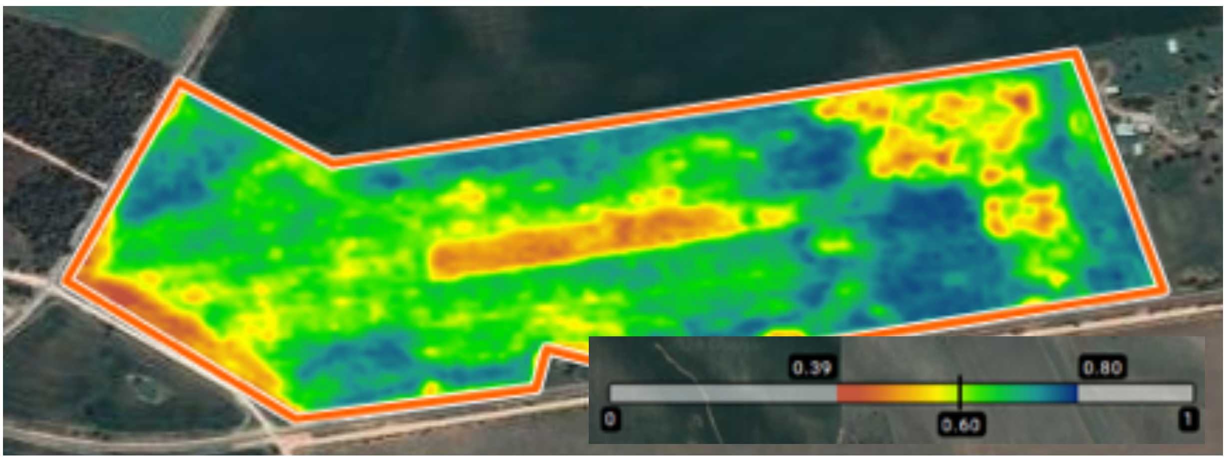

Figure 4. NDVI image (23rd July 2020) outlining the fertiliser treatment effects across the paddock (Courtesy of Data Farming)

Figure 5. Aerial imagery of the paddock. Treatment order (left to right): Grower standard rate, nil, double fertiliser.

Figure 6. Nil fertiliser strip biomass (left) and double fertiliser strip biomass (right).

Comments from the agronomist…

Q: Prior to participating in the project were you aware that the paddock was P deficient?

A: Not really, we have historically applied P to match crop removal only.

Q: Have you/the grower faced challenges implementing/managing the fertiliser test strips?

A: No, the larger nature of the trial strips made the process relatively easy.

Q: In the past were you aware of the degree of variability across the paddock? Would you recommend using variable rate fertiliser in this paddock in the future if you aren't already?

A: Yes, soil type variation is common and often obvious to see when looking at crops throughout the year. Variable rate might be an option in the future, although the seeder does not have this feature. Applying manures or additional fertiliser (via spreader) to these areas would be more feasible in the short term.

Q: Going forward, would you consider continuing to use fertiliser test strips in your paddocks? Why/why not?

A: Yes, simple nil and double fertiliser strips, and possibly N rich strips, are an easy way to check nutrition responses.

Q: Do you have any advice for somebody who suspects they have a soil nutritional deficiency?

A: Basic soil testing as a starting point, then fertiliser test strips to ground truth, and possibly soil test mapping to fine tune things after that. Also, we need good yield maps to check if these deficiencies are limiting yields.

IMPORTANCE OF IDENTIFYING PADDOCK ZONES IN TERMS OF MAXIMISING GROSS MARGINS WITH SOIL TESTING AND DATA LAYERS.

What was done?

Trengove Consulting has identified different production zones (NDVI, grain yields) across paddocks can be linked to soil properties which drive Phosphorus availability. These soil properties can be pH, soil carbonate levels and the P fixation potential (measured by PBI) which can change dramatically over very short distances within a paddock. Through a SAGIT funded project Trengove Consulting tested the implications of these soil attributes on economic P rates by running 4 replicated field P response trials in different zones at two sites in the Mid-North. We have used this response data to outline the potential economic gains that can be made by moving to zone specific soil sampling.

Results

Phosphorus deficient zones were identified at both sites and coincided with high pH, presence of carbonate and corresponding higher PBI zones. Based on yields obtained in 2019 at both sites two zones at the Kybunga site and two zones at Bute responded to P applications well above replacement P rates. These zones were identified by pre sowing soil tests (DGT P and PBI) as requiring higher than replacement P rates to optimise yields. The importance of low P zone identification through soil testing was evaluated by using the gross margins obtained at predicted required P rates and the gross margins obtained at replacement P rates calculated as 3 kg P/ha for every t/ha of grain (Table 2). In scenarios where soil test results were above critical values the recommended P rate resorted back to replacement P rates and therefore both scenarios produce the same partial gross margin. Informed P rates through soil testing was highly profitable for highly P responsive zones (Kybunga – 1,2, Bute – 3). With this analysis it is important to factor in the amount of area and soil type the soil test value relates to for the overall cost benefit of using soil testing for P in the Mid-North region.

What's to come?

Data generated from the GRDC project is undergoing economic analysis to provide information on the value of soil and plant testing for P and N across the Southern region. This assessment will be combined with 2020 season results.

The SAGIT project run by Trengove consulting is continuing for the 2020 season and the combination of two seasons results will be communicated through Hart.

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Table 2: Influence of soil test information on recommended P rates and the partial GM generated compared to replacement P strategies. *Replacement P rates based off 2019 yield potentials at each zone and calculated as 3 kg P/ha for every t/ha grain.

2019 Trial locations	Production zones	P replacement rates kg/ ha*	DGT P ug/ L	PBI	Recommended DGT P rate kg/ ha	1) Grain yield at replacement P rate t/ ha	2) Grain yield at soil test P rate t/ ha	Partial GM 1 $/ ha	Partial GM 2 $/ ha	Advantage of soil test over Replacement P
Koolunga	Zone 1	7	20	126	31	1.95	2.36	979	1136	157
	Zone 2	9	25	141	29	2.54	2.92	996	1130	133
	Zone 3	10	93	44	> Critical	3.1	3.1	1002	1002	0
	Zone 4	9	71	73	> Critical	2.65	2.65	992	992	0
Bute	Zone 1	16	150	25	> Critical	5.09	5.09	1055	1055	0
	Zone 2	14	51	61	4	4.6	4.6	1043	1043	0
	Zone 3	15	20	90	24	4.16	4.42	1046	1108	62
	Zone 4	16	35	73	12	5.12	5.01	1057	1024	-33
							Total ($/ha)	8170	8490	

NOTES

ATTRACTING AND RETAINING STAFF

AUTHOR: Carlyn Sherriff, Pinion Advisory

Background

Working with people is an essential part of running a profitable farming business. There are many challenges facing farm owners and managers including attracting, leading and managing your team. With a proactive and professional approach, your business can improve success in attracting employees and then maintaining positive ongoing relationships. This approach positions your business as an employer of choice.

Key points

To assist your business in becoming an employer of choice, consider these aspects:

1. Culture

Culture is defined as the demonstrable values that are lived by the business owner. Culture is directly influenced by the leaders of an organisation. It can be enhanced or eroded at any time. Cultural alignment between owner and employees is essential for a strong business, as alignment of values and culture leads to improved performance.

- You may have a robust business strategy but without the right culture, the strategy will fail.
- Recruit for the right attitude that reflects your culture. You can train and develop the skills required if your team has the right attitude.

2. Professional operation

Set yourself up for success by operating as a professional business.

This includes:

- Thorough recruitment process.
- Clarity in your employment expectations (job descriptions).
- Systems and procedures that support your workplace culture (lead by example).
- A culture of accountability including record keeping.
- Induct and train all staff members to support their capacity development.
- Regularly undertake performance reviews that provide two way feedback.
- Preserve confidentiality at all times.

3. Communication

Communication is an essential trait of successful teams. On-farm this looks like:

- Developing 'game plans' for key operations such as seeding or harvest.
- Undertaking weekly toolbox meetings to ensure the team is clear on the tasks for the week.
- Clear roles and responsibilities that provide an outline of expectations and tasks.
- Use of messaging apps to keep in touch during the day (whatsapp or messenger).
- Effective delegation ensures clarity on task expectations, facilitates skill development and frees up time. Effective delegation includes – what I need done, by when, what does success look like, what happens when something goes wrong and check-ins along the way.
- Dealing proactively with any team issues as they arise.

4. Know the standards

Ensure your professional business understands the workplace standards and ensures compliance. Employees are motivated by security, structure and clarity.

These workplace standards include:

- FairWork
- Modern Pastoral Award
- Workplace health and safety

5. Leadership

To attract and retain your team, focus on yourself and developing your leadership skills. One foundational framework is to ensure you 'work above the line'. This is operating with ownership, accountability and responsibility. The opposite is blaming, making excuses and being in denial (below the line).

'Working above the line' is a choice you make as a leader; it will create trust and enhance your team function.

Follow-up

Contact Carlyn Sherriff or Dee Heinjus at Pinion Advisory, 1300 746 466.

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deheinjus@pinionadvisory.com

Useful references

FairWork https://www.fairwork.gov.au/

Modern Pastoral Award 2020 https://www.fwc.gov.au/documents/documents/modern_awards/award/ma000035/default.htm

Farmers' guidebook to work health and safety https://www.safework.sa.gov.au/industry/agriculture/farmers-guidebook-to-work-health-and-safety

REGIONAL INTERNSHIP IN APPLIED GRAINS RESEARCH

Since 2016, our internship program has allowed us to invite applications from an exceptional ag science graduate with a passion for grains research to kick-start their career by working with us for a year.

Our interns work directly under our Research & Extension Managers, Sarah Noack & Bek Allen to learn all aspects of trial design, management, sampling and the statistical analysis of data. They also gain experience in written and oral communications and expand their networks by collaborating with a huge range of growers, advisors, researchers and industry representatives.

The internship program has been offered again for a February 2021 start, and for the first time, is a two-year position. We'll be making an announcement about who will be joining us very soon.

2016 - Rochelle Wheaton I 2017 - Dylan Bruce I 2018 - Emma Pearse I 2019 - Jade Rose I 2020 - Brianna Guidera

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