LEADA

Lower Eyre Agricultural Development Association

Presents

The Lower Eyre Peninsula Farming Expo

5 March 2015

Cummins Ramblers Football Club

Wish to acknowledge the support from the following Organizations to help make this event and all our trials possible

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GRDC Grains Research & Development Corporation

Australian Government

Government of South Australia
Eyre Peninsula Natural Resources Management Board

Our Vision: *LEADA is committed to providing support and attracting research activity to the Lower Eyre Peninsula. It is driven by local issues and the search for solutions that suit local systems.*

Our mission: *A grower group that specifically addresses issues and solutions to improve farming systems in your area.*

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PROGRAM FOR THE DAY

7.30 am	Registration and Breakfast

8:30 am **Welcome**

John Richardson, Chair, LEADA

8:35 am **Keynote Speaker**

Wayne Smith, Agronomic Acumen

"Be phenomenal or be mediocre. What's it to be?"

9:35 am **Trial results**

Andrew Ware, SARDI – Focus on Canola

Pat Head, Landmark – Focus on Eyespot

David Davenport, RSSA – Focus on New Horizons and sub soils constraints

10:20 am	Morning Break *and static displays*

10.55 am **Simon Goss,** SARDI

Barley competitiveness and agronomy

11.25am **Grant Pontifex,** Farmer, Paskeville

Experience in alternative legumes

12.10 pm **Therese McBeath / Ed Hunt**

Nitrogen risk management

12:40 pm **Wrap up and Thanks**

LEADA Committee member

12:45 pm	Lunch *and static displays*

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CONTENTS

Chairman's Introduction

John Richardson

Welcome all members, sponsors, industry professionals and guests to another year of LEADA research and extension.

2014 proved a 'mixed bag' for agriculture across the Lower EP, with many farmers and agronomists finding it a highly challenging season, particularly in the higher rainfall environments. One of the wettest winter periods followed by one of the driest springs on record put production systems, across the region, to the test. The emergence of Beet Western Yellows Virus only compounded this situation.

LEADA's 2014 was very productive, with stable financial and administrative governance allowing the committee to focus its attention on attracting funding for research and extension on LEP. The stability of LEADA is in no small part due to the enthusiastic and committed guidance of the outgoing chair Jordan Wilksch. LEADA thanks him for the professionalism and passion he has brought to the role over the past two years. Thanks Jordy.

Thanks also go to outgoing committee members Scott Siviour, Martin Burns and Neil Ackland. A particular thanks to Neil, who has decided to step down from his sustainable agriculture, NRM role within DEWNR. Without Neil's input and his linkages with NRM, LEADA would have been unable to offer the same high level of research and extension. LEADA wishes Neil well in his future endeavours and look forward to continuing our relationship with NRM through Neil's replacement.

During 2014 LEADA was successful in attracting funding for the following new projects to take into 2015:

- Case studying treatment of low pH soils (National Landcare Program)
- Trialling variable treatment rates for spray topping canola (GRDC)
- Various NRM sustainable agriculture grants – livestock case studies, demonstrating soil modification treatments, plus adding value to the low pH soils and demonstrating soil modification projects

Add to these new projects, the ongoing NRM Regional Landcare Facilitator, GRDC Stubble Retention project, New Horizons soil modification work and leadership development programs and it is obvious 2015 will be another busy and productive year for LEADA.

We look forward to working with our sponsors, members and industry and government organisations to deliver positive outcomes and profitable solutions for agriculture across the region.

John Richardson
Chair

To be phenomenal or mediocre. What's it to be?"

Wayne Smith, Agronomic Acumen

agronomic acumen
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March 2015

Agriculture isn't rocket science. We grow food and someone pays us for it. We know an awful lot about how to grow food, but looking out the window, that is not obvious :-(.

Why are so many farmers a quarter of the profits of the leading farmers? Why do people see someone farming really well, but do nothing to change? Why are so many graziers a quarter to a tenth of the production of what is possible?

It has nothing to do with it not being possible :-). If someone has done it, then it was possible, and because we do not live in a perfect world, there is always room for improvement. We can't all be marathon runners, but we can all improve in farming, and usually we can substantially improve.

As in the photo on the right, we have all seen this "fence" phenomena every year. The farm on the right is an intensive grazing farm. The one on the left is district practice.

An example of the yields that are possible with current best practices. This is barley that averaged 4.5t/ha across the farm on only 50mm summer rainfall and 155mm growing season rainfall near Horsham, Victoria in the drought year of 2008. All neighbour's crops yielded 0-1t/ha.

Similarly with cropping, when a district is declared to be in drought, how is it that someone can produce crops like the one in the photo below? And no, fallow nor irrigation was involved.

What we used to think was impossible is now being exceeded by many farmers. There is a long way to go in profit and productivity for most farmers. In the references at the end are some publications suggesting what the cropping potential yields are. The encouraging thing to me is that farmers for many years have been beating these "potential" calculations, and they are all doing the same things right.

In the presentation, I will present some of the most common mistakes we are still making with our farming techniques and how everyone can start making substantially larger profits.

Fortunately, there is an inevitably bright future for agriculture because of more than 200,000 new people added to planet earth every day (www.worldometers.info/world-population/).

The lower Eyre Peninsula region is very fortunate to have excellent rainfall and fairly good soils (relatively) and can make substantial increases to profitability in farming. The future is very bright for you, however, will you continue the status quo and be a mediocre farmer, or will you become a phenomenal farmer pushing profit levels beyond what you thought were impossible?

Free newsletter: At the time of writing this, my March 2015 newsletter is still being written, but when it has been published (hopefully before the conference is held), click on the link below to download your free copy of my agronomy newsletter. This March edition is full of pre-sowing and early post-emergent herbicide brew suggestions, whether they are registered or not.
www.agronomy.com.au/free/LEADA/226Mar2015HR.pdf

If you have any queries, I can be contacted on my mobile (+61 (0)428 188479), or via wsmith@agronomy.com.au, or via PO Box 831, ALBANY 6331, Western Australia.

Yours sincerely,

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J. A. Kirkegaard[A,B]*, J. M. Lilley*[A]*, G. N. Howe*[A]*, and J. M. Graham*[A]
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CSIRO PUBLISHING
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FOCUS ON CANOLA

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Canola growth & development – impact of TOS and seasonal conditions

Keywords: canola, varieties, time of sowing, phenology.

Take home messages

- Understanding the drivers behind canola development will help to improve canola management and variety selection.
- Varietal maturity ratings don't always correlate with varietal phenology
- Early sowing opportunities may provide a great opportunity to maximise canola yield, but selection of the correct variety is important.

Background

In 2014 preliminary field work commenced as part of a new five year GRDC project. This project will undertake physiological and agronomic research across 9 regions in the Northern and Southern GRDC Zones from southern QLD to the Eyre Peninsula designed to increase canola profitability and reduce production risk with tactical agronomy advice underpinned by physiological insights.

Despite the success of canola in Australian cropping systems, significant gaps remain in the underlying knowledge of canola physiology and agronomy, a situation exacerbated by its expansion into new areas and the release of new technologies including vigorous hybrid varieties with herbicide tolerance. Although growers recognise the high profit potential and the farming system benefits of canola, there remains a perceived risk of growing canola largely due to the high level of input required (e.g. seed, nitrogen fertiliser, sulphur fertiliser, windrowing). There is a need to determine the level of investment appropriate for these inputs on a regional scale and the agronomic management practices (for example sowing date decisions) that reduce the overall risk and increase the profitability of canola.

Sound tactical agronomic decisions require an improved physiological understanding of yield and oil formation in canola, and how they are affected by variety, environment and management (G x E x M).

Maximising canola yield and profit will improve through an increased understanding of canola physiology. This will occur through taking the following steps; (i) identifying the optimum flowering window to minimise heat and frost risk at specific sites, (ii) identifying the variety x sowing date combinations that achieve the optimum flowering window, (iii) managing the trajectory of biomass accumulation (of specific varieties) to maximise water-use efficiency, optimise N-use efficiency and minimise the risk of high input costs (e.g. seed costs, N, herbicide types, harvest strategies). Having optimised these steps further investigation may reveal specific varietal adaptations that provide yield advantage under specific stress (heat, drought, frost) or provide further G x E x M synergies.

As a first step to improve understanding between G x E x M interactions in current varieties CSIRO conducted some pre-field experiment modelling using the best available information on variety development, prior to 2014 trial work, and the APSIM model. This explored the potential for planting canola early at a number of locations across Australia and the potential yields that could be achieved by planting cultivars with differing maturity, at a number of sowing times. Table 1 summarises this work and shows there is potential for longer season varieties to be planted in locations such as Cummins and have an improved yield potential, however the opportunity for successfully sowing these varieties only occurs in 15% of years (where sufficient summer rainfall occurs).

Table 1. Example of possible output from APSIM modelling: showing summery of potential yield for four cultivar phenotypes in four locations. Shaded area shows safest sowing window (balance between frost and heat stress risk), % figure is the sowing opportunity (% of years where rainfall allows sowing in this window).

Location	Cultivar phenology type	Sowing window intervals									Mean Potential
		8-Mar	22-Mar	5-Apr	19-Apr	3-May	17-May	31-May	14-Jun	28-Jun	Yield (t/ha)
Kojonup	Taurus	16%									3.5
	CBI406			33%							3.5
	46Y78					59%					3.5
	Hyola 50						93%				3.3
Esperance	Taurus	7%									3.8
	CBI406		20%								3.7
	46Y78				44%						3.6
	Hyola 50					57%					3.6
Cummins	Taurus	10%									4.1
	CBI406		15%								4.0
	46Y78					70%					3.9
	Hyola 50					70%					3.7
Naracoorte	Taurus	15%									3.6
	CBI406			42%							3.5
	46Y78					85%					3.4
	Hyola 50					77%					3.4

Source: J. Lilley, CSIRO

This process highlighted a number of gaps in the understanding of how many of the canola varieties currently being grown, develop and led to the 2014 trial program.

Methodology

As part of the GRDC Optimising Canola Profitability project three preliminary trials were established in South Australia in 2014; at Yeelanna (LEP), Hart (MN) and Lameroo (Mallee). Each trial featured the same six varieties (selected for a range of maturity times); three of the varieties were planted at two establishment rates (15pl/m^2 and 45pl/m^2). Each of the variety treatments were sown at four sowing times, ranging from the earliest seed was available (mid-April) through to mid-June. A range of development stages were recorded throughout the season as well as grain yield.

A further two trials, part of a canola establishment project, funded by SAGIT, will also be reported here. These trials were located at Minnipa (UEP) and Wanilla (LEP). They also had four sowing times, but a limited number of cultivars.

Description of varieties used in 2014 time of sowing trials

ATR Gem Early-mid maturity triazine tolerant variety. High oil content. Medium plant height. Blackleg resistance rating of MR (resistance group A). Tested in NVT trials 2011-14. Bred and marketed by Nuseed Pty Ltd.

ATR-Stingray. Early maturing triazine tolerant variety. Short height. Moderate-high oil content. Blackleg resistance rating MR (resistance group C). Tested in NVT trials 2010-14. Bred by Nuseed Pty Ltd and DPI Victoria. Marketed by Nuseed Pty Ltd.

Pioneer® 44Y87 (CL). Early-Mid maturing Clearfield hybrid. Moderate-high oil content. Medium plant height. Suited to medium rainfall areas. Blackleg resistance rating MR (resistance group A). Tested in NVT trials 2012-14.

Pioneer® 45Y88 (CL). Mid maturing Clearfield hybrid. Moderate-high oil content. Medium plant height. Suited to medium-high rainfall. Blackleg resistance rating R-MR (resistance group A). Bred and marketed by DuPont Pioneer. Tested in NVT trials 2012-14.

Hyola® 559TT. Mid-Early maturing TT Hybrid. High oil content. Medium plant height. Ideally fits medium-low right through to high rainfall areas. Blackleg resistance rating R, (blackleg rotation groups A, B, D). Tested in NVT trials in 2012-14. Bred and marketed by Pacific Seeds.

Hyola® 575CL. Mid maturing Clearfield hybrid. High oil content. Medium plant height. Blackleg resistance rating R (resistance groups B, F). Tested in SA NVT trials in 2010-14. Bred and marketed by Pacific Seeds.

Hyola® 971CL. Late maturing winter Grain n Graze Clearfield hybrid. Extremely high biomass, good grain yield and oil content. Autumn and Spring sowing grain and graze option for very high rainfall or irrigated zones. Provisional blackleg rating of R-MR (resistance group A). Not tested in NVT trials. Marketed by Pacific Seeds.

Results and discussion

Results of 50% flowering dates are presented in Table 2. They show that when planted early, Hyola 575CL reaches flowering a considerable time (up to two weeks) before the other varieties trialled in 2014. Hyola 971CL, when planted in mid-April, had failed to reach flowering at all sites where it was trialled prior to 1 October. The other varieties trialled generally flowered within a few days of each other, with any differences becoming smaller by the last time of sowing.

Table 2. 50% flowering dates recorded for each variety and each time of sowing at four sites, 2014.

Location	Variety	Time of sowing			
		15-Apr	30-Apr	13-May	29-May
Minnipa	ATR Stingray	9-Jul	30-Jul	19-Aug	6-Sep
	Hyola 559TT	31-Jul	10-Aug	28-Aug	6-Sep
		15-April*	5-May	2-Jun	19-Jun
Yeelanna	Pioneer 44Y87CL	8-Aug	7-Aug	12-Sep	15-Sep
	Pioneer 45Y88CL	1-Aug	9-Aug	12-Sep	15-Sep
	ATR Gem	1-Aug	10-Aug	15-Sep	15-Sep
	Hyola 559TT	5-Aug	18-Aug	12-Sep	15-Sep
	Hyola 575CL	10-Jul	11-Aug	12-Sep	19-Sep
	Hyola 971CL	-	-	-	-
		14-Apr	1-May	16-May	2-Jun
Hart	Pioneer 44Y87CL	15-Jul	20-Aug	2-Sep	8-Sep
	Pioneer 45Y88CL	16-Jul	17-Aug	4-Sep	9-Sep
	ATR Gem	6-Jul	10-Aug	3-Sep	10-Sep
	Hyola 559TT	6-Jul	8-Aug	1-Sep	8-Sep
	Hyola 575CL	29-Jun	2-Aug	31-Aug	6-Sep
	Hyola 971CL	2-Oct	1-Oct	4-Oct	7-Oct
		14-Apr	9-May	5-Jun	20-Jun
Lameroo	Pioneer 44Y87CL	28-Jul	27-Aug	8-Sep	17-Sep
	Pioneer 45Y88CL	30-Jul	29-Aug	13-Sep	23-Sep
	ATR Gem	27-Jul	27-Aug	11-Sep	19-Sep
	Hyola 559TT	26-Jul	25-Aug	6-Sep	16-Sep
	Hyola 575CL	8-Jul	28-Aug	7-Sep	19-Sep
	Hyola 971CL	-	-	-	-

* Sown and irrigated with 8mm - through dripper hose

Table 3. Grain yield of canola. Comparing two different establishment rates (15 and 45 plants/m²) at three sites over four sowing times in 2014.

		Time of sowing			
Yeelanna		15-April*	5-May	2-Jun	19-Jun
	15	1.72	1.90	0.91	did not
	45	2.14	2.19	1.23	harvest
	LSD(P=0.05)		0.17		
		14-Apr	1-May	16-May	2-Jun
Hart	15	1.70	1.89	1.69	1.28
	45	1.70	1.94	1.94	1.62
	LSD(P=0.05)		0.17		
		14-Apr	9-May	5-Jun	20-Jun
Lameroo	15	0.50	0.19	0.14	0.14
	45	0.43	0.22	0.18	0.11
	LSD(P=0.05)		0.07		

* Sown and irrigated with 8mm - through dripper hose

Table 3 shows the different responses in grain yield to two different establishment rates (15 and 45 plants/ m²) recorded at Yeelanna, Hart and Lameroo. At Yeelanna, having the higher establishment rate (45pl/m²) produced significantly higher yields at each time of sowing. This reflects other work conducted by the SAGIT canola establishment project on this soil type. At the Hart site, establishment rate only became significant at the third and fourth times of sowing (16 May and 2 June), where having the higher seeding rate improved yields. This shows that while canola has a tremendous ability to compensate for poor establishment, in some situations having a poorly established crop will cost yield and needs to be factored into management.

Table 4 shows that the variety Pioneer 45Y88CL yielded the highest at Yeelanna, Hart and Lameroo when planted in mid-April. The early May time of sowing, showed yield of all varieties, with the exception of ATR Gem and Hyola 971CL, as being very similar. Results from the Hart trial didn't show any yield reduction when seeding was delayed to mid-May (third time of sowing) compared to early-May, however significant yield reductions occurred at the Wanilla site when comparing similar sowing times. This may reflect differences in soil water holding capacity of these two soils. Refer to separate yield tables from LEP NVT trials to put the relative performance in context.

Table 4. Grain yield from canola sown at four sowing times and five South Australian sites in 2014.

Location	Cultivar	Time of sowing			
		15-Apr	30-Apr	13-May	29-May
Minnipa	ATR Stingray	2.12	1.62	1.26	0.34
Jan-Mar rf: 102mm	Hyola 559TT	1.63	1.51	1.12	0.43
Apr-Oct rf: 290mm	P-value	<0.001			
	LSD(P=0.05)	0.18			
		30-Apr	6-May	16-May	28-May
Wanilla	Hyola 575CL	1.41	1.49	0.91	0.65
Jan-Mar rf: 83mm	Pioneer 45Y88CL	1.41	1.50	0.70	0.51
Apr-Oct rf: 399mm	P-value	<0.001			
	LSD(P=0.05)	0.14			
		15-April*	5-May	2-Jun	19-Jun
Yeelanna	Pioneer 44Y87CL	1.96	2.06	1.38	Did not harvest
Jan-Mar rf: 89mm	Pioneer 45Y88CL	2.26	2.17	1.13	
Apr-Oct rf: 346mm	ATR Gem	1.64	1.82	0.73	
	Hyola 559TT	1.89	2.07	1.08	
	Hyola 575CL	2.21	2.34	1.18	
	Hyola 971CL	0.54	0.27	0.20	
	P-value	<0.001			
	LSD(P=0.05)	0.30			
		14-Apr	1-May	16-May	2-Jun
Hart	Pioneer 44Y87CL	1.62	1.80	1.89	1.82
Jan-Mar rf: 84mm	Pioneer 45Y88CL	1.98	1.96	1.89	1.42
Apr-Oct rf: 289mm	ATR Gem	1.29	1.52	1.56	1.15
	Hyola 559TT	1.76	1.84	1.74	1.32
	Hyola 575CL	1.49	2.06	2.05	1.61
	Hyola 971CL	0.37	0.40	0.49	0.25
	P-value	<0.001			
	LSD(P=0.05)	0.24			
		14-Apr	9-May	5-Jun	20-Jun
Lameroo	Pioneer 44Y87CL	0.59	0.36	0.28	0.23
Jan-Mar rf: 62mm	Pioneer 45Y88CL	0.72	0.31	0.24	0.12
Apr-Oct rf: 189mm	ATR Gem	0.46	0.12	0.08	0.10
	Hyola 559TT	0.56	0.22	0.30	0.22
	Hyola 575CL	0.51	0.25	0.23	0.13
	Hyola 971CL	0.00	0.00	0.00	0.00
	P-value	<0.001			
	LSD(P=0.05)	0.18			

* Sown and irrigated with 8mm - through dripper hose

Some of the differences in yields and plant development observed in the time of sowing trials can, in part, be explained by the drivers behind the development of each canola cultivar. There are three main controls of the development of canola; vernalisation response, photoperiod response and basic temperature response. Each of these will play a differing role in every variety.

Vernalisation affects canola from sowing to floral initiation. Varietal response to vernalisation will manifest as reduced time taken from sowing to floral initiation as well as a reduced number of leaves at floral initiation. It is expected that early sowing of canola into a relatively warm period (viz. sowing in early April v mid May) will lead to a delay in the accumulation of vernalisation which will exacerbate the differences in flowering dates of varieties with different vernalisation requirements.

Varietal response to photoperiod occurs between emergence and floral initiation. Canola is a long day plant, meaning that the duration from sowing to floral initiation is reduced in long day situations. In recent studies, varieties commonly responded to day length in the range of 11 to 16 hours. For canola plants emerging in mid-April after an early April sowing, there is potential that some of the photoperiod requirement could be met in autumn where day length is longer than mid-winter.

The basic temperature response is essentially the response of a variety to thermal time (degree-days) when both photoperiod and vernalisation requirements are met. Although there are differences in the basic temperature response amongst commercial varieties in terms of time taken to floral initiation, it is generally less important than the differences as a result of vernalisation or photoperiod response. The basic temperature response is however the main driver of development after floral initiation.

Using the data collected from the South Australian and New South Wales trials collected in 2014 we can start to draw some conclusions about how some of the varieties trialled develop.

Hyola 971CL has a high vernalisation requirement. When this variety was sown in mid-April in the low to medium rainfall area of South Australia in 2014 flowering didn’t commence until the first week in October. Dry conditions through spring in all locations led to this variety being the lowest yielding in all trials.

Hyola 575CL appears to have a relatively flat thermal time requirement, regardless of when it is sown. This resulted in Hyola 575CL being the first variety to commence flowering when sown early. Results from the first time of sowing in all trials show that the yield of Hyola 575CL was lower compared to Pioneer 45Y88CL, meaning that it was a disadvantage to plant this variety early in 2014. The variety description of Hyola 575CL indicated it should have a mid-season maturity, similar to 45Y88CL.

Pioneer 44Y87CL showed a reducing thermal time requirement as sowing was delayed. Further research is needed to understand why this occurred but may have been due to a greater vernalisation requirement of 44Y87CL compared to Hyola 575CL, with early sowing taking longer to accumulate vernalisation than the later sowing dates. This may have helped 44Y87CL avoid some damage from early frost events.

Information generated by trials such as this into the future will add value to other trial results such as NVT and help explain difference in varietal adaptation, and performance as a starting point to growing more profitable canola.

Conclusion

The way each canola variety develops can have a large influence the resulting yield, when planted at different times, and in different environments. The challenge for this project, going forward, is to be able to develop and deliver information on new varieties in a way that is timely and relevant to growers and advisors. Growers and advisors will be able to use this information to help select a suite of varieties that are suited to sowing opportunities that most often occur in their district and also to capitalise on early or delayed sowing opportunities as the seasons dictate.

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CLETHODIM TOLERANCE IN CANOLA

Michael Zerner[1] and Rob Wheeler[2], Formerly SARDI (now University of Adelaide) [1], SARDI[2]

Why do the trial?

Clethodim has become a very important herbicide in the control of annual ryegrass in southern Australia. In recent times, label rate changes have occurred to enable higher rates of up to 500 mL/ha to be used for increased levels of weed control. This rate increase applies to canola, pulse crops and pasture legumes. Since the use of this higher rate of clethodim, a number of crop effects have been reported, particularly in canola. Observed symptoms include, delayed flowering, distorted flower buds and possible grain yield suppression. Symptoms appear to be more severe from later application timings. Other factors that may influence crop effects include herbicide rate, crop stress at herbicide application and possible varietal differences in tolerance.

Given the widespread importance of the use of clethodim in the farming rotation and increased application rates to combat herbicide resistant annual ryegrass, field trials at Yeelanna and Hart were established in 2013 and 2014 to identify the level of crop tolerance to these rates in canola. The level of actual yield losses that may occur from the use of high clethodim rates is relatively unknown.

How it was done?

The Yeelana and Hart trials were established as a split-plot design with three replicates. Three canola varieties were used; AV Garnet (conventional), ATR Gem (triazine tolerant) and Hyola 474 CL (Clearfield) to investigate the influence of clethodim rate and timing. Nine clethodim treatments were applied to each variety as listed below in Table 1. These trials were solely aimed at investigating the impact of clethodim on crop safety rather than weed control. Further trials were conducted at Roseworthy in 2013 and 2014 to identify differences in the level of clethodim tolerance between a number of varieties.

Spray treatments for each growth stage were applied on the same day for each variety. As a result the exact growth stage at the time of application for each variety may have differed slightly, despite all varieties used in this trial being of very similar maturity.

Table 1. Clethodim treatments applied at Yeelanna during 2014.

CLETHODIM TREATMENTS
1. Untreated control
2. 0.5 L/ha applied at 4-leaf growth stage
3. 1 L/ha applied at 4-leaf growth stage
4. 0.5 L/ha applied at 8-leaf growth stage
5. 1 L/ha applied at 8-leaf growth stage
6. 0.25 L/ha applied at 4-leaf and 8-leaf growth stages (0.5 L/ha in total)
7. 0.5 L/ha applied at 4-leaf and 8-leaf growth stages (1 L/ha in total)
8. 0.5 L/ha applied at bud initiation
9. 1 L/ha applied at bud initiation

Application of clethodim at 1 L/ha is not a registered rate and was undertaken for experimental purposes.

What happened?

Yeelanna and Hart trials investigating the influence of timing of clethodim on the degree of crop damage showed less detrimental yield effects compared to the previous year (Tables 1 and 2). Previous trial results indicated early applications of clethodim when the crop is at the 4-leaf stage of development have been the safest on the crop. No significant yield reductions have been observed from spray applications at this time for rates up to 1L/ha at Hart or Yeelanna across both years. When applied at 8-leaf growth stage of canola, the risk of yield reduction becomes greater. At this particular timing significant yield reductions have only been observed when rates exceed 500mL/ha, although small reductions of up to 5% have occurred at the label rate. In comparison to when applied at 1L/ha, yield reductions of up 25% have been observed. Although this was not found to be the case at Yeelanna or Hart during 2014, where no significant yield difference occurred. Splitting the high rate of 1L/ha across two applications (i.e., two applications of 500mL/ha) between 4-leaf and 8-leaf growth stages improved the level of safety to the crop. When applying clethodim later than the 8-leaf growth stage, the level of crop damage significantly increased. Similar results from Yeelanna and Hart during 2014 showed reductions ranging from 7-9% at 500mL/ha and up to 40% at 1L/ha when applied at early bud initiation growth stage. This result closely reflected previous findings identified during 2013. The lower degree of crop yield losses observed during 2014 at each site may be attributed to more favourable growing conditions as overall yields were higher in 2014 trials. These conditions may have provided additional resources to enable sufficient crop recovery to the herbicide damage minimizing yield losses.

Table 1. Effect of clethodim applied at different timings and rates on the grain yield of canola at Hart during 2013 and 2014. Highlighted values indicate significantly less than untreated (*p*<0.05).

Application timing Untreated	Clethodim rate	ATR Gem		AV Garnet		Hyola 474	
		2013	*2014*	*2013*	*2014*	*2013*	*2014*
		1.11 t/ha	1.65 t/ha	1.37 t/ha	2.11 t/ha	1.69 t/ha	2.06 t/ha
		--------------------------grain yield % of control------------------------					
4 leaf	0.5L/ha	98	95	99	101	100	101
	1L/ha	94	99	106	100	96	98
8 leaf	0.5L/ha	99	102	104	95	96	97
	1L/ha	87	101	106	97	87	99
4 leaf and	0.25L/ha + 0.25L/ha	91	103	102	98	92	104
8 leaf split	0.5L/ha + 0.5L/ha	95	103	103	98	91	102
Bud initiation	0.5L/ha	80	95	97	96	87	93
	1L/ha	61	66	90	92	61	60

Table 2. Effect of clethodim applied at different timings and rates on the grain yield of canola at Yeelanna during 2013 and 2014. Highlighted values indicate significantly less than untreated (*p*<0.05).

Application timing Untreated	Clethodim rate	ATR Gem		AV Garnet		Hyola 474	
		2013	*2014*	*2013*	*2014*	*2013*	*2014*
		1.74 t/ha	1.94 t/ha	2.12 t/ha	2.01 t/ha	1.75 t/ha	2.34 t/ha
		-------------------------grain yield % of control-----------------------					
4 leaf	0.5L/ha	98	98	94	105	100	104
	1L/ha	94	107	94	117	100	95
8 leaf	0.5L/ha	95	103	95	99	95	101
	1L/ha	90	96	90	100	75	100
4 leaf and	0.25L/ha + 0.25L/ha	90	101	96	100	99	103
8 leaf split	0.5L/ha + 0.5L/ha	97	100	92	107	98	103
Bud initiation	0.5L/ha	76	91	86	91	70	91
	1L/ha	65	81	87	85	48	60

Variation does exist between varieties across all crop types in their level of sensitivity to clethodim.

The trial at Roseworthy was used to identify differences in the level of clethodim tolerance. The 2014 season provided similar results in varietal tolerance as identified in 2013. This trial included a small number of different varieties as to those tested during the previous year due to seed made available by the respective plant breeders. The variety, AV Garnet was again found to be one of the most tolerant canola varieties tested, also supported by data Hart and Yeelanna trials. Despite the differences in varietal tolerance, there appears to be no influence from crop type (conventional vs TT vs Clearfield) or open-pollinated vs hybrid. The range in yield reductions between varieties was quite large and similar to that observed during 2013 (Figures 1 and 2). At 2L/ha, the highest herbicide rate used (specifically included to further pronounce any differences in varietal tolerance), the range in yield loss between the 10 varieties tested was between 5% and 30%. This is a large difference between varieties, hence identifying the level of clethodim tolerance for each variety would be very useful. This would help assist in determining the level of risk of yield reductions that could occur when using above label recommended rates (>500mL/ha) of clethodim when seeking improved weed efficacy.

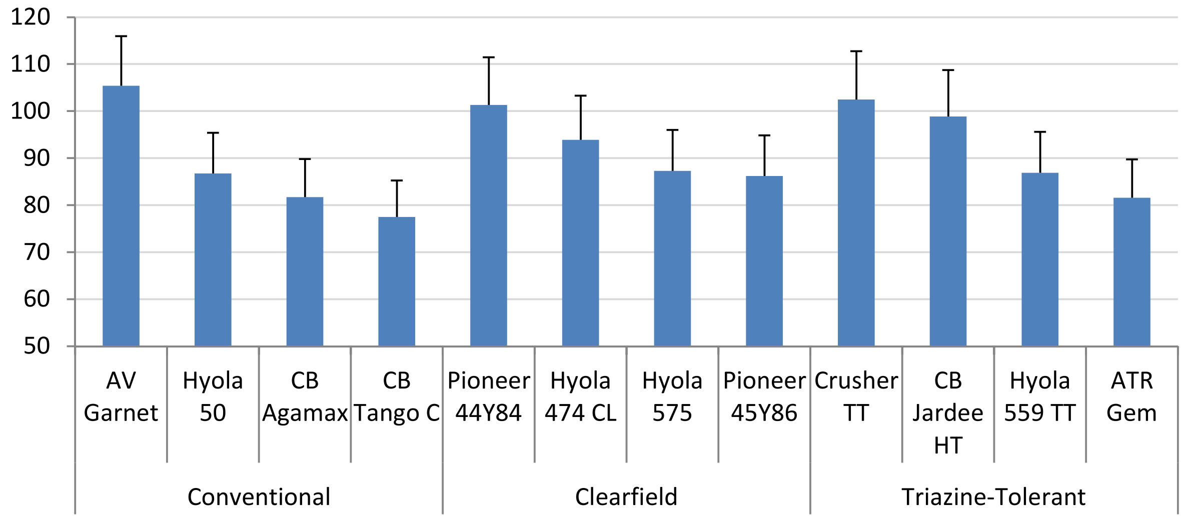


Figure 1. Average grain yields of canola sprayed with 2L/ha of clethodim at Roseworthy, SA during 2013. Yields expressed as a percentage of untreated controls.

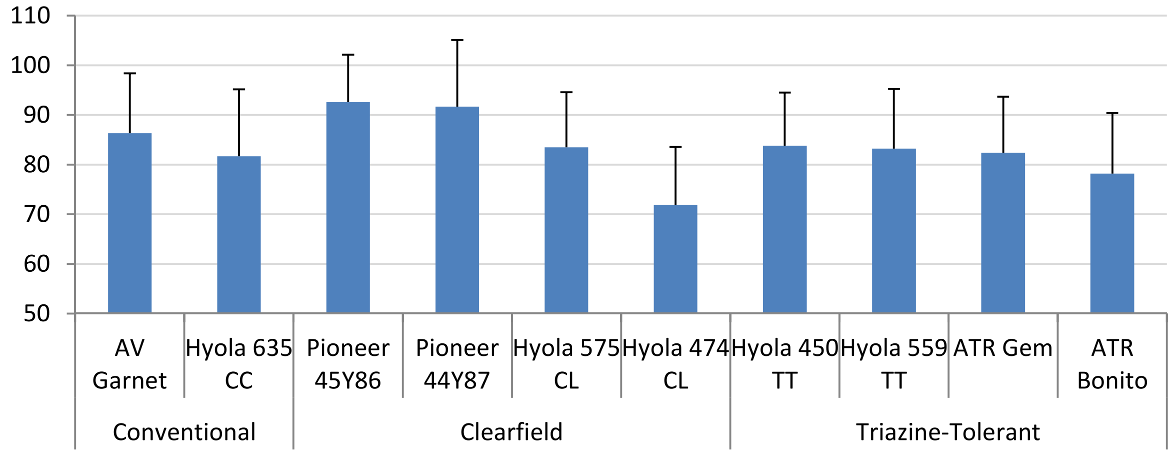


Figure 2. Average grain yields of canola sprayed with 2L/ha of clethodim at Roseworthy, SA during 2014. Yields expressed as a percentage of untreated controls.

Visual damage symptoms observed throughout development following application, flower distortion being the most distinguishable.

During 2014, from a visual damage perspective, the trials very much mimicked what was seen in the previous year. The flower distortion symptom common with clethodim damage was clearly evident in damaged plots and visual degree of damage scores positively correlated with yield losses. SPAD (Chlorophyll/greenness) readings at Roseworthy again were strongly affected by clethodim applications. The higher application rates of clethodim lowered the SPAD readings, effectively reducing the degree of greenness in the crop canopy. Clethodim treatments had no impact on biomass production, plant height or maturity. Although in severely damaged plots, ripening was commonly delayed from pod distortion. Pods would often be much smaller and thicker, maintaining their greenness for a longer period of time.

What does this mean?

As clethodim application rates have increased to manage ryegrass and other grass weeds developing resistance, it has created concern for crop damage to canola, the most sensitive crop of those registered for clethodim use. This trial at Yeelanna has shown that particularly late timings of clethodim can result in severe yield losses, therefore care should be taken to apply at correct growth stages and application rates. Applications exceeding 0.5 L/ha are at high risk of causing yield reductions in most canola varieties. From the trial results it is evident that the early application at 4-leaf growth stage of canola was the safest on the crop but this may not be always the best time of application for targeting weed control. For example, a large proportion of the weed population may germinate later requiring additional follow up sprays or delaying initial spray applications. This may lead to requiring a compromise in rates and timings to best control weeds while minimizing the risk of crop damage. There also appears to be differences in clethodim tolerance between varieties. Such that varietal selection may be a contributing factor in minimizing clethodim damage in canola. Further research is still required to establish ratings for varieties based on their level of clethodim tolerance.

Acknowledgements

The funding support from SAGIT for this research and SARDI Port Lincoln staff for trial management is gratefully acknowledged.

SCREENING FOR EYESPOT RESISTANCE

Patrick Head, Landmark - Cummins Ag Services
Margaret Evans, Greg Naglis and Hugh Wallwork - SARDI, Waite

Findings from trials at Cummins in 2014

Funded by GRDC through DAS00139, "Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease in South Australia".

Summary:

- Due to high inoculum levels and good early rains, eyespot incidence and severity was high in the worst affected entries.
- The range in response to eyespot amongst the bread wheat and barley entries screened suggests that varieties least likely to be affected by eyespot can be selected for paddocks with eyespot issues and those varieties most likely to be affected by eyespot can be avoided.
- Wheat varieties least affected by eyespot included Trojan, Emu Rock, Spitfire and Sunguard as well as the long season variety Gazelle. Varieties most affected by eyespot included Axe, Mace, Shield, Cobra and Corack.
- Barley varieties were inconsistent in their response to eyespot. At Cummins they were less affected by eyespot than bread wheat, but at Tarlee and Templers the variety La Trobe and Hindmarsh (closely related) were badly affected by eyespot. Compass was least affected by eyespot at all sites. The possibility that these variations were due to differences in eyespot pathotypes between sites will be investigated.

Why do the trial?

Eyespot, caused by the fungus *Oculimacula yallundae*, is a disease of the stem base in wheat. Eyespot lesions on the stem cause direct yield loss through reduced water and nutrient uptake. Lesions can also weaken the stem causing lodging and harvest difficulties, resulting further yield losses. The fungus survives on infected stubble and infection occurs via rain splashed spores. Eyespot risk increases with intensification of cereals, stubble retention and larger, denser canopies associated with earlier sowing and high nitrogen inputs.

Overseas where eyespot has been more prevalent (such as Europe), useful resistance has been bred into varieties. But with historically low eyespot levels in Australia, it has not been a priority of plant breeders.

Following the increasing incidence of eyespot on the Lower Eyre Peninsula, in 2013 Cummins Ag Services initiated a trial at Cummins investigating eye spot management. In 2014 this trial was further extended in conjunction with Margaret Evans and Hugh Wallwork (SARDI) as part of a GRDC project with sites at Cummins (Lower Eyre Peninsula), Tarlee (Lower North) and Templers (Adelaide Plains).

This report focuses on results from the Cummins trial.

How was it done?

Location:	Cummins (Jarrod & Jacqui Phelps)
Plot Size:	2m x 8m
Replicates:	3
Soil Type:	Loamy sand over clay
Sowing Date:	19/5/14
Harvest Date:	25/11/14
2014 Rainfall:	430mm Total / 325mm GSR
Rotation:	2013 – Wheat
Seeding Density:	250 Plants / m^2
Fertiliser:	110kg/Ha DAP + 100kg/Ha Urea at sowing 190L/Ha UAN + eNtrench post emergent 90kg/Ha Urea post emergent (187 Units N Total)
Pesticides:	1.8L Roundup Ultramax + 20ml Hammer-400 + 1% Oil 118g Sakura + 3L Avadex 700ml Velocity + 100ml Lontrel Adv + 3L Wilchem Signature ZMC 200ml/Ha Axial + 0.5% Adigor 100ml Transform + 30ml Trojan (Aphids & Armyworm)

Entries were chosen to represent a range of genetic backgrounds and commonly grown South Australian varieties. Entries included long season bread wheats and bread wheats with crown rot resistance. Bread wheat (30 entries), barley (4 entries) and durum wheat (1 entry) varieties were included to assess the relative susceptibility of the major cereal types.

Several measures were put in place in order to maximise the incidence of eyespot in the trial. Firstly, a site was selected in a paddock with a known eyespot problem in the previous cereal. Secondly the sowing rate was increased (250 plants / m^2) and a high nitrogen rate was used (187 units N) to exacerbate lodging due to eyespot.

For Mace, Trojan and Emu Rock, two seeding densities were used; the standard 250 plants/m^2 and also a lower 150 plants/m^2 to see if a lower plant density resulted in lower eyespot infection and effects, due to a smaller canopy.

Varieties were sown using the trial plot seeder with DBS tynes on 300mm spacing in a randomised block design. Plots were rated for lodging and eyespot lesion levels, harvested for grain yield and grain quality was analysed.

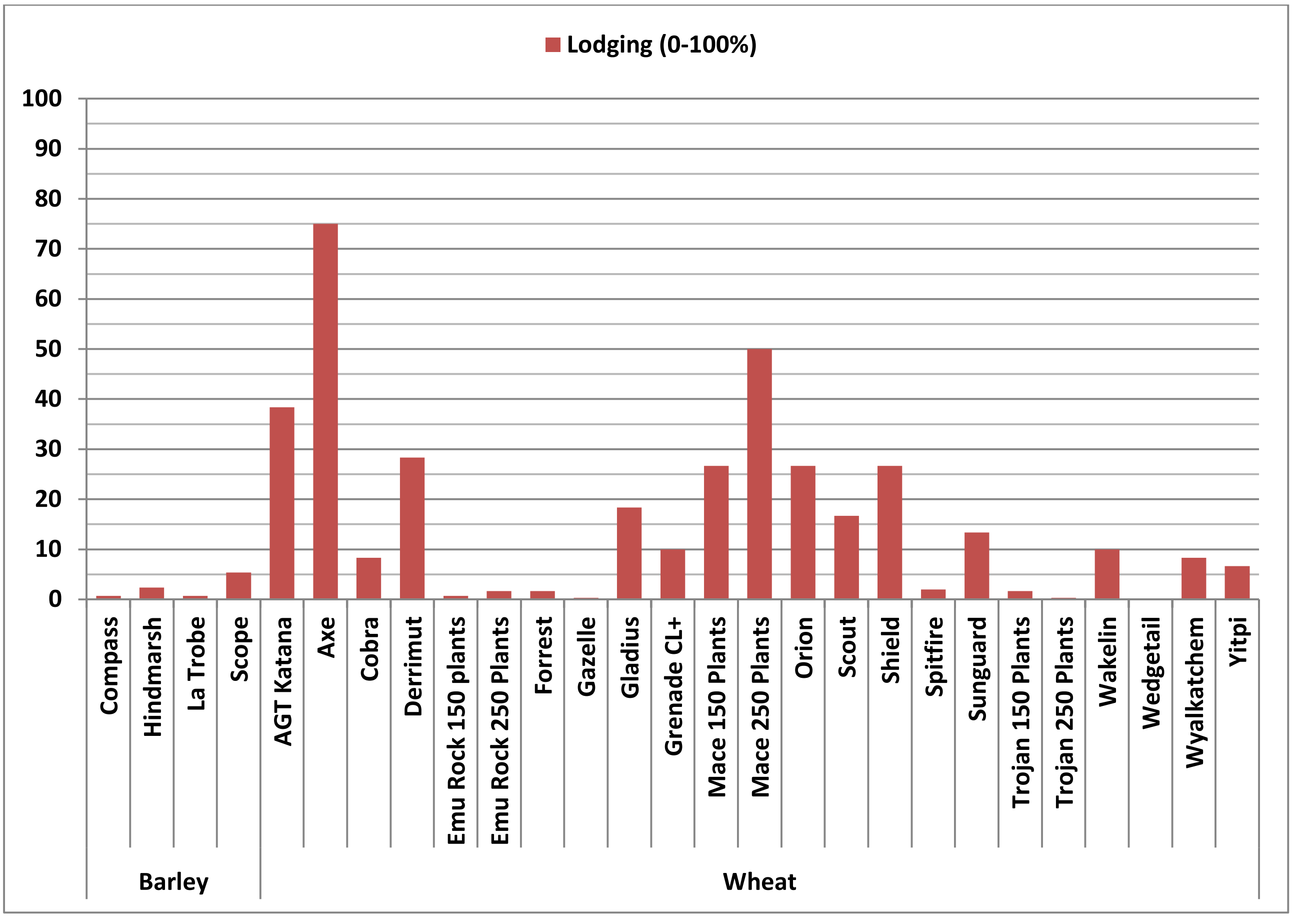
What happened?

2014 was a challenging growing season with a good early start followed by a Decile 9 winter then Decile 1 spring. The trial established well and the site was on rising ground so did not succumb to waterlogging.

Eyespot infection levels were very high in 2014 with much higher disease incidence than 2013 trial work and high levels of disease expression. This provided excellent insight into the different varieties' reaction to eyespot. Some volunteer Mace was present at Cummins, which means that entries may not show as clear an advantage as they should (Mace is susceptible to eyespot).

Following windy weather in September, lodging started to become evident at the site. A rating was carried out on 9/10/14 to assess the different varieties (**Figure 1**). Axe showed the worst lodging followed by Mace and Katana. Mace showed less lodging when sown at the lower density. Emu Rock and Trojan showed similar levels at both seeding rates. Locally grown varieties that showed the least lodging included Trojan and Emu Rock along with La Trobe, Compass and Hindmarsh barley. Interstate varieties that scored well included Wedgetail (winter type), Gazelle (NSW & QLD soft wheat), Forrest (long season) and Spitfire (NSW & QLD prime hard). Note that there are many other factors (varietal effects, agronomy, seasonal and soil conditions) that could have contributed to lodging, not eyespot alone.

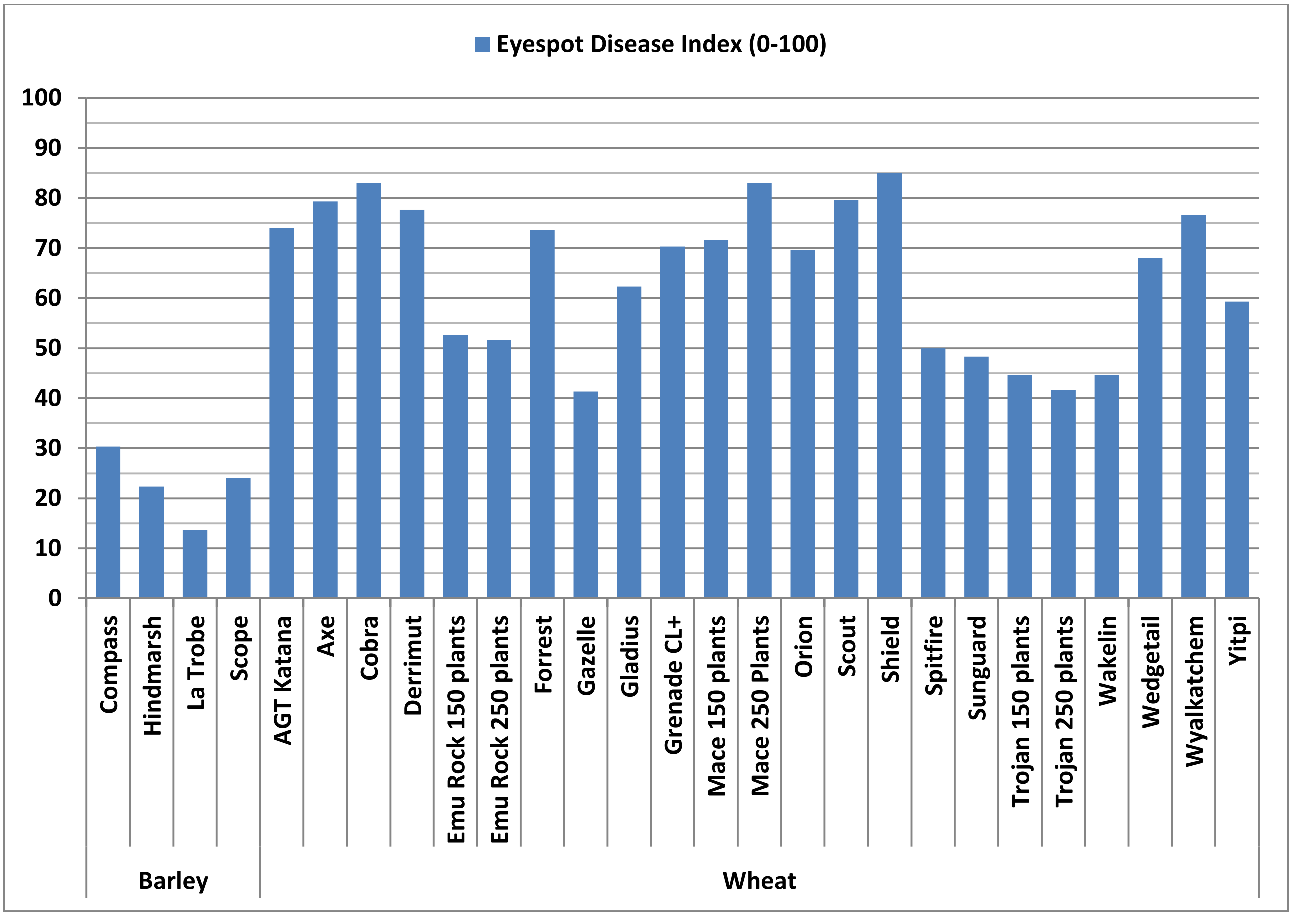
Figure 1. Eyespot variety trial - lodging scores 9/10/14. Rated 0 (Nil) - 100 (100% of plot affected)



To quantify if the observed lodging was related to eyespot, an assessment was undertaken on 22/10/14 to score the severity of eyespot lesions across the different varieties. Eyespot was assessed with assistance from Marg Evans (SARDI) by taking samples of 25 tillers at random from each plot (representing middle 3 rows & either end of plot) and classing them based on if they were uninfected, up to severe eyespot (stem completely girdled by lesions). A disease index was calculated on a 0-100 scale.

These ratings (**Figure 2**) followed a similar pattern to lodging scores. Barley showed the lowest disease indices with La Trobe the lowest. The lowest commercial wheat variety score was Gazelle (41). Gazelle was closely followed by Trojan (42) and Wakelin (45). The next best locally grown variety after Trojan was Emu Rock (52). Mace (83), Cobra (83), Scout (80) and Wyalkatchem (77) all showed among the highest infection levels. Mace had lower infection (72) at the lower 150 plants/m^2 seeding rate (not significant). Emu Rock and Trojan showed similar levels at both seeding rates.

Figure 2. Eyespot variety trial – eyespot disease assessment 22/10/14



Eyespot lesions	
	

Yield data (Table 1 and Table 2) also followed similar trends. For barley, yields were not statistically significant and ranged from 6.08T/Ha (La Trobe) to 5.13T/Ha (Scope). Grain quality was excellent apart from La Trobe not meeting the minimum retention for malt 1 grade.

Emu Rock (150 plants, 5.54T/Ha) and Trojan (250 plants, 5.26T/Ha) were the highest yielding wheats with Axe yielding lowest (2.87T/Ha). Mace showed higher yields at the lower seeding rate (significant) but Trojan and Emu Rock were not affected by seeding density.

Table 1. Eyespot variety trial – barley yield & quality results

	Variety	Yield (T/Ha)	PR	TW	SC	RT	Grade	Limiting Factors
Barley	**La Trobe**	6.08	10.9	69.4	6.0	68.9	M2	RT
	Hindmarsh	5.77	11.2	69.3	4.9	76.8	M1	
	Compass	5.32	9.9	66.5	2.5	91.5	M1	
	Scope	5.13	11.3	67.0	3.4	77.0	M1	
	Mean	5.58	10.8	68.1	4.2	78.6		
	LSD 0.05	ns						
	CV	9.3%						

Table 2. Eyespot variety trial - wheat yield & quality results

	Variety	Yield (T/Ha)		PR	TW	SC	Grade	Limiting Factors
Wheat	Emu Rock 150 Plants	5.54	*a*	10.8	80.4	3.9	APW	PR
	Trojan 250 Plants	5.26	*ab*	10.3	82.1	4.2	ASW	PR
	Emu Rock 250 Plants	5.24	*ab*	10.7	81.4	4.7	APW	PR
	Trojan 150 Plants	5.15	*ab*	9.9	81.8	3.7	ASW	PR
	Mace 150 Plants	4.63	*bc*	9.8	79.7	4.0	ASW	PR
	AGT Katana	4.45	*cd*	10.9	80.5	4.3	APW	PR
	Wakelin	4.41	*cd*	10.1	82.2	2.5	ASW	PR
	Gazelle	4.36	*cde*	9.4	78.3	3.4	SFE1	
	Wyalkatchem	4.34	*cde*	10.8	80.5	1.8	APW	
	Spitfire	4.30	*cde*	11.3	80.0	4.2	APW	PR
	Cobra	4.23	*cdef*	10.6	78.9	3.9	APW	PR
	Grenade CL+	4.04	*cdefg*	10.8	78.0	3.4	APW	
	Mace 250 Plants	3.91	*defgh*	10.3	79.5	4.1	ASW	PR
	Sunguard	3.88	*defgh*	10.5	81.9	2.5	APW	PR
	Wedgetail	3.87	*defgh*	10.9	78.8	3.3	APW	
	Yitpi	3.86	*defgh*	10.7	78.7	4.8	APW	PR
	Shield	3.73	*efgh*	10.3	76.5	6.3	AGP	PR SC
	Gladius	3.72	*efgh*	10.4	79.7	3.4	ASW	PR
	Orion	3.61	*fgh*	10.5	75.4	3.7	SFE2	PR TW
	Forrest	3.50	*ghi*	11.1	81.8	5.2	AGP	SC
	Scout	3.43	*ghi*	9.8	80.1	5.1	ASW	PR
	Derrimut	3.31	*hi*	10.1	76.7	7.2	AGP	PR SC
	Axe	2.87	*i*	11.0	77.9	4.2	APW	PR
	Mean	4.26		10.5	79.6	4.1		
	LSD 0.05	0.66						
	CV	9.6%						

Grain quality was generally good apart from some AH varieties not achieving protein for H1 grade. Shield, Forrest and Derrimut exceeded 6% screenings. Orion was the only variety to fall below the minimum test weight (76). Note that there are many other factors (varietal effects, agronomy, seasonal and soil conditions) that contribute to grain quality, not eyespot alone.

The range in response to eyespot amongst the bread wheat and barley entries screened suggests that varieties least likely to be affected by eyespot can be selected for paddocks with eyespot issues and those varieties most likely to be affected by eyespot can be avoided.

Wheat varieties least affected by eyespot included Trojan, Emu Rock, Spitfire and Sunguard as well as the long season variety Gazelle. Varieties most affected by eyespot included Axe, Mace, Shield, Cobra and Corack. (Based on Cummins, Tarlee and Templers sites)

Barley varieties were inconsistent in their response to eyespot. At Cummins they were less affected by eyespot than was bread wheat, but at Tarlee and Templers the variety La Trobe and Hindmarsh (closely related) were badly affected by eyespot. Compass was least affected by eyespot at all sites. The possibility that these variations were due to differences in eyespot pathotypes between sites will be investigated.

LEADA NEW HORIZONS

Brimpton Lake

Acknowledgements:
Michael Heath, Greg and Luke Moroney: property access, time and machinery input
Incitec Pivot: Mineral Fertiliser for all treatment

PREMIUM FOOD AND WINE FROM OUR CLEAN ENVIRONMENT

SOUTH AUSTRALIA

Government of South Australia
Primary Industries and Regions SA

This site is one of three trial sites (Brimpton Lake, Karoonda and Cadgee) established under the **New Horizons** program. New Horizons is a PIRSA initiative aiming to capture an additional $800 million per annum increase in agricultural production in South Australia.

This site was co-funded by the EP Rail Levy and the state government and delivered by PIRSA Rural Solutions SA and SARDI.

Site Details

Site Location: North-east corner Brimpton Lake Rd

Coolidie Rd intersection

Landholder: Michael Kenny

Cooperator: Greg and Luke Moroney

The site is very gently undulating with a soil profile consisting of a grey sandy, shallow, topsoil, over a bleached white sandy horizon of varying depth over a clay B horizon between 30-50cms deep.

Soil data

- Bulk density (BD) values increased with depth, ranging from 1.41 in the surface to 1.71 g/cm^{-3} at depth
- Soil organic carbon values were very low (ranging from
- Major nutrients were good in 0-10 but poor in bleached horizons (lucerne hay resulted in a large increase in N levels prior to seeding)

Trial Details

Treatments were designed to address major constraints affecting sands – non-wetting, compaction, low fertility and comprised 12 treatments including the control (refer Table 1) replicated 4 times.

Table 1: Trial treatments

Control	Clayed
Deep placed high nutrition	Clayed + deep placed high nutrition
Spaded	Clayed + spaded
Spaded + high nutrition	Clay + high nutrition + spaded
Spaded + organic matter	Clayed + spaded + OM
Spaded + high nutrition + organic matter	Clayed + spaded + OM + nutrition

Note - control employed best current management practice

Claying around 40-50% clay was applied on average 451.5t/ha, post application levelling to some extent evened out rates, spreading of lucerne hay, high nutrition treatments and spading all undertaken in the third week of April.

Basal fertiliser (DAP @ 100kg/ha) with Corack wheat @ 78 kg/ha sown 19/5/14.

Seasonal Conditions

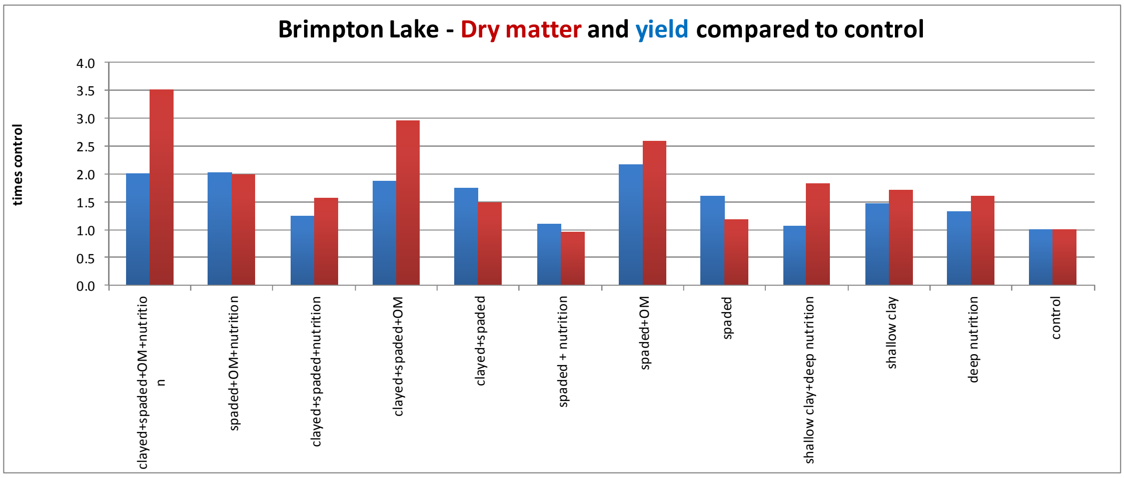
The start to the season was excellent with good early rainfall and high temperatures. June and July were excessively wet (mm). Rainfall for the rest of the season was exceptionally low (mm). This resulted in crop impacts including:

- Waterlogging was variable across the site and may have impacted on early growth.
- Dry finish - Grain yields did not reflect midseason biomass of different treatments with the highest biomass treatments not delivering the highest yields. Conversely some treatments with low midseason biomass e.g. spading delivered medium to high yields. Clayed treatments also appeared to suffer from the dry season (refer Figure 1).

Results

Results are highly variable and may have been influenced by the extreme seasonal conditions, however there were some clear trends including:

- Non-wetting did not appear to be an issue affecting this site this year - no significant difference in plant numbers between treatments
- 3.5 times increase in dry matter on best treatments compared to the control
- Doubling of yield on multi-amendment treatments – Spaded only treatments performed well but organic matter treatments yielded higher than corresponding treatments without OM. High nutrition treatments delivered mixed results.
- Max potential yield based on rainfall = 4.3 t/ha, max plot in the trial was 4.2 t/ha



Where to now?

Major questions arising from results this year include:

- Relative benefit from addressing compaction compared to mixing of soil horizons – spading reduced the bulk density of subsoils but at the same time mixed soil horizons. Compaction may have been an issue at this site but similar increases in yield from spading were observed at the Cadgee site where bulk density values were very low.

- Depth of modification - soil water (gravimetric) below the depth of modification (30-35cms) was relatively uniform across treatments. This suggests that root exploration was still constrained below depth of modification.
- Benefit of organic matter compared to high rates of mineral nutrient – high nutrients alone at Brimpton lake appeared to negatively impact on yield but increased yield at the other New Horizons sites. However, the addition of organic matter gave a greater yield increase across all sites. Why?
- The impact of claying in a dry season – there appears to have been a negative impact to clay addition. In these trials the amount of clay added are high compared to standard industry practice but when mixed to 30cms only raise the total clay percentage to around 7-8 % (less at Karoonda, more at Cadgee). Compared to a sandy loam soil with around 10-15% clay this is still quite a low level of clay. Why does it affect yield when we would not expect the same impact on a soil with clay levels at this level naturally?

The Brimpton Lake and the other two New Horizons sites will be resown, monitored and analysed in 2015. Measurements to be conducted in 2015 include:

- Grain yield/grain protein
- Crop establishment (4 weeks post-sowing)
- Biomass at flowering
- N prior to sowing (mid-April)
- Moisture probes – soil moisture over time
- Gravimetric soil moisture pre sowing and post harvest

The benefits and costs of the treatments will also be amortised over this period.

WORKING TOWARDS EFFECTIVE MANAGEMENT OF NITROGEN ON LOWER EP SOILS

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Therese McBeath, Agriculture, CSIRO, Waite Campus.

Why do it?

The best management practice for N will depend on the specific combination of soil, season, crop and grower preference for yield vs. profit maximisation. As cropping continues to intensify on the Lower Eyre Peninsula, the pressure to manage N fertiliser for the most efficient outcome grows in parallel.

We know that N is a nutrient prone to the losses through the processes of leaching (moving beyond the root zone), denitrification (losses under waterlogging) and volatilisation (losses when applied and left on dry soil) but the magnitude of these losses has not been well captured in the Lower EP environment. Recent work by Latta et al. (2013 LEADA results) suggests losses through denitrification are lower than other high rainfall environments due to the relatively low carbon content of these soils, but it is a loss process that increases with increasing applications of N fertiliser. Losses through leaching can be estimated using rules of thumb and modelling but increasing the number of sites of soil characterisation in this region is likely to improve our understanding of N loss through this process.

At the moment the estimated N losses have been managed through high inputs of N relative to yield potential. On the water logging prone duplex soils in particular, growers perceive that they are operating at low N use efficiency and recent LEADA trials support this notion. An ideal situation would be to minimise the losses of fertiliser N applied and ensure a better match between the timing of supply and crop demand for N.

With the objective of managing N for a better synchrony between crop demand and supply we have developed some trials at Brimpton Lake where we are using a combination of techniques including:

- a full characterisation of the soil to help us understand the production potential of the site,
- some agronomic treatments related to timing and controlled release product, and
- measurement of N use efficiency on spaded and unspaded soil.

How was it done?

The trials were sown on the 20th of May, after more than 50mm of rain in the previous two weeks. Mace wheat was sown at 100 kg/ha with 100 kg/ha DAP, placed below the seed with 400 mL/ha Impact In-furrow®. Due to prolonged waterlogging an additional 50 kg/ha Urea was applied at second node (GS32) to all treatments except the nil.

Table 1. Treatments implemented on the Spaded and Unspaded Sections of the Paddock and the total nitrogen input (kg/ha) for the growing season.

No	Treatment	Total Nitrogen Input (kg/ha)
	Unspaded	
1	Nil N fert	18
2	50 kg/ha urea @ sow	64
3	50 kg/ha controlled release urea @ sow	62
4	100 kg/ha controlled release urea @ sow	82
5	200 kg/ha controlled release urea @ sow	123
6	50 kg/ha controlled release urea @ sow + 50 kg/ha urea @ sow	85
7	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22	87
8	50 kg/ha controlled release urea @ sow+ 50 kg/ha urea @ GS22	85
9	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31	110
10	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31 + 50 kg/ha urea @ GS39	133
	Spaded	
1	Nil N fert	18
2	50 kg/ha urea @ sow	64
3	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22	87
4	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31	110
5	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31 + 50 kg/ha urea @ GS39	133

*Controlled release product is a temperature dependent product used in turfgrass; Polyon 41-0-0®.

In-season measurements of emergence, NDVI at tillering and second node along with biomass and tissue N content at 2nd node and a subset of plots were sampled for soil mineral N at 49 growth stage.

In September two soil pits were characterised to 1.5 m depth in the area directly adjacent to and at the western and eastern end of the trial site. Assessments were made of the soil type, texture, key chemical (nutrients and toxicities) properties, bulk density and water holding capacity.

The plots were harvested using a plot harvester on the 1st of December and grain yield, harvest index and protein was measured. Harvest soil water was measured to 1 m depth on the 2nd of December.

What happened and what does this mean?

Seasonal conditions on Lower Eyre Peninsula in 2014 saw above rainfall in February, followed by a break to the season on the 26th April. Well above average rainfall fell on the Brimptom Lake site during May, June and July, followed by well below average August and September (figure 1). Temperatures were well above average in May. Several frosts occurred in August and September, but were not thought to have affected yield at this site.

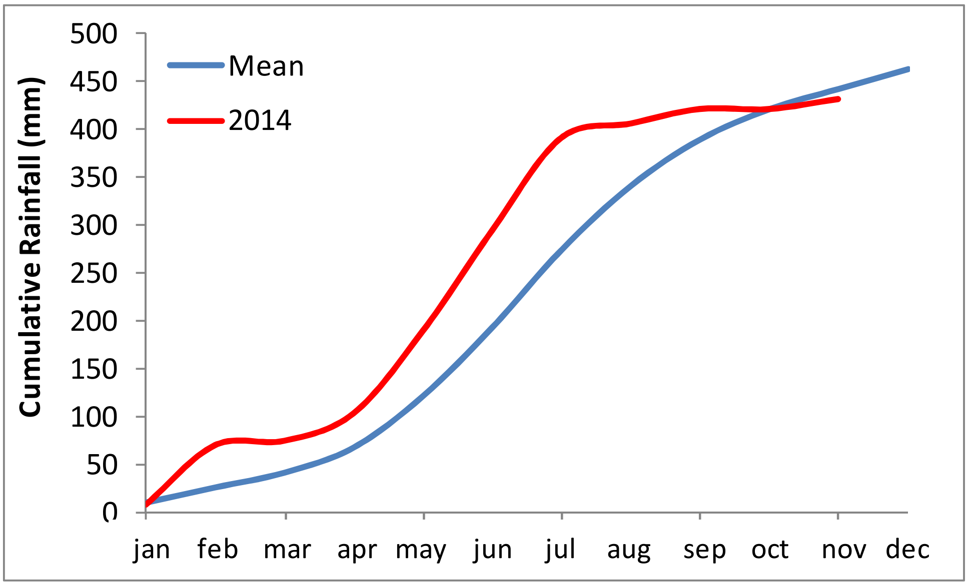

Figure 1. Cumulative mean and 2014 rainfall for Brimpton Lake

In order to be able to better understand the production potential of the site two soil pits were characterised to 1.5 m depth. The surface 30 cm of soil had been spaded at both sites but there was no disturbance of the subsoil clay or incorporation of clay into the topsoil with this operation. The soils are described as sand over poorly structured red-brown clay with the clay layer at 28-34 cm depth between the two pits. The soil pits were characterised after a prolonged period of waterlogging for most of July, and there were no roots detected in the clay layers. The clay layers were found to be sodic and imperfectly drained with a strongly alkaline pH (>9.0 in water) below 45 cm.

Analysis of pre-sowing mineral N showed distinct differences between the spaded and unspaded sites with the unspaded site having substantially more N in the rootzone (here defined as 40cm) (Table 2). There were still differences between the two sites when sampled in late August, with the unspaded site generally having more surface mineral N than the spaded site. There was also more in-season mineral N measured in the surface soils in the high N input treatments (Treatment 10- unspaded, Treatment 5-spaded) (Table 2).

Table 2. *Mineral N sampled prior to sowing and in-season at the spaded and unspaded sites.

	Mineral N (kg/ha) 0-40 cm	Mineral N (kg/ha) 40-100 cm
	Pre-sowing sampling	
Unspaded	155	68
Spaded	11	60
	In-season sampling	
Unspaded- Control	30	38
Unspaded- High N input	69	80
Spaded- Control	20	98
Spaded- High N input	33	90

*Note these are indicative measures and not fully replicated.

Within the trial plots, soil analyses suggested that there were some distinct differences between the spaded and unspaded trial sites. However, these sites were quite some distance apart (approx 200m) and it is highly likely that the position of the sites in the paddock had important effects. Therefore an analysis of the effect of spading on nitrogen response and dynamics is not warranted in this case.

The difference in soil mineral N between the two sites was likely reflected in the greenseeker measurements of NDVI at early tillering (GS25) which gave an average value of 44 on the unspaded site and 27 on the spaded site. The NDVI measurements at GS 25 and GS 32 (2nd node) were also picking up differences between levels of N application at the two sites (Table 3), as were the tissue tests at GS32 suggesting that wheat growing on both sites were responsive to N. The tissue levels at the spaded site were adequate at the spaded site and near deficiency at the unspaded site for this growth stage.

Table 3. Plant measurements of NDVI at early tillering and 2nd node and tissue N at 2nd node. Within a site and a sampling for NDVI, a treatment appended with a different letter is significantly different from another.

No	Treatment	NDVI @ GS22 (early tillering)	NDVI @ GS32 (2nd node)	Tissue N @ GS32 % w/w (2nd node)
	Unspaded			
1	Nil N fert	33 d	34 c	
2	50 kg/ha urea @ sow	38 cd	38 c	2.2
3	50 kg/ha controlled release urea @ sow	43 bc	53 b	
4	100 kg/ha controlled release urea @ sow	43 bc	57 b	
5	200 kg/ha controlled release urea @ sow	48 ab	70 a	
6	50 kg/ha controlled release urea @ sow + 50 kg/ha urea @ sow	46 b	58 b	
7	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22	52 a	59 ab	2.7
8	50 kg/ha controlled release urea @ sow+ 50 kg/ha urea @ GS22	38 cd	55 b	3.0
9	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31	51 a	60 ab	
10	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31 + 50 kg/ha urea @ GS39	48 ab	51 b	
	P<0.05	LSD 7	LSD 11	
	Spaded			
1	Nil N fert	18 c	18 b	
2	50 kg/ha urea @ sow	24 b	25 b	4.6
3	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22	29 ab	43 a	5.6
4	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31	29 ab	43 a	
5	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31 + 50 kg/ha urea @ GS39	30 a	45 a	
	P<0.05	LSD 8	LSD 11	

#Note that due to prolonged waterlogging an additional 50 kg/ha Urea was applied at GS32 to all treatments except the nil.

On the unspaded site there were some interesting comparisons to make between urea and controlled release urea. The use of 50 kg/ha controlled release urea conferred a 0.7 t/ha yield advantage over 50 kg/ha urea at sowing and yielded similarly to all other doses of N (3.2 t/ha compared with 3.16-3.33 t/ha). The only exception was 100 kg/ha controlled release urea which yielded less at 2.70 t/ha, indicative of the variability between reps on this soil type. Protein levels were closely associated with N input and the highest protein levels were aligned with higher inputs of N (110-123 kg/ha). There were no reportable differences in harvest index or nitrogen use efficiency between treatments on the unspaded site (Table 4).

On the spaded site, N inputs of more than 100 kg /ha of urea yielded (2.65-2.97 t/ha) better than 50 kg/urea and below (1.57-1.89 t/ha) while inputs of more than 150 kg/ha urea gave the best protein results. The lowest yielding treatment on the spaded site (nil N fert) also had the lowest level of harvest soil water with 33 mm remaining compared with 70-72 mm for treatments 3 and 5 ($P<0.05$, LSD 29mm). This same treatment that received the lowest input of N receiving only DAP at sowing recorded the highest N use efficiency with 54 kg grain/ kg N supply (Table 4). The N use efficiency was higher on the spaded site due to the lower levels of mineral N measured in the top 40 cm of soil at sowing.

Conclusions and into the paddock

We measured two very different levels of starting fertility, yield potential and nitrogen use efficiency within the same paddock likely due to a combination of different levels of starting fertility and soil modification.

Despite these differences, the best fertiliser treatment was the same with a benefit for treatments with three applications of 50 kg/ha of urea (sowing, tillering and second node) but no additional benefits at inputs higher than this level. Interestingly on the higher fertility unspaded site, the addition of 50 kg/ha of controlled release urea with 50 kg urea/ha at second node achieved the same yield as the best conventional urea treatments, which may warrant further exploration. Note that all treatments received 100 kg DAP/ha at sowing.

Acknowledgements

Thanks to the Moroney family for the provision of land for the site and to GRDC and LEADA for the provision of funding for the trial through the Stubble Retention Initiative. Thanks to Vadakattu Gupta for the provision of nitrogen and biological soil analysis and to Kirsten Verburg for advice on experimental design.

Table 4. Harvest measurements of yield (t/ha), harvest index, protein (%) and nitrogen use efficiency. Within a site and a measurement, a treatment appended with a different letter is significantly different from another.

No	N input (kg/ha)	Treatment	Yield (t/ha)	Harvest Index	Protein (%)	NUE# (kg grain/kg N)
		Unspaded				
1	18	Nil N fert	2.25d	0.41	10.3ef	13
2	64	50 kg/ha urea @ sow	2.50cd	0.38	10.6de	11
3	62	50 kg/ha controlled release urea @ sow	3.21ab	0.43	10.1f	15
4	82	100 kg/ha controlled release urea @ sow	2.70bcd	0.41	10.5def	11
5	123	200 kg/ha controlled release urea @ sow	3.39a	0.44	11.7a	12
6	85	50 kg/ha controlled release urea @ sow + 50 kg/ha urea @ sow	3.16ab	0.4	10.8cd	13
7	87	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22	3.18ab	0.44	11.2bc	13
8	85	50 kg/ha controlled release urea @ sow+ 50 kg/ha urea @ GS22	3.03abc	0.43	10.4ef	13
9	110	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31	3.33a	0.36	11.3ab	11
10	133	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31 + 50 kg/ha urea @ GS39	3.30a	0.42	11.2bc	11
		P<0.05	LSD 0.59	NSD	LSD 0.4	NSD
		Spaded				
1	18	Nil N fert	1.57b	0.46	10.3c	54a
2	64	50 kg/ha urea @ sow	1.89b	0.49	10.4c	25b
3	87	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22	2.75a	0.46	10.5bc	28b
4	110	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31	2.65a	0.43	11.1a	22b
5	133	50 kg/ha urea @ sow + 50 kg/ha urea @ GS22 + 50 kg/ha urea @ GS31 + 50 kg/ha urea @ GS39	2.97a	0.45	10.9ab	21b
		P<0.05	LSD 0.62	NSD	LSD 0.4	LSD 16

#Nitrogen Use Efficiency (NUE, kg grain/kg N supply)= Grain yield (kg/ha)/ N supply (kg/ha) and N supply (kg/ha) = Initial soil mineral N (kg/ha, top 40cm) + fertiliser N (kg/ha).

CAN WE USE NITROGEN RESEARCH TO BETTER INFORM RISKY BUSINESS?

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Keywords: profit-risk, bio-economics, cash flow

Take home messages

- Intensive cropping requires increased inputs of nitrogen (N) to maintain productivity, and fertiliser N efficiency is variable.
- Where there is a low frequency of grain and pasture legumes in the sequence, total soil N and organic N will decline.
- Farm businesses with crop intensive rotations make greater losses in poor seasons and the potential for upside gain may be constrained by sub-optimal N inputs.
- Advisors can utilise analysis of both probable responses to N management based on research and farm business strength to formulate their advice.
- Farmers can make more informed decisions when advice is placed in the context of likely productivity over a range of season types and resulting business strength.

Managing N in intensive cropping

To maintain productivity and the amount of nitrogen (N) stored in soils, N removed in the grain must be replaced through fertiliser additions or N fixation inputs (Baldock, 2003). Until recently, a legume based pasture phase in rotation with cereal crops has been used in much of southern Australia to maintain soil fertility, with most of the N requirement of the crops being met from the mineralisation of soil organic matter and plant residues (Fettel and Gill, 1995). In regions with Mediterranean type climates, biologically fixed N from pastures led to replenishment of soil organic matter that decomposed gradually and sustained the yields of several subsequent crops (Angus et al., 1998).

A shift to intensive cropping over the last decade has seen a reduction in the intensity of legume phases in paddock rotations. A move to more intensive cropping is likely to increase the loss of soil organic matter and contribute to a decline in fertility (Fettel and Gill, 1995). Angus et al (2006) reported that the concentration of total N in the top 10 cm of soil decreased from an initial value of 1.85 g/kg to 0.95 g/kg 14 years after a continuous cropping system was implemented. Early work on the Mallee Sustainable Farming Project showed net negative N balances under cereals and in some rotations (Baldock, 2003). Even with high fertiliser N inputs used in the MSF core trials (27 kg N ha^{-1}), negative N balances (13-30 kg N ha^{-1}) were obtained under cereal crops (Baldock, 2003).

Recent research at Karoonda has demonstrated the N-related benefits of incorporating medic-based pasture in the rotation (McBeath et al. 2015). In the first year following pasture, N supply potential increased by 8 to 16 kg N/ha/season more when compared to N inputs at sowing increased to 40 kg/ha. The benefits from the legume pasture decreased with time and in the second year after pasture the benefit against 40 kg N/ha at sowing was 0.4-9 kg N/ha/season.

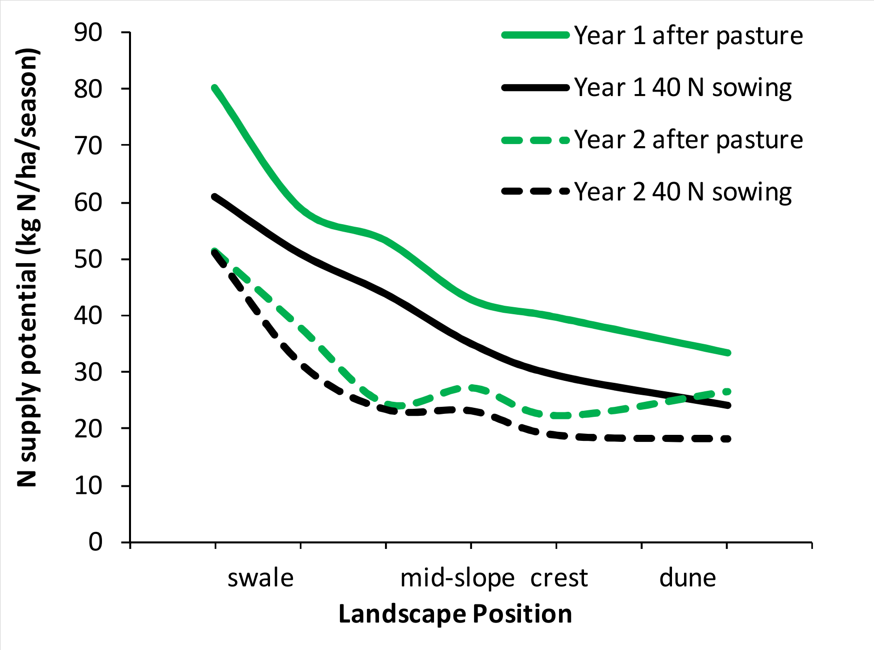


Figure 1. Soil N Supply Potential (kg N/ha/season) in the first and second year following pasture compared with the first and second year of increased inputs of fertiliser N (40 kg N/ha at sowing compared with 7-9 kg N/ha at sowing in previous seasons). Data courtesy of Dr Gupta Vadakattu.

Implications for farm business management

A decline in the supply of soil N results in increasing demand for N fertiliser inputs to make up the short fall. However this approach to fertiliser management can constrain profitability and increase risk in farm businesses. The effect of different strategies for managing N using more frequent legume phases in paddock rotations was compared to managing N "out of the bag" in a series of profit and risk workshops. These workshops looked at the core requirements of farm businesses to remain viable in an ever challenging environment of increasing costs and decreasing profits.

Workshops were run at West Wyalong, Birchip, Ouyen, Waikerie, Karoonda and Cummins. Participants, which included farmers, advisors and researchers, constructed a model farm that was representative of all aspects of their local farming systems, such as:

- Farm Size
- Machinery and labour requirements
- Enterprise mix
- Costs both variable and fixed, including extensive discussions on fertiliser and chemical strategies
- Yields of crops for different deciles - based on local trial data, APSIM/ Yield Prophet runs, paddock history and further input from the group
- Price - based on decile 5 values
- Off farm income

Here we will highlight the outcomes of workshops at Karoonda and Cummins where the focus was on nitrogen management.

Karoonda

Karoonda is situated in the Southern South Australian Mallee with a mean annual rainfall of 337 mm and growing season rainfall of 237 mm. Terminal drought in Spring is common and heat and frost damage are both significant possibilities in late Spring. The soil types range from low carbon, low fertility sandy dunes to heavier clay loam flats that perform well in wetter seasons but suffer the consequences of subsoil constraints and low plant available water in dry seasons. While there has been a trend towards more intensive cropping, the inclusion of livestock in the enterprise mix is common.

The key attributes of the farm developed at the workshop were:

- total size 2400 ha;
- two labour units drawing $50,000 per unit and $20,000 allocated to casual labour;
- starting equity position of the farm of 72 per cent;
- plant and machinery inventory $780,000 ($220/t grain produced);
- total fixed costs of $77,000; and
- a range of enterprise mixes were discussed but for the purpose of this article the 100 per cent cropping scenario contained 70 per cent cereal, 15 per cent canola and 15 per cent lupins.

There has been active research on nitrogen management since 2009. Due to the intensity of research, the soil types have been well characterized for the model APSIM and yields can be predicted for a range of season types with a reasonable level of confidence (Monjardino et al. 2013). Data from the trials at Karoonda were combined with APSIM modeled yields (to fill in the yield expected in a wider range of season types) and the experience and paddock records of the workshop participants to develop up yield tables in response to a range of management scenarios including differing inputs of N fertiliser and differing enterprise mixes. An example of the yields developed in response to N fertiliser management is given in Table 1.

Table 1. Cereal yield (t/ha) in response to Nitrogen (N) management strategy and season type (decile) for the Karoonda model farm.

N management	Soil	Decile 1	Decile 3	Decile 5	Decile 7	Decile 9
Fixed Low Input	Dune	0.2	0.4	0.8	1.2	1.8
30 kg/ha Urea all	Mid	0.5	1.1	1.9	2.1	2.5
	Swale	0.1	1.1	2.0	2.9	4.0
Fixed High Input	Dune	0.2	0.8	1.6	2.2	2.8
80 kg/ha Urea all	Mid	0.5	1.1	2.2	3.1	3.5
	Swale	0.1	1.1	2	3.5	4.5
Soil-specific Input	Dune	0.2	0.8	1.6	2.2	2.8
80 Dune, 40 mid, 20 swale kg/ha urea	Mid	0.5	1.1	2.2	2.6	3.1
	Swale	0.1	1.1	2.0	2.9	4.0

Nitrogen fertiliser inputs are a significant expense to the 100% crop farm, even in a decile 1 year. At least $50000 investment in fertiliser was made in the model farm. Recent research suggests that increased inputs of N on the sandy soil types will increase yield (Kirkegaard et al. 2014). However, increased inputs will increase risk to the farm business in low rainfall seasons with $109 000 downside risk from increasing inputs in a decile 1 season shown in Figure 2. One way to manage this risk is to only increase inputs on the sandy soil types and even moderately reduce inputs on the heavier soil types (Monjardino et al. 2013). This will moderate the top-end profit in a very wet season (upside gain in a decile 9 was $178 000 with soil specific input compared to $298 000 with high inputs across all soil types) but also substantially reduce the risk in poor seasons (i.e. downside risk reduced to $36 000).

Logically, the best way to capture the gap in the upside gain that came from increasing inputs across all season types would be to increase inputs of N in-season in the better years. However, research at the Mallee Sustainable Farming Karoonda site in the SA Mallee have consistently shown that N inputs applied to sands at sowing are more effective than those applied in-season (Llewellyn et al. 2014). Furthermore, workshop participants highlighted that in-crop N inputs are difficult to manage due to extended periods with no rainfall in winter and large farm areas that hinder the application of N in a timely manner. For these reasons, farmers are increasingly applying N inputs up-front where there is a significant risk to the return on N investment if the season finishes poorly.

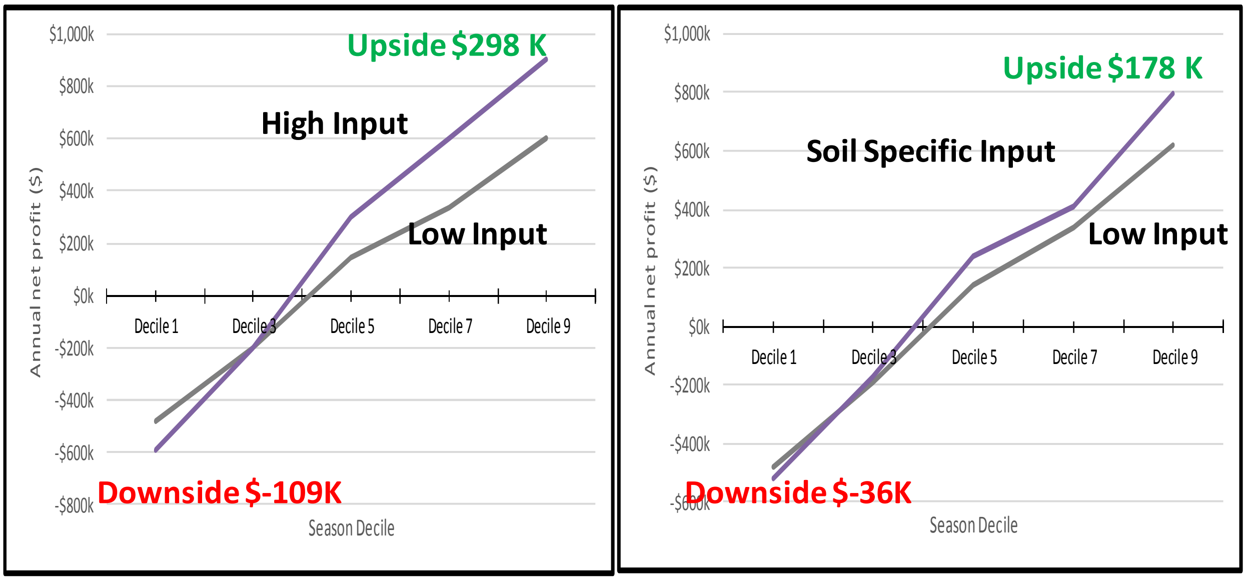
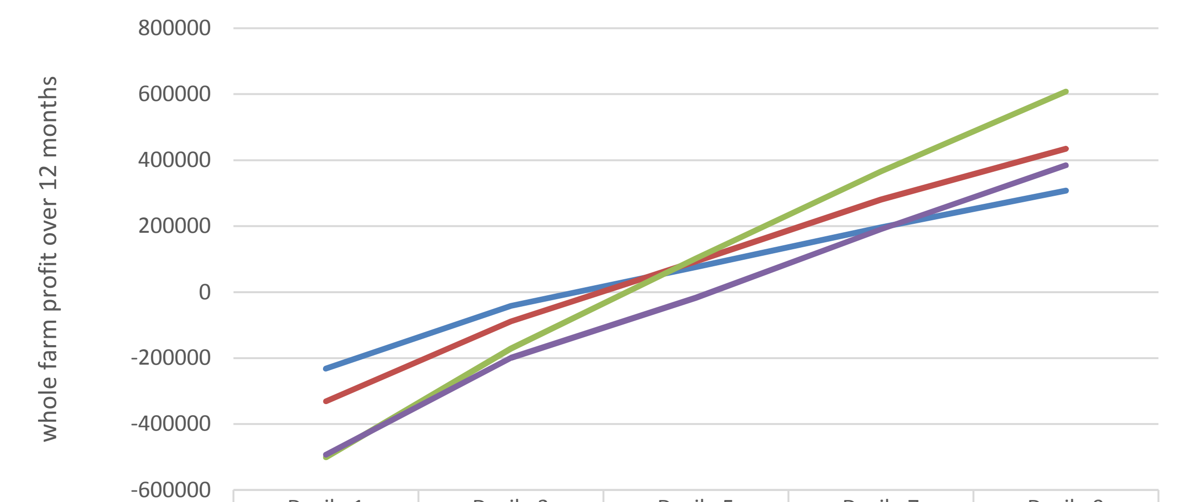


Figure 2. Annual farm net profit ($) at the Karoonda model farm resulting from low (30 kg Urea/ha across all soils) vs high input (80 kg Urea/ha across all soils) and low vs. soil specific (20 kg Urea/ha on heavy flats, 40 kg Urea/ha on mid-slopes and 80 kg/ha Urea on dunes).

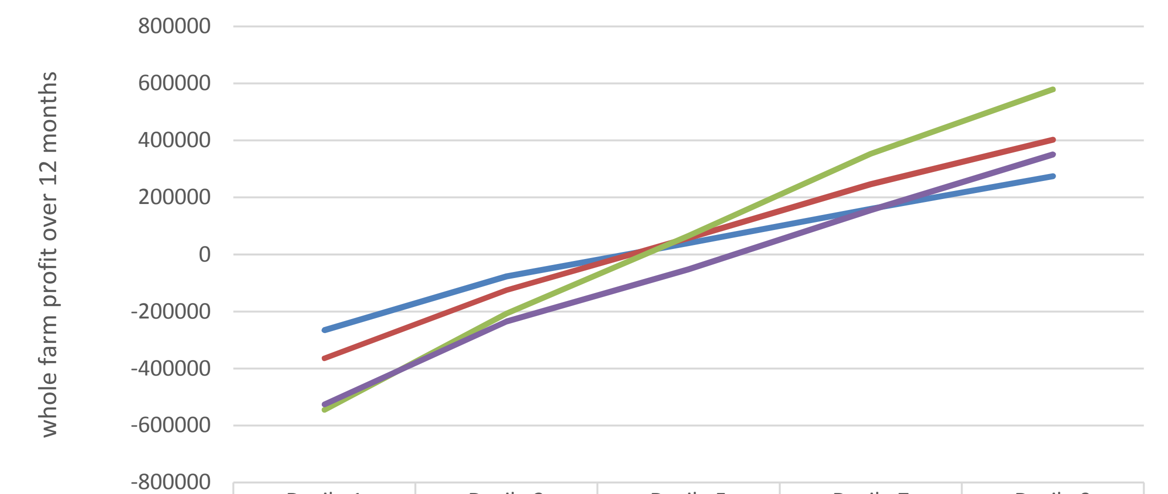
Research at the Karoonda trial site has demonstrated the benefits of the inclusion of breaks, in particular the increase in N supply from legume based breaks (including medic pastures) (McBeath et al. 2015). Analysis of the Karoonda model farm highlights how the move towards intensive cropping is increasing the business risk of modern day farming systems, that is, as cropping intensity increases, so do financial losses in poor seasons (Figure 3). At the most extreme, losses in the 100% crop farm are expected to be $170 000 or $70/ha greater in a decile 1 season compared to a farm with only 70% cropping intensity. A common thought is that high crop intensity will increase business profitability in better seasons. Figure 3 shows that the 100% crop scenario was significantly more profitable than all other enterprise mixes in decile 7-9 years, however the cereal intensive 100% crop example was least profitable. The farmers in the workshops said that they would not apply N fertiliser rates above 100 kg of urea per year and therefore, the yields achieved in the cereal intensive scenario are likely constrained by sub-optimal N inputs in high rainfall years. Profits in the rotations that maintain at least 30% break crops do not plateau as in the cereal intensive cropping system as increased levels of organic soil N have a greater capacity to respond to the season to meet crop demand in high rainfall seasons.



	Decile 1	Decile 3	Decile 5	Decile 7	Decile 9
50%	-232000	-42000	76000	196000	308000
70%	-331000	-89000	94000	281000	435000
100%	-501000	-171000	102000	366000	608000
100% cereal	-493000	-199000	-17000	190000	384000

Figure 3. Annual Farm Net Profit ($) over a range of season types (Decile 1,3,5,7 and 9) of four crop intensity scenarios for a 2400ha farm at Karoonda with a starting equity of 80%

Crop intensive rotations further increase risk when a farm has low business strength. When equity was 80%, both 100% crop scenarios made reasonable losses in below average (decile 3) seasons. However, when equity was reduced to only 65%, both scenarios made a substantial loss in a decile 1 year (Figure 4). In other words, the 100% cropping business with two decile 1 years in a row moved from 80% to 35% equity which is a difficult position to recover from.



	Decile 1	Decile 3	Decile 5	Decile 7	Decile 9
50%	-265000	-77000	40000	160000	274000
70%	-364000	-125000	58000	246000	402000
100%	-545000	-207000	66000	353000	578000
100% cereal	-526000	-235000	-52000	155000	351000

Figure 4. Annual Farm Net Profit ($) over a range of season types (Decile 1,3,5,7 and 9) of four crop intensity scenarios for a 2400ha farm at Karoonda with a starting equity of 65%

Cummins

Cummins is situated on Southern Eyre Peninsula (EP) with average annual rainfall of 424mm and growing season rainfall of 324 mm. It is a relatively small but productive sub-region and there are some strongly contrasting soil types including shallow ironstone gravels, deep alkaline clays and red clay loam duplex soils. The climate in the region is quite reliable with a low frequency of heat, drought and frost stress, but waterlogging is a significant cause of crop stress in the region. The farming system tends to be very intensive with a high production cost canola-wheat rotation dominant.

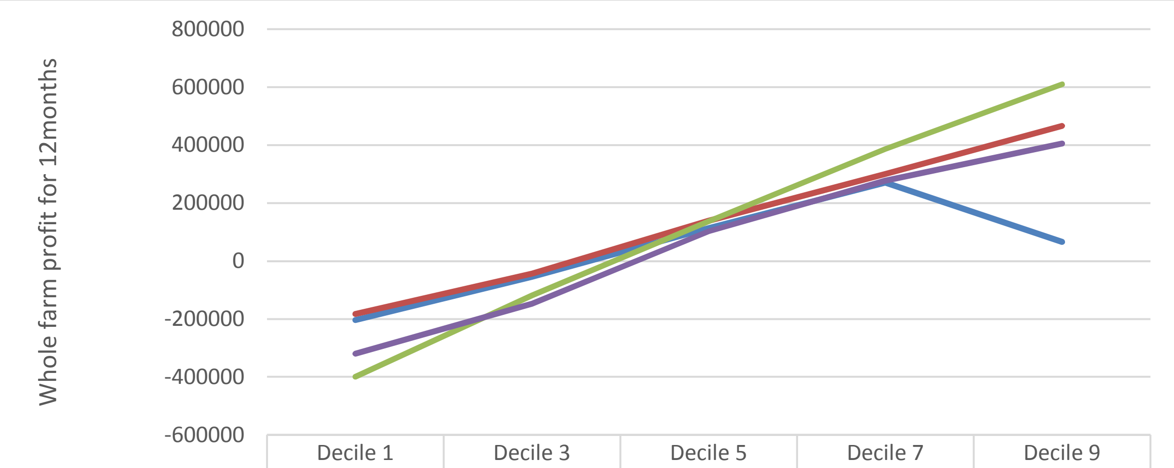
Nitrogen inputs in the region tend to be high (average Urea inputs in 2014 were 200 - 300 kg/ha) and nitrogen use efficiency low on the gravel soils. Consequently, there has been a number of N management trials delivered through the Lower EP Ag Development Association since 2008. Through the GRDC Water Use Efficiency Initiative, the key soil types were characterised and some, but not all, of these were able to be utilized to reliably predict yields across a range of season types using APSIM (McBeath 2012).

There were several model farms developed at the workshop, based around the key soil types (Cummins deep clay, Ungarra red clay loam and Greenpatch gravel-ironstone). The farms are based on two labour unit operations similar to the model farms in the other districts. The combination of research data, APSIM predicted yields and the experience and paddock records of the workshop participants were used to develop up yield tables in response to a range of management scenarios, including differing inputs of N fertiliser and differing enterprise mixes. An example of the yields developed for the Cummins model farm is given in Table 2.

Table 2. Yield (t/ha) in response to crop type and season type at the Cummins model farm.

Crop	Soil	Decile 1	Decile 3	Decile 5	Decile 7	Decile 9
Wheat	Clay	2.7	3.2	3.8	4.2	5.0
	Sand over loam	2.5	2.8	3.5	4.0	2.5
	Gravel	2.1	2.5	3.2	3.8	2.1
Lupins	Clay	0.5	0.8	1.4	1.8	2
	Sand over loam	0.5	1	1.8	2.3	0.8
	Gravel	0.5	0.8	1.5	2.0	0.8
Canola	Clay	0.8	1.4	1.8	2.5	2.5
	Sand over loam	1	1.4	1.8	2.3	1.2
	Gravel	0.8	1.2	1.7	2.3	1.1

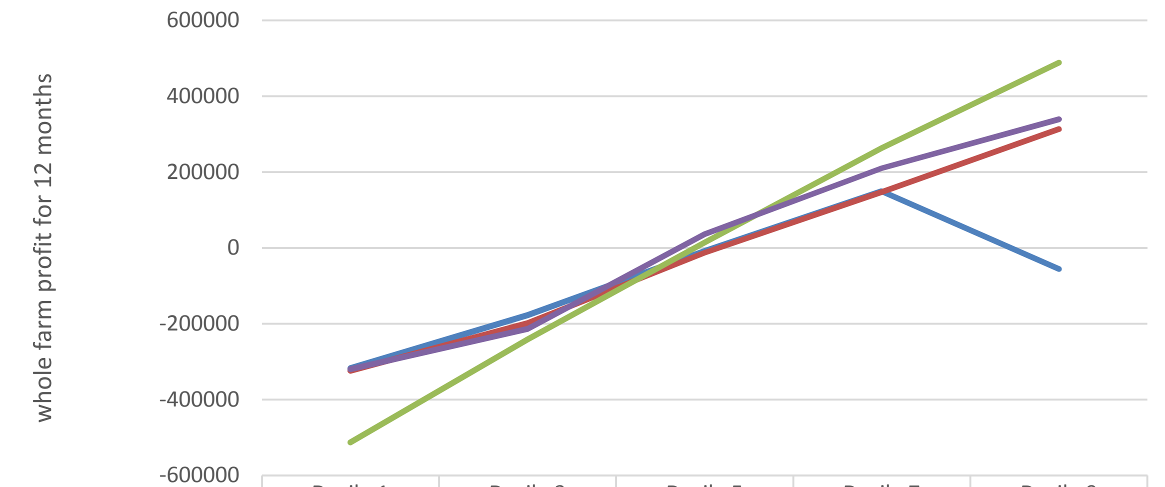
To date we have explored the baseline position of the model farms for Lower EP with more detailed analysis of the business response to N management to occur in March. While 100% cropping was acceptable at Cummins on a farm with business strength of 80% equity (Figure 5), when equity is reduced, continuous cropping quickly becomes a risky strategy.



	Decile 1	Decile 3	Decile 5	Decile 7	Decile 9
Cummins south	-204000	-54000	114000	271000	66000
Cummins	-183000	-44000	139000	300000	466000
Ungarra	-400000	-119000	137000	386000	610000
Ungarra sand	-320000	-147000	102000	277000	405000

Figure 5. Annual Farm Net Profit ($) over a range of season types (Decile 1,3,5,7 and 9) of the 100% cropping model farm scenario at four medium to high rainfall locations on the Eyre Peninsula. Each farm had a staring equity of 80%.

High land values on Lower EP allow large borrowings with financing costs eroding farm profit. A farmer at Cummins on 80% equity applying additional N to optimize yield is relatively low risk however at 65% equity the business has only marginal profit even in an average year. Figure 6 compares four farms on the Eyre Peninsula at a lower equity (65%) and with the following starting debt positions: Cummins South -$2.5m, Cummins -$3.5m, Ungarra -$2.5m and Ungarra sand -$1.25m. At 65% equity, even in the reliable lower Eyre Peninsula, the four farms are either having a small loss to marginal profit in a decile 5 (average) year. Cummins South with higher rainfall on poorer soil types struggles to capitalise in a decile 9 year due to waterlogging and poor N use efficiency. With this model farm losses occurred in decile 1, 3, 5 and 9 seasons. At lower equity, the ability to optimise yield using increased inputs of N fertiliser poses significant risk to the business. It is a clear demonstration that agronomic decisions cannot be treated in isolation from the business strength of the farm.



	Decile 1	Decile 3	Decile 5	Decile 7	Decile 9
Cummins south	-317000	-177000	-8000	149000	-56000
Cummins	-324000	-198000	-13000	147000	313000
Ungarra	-513000	-241000	14000	263000	488000
Ungarra sand	-320000	-213000	36000	210000	339000

Figure 6. Annual Farm Net Profit ($) over a range of season types (Decile 1,3,5,7 and 9) of the 100% cropping model farm scenario at four medium to high rainfall locations on the Eyre Peninsula. Each farm had a staring equity of 65%.

Decision making for the Advisor

The role of the advisor should be to aid farmers in their decision making not to be the decision maker. As farmers get busier, the trend is to outsource decisions to the advisor, and can have problems. The advisor takes this responsibility seriously and therefore ensures the recommendation will work. However, the advisor is often unaware of the farmer's business position. This can often result in recommendations that are low risk to production but may not be the best outcome for the business.

By documenting the production outcomes expected from a range of management decisions over the full range of season types and integrating the effect on the farm business, advice is more robust and the farmer will have more confidence in the right decision for their business. Farmers who rely too heavily on the advisor to be the main decision maker are actually losing confidence in their own decision making, and this potentially adds costs to the farm business. This is not a reflection on the advisor but rather a reflection of the increased intensity and complexity of farming. Understanding these issues will be a benefit to the farmer and the advisor into the future

Acknowledgments

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SOWING EARLY IN 2014 – HOW DID IT WORK?

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Take home messages

- Despite wide-spread stem frost, in the majority of 2014 ToS trials in SA highest yields still came from mid-late April sowing.
- Based on one year of data, Trojan (mid maturing) complements Mace (fast maturing) in a cropping program and allows growers to sow earlier and achieve higher yields (16%) than they could with Mace alone sown in its optimal window.
- Existing slow maturing wheat cultivars from other states are poorly adapted to most regions in SA.
- For growers in frosty environments wishing to sow before ~20 April, EGA Wedgetail is the safest option evaluated in these trials, but yields are likely to be less than Mace sown in its optimal window.

Background

In SA the time at which wheat flowers is very important in determining yield (Figure 1). With farm sizes increasing and sowing opportunities decreasing, getting wheat crops established so that they flower during the optimal period for yield is difficult. Whilst no-till and dry-sowing have been used successfully in SA to get more area of crop flowering on time, an opportunity exists to take advantage of rain in March and April to start sowing crops earlier than currently practiced. This is a tactic which **complements** dry sowing. Earlier sowing is now possible with modern no-till techniques, summer fallow management and cheaper insecticides and fungicides to protect against diseases associated with early sowing.

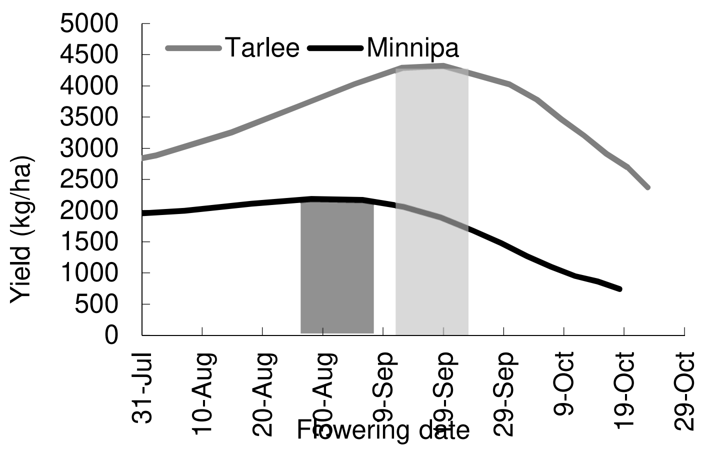

Figure 1. The relationship between flowering time and yield at Minnipa and Tarlee – optimal flowering periods are highlighted by light and dark grey boxes. Curves are derived from APSIM from 120 years of climate data and with a yield reduction for frost and extreme heat events. Optimal flowering periods are late August-early September at Minnipa, and mid September at Tarlee.

However, in the last few decades wheat breeding has focused on mid-fast maturing varieties which are only suited to sowing in late April-May. Sowing earlier than is currently practiced requires cultivars which are not widely grown in SA, and which are much slower to mature, either through having a strong vernalisation/cold requirement (winter wheats) or strong photoperiod/day length requirement (slow maturing spring wheats – Figure 2).

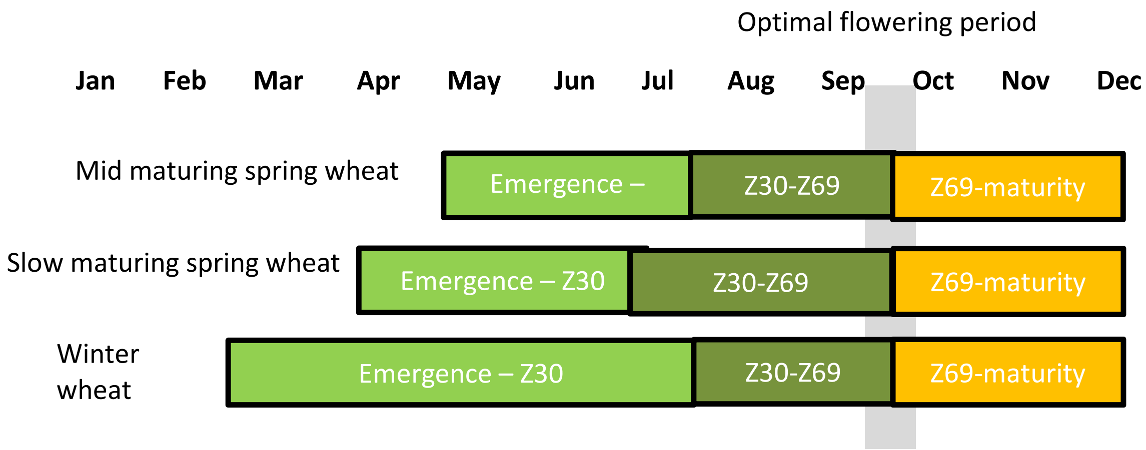

Figure 2. Diagram showing pattern of development in winter and slow maturing spring wheat relative to mid maturing spring (most currently grown varieties in SA are mid to fast). When sown at their optimal times, they all flower during the optimal period in a given environment. Winter wheats also have a very flexible sowing window and if well adapted will flower during the optimum period in a given environment from a broad range of sowing dates.

GRDC funded research in NSW has demonstrated that slow maturing varieties sown early yield more than mid-fast varieties sown later when they flower at the same time . This is because early sowing increases rooting depth and water use, reduces evaporation and increases transpiration efficiency. Early sowing of slow maturing varieties is a way of increasing yield potential with very little initial investment.

APSIM modeling indicates that even with SA's Mediterranean climate, adoption of slow maturing varieties to allow early sowing has potential to increase whole-farm wheat yield, particularly in mid-high rainfall zones (Table 1). GRDC have funded a series of trials across rainfall zones to experimentally evaluate the suitability of early sowing in SA.

Table 1. Average farm wheat yields from 50 years of simulation at different locations in SA assuming either current practice (mid-fast varieties sown from mid-May including dry sowing) or the addition of a slow maturing variety to the cropping program which can be planted from 1 April, but is only sown when planting opportunities arise (occurs in ~60% of years).

LOCATION	AVERAGE FARM YIELD – CURRENT PRACTICE (T/HA)	AVERAGE FARM YIELD – EARLY SOWING (T/HA)	YIELD BENEFIT FROM EARLY SOWING (T/HA)	YIELD BENEFIT FROM EARLY SOWING (%)
Conmurra	4.0	6.1	2.1	53%
Cummins	3.3	4.0	0.8	24%
Minnipa	2.1	2.2	0.1	5%
Port Germein	1.9	2.1	0.2	11%
Tarlee	3.5	4.0	0.5	14%

Methodology

GRDC early sowing trials in SA are at 5 locations (Cummins, Minnipa, Port Germein, Tarlee and Conmurra) and each has 3 times of sowing (aimed at mid-April, early-May, late-May) and 10 wheat lines (6 commercial, 4 near-isogenic lines, or NILs, in a Sunstate background).

The commercial lines are described in Table 2. Hart Field Site Group also planted a similar early sowing trial, and there are also trials funded by SAGIT evaluating different wheat lines for early sowing in the Mid North and upper YP.

Table 2. Commercial wheat varieties used in the SA trials at Cummins, Minnipa and Port Germein.

Variety	Maturity	Comments
Manning (Conmurra only)	Very slow winter (very strong vernalisation, unknown photoperiod)	White feed – Resistant to BYDV but only adapted to environments with a very long, cool growing season
SQP Revenue (Conmurra only) (NIL match: W46A)	Slow winter (strong vernalisation, unknown photoperiod)	Red feed – also adapted to long cool growing seasons, it is widely grown in SW Victoria and SE SA.
EGA_Wedgetail (NIL match: W8A)	Mid maturing winter (strong vernalisation moderate photoperiod)	APW (default in SA – APH in NSW) - The early sowing and dual purpose standard in SNSW and an excellent grain-only option. May be too slow in most of SA, only has APW quality and can be quite intolerant of problems associated with alkaline soils (CCN, boron, aluminium).
Rosella (NIL match: W7A)	Fast maturing winter (strong vernalisation weak photoperiod)	ASW - Slightly faster than Wedgetail and trials in Victoria has shown better adaption to alkaline soils. However, being 29 years old it is at a distinct yield disadvantage to modern spring wheats.
EGA_Eaglehawk (NIL match: W16A)	Very slow maturing spring (moderate vernalisation, very strong photoperiod)	APW (default in SA – APH in NSW) Very slow maturing photoperiod sensitive spring wheat that will flower at the same time as Wedgetail from a mid-April sowing but hit Z30 ~3 weeks earlier, therefore not as suited to grazing.
Forrest (NIL match: W16A)	Very slow maturing spring (weak vernalisation, very strong photoperiod)	APW - Very slow maturing photoperiod sensitive spring wheat which performs well in higher yielding environments
Bolac (Tarlee and Conmurra only)	Slow maturing spring (moderate vernalisation, moderate photoperiod)	AH – Bred for the HRZ of SW Victoria but has performed well when sown early in the low rainfall regions of the western Riverina in NSW.
Estoc	Mid maturing spring (weak vernalisation, strong photoperiod)	APW - probably the slowest maturing recently released variety with good adaptation to SA. Not suited to sowing much before 20 April in most environments.
Trojan	Mid-fast maturing spring (moderate vernalisation, moderate photoperiod)	APW - Has demonstrated good adaption to SA and has an unusual photoperiod gene which may allow it to be sown in late April and flower at the optimal period
Mace (NIL match: Sunstate)	Fast maturing spring (weak vernalisation, weak photoperiod)	AH - No introduction necessary! SA main-season benchmark and in the trial as a control from a mid-late May sowing.
Cobra (Conmurra only)	Fast maturing spring (weak vernalisation, weak photoperiod)	AH – very similar maturity to Mace but based on NVT results may out yield it in higher yielding environments.

Results

Results from all experiments are presented in Table 3. At 4 out of 5 sites, Trojan sown in mid to late April was the highest or equal highest yielding treatment. Slow maturing cultivars bred in other states (e.g. EGA Wedgetail, EGA Eaglehawk and Rosella) showed poor adaptation to all sites.

Table 3. Grain yield for 5 out of 6 early sowing trial sites in SA in 2014 (results for Conmurra not available at time of preparation). Treatments known to have been affected by frost are marked with an asterisk.

		Time of sowing			
Location	**Cultivar**	**15-Apr**	**6-May**	**29-May**	
Cummins	**EGA Wedgetail**	4.0	2.9	3.7	
	Rosella	4.0	4.1	2.5	
	EGA Eaglehawk	3.8	2.9	2.7	
	Estoc	4.3	4.7	3.8	
	Trojan	4.9	5.0	4.4	
	Mace	2.6*	5.1	4.1	
	P-value		<.001		
	LSD (P=0.005)		0.6		
		11-Apr	**13-May**	**28-May**	
Minnipa	**EGA Wedgetail**	2.9	2.2	2.1	
	Rosella	2.7	2.4	2.1	
	EGA Eaglehawk	3.0	1.8	1.7	
	Estoc	4.0	2.7	2.6	
	Trojan	4.6	3.1	3.0	
	Mace	3.7	3.0	2.8	
	P-value		<.001		
	LSD (P=0.005)		0.2		
		11-Apr	**30-Apr**	**20-May**	
Port Germein	**EGA Wedgetail**	2.5	1.9	1.7	
	Rosella	2.2	1.7	1.6	
	EGA Eaglehawk	3.0	2.1	1.9	
	Estoc	4.4	3.5	3.4	
	Trojan	5.2	4.2	3.9	
	Mace	4.3	4.3	3.7	
	P-value		<.001		
	LSD (P=0.005)		0.5		
		14-Apr	**8-May**	**2-Jun**	
Hart	**EGA Wedgetail**	4.5	4.0	3.0	
	Rosella	4.3	3.7	2.8	
	Trojan	5.7	5.3	3.7	
	Mace	3.9*	4.7	3.3	
	RAC1843	0.8*	3.6	3.5	
	P-value		<.001		
	LSD (P=0.005)		0.3		
	Cultivar	**14-Apr**	**29-Apr**	**12-May**	**30-May**
Tarlee	**Rosella**	5.5	5.4	4.6	3.5
	Bolac	6.1	6.1	4.6	3.7
	Trojan	6.6	7.4	6.1	4.6
	Mace	4.1*	7.4	6.4	5
	P-value			<.001	
	LSD (P=0.005)			0.6	

Putting early sowing into practice in SA

Based 2014 trial data, growers in SA could improve whole-farm yields by including Trojan in their cropping program to complement Mace (Figure 3). Trojan has an unusual photoperiod sensitivity allele inherited from a European parent which is rare in Australian cultivars. This allele seems to delay flowering from an April sowing relative to Mace quite successfully (Table 4).

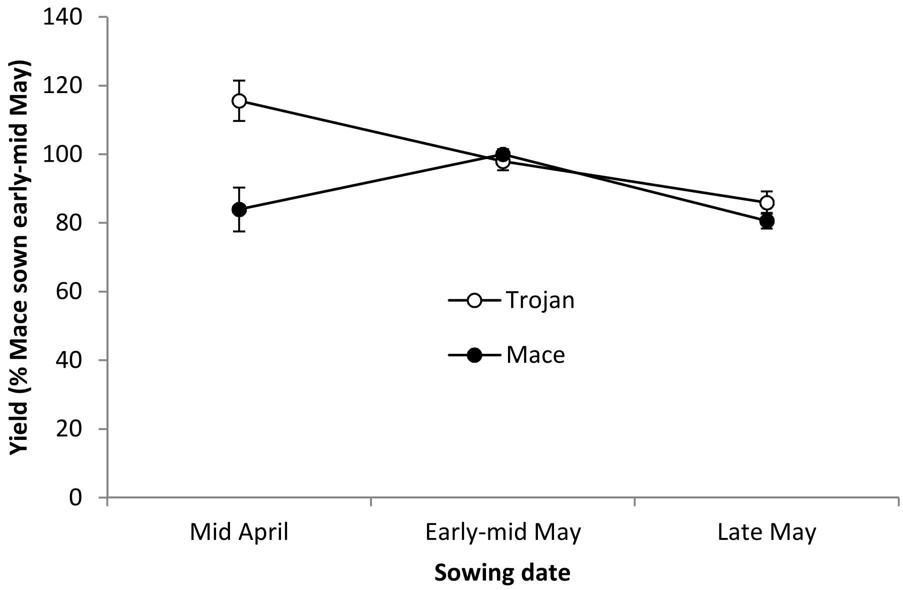

Figure 3. Mean yield performance (Minnipa, Cummins, Port Germein, Hart, Tarlee) of Trojan and Mace at different times of sowing relative to Mace sown in its optimal window of early-mid May. Error bars are standard error of means.

Table 4. Flowering dates for Trojan and Mace from different times of sowing at Minnipa in 2014.

Flowering date - Minnipa	Time of sowing		
Cultivar	**11-Apr**	**13-May**	**28-May**
Trojan	6-Aug	10-Sep	17-Sep
Mace	8-Jul	6-Sep	13-Sep

Despite performing strongly from a mid-April sowing in these trials, it is not recommended that Trojan be planted this early in the majority of SA locations as it incurs excessive frost risk. As a rough rule of thumb, it is best suited to being planted ~10 days earlier than Mace. As an example of how it may fit in a program, if 10 May is the optimal sowing time for Mace in a given environment, then the optimal sowing time for Trojan is 1 May. If a grower has a 20 day wheat sowing program and wants to grow half Trojan and half Mace, to maximize whole farm yield they should start with Trojan on 25 April, switch to Mace on 5 May and to finish on 15 May.

Sowing mid April in low-frost environments such as Port Germein carries little risk, and as the results from this year show, significant yield gains (0.9 t/ha relative to Mace) can be achieved by sowing Trojan in mid-April purely because its longer growing season allows it to accumulate more dry matter.

For growers in frosty environments who wish to sow earlier than is safe with Trojan/Mace, EGA Wedgetail is probably the best option in most environments. However, because of its poor adaption to SA even if sown in early-mid April it is unlikely to yield as well as Mace sown in its optimal window. In this set of trials there was an average yield penalty of 0.5 t/ha between EGA Wedgetail sown mid April and Mace sown in mid-May. Grazing early sown EGA Wedgetail would offset some of the reduction in income compared to mid-May sown Mace.

Remember that early sown crops require different management in order to get the most out of them;

- Don't dry-sow slow maturing varieties (EGA Wedgetail, EGA Eaglehawk) , they will flower too late if not established early. There needs to be seed-bed moisture and ideally some stored soil water to get them through to winter.
- If growing winter wheat (EGA Wedgetail) and not grazing, sow at lower plant density and defer N inputs until after Z30.
- Pick clean paddocks – winter wheat at low plant densities is not competitive with ryegrass, and common root diseases are exacerbated by early sowing.
- Protect against diseases associated with early sowing – barley yellow dwarf virus (imidicloprid on seed backed up with in-crop insecticides at the start of tillering if aphid pressure high), *Septoria tritici* in some areas (flutriafol on fertilizer and timely foliar epoxiconazole applications at Z30 & Z39). Many slow maturing varieties also have poor resistance to stripe rust (flutriafol on fertilizer and timely foliar fungicide application at Z39)

Conclusion

Despite a frosty July and August, highest yields in most trials still came from mid-April sowing with Trojan being the stand-out performer. Trojan complements Mace in a cropping program and extends the sowing window about ten days earlier. EGA Wedgetail was the best performing variety suited to very early sowing, but even sown early it yields less than Mace planted in its optimal window.

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KAPINNIE HERBICIDE EFFICACY

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Key messages

- No significant difference in ryegrass control was found between plots treated with any of the three pre-emergent herbicides tested
- Though not statistically significant, the trial demonstrated a trend of increased herbicide efficacy with increasing herbicide carrier volume

Why do these trials?

These trials are associated with the GRDC Stubble Retention Project seeking to develop management guidelines for stubble retained farming systems on the Lower Eyre Peninsula (LEP). Two key areas of concern in farming systems where stubble is not grazed, burned or cultivated are reliance on herbicides to combat weeds and the efficacy of pre-emergent (soil incorporated) herbicides when applied to stubble-covered soil.

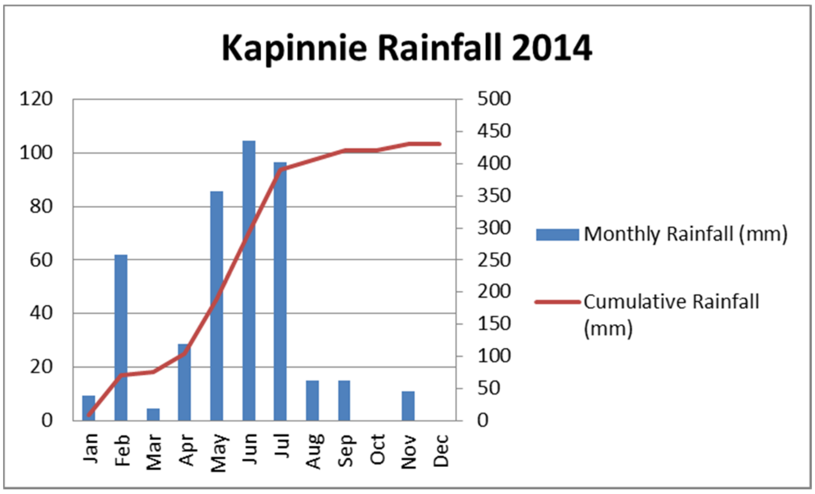
How was it done?

Two trials were conducted at Wanilla and Kapinnie throughout 2014 to assess the efficacy of three herbicide types applied at four different carrier volumes. Because of logistical constraints at sowing, the Wanilla site did not present useful data; this report refers only to the Kapinnie trial hereafter.

The twelve treatments included herbicides pyroxasulfane (as 118 g/ha Sakura), prosulfocarb (as 2.5 L/ha Boxer Gold) and combined trifluralin (1 L/ha) and tri-allate (as 1.6 L/ha Avadex), each applied with carrier volumes (rainwater) of 50, 75, 100 and 150 L/ha. Treatments were applied immediately prior to sowing the plots with wheat (variety Wyalkatchem) at 180 pl/m2 to a depth of 4 cm. Plots were sown on the 23rd May using a tined plot seeder with 22.5 cm row spacing. An 18:20 N:P fertiliser was applied at 100kg/ha, treated with fungicide (Impact @ 400mL/ha). Each combination of herbicide and carrier volume was replicated four times in a randomised complete block design.

The site received approximately 345 mm of growing season rainfall, however, as Figure 1 (below) highlights, this rainfall was largely concentrated in May-July, with a sharp shut off in the season. Because of the nature of the trial site's soils (sand over dense sodic clay), the trial suffered some waterlogging, as did much of the region.

Figure 1 – Rainfall at the Kapinnie trial site in 2014



What happened?

Crop establishment showed no signs of being affected by application of pre-emergent herbicides (P = 0.9728, CV 14.72). With no significant differences in crop establishment evident, differences in crop yield would likely indicate impact of resource competition from ryegrass. However, there was no significant effect of treatment on yield (P = 0.8882, CV 26.19). Table 1 (below) displays the average yield for each treatment combination.

Table 1 – Average yield across replicates for each treatment combination

Herbicide X Carrier Volume	Yield (t/ha)
BoxerGold@100L/ha	3.49
Sakura@75L/ha	3.46
BoxerGold@150L/ha	3.42
Trifuralin+Avadex@100L/ha	3.41
Trifuralin+Avadex@150L/ha	3.38
Trifuralin+Avadex@75L/ha	3.35
Sakura@150L/ha	3.24
Sakura@100L/ha	3.23
BoxerGold@50L/ha	3.05
Sakura@50L/ha	2.99
Trifuralin+Avadex@50L/ha	2.81
BoxerGold@75L/ha	2.53
P < 0.05	**LSD 1.20**

This trial evaluated whether different herbicides were more or less responsive to carrier volume at application. It has been previously suggested that low-solubility pre-emergent herbicides such as trifluralin may benefit from higher carrier volumes in stubble-retained systems (Borger *et al*, 2013). The interaction of herbicide with carrier volume in this trial did not result in a significant difference on either ryegrass emergence (P = 0.6409, CV 122.67) or late-season ryegrass abundance (P = 0.6409, CV 122.67).

Similarly, no significant difference in ryegrass abundance was detected between herbicides, independent of the effect of carrier volume (P = 0.2303, CV 84.63). These results reflect a similar study conducted in Western Australia, which found no difference in efficacy between trifluralin and pyroxasulfane on ryegrass abundance (Borger *et al*., 2013).

Table 2 – Effect of herbicide treatment only on average ryegrass abundance and crop yield

Herbicide	Ave. Ryegrass Abundance	Average Yield (t/ha)
Boxer Gold	15.44	3.12
Sakura	9.23	3.23
Trifluralin & Avadex	11.35	3.24
P < 0.05	**LSD 7.34**	**LSD 0.41**

Finally, the effect of carrier volume, independent of herbicide type, on ryegrass abundance was considered. Whilst the effect of carrier volume on late season ryegrass counts was not statistically significant to the 5 % confidence level (P = 0.2302, CV 94.11), and likewise, neither was the effect of carrier volume on crop yield (P = 0.08, CV 14.23), there did appear to be a trend of reduced ryegrass/increased yield with increased water rate. Table 3 (below) presents the average ryegrass counts and crop yields for each of the four carrier volumes.

Table 3 – Effect of carrier volume only on average ryegrass abundance and crop yield

Carrier Volume (L)	Ave. Ryegrass Abundance	Ave. Yield (t/ha)
50	17.33	2.95
75	12.36	3.11
100	7.83	3.38
150	10.50	3.3458
P < 0.05	**LSD 9.39**	**LSD 0.38**

What does this mean?

The variability of naturally-occurring ryegrass makes presents difficulties in statistical analysis. This variability is reflected in the high CV coefficients reported throughout. Despite this, the trial did demonstrate a likely ryegrass-control benefit from applying pre-emergent herbicides at carrier volumes beyond 100 L/ha. This is evident in the 'trend' of reduced ryegrass and higher crops yield (potentially the result of decreased competition from less-vigorous ryegrass), in plots sprayed with either the 100 or 150 L/ha carrier volumes. These proposed carrier volumes sit above the common industry practice of around 70 L, evident from anecdotal accounts.

Whilst it is surprising that no differences were detected between herbicide types, given the anecdotal suggestion of ryegrass resistance to trifluralin particularly, it may be that the addition of tri-allate is sufficient to counter any loss of efficacy in trifluralin. It may also be possible that trifluralin resistance has not developed on this site.

Where to from here?

A further trial seeking to 'iron out' the variability of ryegrass abundance is proposed for 2015 and will hopefully further evaluate carrier volume impact and differences in efficacy between herbicide types. If variability in ryegrass sampling can be reduced, it is possible that more subtle, yet significant, differences in herbicide efficacy may be evident. It is planned that the proposed trial will also evaluate the impact of varying stubble loads and stubble treatments such as high standing, slashing, burning and rolling.

Acknowledgements

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KAPINNIE YELLOW LEAF SPOT

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Key messages

- Significant variation in yellow leaf spot susceptibility exists between varieties of wheat commonly grown on the Lower Eyre Peninsula and this is correlated with significant yield differences
- If sowing into stubble with a history of yellow leaf spot, it is important to make good management decisions to avoid yield losses
- Choice of variety has more impact on yield than does fungicide management strategy, and is likely to lead to greater profit

Why do these trials?

These trials are associated with the GRDC Stubble Retention Project aimed at developing management guidelines for stubble-retained farming systems on the Lower Eyre Peninsula (LEP). Retained stubble can act as a refuge for disease, including fungal diseases such as yellow leaf spot (YLS), throughout the summer fallow and this can result in considerable infection of subsequent crops. This issue is exacerbated where wheat is sown directly into wheat stubble, allowing direct transfer of YLS to the subsequent wheat crop. Identifying management strategies that maximise yield and reduce input costs is likely to be of value on the LEP where YLS is common, stubble is generally retained and short rotations are the norm.

How was it done?

Two separate trials (‘YLS Susceptibility’ and ‘YLS Fungicide’) were conducted in the same paddock at Kapinnie in 2014. The first trial sought to evaluate the reported YLS-susceptibility ratings of 20 common wheat varieties, within LEP conditions, as well as determine the yield penalty associated with YLS infection for each variety. The second trial compared two commonly-planted wheat varieties, Scout and Corack, tested under three different fungicide regimes. These two varieties represent opposite ends of the YLS-susceptibility spectrum with Scout rated susceptible-very susceptible (SVS) and Corack rated moderately resistant (MR). Both varieties have proven themselves above-average yielders in South Australia, including the LEP, with Corack generally only slightly (2%) ahead of Scout in most NVT trials.

Both trials plots were sown on the 23rd May using a six-row tined small-plot seeder at a rate of 180 plants/m^2, to a depth of 4 cm, at 22.5 cm row spacing. Each plot received the equivalent of 100 kg/ha of 18:20 P:N fertiliser. Fertiliser was treated with 400 mL/ha of fungicide (Impact), placed with the seed during sowing, except in the control plots for the ‘YLS Fungicide’ trial.

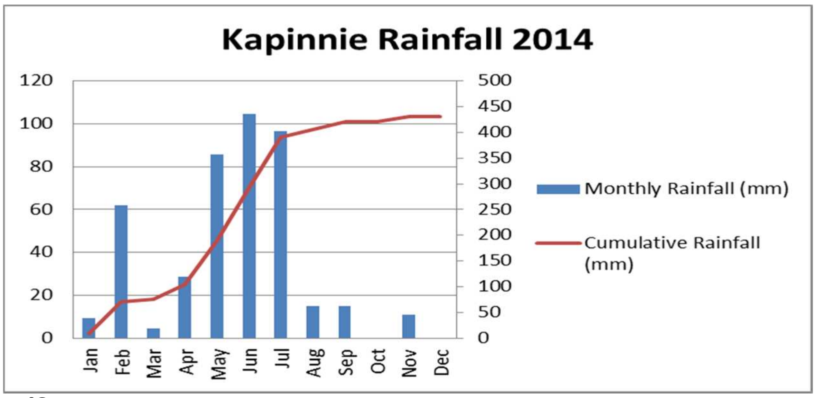
For the ‘YLS Susceptibility’ trial, each plot was visually evaluated on the 10th July 2014 and given a score from 1-9 (low-highly affected), based on the degree of YLS present in the plot. Plots were harvested on the 3rd December 2014 and the yield recorded.

For the ‘YLS Fungicide’ trial, plots of Corack and Scout wheat were subjected to the following treatments: nil fungicide (Nil), soil-applied fungicide only (Impact @ 400 mL/ha)

(Soil) and soil and foliar-applied fungicides (Impact @ 400 mL/ha + Prosaro @450 mL/ha applied to foliage @ Zadock's GS25) (Foliar). Each treatment was replicated 4 times, with the 'Nil' treatment replicated 8 times.

For both trials, the site contained an even coverage of wheat stubble known to carry YLS. Soil at this site comprises sand over dense sodic clay, a common soil type on the LEP. As with much of the district, this trial was heavily impacted by uneven rainfall distribution throughout the growing season with 314.8 mm recorded at nearby Brimpton Lake from April to July (inclusive) and just 15 mm in each of August, September (no rainfall in October). Rainfall data are presented in Figure 1 (below).

Figure 1 – Rainfall data for Kapinnie through 2014



What happened?

YLS Susceptibility Trial

Table 1 (below) summarises the results of the trial, giving the mean yield and YLS score across four plots for each variety. The data are ranked by yield.

Table 1 – Summary of yield and YLS scores for all varieties in trial (ranked by yield)

Variety	Average Yield (t/h)	Average YLS (score/9)
Magenta	2.80	1.25
Corack	2.76	1.75
Kord	2.72	2.25
Mace	2.66	1.75
Wyalkatchem	2.65	2.00
Esparda	2.64	2.00
Cobra	2.53	2.75
Justica	2.29	3.25
Estoc	2.27	3.00
EmuRock	2.25	3.00
Trojan	2.05	2.50
Gladius	1.97	2.00
Grenade	1.89	3.75
RAC1843	1.80	4.50
Shield	1.78	2.75
Axe	1.71	3.00
Catalina	1.66	2.25
Yitpi	1.47	3.75
Phantom	1.46	3.25
Scout	1.16	3.50

The trial demonstrated significant differences in the resistance of varieties to YLS ($P < 0.0001$, CV 24.18). Table 2 (below) summarises the differences in mean YLS score for each of the varieties, giving an indication of the degree to which each variety may be susceptible to YLS; the rating, given in brackets after each variety name, is the proposed YLS-resistance rating taken from the 2015 GRDC NVT sowing guide. This trial demonstrated that the YLS-susceptibility ratings reported in the NVT sowing guide are representative of varietal susceptibility under LEP conditions.

Table 2 – Ranked YLS scores for wheat varieties. NVT sowing guide susceptibility ratings in brackets.

Variety	YLS (score/9)
Magenta (MRMS)	1.25 (0.25)
Corack (MR)	1.75 (0.25)
Mace (MRMS)	1.75 (0.25)
Wyalkatchem (MR)	2 (0.41)
Espada (MS)	2 (0.41)
Gladius (MS)	2 (0.41)
Kord (MSS)	2.25 (0.25)
Catalina (MSS)	2.25 (0.48)
Trojan (MSS)	2.5 (0.29)
Cobra (MRMS)	2.75 (0.75)
Shield (MSS)	2.75 (0.48)
Estoc (MSS)	3 (0.00)
EmuRock (MRMS)	3 (0.41)
Axe (S)	3 (0.58)
Justica (S)	3.25 (0.25)
Phantom (SVS)	3.25 (0.63)
Scout (SVS)	3.5 (0.29)
Grenade (S)	3.75 (0.48)
Yitpi (SVS)	3.75 (0.25)
RAC1843 (N/A)	4.5 (0.29)
P < 0.05	**LSD 0.93**

Cobra, rated as being moderately resistant to moderately susceptible by the NVT sowing guide, stands out as a variety more affected in this trial than its rating would suggest. However, the high variability between plots for this one variety (SE = 0.75) suggests its results may be unbalanced due to a single bad outbreak or other factor.

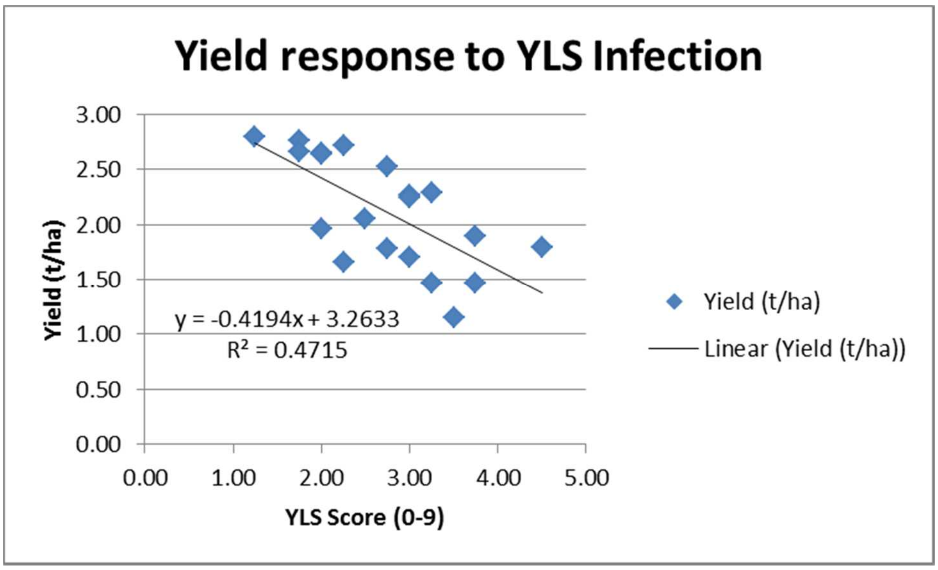
The trial also highlighted a significant linear relationship between YLS score and yield ($P = 0.0313$, $R2 = 0.4715$), indicating that YLS susceptibility does translate to yield losses. Table 3 (below) highlights the effect that increased YLS had on yield across varieties.

Table 3 – Yields of wheat varieties, ranked by YLS score. Numbers in brackets are standard error of mean.

Variety	Yield (t/ha)	YLS (Score/9)
Magenta	2.80 (0.23)	1.25 (0.25)
Corack	2.76 (0.22)	1.75 (0.25)
Mace	2.66 (0.24)	1.75 (0.25)
Wyalkatchem	2.65 (0.28)	2 (0.41)
Esparda	2.64 (0.35)	2 (0.41)
Gladius	1.97 (0.20)	2 (0.41)
Kord	2.72 (0.21)	2.25 (0.25)
Catalina	1.66 (0.08)	2.25 (0.48)
Trojan	2.05 (0.26)	2.5 (0.29)
Cobra	2.53 (0.41)	2.75 (0.75)
Shield	1.78 (0.27)	2.75 (0.48)
Estoc	2.27 (0.34)	3 (0.00)
EmuRock	2.25 (0.28)	3 (0.41)
Axe	1.71 (0.10)	3 (0.58)
Justica	2.29 (0.20)	3.25 (0.25)
Phantom	1.46 (0.29)	3.25 (0.63)
Scout	1.16 (0.31)	3.5 (0.29)
Grenade	1.89 (0.26)	3.75 (0.48)
Yitpi	1.47 (0.36)	3.75 (0.25)
RAC1843	1.80 (0.39)	4.5 (0.29)
$P < 0.05$	**$R^2 = 0.4715$**	

Whilst the effect of YLS on yield is significant between groups of varieties, the yield response to YLS infection varies between varieties, reducing the linearity of the relationship i.e. the relationship exists but does not explain all variation in yield. Figure 2 (below) demonstrates this relationship.

Figure 2 – linear regression demonstrating impact of YLS on yield.



YLS Fungicide Trial

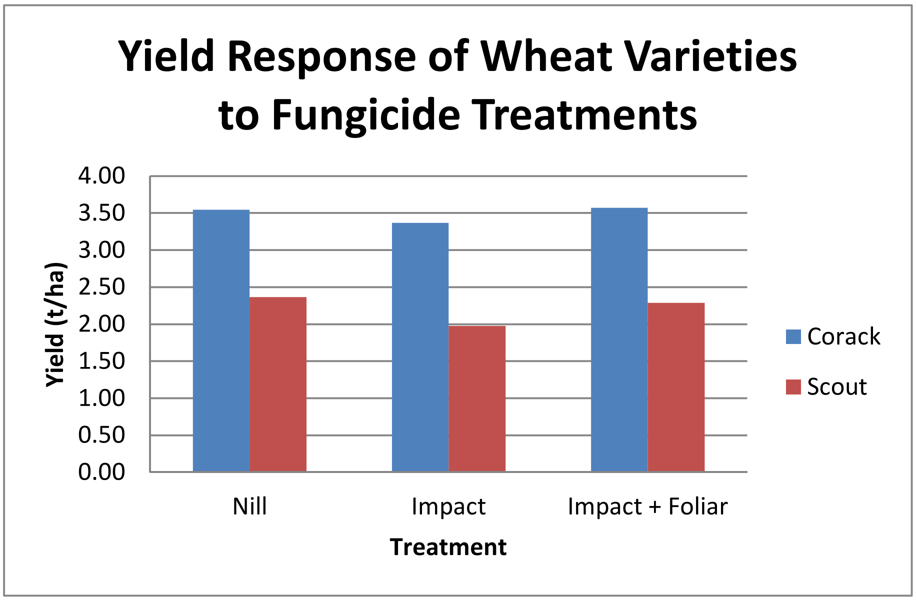
Across all treatments in the 'YLS Fungicide trial', Corack yielded significantly better than Scout ($P < 0.0001$, CV 20.66). Whilst Corack has generally performed better than Scout in NVT trials – 110 % compared with 108 % of site average across the LEP – the difference in yield noted in this trial is substantially greater than this expected approximate 2 % difference. Table 4 (below) provides a summary of thee mean yield of each variety for each treatment.

Table 4 – yield data for each variety by each treatment

	Variety Yield (t/ha)	
Treatment	Corack	Scout
Nill	3.55	2.37
Impact	3.37	1.98
Impact + Foliar	3.57	2.29

Figure 3 (below) demonstrates the lack of response of either variety to treatments.

Figure 3 – Yield responses of wheat varieties Corack and Scout to fungicide treatments



Notably, untreated Scout out-yielded either fungicide treatment. This is a surprise, given Scout was clearly affected by YLS. It demonstrates that the treatments were ineffective during this trial. Furthermore, the relative difference between Corack and Scout actually gets bigger (though not significantly) with treatment. Unexplained is the appearance that both varieties yielded lowest when treated with Impact at sowing. This difference is not statistically significant and may be due to random error alone.

What does this mean?

These two trials have important implications for LEP growers. The 'YLS Susceptibility' trial generally confirms the resistance ratings associated with NVT trials. However, critically, this trial establishes YLS resistance in an environment known to contain significant infection with YLS. For growers on the LEP, where YLS is common, this provides good information on the reliability of the NVT YLS-resistance ratings to their specific circumstance. Furthermore, the 'YLS Susceptibility' trial clearly shows the yield penalty associated with planting a susceptible variety into a paddock with a history of YLS.

The 'YLS Fungicide' trial demonstrates the importance of selecting a wheat variety based on more than just potential yield. In a YLS-free environment, the difference between a susceptible variety and a resistant variety may be very little (i.e. 2 % difference across LEP for Corack and Scout). However, where YLS exists, the difference is likely to be highly significant. What the NVT ratings do not make clear is the yield penalty associated with sowing a susceptible variety into an infected paddock. Of greatest interest however is that multiple treatments of fungicide had no benefit, even for the susceptible Scout, where a response could be expected. This trial demonstrates the value in selecting resistant varieties, rather than making selection based on other factors and hoping that management with fungicides will make the difference.

Where to from here?

The research undertaken here generally confirms the susceptibility ratings reported in the NVT sowing guides. Furthermore, this research demonstrates that infection with YLS does impact final yield and must therefore by avoided. It was anticipated that a yield response to fungicide treatment would be measurable in a YLS-susceptible variety such as Scout, however this was not the case. Research undertaken by AGT (2014), including trials on the EP, demonstrated that the best response to fungicides generally came where foliar sprays were applied after GS 31, something this trial did not address. It may be that further research would demonstrate yield responses to later fungicide application. However the work by AGT also indicated, as did this trial, that it is not possible to fully protect wheat from the effects of YLS through management with fungicide and, consequently, selecting resistant varieties is the most important strategy for reducing the effects of YLS, particularly when sowing into wheat stubble containing YLS spores.

Acknowledgements

The funding support from GRDC for this research and the Moroney family for hosting this trial is gratefully acknowledged.

Ryegrass Competition

Blake Gontar[1], Andrew Ware[1], Brian Purdie[1], Ashley Flint[1]

[1]SARDI, Port Lincoln

Key messages

- Early sowing of barley may be an effective way of controlling ryegrass growth and limiting seed set
- Results in wheat are more variable than for barley: at Wanilla, mid-May seemed the optimal time of sowing to reduce ryegrass with less effect obvious at Yeelanna
- Higher seeding rates also followed the same trend, with little ryegrass suppression benefit seen in wheat but a benefit evident in barley
- Increasing seeding rate did not improve wheat yields significantly however barley (Fleet) did seem to benefit from higher seeding rates when sown late (mid-June)

Why do these trials?

These trials are associated with the GRDC Stubble Retention Project seeking to develop management guidelines for stubble retained farming systems on the Lower Eyre Peninsula (LEP). Historical dependence on herbicides for control of weeds in reduced-till/stubble-retained farming systems has resulted in populations of ryegrass found in these farming systems exhibiting increasing resistance to many known herbicides, thus increasing reliance on newer, more expensive herbicides. This reliance on a small selection of expensive herbicides is both expensive and is also likely to lead to further herbicide resistance and, ultimately, fewer herbicide options available to farmers. The aim of these trials is to investigate proactive non-herbicidal management strategies for reducing ryegrass seed set and so 'run down' the seed bank.

How was it done?

Two trials were established in 2014 – one at Yeelanna and another at Wanilla. Trial site selection reflected two common soil types on the LEP as well as historical ryegrass infestation. In each trial, three wheat varieties (Mace, Emu Rock and Wyalkatchem) and one barley variety (Fleet) were sown, each at two rates of sowing (150 & 250 plants/m^2) and at three different times of sowing. Sowing dates were 5th May, 16th May and 11th June.

Plots were sown using a six-row tined plot seeder set to a depth of 4 cm, with row spacing of 22.5 cm. Seeding was preceded by application of glyphosate and pyroxasulphane (as 118 g/ha Sakura), per normal farmer practice. Each plot received the equivalent of 100 kg/ha of 18:20 N:P fertiliser, treated with fungicide (Impact @ 400mL/ha).

Data on crop emergence, ryegrass emergence and late season ryegrass abundance were all collected by randomly sampling each plot. Ryegrass sampling consisted of counting plants within a 0.1 m^2 quadrat, whereas crop sampling consisted of counting plants along both sides of a 50 cm ruler placed between rows. Sampling was replicated three times within each plot and plant densities were calculated from these measurements. Emergence counts were conducted approximately 2 weeks after each time of sowing while late season ryegrass counts were conducted in October for all plots.

What happened?

Plots sown in the final time of sowing (11th June) at both trials were affected by heavy rain around this period. This is the explanation for the statistically significant influence of time of sowing (TOS) on crop yield seen in both trials. The strong correlation between crop emergence and yield (R = 70.1 & 70.8 at Wanilla and Yeelanna respectively) throughout the whole trial together with the use of knockdown herbicides prior to seeding suggest substantial yield losses in the third time of sowing were likely caused by poor establishment due to the direct effects of waterlogging, rather than being related indirectly to competition from ryegrass (as it is unlikely under these circumstances that ryegrass emergence would have reduced crop establishment). Rather, it seems likely that ryegrass has flourished in the absence of a vigorous crop, or perhaps even just due to a preference for moist soil conditions. Tables 1 and 2 (below) summarise the mean yields for all combinations of variety and sowing rate, across all times of sowing at Wanilla and Yeelanna, demonstrating the extent of yield losses in the third time of sowing.

Table 1 – Mean yields of all entries across all times of sowing at Wanilla

		Yield (t/ha)	
Variety x Sow Rate	**TOS 1**	**TOS 2**	**TOS 3**
Fleet @ 150	3.53	2.87	1.63
Fleet @ 250	3.23	3.24	2.42
Mace @ 150	3.93	3.70	1.94
Mace @ 250	2.85	3.10	2.77
Emu Rock @ 150	3.52	3.48	1.97
Emu Rock @ 250	3.16	3.20	1.76
Wyalkatchem @ 150	3.80	3.77	2.21
Wyalkatchem @ 250	3.45	3.07	2.07
P < 0.05		**LSD 1.11**	

Table 2 – Mean yields of all entries across all times of sowing at Yeelanna

	Yield (t/ha)		
Variety x Sow Rate	**TOS 1**	**TOS 2**	**TOS 3**
Fleet @ 150	3.07	3.44	1.53
Fleet @ 250	3.37	*3.62*	2.43
Mace @ 150	3.18	2.86	1.68
Mace @ 250	3.08	2.83	2.45
Emu Rock @ 150	3.15	2.80	1.66
Emu Rock @ 250	3.12	2.81	2.13
Wyalkatchem @ 150	3.20	3.02	2.28
Wyalkatchem @ 250	3.41	2.64	2.00
P < 0.05		**LSD 0.96**	

At either site, no significant differences were found between mean yields of the four varieties taken across all times of sowing. This being the case, the effect of time of sowing and sowing rate on ryegrass control was considered independent of the varieties.

At Yeelanna, the interaction of TOS with sow rate had no significant effect on ryegrass emergence (P = 0.7613) Furthermore, the same interaction had no significant effect on ryegrass plant abundance later in the season (P = 0.1059). Ryegrass density at late season sampling is presented in Table 3 (below).

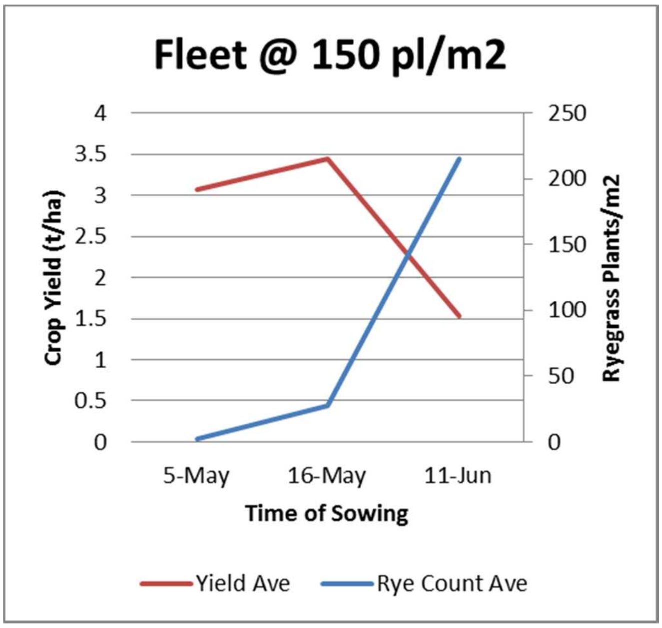
Table 3 – Ryegrass plant density at Yeelanna

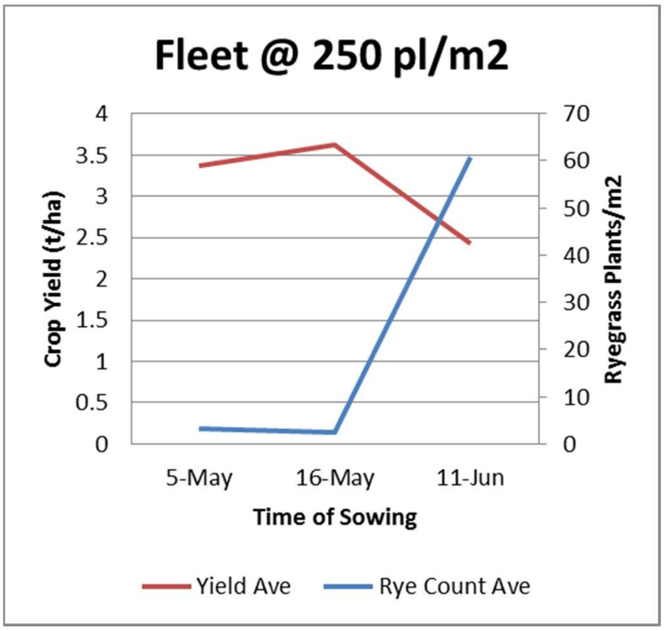
	Ryegrass (plants/m2)		
Variety x Rate	**TOS1**	**TOS2**	**TOS3**
Fleet @ 150	2.50	27.50	215.00
Fleet @ 250	3.33	2.50	60.83
Mace @ 150	19.17	44.17	35.00
Mace @ 250	30.00	45.83	5.83
Emu Rock @ 150	13.33	59.17	88.33
Emu Rock @ 250	25.83	60.00	0.83
Wyalkatchem @ 150	20.83	20.00	25.00
Wyalkatchem @ 250	16.67	14.17	5.00

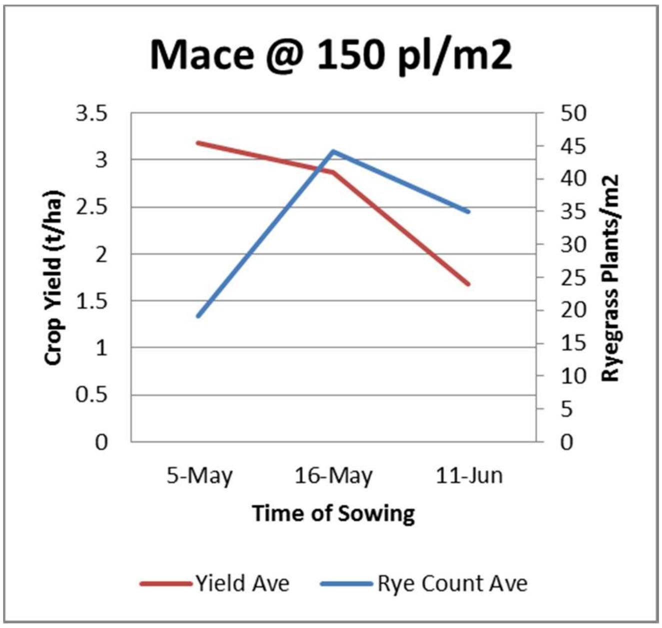
Results from the Wanilla trial proved similar, however were less significant and more variable.

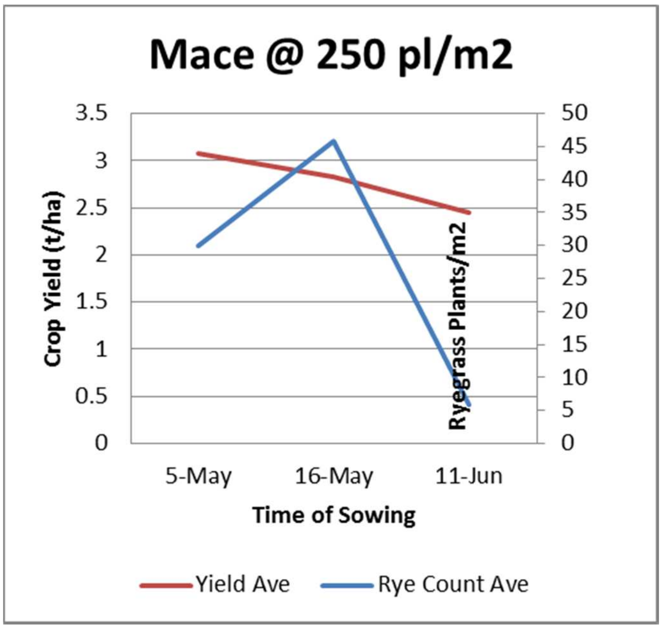
It is clear that there are marked differences in ryegrass densities, however, the variability of ryegrass density within each treatment means differences between treatments are insignificant. Because of the extreme variability in ryegrass numbers throughout the trial, only general trends were observable, with these best illustrated in the graphs below.

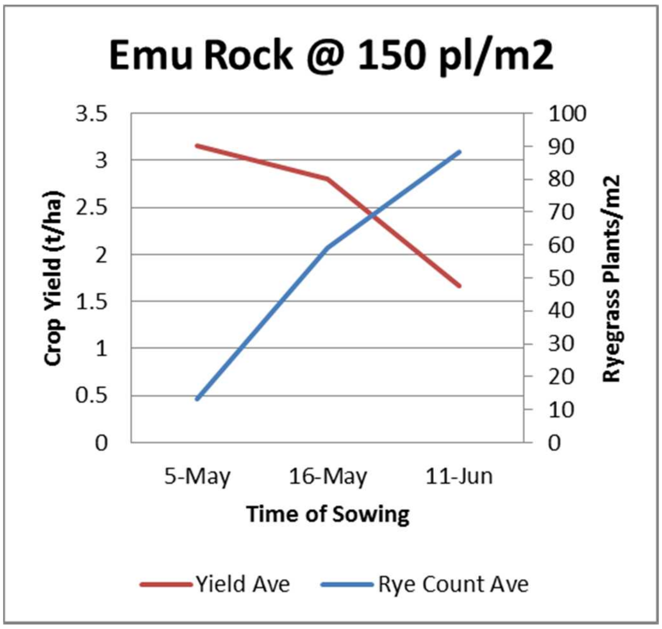
Figure 1 – Ryegrass and yield results over times of sowing at Yeelanna

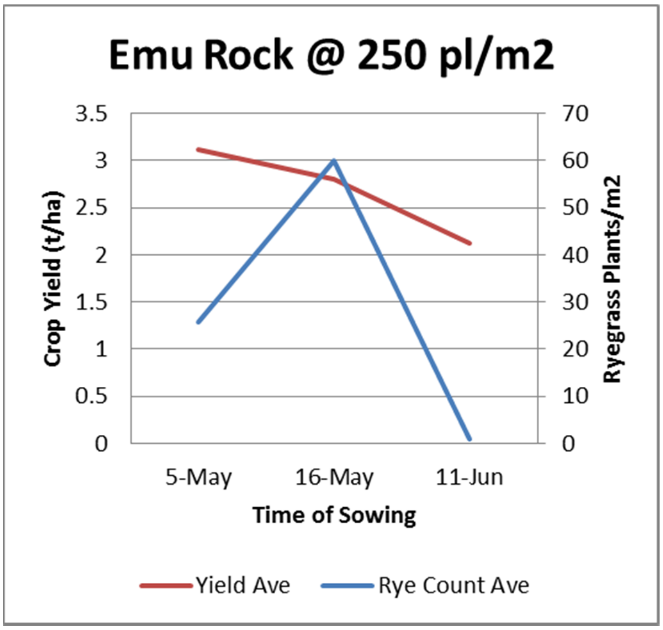


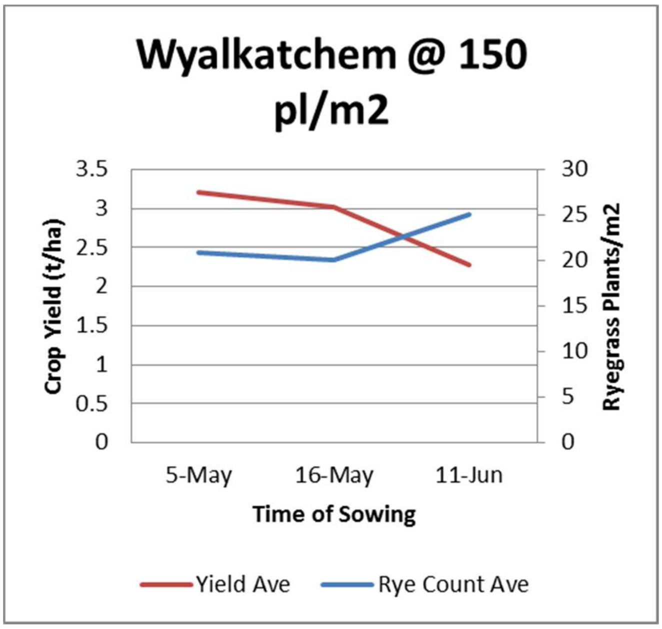







Emu Rock @ 150 pl/m2
3.5
3
2.5
2
1.5
1
0.5
0
100
90
80
70
60
50
40
30
20
10
0
Crop Yield (t/ha)
Ryegrass Plants/m2
5-May
16-May
11-Jun
Time of Sowing
Yield Ave
Rye Count Ave


Emu Rock @ 250 pl/m2
3.5
3
2.5
2
1.5
1
0.5
0
70
60
50
40
30
20
10
0
Crop Yield (t/ha)
Ryegrass Plants/m2
5-May
16-May
11-Jun
Time of Sowing
Yield Ave
Rye Count Ave


Wyalkatchem @ 150 pl/m2
3.5
3
2.5
2
1.5
1
0.5
0
30
25
20
15
10
5
0
Crop Yield (t/ha)
Ryegrass Plants/m2
5-May
16-May
11-Jun
Time of Sowing
Yield Ave
Rye Count Ave

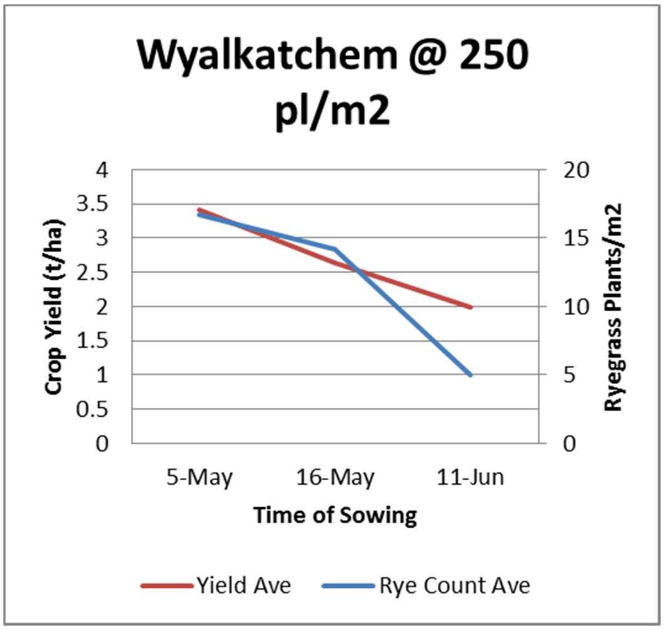
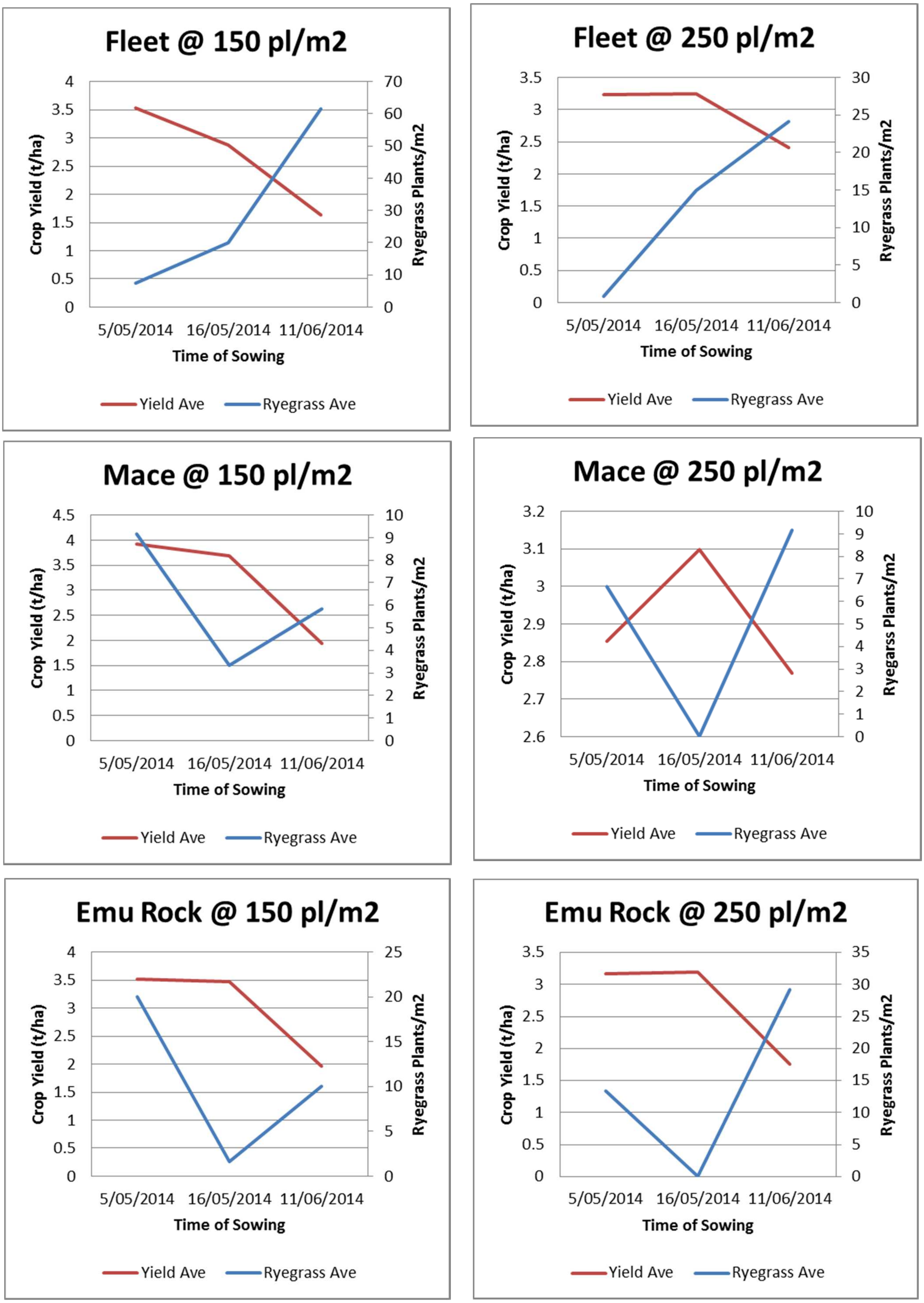
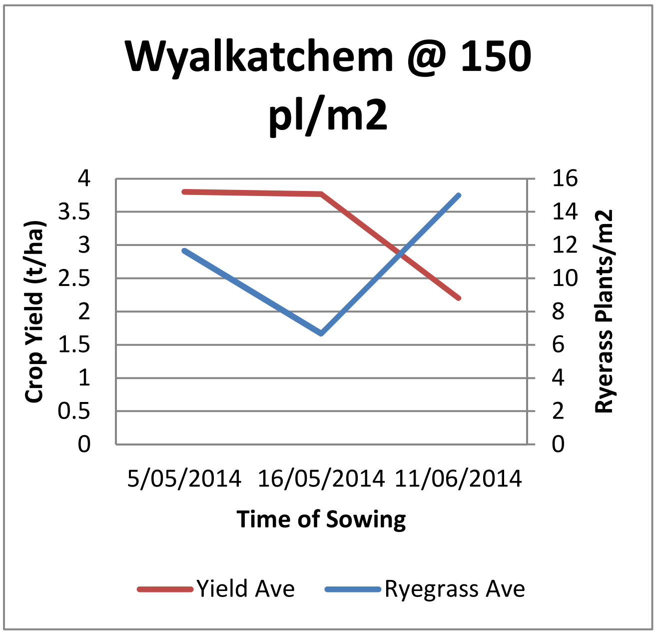
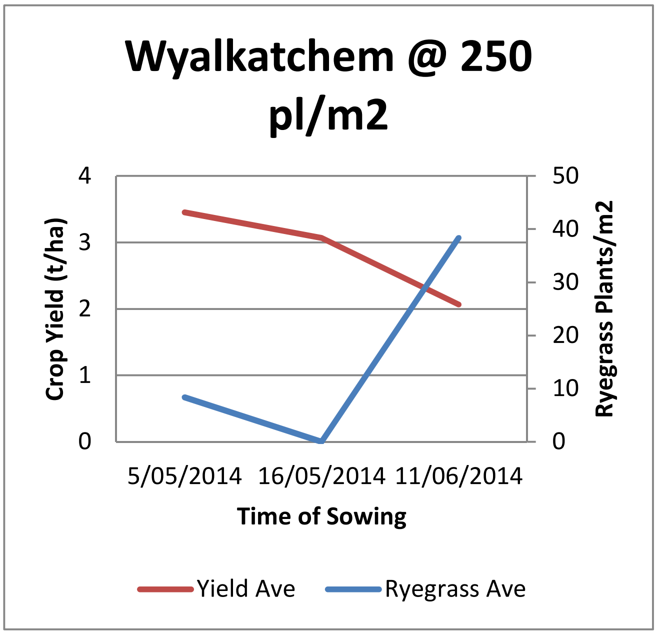

Wyalkatchem @ 250 pl/m2
4
3.5
3
2.5
2
1.5
1
0.5
0
20
15
10
5
0
Crop Yield (t/ha)
Ryegrass Plants/m2
5-May
16-May
11-Jun
Time of Sowing
Yield Ave
Rye Count Ave

Figure 2 – Ryegrass and yield results over times of sowing at Wanilla







What does this mean?

The results from this trial are unclear for two reasons. Firstly, variability in ryegrass numbers between plots mean that statistically significant differences associated with treatments are hard to determine (as the sampling error is high). Analysis of the effects of interactions of TOS, variety and sowing rate on ryegrass returned extreme coefficients of variability. Simpler analysis of the effects of isolated treatments reduced this variability and showed useful 'trends'. Sowing earlier improved yields at Yeelanna and generally limited ryegrass, while sowing at a higher rate generally suppressed ryegrass at both sites.

A second issue is determining causality in any 'perceived trend' in crop yield with earlier/later times of sowing. It may be that in some cases earlier sowing results in a crop more capable of competing for resources, thus crowding out the ryegrass and utilising available resources to provide optimal yield. Alternately, it may simply be that, where a crop fails to thrive entirely due to seasonal conditions, ryegrass will obligingly take its place.

Where to from here?

The intention is to repeat these trials over two further years. Firstly, it is expected that improved methods may allow greater distinction between treatment effects and random error, with regards to ryegrass numbers. Reducing trial variability will allow the trial to be analysed more successfully. Furthermore, there is an expectation that, while crop competition may not have had a single-season, immediate effect of the emergence and survival of ryegrass, there may be a compound effect over a number of seasons. It could reasonably be expected that, while ryegrass may not have been totally suppressed by increased crop density or early crop vigour, there may have been an effect on ryegrass seed set. This may become evident in following seasons.

Acknowledgements

Thank you to the Puckridge and Wilksch families for the generous use of their properties to conduct the trials.

Copper Deficiency on soils of Lower EP

Prepared by: David Davenport, Rural Solutions SA

RURAL SOLUTIONS SA
PIRSA

Copper is an essential element required by plants. It is essential for pollen formation, has a role in formation of photosynthesis and developing cell wall strength and in supporting rhizobial activity in legumes.

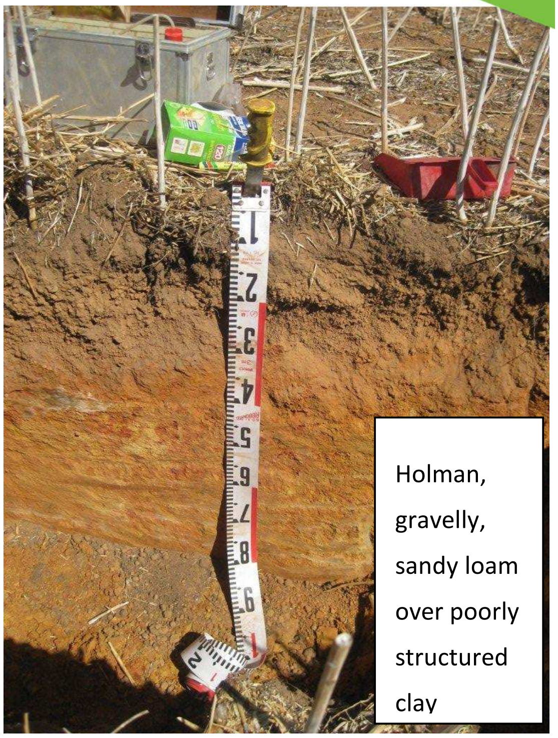
Deficiency symptoms include point death and tip withering before flowering, bleaching and twisting up to half the length of young leaves yellow leaf (particularly on legumes), mature plants are dull in colour with white or stained, empty heads.

Copper deficiency is widespread in soils on Lower Eyre Peninsula. Availability is affected by a wide range of factors including high and low pH, soil carbonate and organic carbon levels. Also as copper is not very mobile in the soil any impediment to root growth can impact on plant access to copper. Plants do not require very high copper levels but the levels of copper in most soils are very low. Deficiency is often highly variable depending on the season, crop grown and the range of variables impacting on availability.

Soils most likely to evidence copper deficiency on Lower EP include; calcareous soils (most cost effective remedy is to apply foliar sprays) and low pH gravelly soils.

In 2014 LEADA conducted trials on 2 soils on the property of Scott Siviour (Wangary), Jeff and Jim Holman (Cockaleechie).

Sivour red brown earth with ironstone gravel.



Holman, gravelly, sandy loam over poorly structured clay

Soil copper application at Holmans delivered around a 10% increase in yield compared to the nil and foliar copper treatments. At Siviours soil applied copper delivered a similar increase in dry matter at late tillering but no increase in yield compared to the rest of the site that had a foliar spray applied. (Note that soil applied copper was not fully incorporated).

Conclusions

- Gravelly soils on Lower EP are highly susceptible to copper deficiency.
- Soils with Copper EDTA levels of below 1 mg/kg may respond to the addition of copper.
- Foliar applications are the cheapest option in the short term but if only applied at the correct growth stage and are only effective in the current season

Soil applied copper is the safest option on non-calcareous soils but for best results should be incorporated as deep as possible.

NVT VARIETY TRIAL RESULTS

LEP Canola Variety NVT Trial Yield Performance

(2014, and Long Term 2010-14, expressed as % of site average yield)

Variety	LOWER EP					
	2014 Yield		2014 Oil %		Long Term 2010-14	
	Mt Hope	Yeelanna	Mt Hope	Yeelanna	% Site mean	# sites
AV Garnet	99	88	45.6	46.1	106	10
AV Zircon	91	94	46.8	46.7	103	8
Hyola 50	106	113	46.3	46.9	111	10
Hyola 635CC	94	104	47.6	48.4	109	3
Nuseed Diamond	100	102	45.3	46.3	113	5
Victory V3002	94	97	45.6	45.5	108	4
Site av yield (t/ha)	2.32	1.60			2.21	
LSD (%)	6	15				
Archer	99	91	45.3	46.0	106	4
Carbine					99	4
Hyola 474CL	99	107	45.3	46.7	99	6
Hyola 575CL	98	111	45.2	47.2	102	8
Hyola 577CL	95	96	46.4	47.6	103	2
Pioneer 43Y85 (CL)	-	-	-	-	92	2
Pioneer 44Y84 (CL)					100	8
Pioneer 44Y87 (CL)	99	103	43.4	44.6	104	2
Pioneer 44Y89 (CL)	102	102	44.8	45.5	-	-
Pioneer 45Y86 (CL)	101	97	45.9	46.7	105	8
Pioneer 45Y88 (CL)	98	93	43.4	44.5	107	4
Site av yield (t/ha)	2.23	2.20			2.18	
LSD (%)	6	11				
ATR Bonito	-	-	-	-	103	4
ATR Gem	96	96	46.7	46.4	100	8
ATR Stingray	93	85	45.4	45.9	94	10
ATR Wahoo	93	81	47.2	47.2	102	6
Crusher TT					104	8
Hyola 450TT	103	114	47.5	46.6	99	4
Hyola 559TT	-	-	-	-	105	5
Hyola 650TT	108	103	45.8	46.1	106	3
Monola 314TT	-	-	-	-	89	2
Monola 515TT	-	-	-	-	-	-
Pioneer Atomic TT	-	-	-	-	-	-
Pioneer Sturt TT	95	95	-	-	92	2
Telfer	-	-			80	2
Thumper TT	-	-			93	8
Site av yield (t/ha)	2.06	1.62			1.97	
LSD (%)	7	15				
Date sown	30-Apr	30-Apr				

Soil Type	LS	CL	
Jan-Mar/ Apr-Oct rf	(82) 359	(80) 318	
pH (H_2O)	5.4	7.1	
Previous Crop	Wheat	Wheat	
Stress Factors	-	sd	

Data source: GRDC/NVT.

*Comparisons **cannot** be made across chemistry types as the trials were not structured to allow this*

SD = Standard Deviation

Summary of all Australian blackleg monitoring sites.

Cultivars representing each of the resistance groups were sown adjacent to canola National Variety Trial sites across Australia and monitored for levels of blackleg. These data indicate which resistance groups have high levels of disease compared to the other groups at a particular site.

For more detail consult the individual site summaries and recommendations on the NVTonline website.

	Group							Comments
NSW	**A**	**B**	**C**	**D**	**E**	**F**	**S**	
BECKOM								High blackleg severity in groups A,B and S.
BELLATA								Low blackleg severity in all groups.
COOTAMUNDRA								High blackleg severity in group S. Moderate in groups A and B.
CUDAL								High blackleg severity in groups B and S. Moderate in group A.
GEROGERY								High blackleg severity in groups A, B and S.
GOULBURN								Moderate blackleg severity in group A.
GREENETHORPE								High blackleg severity in group S.
GRENFELL								High blackleg severity in groups B and S. Moderate in group A.
LOCKHART								High blackleg severity in groups A, B and S.
MULLALEY								Low blackleg severity in all groups.
PARKES								High blackleg severity in groups B and S.
TAMWORTH								High blackleg severity in groups A and S. Moderate in group B.
WAGGA WAGGA								High blackleg severity in groups B and S. Moderate in group A.

SA	A	B	C	D	E	F	S	
ARTHURTON								High blackleg severity in group S.
BORDERTOWN								High blackleg severity in groups B and S.
CUMMINS								High blackleg severity in groups D and S.
FRANCES								High blackleg severity in group S. Moderate in groups B and D.
MT HOPE								High blackleg severity in group B. Moderate in group D.
RIVERTON								High blackleg severity in group S. Moderate in groups A and D.
SPALDING								Moderate blackleg severity in groups B and S.
TURRETFIELD								High blackleg severity in groups D and S. Moderate in groups A and B.
WANILLA								High blackleg severity in groups A, B, D and S.
YEELANNA								High blackleg severity in groups B and D.
VIC	**A**	**B**	**C**	**D**	**E**	**F**	**S**	
CHARLTON								Moderate blackleg severity in group S.
DIGGORA								High blackleg severity in groups B and S. Moderate in group A.
HAMILTON								High blackleg severity in group S. Moderate in groups B and D.
KANIVA								High blackleg severity in groups B and S.
LAKE BOLAC								High blackleg severity in group A. Moderate in group B.
MINYIP								Moderate blackleg severity in group S.
WUNGHNU								High blackleg severity in groups B and S.
YARRAWONGA								High blackleg severity in groups B and S. Moderate in group A.
WA	**A**	**B**	**C**	**D**	**E**	**F**	**S**	
BADGINGARRA								High blackleg severity in group B.
CORRIGIN								High blackleg severity in group B.
GIBSON								High blackleg severity in groups A and B.

KATANNING								High blackleg severity in groups A and B. Moderate in group S.
KENDENUP								High blackleg severity in group B. Moderate in group S.
KOJONUP								High blackleg severity in groups B and S.
SOUTH STIRLING								High blackleg severity in group A. Moderate in group S.
WILLIAMS								High blackleg severity in groups B and S.

	Low blackleg severity compared to other groups at that site – continue with current management techniques.
	Moderate blackleg severity compared to other groups at that site – monitor crops for disease, see the Blackleg Management Guide.
	High blackleg severity compared to other groups at that site – high risk of yield loss if environmental conditions are conducive to high disease severity – see the Blackleg Management Guide.

LEP Wheat Variety NVT Trial Yield Performance
(2014, and Long Term 2010-14, expressed as % of site average yield)

	2014 (% Site Mean)			LEP Ave. 2014 Grain Quality			Long Term 2010-14	
	Cummins	**Ungarra**	**Wanilla**	**Test Weight**	**Protein**	**Screenings**	**(% Site mean)**	
Variety Name	**%**	**%**	**%**	kg/hl	(%)	(% <2.2mm)	%	# trials
AGT Katana	98	97	114	84.4	11.5	1.9	102	15
Axe	97	99	88	81.8	11.5	2.0	98	15
Bremer	104	101	91	82.7	11.4	2.1	-	-
Cobra	100	98	98	81.8	11.7	2.3	106	12
Corack	104	109	117	82.6	10.5	2.5	109	15
Correll	106	96	88	79.9	11.2	4.6	98	15
Cosmick	111	108	114	81.7	11.1	2.9	110	6
Emu Rock	94	105	105	82.2	11.5	3.9	103	15
Espada	108	99	90	80.6	11.4	2.8	101	15
Estoc	97	98	98	84.6	11.4	2.2	101	15
Gladius	101	92	91	81.0	11.3	3.9	98	15
Grenade CL Plus	101	95	86	82.0	11.1	2.2	96	12
Harper	95	94	101	82.8	11.6	3.9	99	8
Justica CL Plus	89	96	95	80.5	11.4	1.7	97	15
Kord CL Plus	96	92	96	81.0	11.2	3.6	97	12
Mace	93	109	113	82.4	10.4	2.1	107	15
Phantom	102	99	94	81.7	10.8	2.6	100	15
Scout	103	102	97	83.6	10.6	3.2	105	15
Shield	91	99	100	81.3	11.3	4.4	100	12
Supreme	93	102	108	82.6	10.6	2.8	103	5
Trojan	112	107	89	83.3	10.9	2.6	110	12
Viking	106	92	92	83.8	11.2	2.0	102	10
Wyalkatchem	99	101	109	82.6	11.4	1.2	104	15
Yitpi	95	92	89	82.7	11.2	4.4	97	11
Zen	104	105	117	82.2	10.8	1.3	107	5
Site Mean (t/ha)	4.01	4.07	2.32				4.31	
CV (%)	6.07	4.79	6.13					
LSD (%)	11	8	11					
Sowing Date	16-May	12-May	15-May					

LEP Barley Variety NVT Trial Yield Performance
(2014, and Long Term 2010-14, expressed as % of site average yield)

	2014 (% Site Mean)			LEP Ave. 2014 Grain Quality				Long Term 2005-14	
Nearest Town	Cummins	Wanilla	Wharminda	Test Weight	Protein	Retention	Screenings	(% Site mean)	
Variety Name	%	%	%	kg/hl	(%)	(%>2.5mm)	(% 2.2mm)	%	# trials
Alestar	107	95	89	70.5	12.1	76.3	3.8	102	6
Bass	101	102	95	72.2	13.0	88.1	1.4	104	21
Buloke	98	107	100	70.8	12.1	70.5	5.0	101	28
Commander	103	101	100	69.3	11.7	72.6	7.3	105	28
Compass	99	119	119	67.8	11.0	79.4	4.2	114	8
Fathom	104	101	103	70.3	12.6	82.2	2.7	110	14
Flagship	88	97	96	71.7	12.3	67.2	6.8	97	28
Fleet	97	109	97	69.7	11.7	73.5	4.0	107	28
Flinders	91	87	92	71.0	13.0	79.8	2.8	102	14
Gairdner	108	78	84	70.5	12.6	64.7	7.1	96	26
Granger	104	92	90	71.2	12.2	79.0	3.4	106	14
Hindmarsh	100	117	116	70.7	11.8	68.9	5.2	110	26
Keel	98	102	112	70.3	11.7	68.1	10.0	102	28
LaTrobe	106	110	112	72.1	11.4	70.0	5.9	111	11
Macquarie	95	77	84	69.7	12.2	61.8	9.1	97	10
Maltstar	98	97	96	70.5	11.4	60.1	8.9	103	8
Maritime	102	96	94	70.8	12.4	88.9	1.4	98	28
Oxford	97	91	93	70.5	12.0	61.7	8.3	105	19
Schooner	89	91	87	72.0	12.7	78.4	3.4	91	28
Scope	96	104	98	70.9	12.5	77.0	2.9	101	17
Skipper	98	106	111	70.8	12.0	78.2	4.6	107	14
Westminster	93	76	78	71.0	13.3	78.2	3.4	98	12
Site Mean (t/ha)	4.62	3.07	3.51					3.63	28
CV (%)	8.72	4.99	3.64						
LSD (%)	15	9	6						
Sowing Date	16-May	15-May	14-May						