LEADA
Lower Eyre Agricultural Development Association

2019 LEADA EXPO

15 March, 2019

Ungarra Sports Club

LEADA wish to acknowledge the support from the following organisations to help make this event and all our trials possible

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.*

LEADA COMMITTEE

Bruce	Morgan (Chair)	freddomorgan62@gmail.com	0427 872 038
John	Richardson (Chair)	rig_21@hotmail.com	0429 407 073
Daniel	Adams (Treasurer)	danads243@gmail.com	0428 177 963
Mark	Habner	markh@cumminsag.com.au	0428 873 011
Josh	Telfer	jtelferoz@gmail.com	0458 709 585
Derek	Macdonald	speedamoto@gmail.com	0447 816 224
Dustin	Parker	bordapark1@bigpond.com	0427 300 317
Billy	Pedler	jspedler@activ8.net.au	0447 014 676
George	Pedler	George@georgepedlerag.com.au	0427 876 043
Mark	Dennis	markmd1@bigpond.com	0428 844 250
Mary	Crawford	Mary.crawford@sa.gov.au	0407 187 878
Mark	Stanley	mark@regionalconnections.com.au	0427 831 151
David	Davenport	david.davenport@sa.gov.au	0427 301 956
Andrew	Ware	andrew@epagresearch.com.au	0427 884 272
Megan	Low (EO)	leadaexec@gmail.com	0409 885 606

LEADA Agronomist: George Pedler Ag

GeorgePedlerAg
INDEPENDENT CONSULTING SERVICES

PROGRAM FOR THE DAY

7.30am	**Registration and Breakfast**
8.15am	**Bruce Morgan, Chair, LEADA,** Welcome
8.20am	**Hamish Dickson – AgriPartner Consulting** – Sheep nutrition and containment feeding
9.05am	**David Davenport – PIRSA (Rural Solutions SA)** – Inclusion Plates and soil acidity
9.35am	**George Pedler – George Pedler Ag** – Copper Management for the future
9.55am	**Morning Tea**
10.30am	**Jess Gunn (nee Crettenden) – SARDI, Minnipa Ag Centre** – Improve whole farm profit through successful integration of cropping and livestock enterprises
10.40am	**Jason Trompf – Consultant, Greta Valley, Victoria** – Profitable sheep production in mixed farming
11.25am	**Blake Gontar – SARDI** – Sclerotinia in canola on lower EP
11.55am	**Andrew Ware – EP Ag Research** – Relevant Trial work on lower EP
12.50pm	**Bruce Morgan, Chair, LEADA** – Close
1.00pm	**Lunch and Static Displays**
7.30am	**Registration and Breakfast**

THANKS TO OUR 2018 SPONSORS

THANK YOU TO OUR FUNDERS IN 2018

CONTENTS

CHAIRMAN'S INTRODUCTION

Bruce Morgan

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

2018 across lower EP saw a good start to the season, with average rainfall in the growing season; and with the pattern and timing of falls at the needed time for most areas. This resulted in above average yields for many.

LEADA continued to focus on attracting funding for research and extension across lower EP in 2018. A strategic review of research priorities for the region directed project proposals into profitable pulses and pastures; cover crops and soil carbon; summer fodder trials and continuing soil amelioration work, amongst many others.

LEADA had a productive 2018 with winding up of our major GRDC Stubble Management project with a focus on extending the findings to the farming community at or Expo and a Post-seeding forum. The second year of the SAGIT project, Copper management for the future saw some good results – see the article in this booklet. The continuation of the GRDC South Region Pulse Extension project has been running along smoothly with George Pedler at the helm.

LEADA is involved in some new grants which will commence this year:

- NLP II Warm and cool season mixed cover cropping will see two demonstration sites established on lower EP and a cover crop Plant species trial;
- GRDC Sandy soils impacts program where LEADA will establish two validation trials;
- EPNRM Managing Practice Change in Agriculture 2018-2019 Program Understanding Soils on lower EP for Women will see a one day workshop in May 2019.

The LEADA committee welcome new member Billy Pedler. Thanks to outgoing committee members David Giddings and Kieran Wauchope for their service to LEADA and agriculture across LEP.

LEADA would like to extend a huge thank you to the SARDI Team that worked out of Port Lincoln, a special mention of Andrew Ware, Blake Gontar and Jake Giles who have moved on. LEADA is looking forward to working with Andrew in his new capacity as owner and director of EP Ag Research as his contribution to agriculture on Eyre Peninsula and the support and guidance he provides to LEADA is greatly valued. LEADA is hoping to continue some work with Blake as he moves to a more challenging role with SARDI at Waite and we wish Jake the best for his future venture.

We are now looking forward to a positive 2019. Thanks to our ongoing sponsors and funders, the ongoing support from PIRSA through SARDI and RSSA delivery, thanks to ongoing relationship with EPNRM and thanks to committee for their support and input.

Bruce Morgan
Chair

SHEEP NUTRITION AND CONTAINMENT FEEDING

Hamish Dickson, AgriPartner Consulting

Key Message

- The use of a containment area is an effective strategy to better manage livestock and paddock conditions during dry times. Whilst it is important to undertake a budget, the cost of feeding ewes to maintain condition is often recouped given market prices for wool and meat, despite high feed prices.

Confinement feeding

Confinement feeding is a drought feeding practice that aims to promote animal health and welfare while preserving ground cover and land condition across the majority of the property. This is achieved by confining livestock to a small area where they are fed a total ration.

Successful confinement feeding relies on good site selection, an appropriate mob size and stocking density, and the provision of appropriate nutrition.

Confinement feeding typically applies to sheep.

Site selection

When selecting a site for confinement feeding, there are several important factors that must be considered:

- The site should be conveniently located near yards, silos, water and residence so as to minimise labour, but far enough from the residence so as not to place an unnecessary burden (physical and emotional) on the occupants.
- The yards should be sited far enough away from waterways to prevent pollution from run-off.
- A slope of 3-4% is recommended to aid run-off but prevent erosion.
- The yards should be sited on a soil type, such as clay, that will compact rather than pulverise so that dust is minimised.
- Existing shade should be incorporated in the design if possible (trees within the enclosure must be protected from ringbarking).

Mob size and stocking density

Stocking density is a compromise between allowing livestock enough space to be comfortable, but not too much space so that excessive land is degraded and livestock lose condition by pacing. While the appropriate density depends on the livestock class, about five m^2 is recommended for dry adult sheep.

Mob size is better kept as small as possible without adding unnecessarily to infrastructure requirements and labour. Mobs of 200-500 head are recommended, however, this will vary depending on livestock class. A sick pen should be maintained to allow shy feeders and poorer animals to receive additional attention.

Self-feeders can also be used.

Yard design

Feed troughs

Feed troughs are required to minimise wastage and animal health issues associated with grazing close to the ground.

The design of the feed troughs should prevent sheep from fouling the feed and provide sufficient space for each animal to access feed - approximately 15-20m of double-sided trough per 100 sheep. Consideration should also be given to how the troughs will be filled around the sheep in the yard. Troughs can be designed to be filled from outside the pen or sheep can be excluded from the trough area while the troughs are filled.

Water

One of the main limitations of feeding animals through a drought is the availability of good quality water. If water is a limiting factor, calculating the total water available and the total water required by livestock will help determine how many livestock can be carried and for how long.

Water should be supplied through troughs, not dams which become boggy and dangerous, and sufficient trough space should be provided for all sheep to water readily.

Nutrition

Feeding in confinement involves the provision of a full ration. This means that the sheep's total requirement for energy, protein, roughage and minerals must be met. Grain, supplemented with some hay, is often the most affordable way to satisfy this requirement during drought. Mineral supplements may also be required depending on the type of livestock being fed.

The amount of feed fed should at a minimum maintain the livestock condition. A selection of livestock may be drafted and weighed on a regular basis to ensure the maintenance of condition.

The reintroduction of sheep to pasture after confinement feeding must be managed carefully to prevent rumen disruption and animal health conditions such as pulpy kidney.

Livestock management

Other issues of livestock management must be carefully considered and planned for when feeding in consignment including:

- Whether to join - joining in confinement presents issues and may result in lambing in confinement and significantly increased nutritional requirements if the drought is prolonged.
- Whether to mark and mules or defer the procedure - marking and mulesing can be difficult in confinement and lead to additional animal health issues.
- Whether to wean early - weaning early can allow ewes to regain or maintain condition.
- When to shear - dust can be a problem when sheep are fed in confinement and it may be best to salvage wool early to prevent dust damage in long wool.

More information

- The MLA Tips & Tools: Looking after drought pastures and Managing weeds after drought
- Rainfall To Pasture Growth Outlook Tool
- Drought Feeding and Management of Sheep - A guide for farmers and land managers, Victorian Department of Primary Industries.
- Feeding and managing sheep in dry times, Australian Wool Innovation and he Department of Primary Industries and Resources of South Australia.
- Drought Feeding and Management of Beef Cattle - A guide for farmers and land managers, Victorian Department of Primary Industries.
- The Queensland Department of Employment, Economic Development and Innovation have a series of resources relating to the welfare of drought-affected livestock during transport as well as information relating to animal welfare in natural disasters.

Contact details

Hamish Dickson

AgriPartner Consulting Pty Ltd

Clare

Mob: 0427 446 499

Email: Hamish@agripartner.com.au

Website: www.agripartner.com.au

PRACTICAL SOLUTIONS FOR INCREASING CROP YIELDS ON SANDS ON EYRE PENINSULA

David Davenport, *Rural Solutions SA, PIRSA, Port Lincoln*

Prepared by: David Davenport, Mel Fraser, Brett Masters, PIRSA Rural Solutions.

Key messages

- Physical disturbance of sandy soils has delivered large yield responses with residual benefits lasting several seasons.
- Addition of clay resulted in higher plant numbers and has increased yield on deeper sands but benefits are less consistent on shallow sand over clay soils.
- On sites with high soil strength physical disturbance alone has increased yields, the greater the mixing and deeper the disturbance the better the results.
- Ripping with inclusion plates has provided large increases in yield on a variety of sites with or without previously added clay.
- The addition of organic matter or mineral nutrients further increased yield but more work is required to determine longevity of treatment and rates of material required.

Background

Sandy soils on Eyre Peninsula and elsewhere commonly deliver less than half the yield of crops on other soil types. Constraints to production on these soils include water repellence, compaction, low fertility and water holding capacity and low soil organic carbon levels. Research conducted here and elsewhere has shown that ripping with inclusion plates appears to be a cost effective method to increase yields on these soils.

New Horizons, GRDC Sands Project

Funded through the PIRSA New Horizons program three trial sites were established in 2014 at Brimpton Lake, Karoonda and Cadgee. A range of treatments were applied to overcome constraints including water repellence, low water holding capacity and poor fertility. These treatments included the addition and incorporation of clay, fertiliser or organic matter and combinations of these. Soil and production data has been collected annually with the sites incorporated into the GRDC funded Sandy soils project in 2017.

While responses have varied depending on the season and crop type, large yield increases have been delivered. These benefits have been maintained on some treatments with the best treatments at the Brimpton Lake site (Table 1) and Cadgee sites yielding more than double that of the control in 2018.

Table 1. Brimpton Lake site annual grain yield (t/ha) for the life of the project (figures in bold are significantly different to the control).

Year	'14	'15	'16	'17	'18	Total t/ha increase	% increase
Crop	wheat	wheat	barley	lupins	wheat		
unmodified (control)	1.4	1.89	3.63	1.07	2.35	10.34	-
deep nutrition	**1.86**	2.18	3.44	1.38	2.85	1.37	13
shallow clay	**2.01**	**2.75**	3.74	1.36	**3.89**	3.41	33
shallow clay + deep nutrition	1.51	2.05	3.71	1.11	3.36	1.40	14
spading	**2.29**	**2.71**	3.67	**1.58**	**4.17**	4.08	39
spading + nutrition	1.56	**2.68**	3.22	**1.97**	**4.52**	3.61	35
spading + clay	**2.48**	**2.85**	3.97	**1.59**	**4.22**	4.77	46
spading + clay + nutrition	1.69	**2.48**	3.9	**1.6**	**4.30**	3.63	35
spading + luc	**2.96**	**3.69**	3.94	1.5	**4.04**	5.79	56
spading + luc + nutrition	**2.85**	**3.82**	3.91	**1.66**	**4.58**	6.48	63
spading + clay + luc	**2.62**	**3.42**	3.63	**1.59**	**4.76**	5.68	55
spading + clay + luc + nutrition	**2.81**	**3.38**	4.01	**1.69**	**4.79**	6.34	61

Despite the variability observed there are some clear messages emerging including:

- On sites with high soil strength in the A2 horizon (Brimpton Lake and Karoonda) physical intervention has provided on-going yield benefits.
- Clay application has overcome water repellence, but on shallow sandy soils there has been a poor correlation between plant numbers, biomass production and yield.
- The addition of organic matter without clay has provided additional yield benefits but appears to have limited impact after 2-3 years.

Whilst this work has delivered large yield increases, these interventions can be costly. Based on these results a further trial was implemented at Murlong in April 2018 to test cheaper options for amelioration of sandy soils.

This trial is located on a low dune with clay at 60-70 cms depth. Constraints include water repellence, low nutrient and water holding capacity and low inherent fertility (CEC) in the bleached A2 horizon. The trial comprises 11 treatments x 4 replicates and compares an unmodified control to spading or ripping with inclusion plates (IP) to 2 depths (30 cm and 41 cm) with and without the addition of high rates of mineral fertiliser or lucerne pellets. Yields in 2018 (Figure 1) showed large increases to ripping with inclusion plates, with the deeper ripping providing bigger responses. Spading delivered even higher yields that were further increased through the addition of fertiliser or Lucerne pellets.

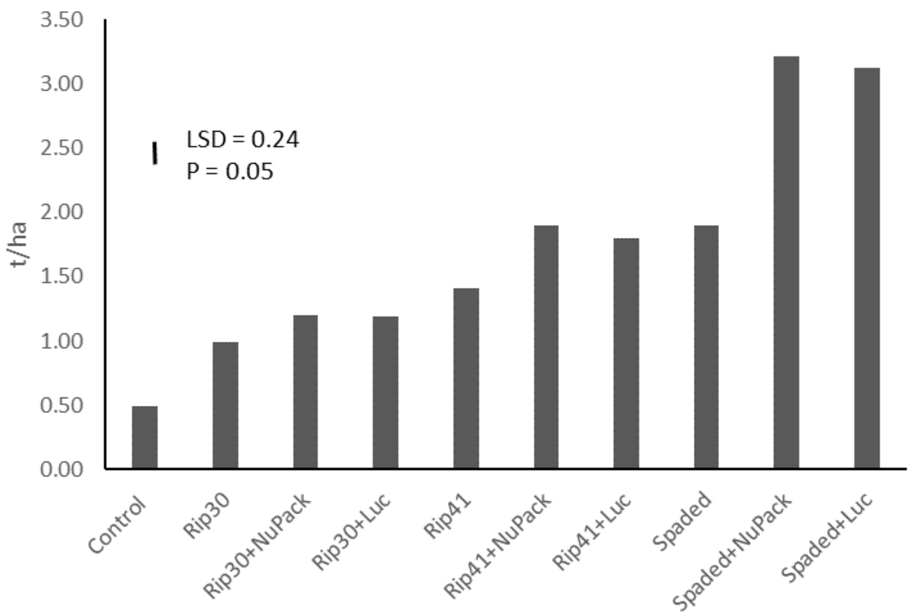


Figure 1. *Grain yield (t/ha) at Murlong 2018. (LSD, 5 % = 24)*

Driver River Catchment Demonstrations

Farmer managed demonstrations are also showing similar results with a number of sites funded by the Driver River Catchment group in 2018 showing strong responses to ripping with inclusion plates on sandy soils with or without clay (Figure 2).

Site	**Soil type**	**Treatment**	**Yield (t/ha)**	**Increase over the control (t/ha)**
Darke Peak	Deep sand	Control	1.07	0
		Rip	2.96	1.89
		Rip + IP	3.85	2.78
		Rip + IP	3.75	2.68
Gum Flat	Acidic deep sand over clay	control	4.25	0
		surface lime	3.46	-0.79
		rip+IP	4.51	0.26
		lime+rip+IP	4.50	0.25
		lime+rip+IP+OM	6.55	2.3
Wharminda	Clayed sand over clay	Clay	2.46	0
		Clay + Rip	3.71	1.25
		Clay + Rip + IP	4.33	1.87

Figure 2. *Grain yield (t/ha) on demonstrations in the Driver River Catchment.* .Rip; to 40 cm, Rip + IP; rip to 40 cm with inclusion plates**.**

A number of trial and demonstration sites will be established by LEADA and EPARF in 2018 with funding under the GRDC Sandy Soils Impacts program to further validate some of these soil modification treatments for overcoming production constraints on sandy soils.

Acknowledgements
We would like to acknowledge the Farmer co-operators involved in this work and funding organisations including; PIRSA, GRDC and the Driver River Catchment Group.

Contact details
David Davenport
Rural Solutions SA
1 Hindmarsh St, Port Lincoln SA 5606
0427 301 956
david.davenport@sa.gov.au

LATEST STRATEGIES FOR TREATMENT OF SOIL ACIDIFICATION

David Davenport, *Rural Solutions SA, PIRSA, Port Lincoln*

Brian W Hughes, Andrew P Harding, Brett Masters and David Davenport
Primary Industries and Regions, SA.

Take home messages

- Soil acidity is increasing in low buffered soils in the low to medium rainfall cropping zone.
- New decision support tools are available to compare liming products, estimate paddock acidification rates and determine the economic cost of not addressing acidity.
- pH stratification under no-till and sub-surface acidification are issues which need different approaches to soil testing and treatment.
- Trials comparing lime sources have shown greater responses with better quality limes, especially in sensitive crops, although the benefits can be restricted by the subsoil 'acid throttle'.
- Soil pH mapping provides a method of determining pH variation in paddocks and allows for precision lime application to improve the effectiveness and efficiency of liming.

Background

Soil acidity is increasing in South Australia due to increased cropping intensity and higher yields with a 3-4 fold increase in product removal and a similar increase in nitrogen fertiliser use. With the adoption of no-till has also increased the stratification of pH in the soil profile following surface lime applications. A combination of lime applications below the acidification rate and an increase in subsoil acidification is resulting in major losses in production to the EP region estimated to be between $16M and $19M per year (DEW 2018)

Extent of soil acidity

Mapping of acidity on Eyre Peninsula (Figure 1.) has identified that:

- 7% (186,000 ha) of EP region's agricultural land has surface soil acidity (0-10cm depth)
- 4% has sub-surface acidity (10-20cm) and 1% has sub-soil acidity (below 20cm)

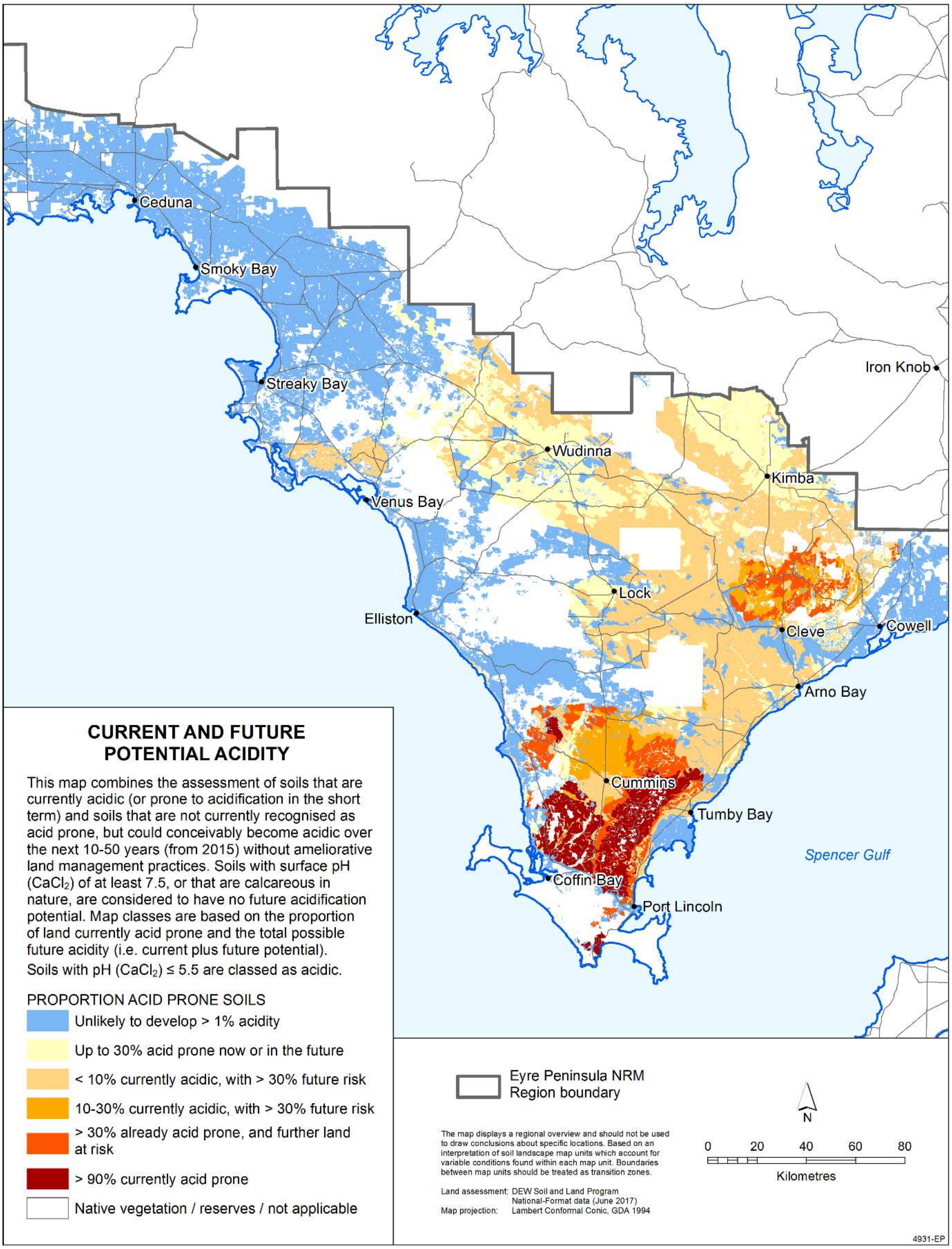


Figure 1. Current and future acidification potential on EP (Source: DEW, 2018).

Lime use

The 'catch-up' lime requirement to increase the pH of acid soils on EP to target pH values (Ca 5.5 surface / 5.0 subsurface) is estimated at 227,000 tonnes. However, despite a large increase in lime application in the last 2 years the average lime use in the past 2 decades has been well below the acidification rate (Figure 2). The average deficit is equivalent to about 1.37 tonnes of lime per hectare of acid soil. Therefore, soil acidity will continue to increase unless lime use rates are maintained above the current acidification rate of 35,000 tonnes per year and a further 19% (509,000 ha) of agricultural land could become acidic on EP in the next 10-50 years.

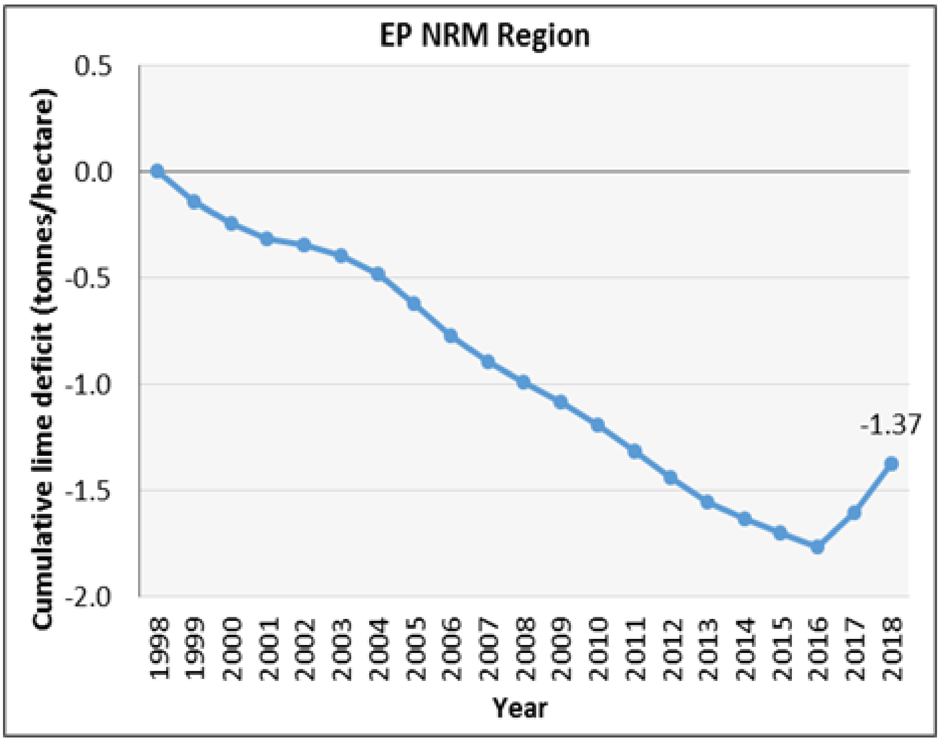


Figure 2. Lime application verses acidification rates on EP (Source: DEW, 2018).

Subsoil acidity and pH stratification

Many of our current lime recommendations are based on trials conducted many years ago under cropping systems where tillage and incorporation of lime to at least 10 cm was common. In the absence of tillage, top dressed lime moves slowly into the subsurface layers, and acidification below 5-10cm is possible, even though lime has been applied to the surface.

This type of pH stratification results in an acid layer that restricts root growth and crop yields, especially for sensitive crops like pulses – the so called 'acid throttle'. Through the DEW funded soil acidity project investigations were carried out on six no-till sites with a history of lime application. The mean pH of four of the sites by depth shows how stratification is present at these sites (Table 1).

Table 1. Mean pH (CaCl) by depth, shaded pH depths indicate serious acidity issues.

Site	Kapunda 1	Bagot W 1	Bagot W 2	Kangaroo Is
Lime history	3 times/ 15yrs	yes	yes	6t/ 8 years
Soil type	Loamy red-brown earth	Thick sand over clay	Sand over clay	Loamy ironstone
Depth cm				
0-2.5	5.4	5.9	5.1	5.6
2.5-5.0	4.9	5.5	4.7	4.8
5.0-7.5	4.6	4.9	4.5	4.4
7.5-10	4.4	4.5	4.4	4.4
10-12.5	4.6	4.3	4.5	4.6
12.5-15	4.9	4.4	5.7	4.8

This type of stratification can be solved by strategically incorporating lime, but this becomes increasingly costly the deeper the 'acid throttle'. Experience from other states suggests that the topsoil pH needs to be kept above 5.5 CaCl to encourage lime to move deeper into the soil.

Acidity diagnosis

Emerging acidity develops gradually and until it becomes a serious issue it is usually difficult to recognise based on crop symptoms. By the time crop symptoms are visible, production has already been compromised for several years. Sensitive crops like lentils and canola will be the first to show patchy growth with areas of low vigour, short fat roots, poor phosphorus uptake and poor nodulation in legumes.

A regular soil testing program where the top soil of each paddock is tested every 3-5 years is the best approach. These samples can also help to monitor soil nutrients and fertiliser recommendations. Acidity often varies considerable across a paddock so it is important to take separate soil samples, focussing on areas where crop growth and yields are best and worst. Lime is generally recommended where the topsoil pH is less than 5.2 CaCl- the aim is to keep the 0-10cm layer at or above pH 5.5 CaCl and the 10-20cm above pH 5.0 CaCl.

There are now several commercial precision pH mapping operators which can help to diagnose paddock pH variability and develop variable lime application prescription maps. By ensuring the lime is applied to areas of the paddock that need it the most, pH mapping and variable rate lime applications can improve the cost effectiveness of liming operations. It is important to test paddocks which are vulnerable to pH stratification after liming to review the effectiveness of the application and to monitor subsoil acidity. Soil sampling at 0-5, 5-10 and 10-20cm (and 20-30cm if a deep topsoil) depth increments is recommended. Although this increases the number of soil tests considerably, these samples can also be used to measure available soil moisture and N where required. Field pH kits available from hardware shops can be used to assess pH stratification by depth.

Decision support tools

Three tools based on excel are available on the soil acidity website (https://agex.org.au/project/soil-acidity/).

- ***Lime Cheque –*** *This estimates lime application rates for acidic soils and compares the costs of lime from different suppliers. Inputs required include lime costs, freight, spreading charge, actual and target pH and lime quality information. It can also use for Neutralising Value (NV), purity or for Effective Neutralising Value (ENV) and fineness.*
- ***Maintenance Lime Rate calculator –*** *This estimates the lime required to counteract the annual acidification of the surface soil layer, based on product removal, fertiliser inputs, soil and leaching impacts and legumes. It can be used on a paddock basis.*
- ***Acid cost –*** *This estimates the losses in production for a farm business caused by acidic soils using all available trials with lime response data by pH. Inputs include current pH, crop type and $/tonne.*

Contact details

Brett Masters
PIRSA Lincoln Marine Science Centre
Mob: 0428105184
e-mail: brett.masters@sa.gov.au

Brian Hughes
PIRSA Nuriootpa Research Centre
Mob: 0429 691 468
e-mail: brian.hughes@sa.gov.au

COPPER MANAGEMENT FOR THE FUTURE

George Pedler, LEADA Extension Agronomist

Project Aims

The project aims to explore different management strategies to overcome copper deficiency in cereals. The project will compare the effectiveness of copper sulphate and copper chelate applied either as liquids banded at seeding or as a foliar spray. The project will also evaluate the effect of different timings of application of the foliar sprays and their efficiency.

2018 Conclusions reached include:

- That single application at GS49 (most common use timing) or later is too late in copper deficient soil at the Edillilie site.
- Early foliar applications individually or in combination with another timing consistently produced the best results.
- In-furrow treatments were not adequate in the initial year of application
- There were no significant differences between product type (eg. Sulphates vs chelates).

Plans for the coming year include:

- To have one main site that will include replicating the trial in another crop type(s), which we are planning on being canola. Canola is the next major crop grown in these copper deficient soils and we are very interested to examine its response to copper applications.

Contact details

George Pedler
LEADA Extension Agronomist
0427 876 043
George@georgepedlerag.com.au

Edillilie Site

Co-operator: Jed and Melissa Siegert

Soil Test Results:

Depth (cm)	P (cowell)	pH (cacl)	Cu (DPTA)
0-10	58	5.7	0.55

Critical soil test DTPA extractable Cu is around 0.12 and has moderate to poor reliability

Sowing Date:	10 May 2018	
Urea spread @ 75 kg/ha	14 June 2018	No leaf disease. (GS13-21)
Urea spread @ 100 kg/ha	3 July 2018	
ZN and Mn foliar applied		
Copper Treatments		
GS 25	9 July 2018	Most plants closer to GS 31
GS 31	25 July 2018	Most plants closer to GS32

Collected 9 July 2018

YEB tissue test	Cu (mg/kg)	Zn (mg/kg)	Mn (mg/kg)
	< 2	40	51

Collected 12 September 2018

LEADA Copper Flowering		Cu	Zn	Mn	Biomass
Treatment	**Site**	**mg/kg**	**mg/kg**	**mg/kg**	**t/ha**
Infurrow_Sulphate_3kg/ha	Edillilie	2.58	19.3	42.7	8.8
Untreated_Control	Edillilie	3.81	18.5	37.4	7.8
GS31_Sulphate_300gms/ha	Edillilie	8.72	14.9	36.6	8.1
GS31_Chelate_4L/ha	Edillilie	4.97	15.9	26.6	8.7

Trial Management:

- Scepter wheat from grower – graded and treated by SARDI
- Sown on ok moisture resulting in good germination
- Sown to 4cm depth – may have resulted in some blanching of wheat coleoptiles

Herbicide:

- 2.5 l/ha Boxer Gold
- Bromicide MA

Trial Results:

Trial 1 – Timing x Product x Rate

Treatment	Yield (t/ha)	
GS31_Chelate_4L/ha	3.75	g
GS31_Sulphate_300gms/ha	3.64	fg
GS22_Chelate_4L/ha	3.48	efg
GS31_Chelate_1L/ha	3.27	def
GS49_Chelate_4L/ha	3.08	def
GS22_Sulphate_300gms/ha	3.04	def
GS49_Chelate_1L/ha	3.02	def
GS49_Sulphate_150gms/ha	3.01	def
GS31_Sulphate_150gms/ha	3.00	cde
GS22_Chelate_1L/ha	2.98	cde
GS49_Sulphate_300gms/ha	2.86	cde
GS22_Sulphate_150gms/ha	2.84	cd
Infurrow_Sulphate_1kg/ha	2.51	bcd
Infurrow_Sulphate_3kg/ha	2.43	bcd
Infurrow_Chelate_3L/ha	2.37	bc
Infurrow_Chelate_1L/ha	2.03	ab
Untreated_Control	1.93	a

Trial 2 - Timing

Treatment	Yield (t/ha)	
GS22+49	3.43	c
GS31	3.32	c
GS31+59	3.08	bc
GS31+49	3.08	bc
GS22+59	2.86	abc
GS49	2.62	abc
GS22	2.62	abc

Trial 3 – Product x Rate – all applied GS49

Treatment	Yield	
Chelate1_recommend_rate	2.65	b
Chelate2_recommend_rate	2.51	b
Chelate1_half_rate	2.50	b
Sulphate_2xrate	2.49	b
Chelate2_2xrate	2.48	b
Chelate1_2xrate	2.44	b
Chelate2_half_rate	2.40	b
Sulphate_recommend_rate	2.37	b
Sulphate_half_rate	2.36	ab
Nil	1.73	a

Stokes Site

Co-operator: John Richardson

Soil Test Results:

Depth (cm)	P (cowell)	pH (cacl)	Cu (DPTA)
0-10	30	5.2	0.93

Critical soil test DTPA extractable Cu is around 0.12 and has moderate to poor reliability

Sowing Date:	15 May 2018	
Urea spread @ 75 kg/ha	14 June 2018	No leaf disease. (GS13-21)
Urea spread @ 100 kg/ha	3 July 2018	
ZN and Mn foliar applied	9 July 2018	
Copper Treatments		
GS 25	9 July 2018	Most plants closer to GS 31
GS 31	27 July 2018	Most plants closer to GS32

Collected 9 July 2018

YEB tissue test	Cu (mg/kg)	Zn (mg/kg)	Mn (mg/kg)
	< 2	30	88

Collected 12 September 2018

LEADA Copper Flowering		Cu	Zn	Mn	Biomass
Treatment	**Site**	**mg/kg**	**mg/kg**	**mg/kg**	**t/ha**
GS31_Chelate_4L/ha	Stokes	1.65	14.5	68.1	7.1
Infurrow_Sulphate_3kg/ha	Stokes	2.09	13.9	63.3	7.7
Untreated_Control	Stokes	1.55	17.0	64.0	7.4
GS31_Sulphate_300gms/ha	Stokes	2.59	14.0	65.9	7.1

Trial Management:

- Scepter wheat from grower – graded and treated by SARDI
- On ok moisture resulting in good germination
- Sown to 4cm depth – may have resulted in some blanching of wheat coleoptiles

Herbicide:

- 2.5 l/ha Boxer Gold
- Bromicide MA

Trial Results:

Trial 1 – Timing x Product x Rate

Treatment	Yield	
GS22_Chelate_1L/ha	5.18	a
GS22_Chelate_4L/ha	5.32	a
GS22_Sulphate_150gms/ha	5.12	a
GS22_Sulphate_300gms/ha	5.23	a
GS31_Chelate_1L/ha	5.04	a
GS31_Chelate_4L/ha	5.09	a
GS31_Sulphate_150gms/ha	5.06	a
GS31_Sulphate_300gms/ha	5.06	a
GS49_Chelate_1L/ha	5.19	a
GS49_Chelate_4L/ha	5.21	a
GS49_Sulphate_150gms/ha	5.08	a
GS49_Sulphate_300gms/ha	5.13	a
Infurrow_Chelate_1L/ha	5.29	a
Infurrow_Chelate_3L/ha	5.41	a
Infurrow_Sulphate_1kg/ha	5.36	a
Infurrow_Sulphate_3kg/ha	5.31	a
Untreated_Control	5.05	a

Trial 2 - Timing

Treatment	Yield	
GS22	5.25	b
GS22+49	5.10	ab
GS31	5.14	ab
GS39	4.85	ab
GS49	5.06	ab
GS59	4.96	ab
Nil	5.03	a

Trial 3 – Product x Rate – all applied GS49

Treatment	Yield	
Chelate2_recommend_rate	5.27	a
Sulphate_recommend_rate	5.23	a
Chelate2_2xrate	5.21	a
Chelate1_2xrate	5.19	a
Chelate1_recommend_rate	5.12	a
Chelate2_half_rate	5.09	a
Sulphate_2xrate	5.08	a
Chelate1_half_rate	4.96	a
Nil	4.86	a
Sulphate_half_rate	4.84	a

* EXPRESSIONS OF INTEREST SOUGHT FROM MIXED FARMERS *

Are you interested in improving your sheep productivity and performance?

Do you want to have a good plan in place to make the decision making process easier throughout the season?

Are you interested in understanding how to better match your feed to your sheep requirements and fluctuating seasonal conditions?

Do you want to know how altering your sheep and cropping mix will impact on your bottom line and level of risk?

An exciting new opportunity has been made available to mixed farmers on Eyre Peninsula in 2019 – express your interest now!

Thanks to a GRDC funded project '*Extension of knowledge and resources to manage risk and exploit opportunities to improve whole farm profit through successful integration of cropping and livestock enterprises in the GRDC Southern Region*', we are able to offer two 'supported learning groups' on Eyre Peninsula in 2019.

Program: The 12 month program includes six workshop/field based sessions over the year, along with 15 hrs of personal consulting time for each farm business. The one to one consulting time enables the knowledge and tools from the workshop sessions to be customised to each individual farm.

Titled '*Utilising the feedbase in a mixed farming business*', this workshop program brings together key aspects of the Grain and Graze project and other local R&D into a whole farm package that addresses the management and matching of different feed sources with animal requirements.

The program will be led and supported by local deliverers Jessica Crettenden and Naomi Scholz.

A range of simple tools will be used to assess grazing value of stubbles, compare the value of grazing a crop against possible grain yield loss, understand how bringing short-term pasture into a crop rotation affects overall profitability and risk and the use of livestock and feedbase management approaches to assist in making tough decisions.

The program also includes access to an innovative 'Farm Options' program tailored to mixed farming businesses to assess enterprise risk and volatility according to farm management methods and seasonal conditions. An important part of the program is identifying critical decision points and contingencies for when things don't go according to plan.

INVESTMENT: At this stage, the investment per business for the whole 12-month program is $1800 (multiple participants per business are encouraged to attend), but we are currently seeking further funding support to bring the cost down.

LOCATION: Location of workshops will be tailored depending on level of interest – if you can encourage a group of local farmers to be involved, we can bring the workshops to a venue near you!

CONTACT: For more information on the program and to register interest contact:

Jessica Crettenden jessica.crettenden@sa.gov.au 0428 103 792 or

Naomi Scholz naomi.scholz@sa.gov.au 0428 540 670.

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

EPARF Eyre Peninsula Agricultural Research Foundation Inc

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SCLEROTINIA IN CANOLA ON LOWER EP

Blake Gontar, SARDI Port Lincoln

Key Messages

- Commercial paddock monitoring and fungicide field trials over the 2017-18 period suggest that canola spray decisions are best made with reference to seasonal disease conditions and presence of inoculum, rather than yield potential alone
- Many canola crops Lower Eyre Peninsula exceeded average yield in 2018, yet serious disease issues were avoided, likely due to a drier than average May and June
- The incidence of Sclerotinia ranged from 0-10.6% of plants infected across 20 paddocks surveyed on the LEP in 2018, very similar to the 0-16.8% in 2017
- The overall impact of Sclerotinia (incidence x severity) on crop yields was therefore quite minor, ranging from 0.23 to 1.95% yield loss in 2018, again similar to the <2% total yield loss in early sown paddocks monitored in 2017
- In a fungicide trial conducted at Mt Hope in 2018, excellent rainfall distribution resulted in canola yields of up to 4 t/ha, fungicide application reduced Sclerotinia in the TOS1, yet there was no affect on yield from a single fungicide application

Why do the trial?

Sclerotinia stem rot affects canola and pulses. Sclerotinia affects canola crops in Australia, with significant yield loss up to 30% recorded in parts of NSW and northern Victoria (Hind et al. 2003; Kirkegaard et al. 2006). It is common in South Australia, in particular on the Lower Eyre Peninsula (LEP) and South-East, but has rarely been reported as causing significant yield loss in these regions. However, reports from growers and advisors suggest Sclerotinia is becoming more common and more severe, with some growers and advisors applying expensive fungicides as a precaution.

This program, comprising field trials and commercial paddock surveys aims to quantify the extent of any Sclerotinia issue on the LEP across a range of seasons and evaluate fungicide management in the context of common crop agronomy.

How was it done?

This project began in 2017, comprising field trials and commercial paddock monitoring and surveying each year. In 2017, six commercial paddocks were monitored, 14 paddocks surveyed and one field trial was conducted. The project continued in 2018 as described below.

Paddock Monitoring & Survey

Monitoring points were established in nine commercial canola crops on the LEP in 2018. Five other paddocks across South Australia, in the Mid-North and the South-East regions, were also included in the study (data not presented). Sites were visited weekly to record crop characteristics and the presence of Sclerotinia symptoms, and to collect a sample of petals to test for the presence of Sclerotinia spores during flowering. A data logger located at 50cm above ground level recorded temperature and relative humidity (RH) at 15-minute intervals in-crop throughout the growing season.

At windrowing timing, the incidence of sclerotinia was calculated by counting 500 plants within 10m of the monitoring point, and recording the number of plants with any type of sclerotinia lesion. The severity of this infection was determined by comparing yield from a sample of healthy plants to that of infected plants.

In addition to the detailed monitoring paddocks, 12 other commercial paddocks were surveyed at windrow timing and the incidence of sclerotinia calculated using the same method described above. Severity of infection was only calculated for the additional paddocks at Tumby Hills and Wangary, where infection was sufficiently large (>1% incidence) to justify sampling for yield loss. At Wangary, the grower had applied a fungicide in a single unreplicated strip and incidence was calculated for both the treated and untreated strips for comparison.

It has previously been reported that Sclerotinia requires free water for an extended period to develop (GRDC, 2014). Leaf wetness was not measured in this study, however >95% RH in crop was used as an approximation for leaf wetness. Although Sclerotinia may develop under wet conditions more quickly, at least 48 hours is considered optimal for sclerotinia disease development. Thus, the total number of hours within each period which exceeded the 48 hours where average RH > 95%, RH did not go below 95% for more than an hour and RH did not at any time go below 80%, are reported, as well as the number of these periods within each season. Weather data are presented for each site and the relationship between RH, inoculum presence, timing of flowering and disease is discussed.

Plot Trial

A plot trial was established at Mt Hope on the 1st May prior to opening rains. This trial was established within 50 m of the Mt Hope monitoring site, as mentioned above. The trial comprised two sowing dates (Time of Sowing (TOS)1 1/5/18 & TOS2 16/5/18), with the first TOS irrigated with approximately 15mm on the 3rd May to ensure early germination. Two varieties (Diamond and DG560TT) and five spray treatments (Unsprayed, 10% Bloom, 30% Bloom, 50% Bloom and Full Control with a registered fungicide (Prosaro® at 450ml/ha) comprised the other treatments. The full control treatment received 2-3 spray applications, depending on flowering timing and weather. Seed of both varieties was treated with fluquinconazole (Jockey® at 20L/T) which is not known to affect Sclerotinia. A plant density of 45 plants/m2 was targeted for both varieties although TOS2 established well below this level due to a drying soil profile at seeding.

Weeds, pests and nutrition were managed as per district practice. A fungicide (Prosaro®) application was made at the 3-5 leaf growth stage to assist in controlling blackleg in the vulnerable young crop, but is not expected to have influenced the later development of sclerotinia during flowering stages.

What Happened?

Paddock Monitoring & Survey

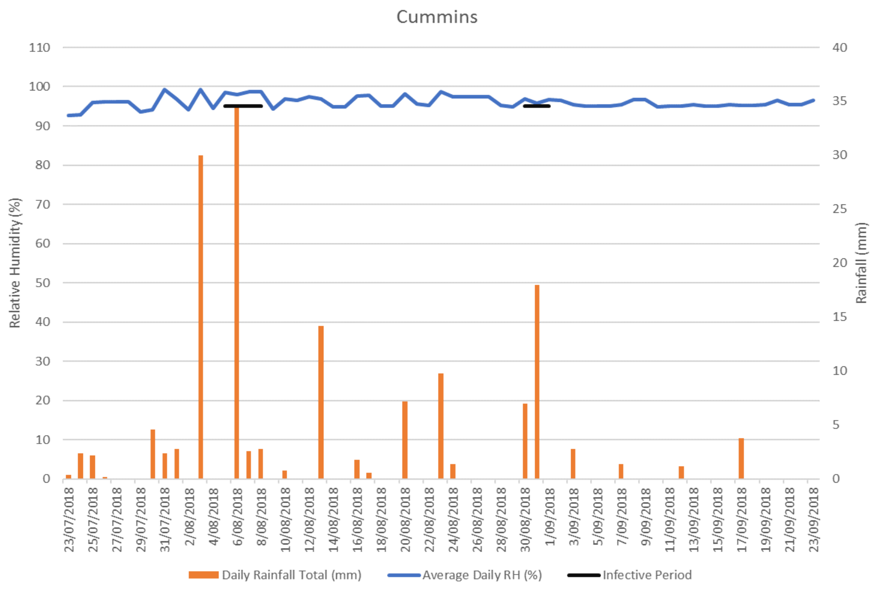
Crop Development and Weather

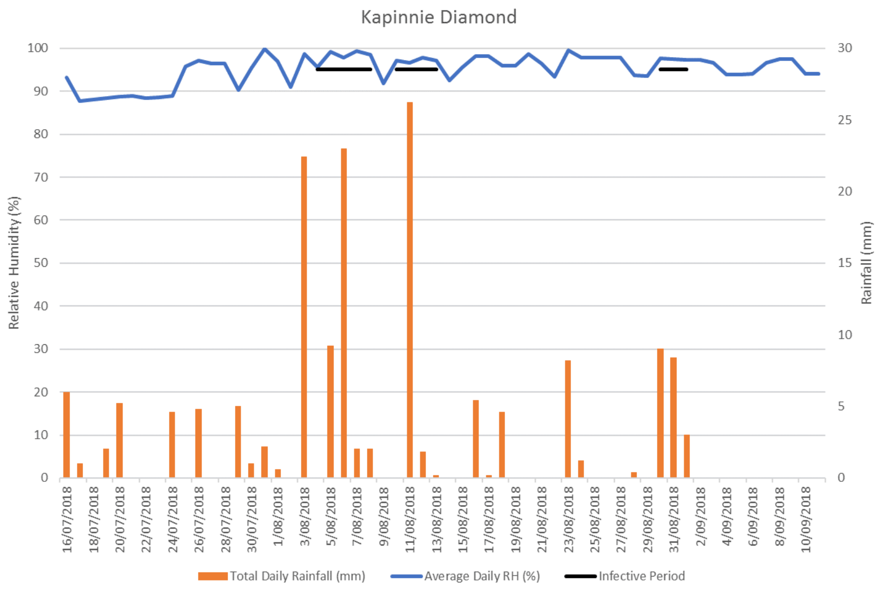
Growing season rainfall ranged between 300-400mm across the nine LEP monitoring sites. This generally above-average rainfall was characterised by season-breaking rain on the 3-4th May of around 20-35mm, followed by a relatively dry period until mid-June, then August rainfall of around 125-160mm. Details of monitoring sites are given in Table 1.

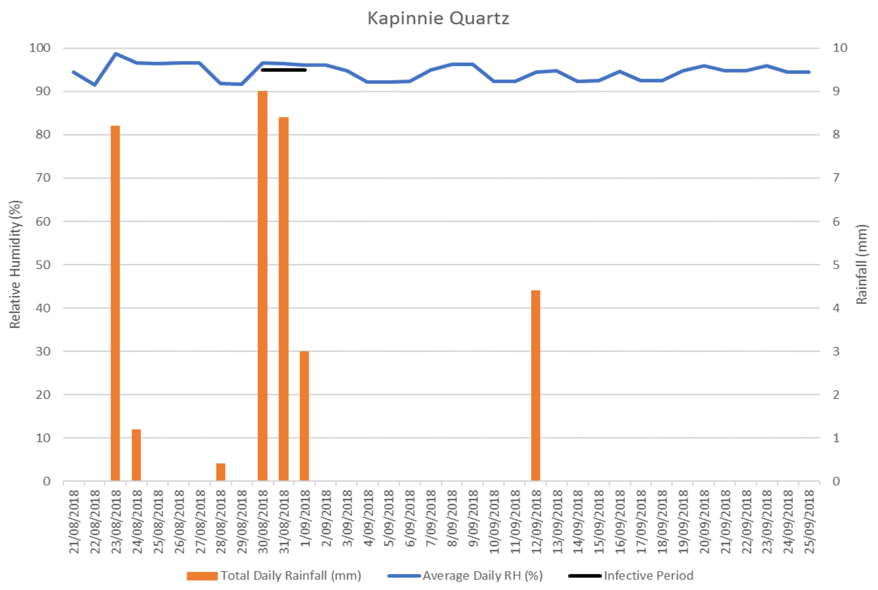
Table 1 Canola variety, sowing date, 30% bloom date, fingicide date, growing season rainfall (GSR) and crop yield for monitoring sites on LEP in 2019

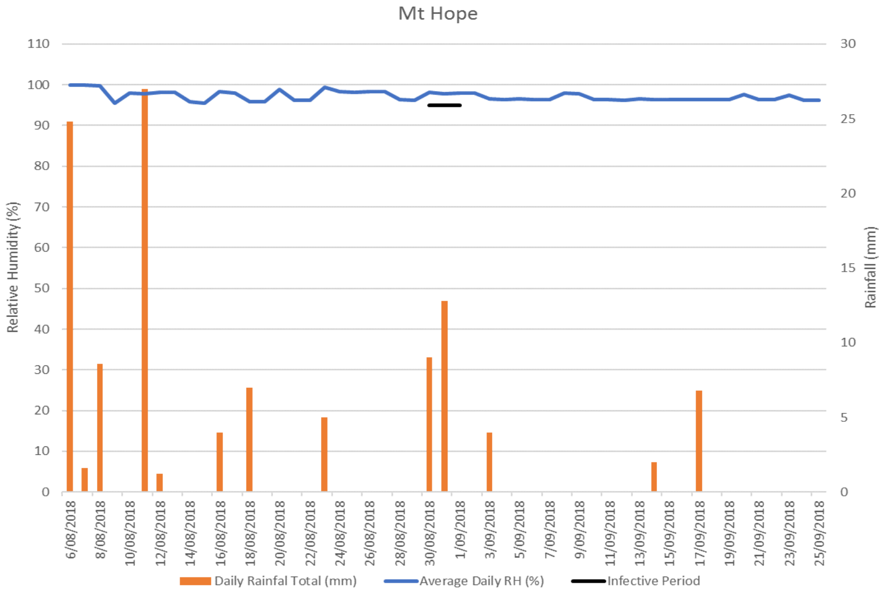
Site	Variety	Sow Date	30% Bloom Date	Fungicide Date	GSR (mm)	Paddock Yield (t/ha)
Cummins	Diamond	6 May	6 Aug	27 Jul	305	2.8
Kapinnie D	Diamond	4 May	30 Jul	None	314	2.9
Kapinnie Q	Quartz	7 May	27 Aug	None	314	2.5
Mt Dutton Bay	44Y90	20 Apr	30 Jul	None	402	3.3
Mt Hope	Banker	6 May	21 Aug	17 Aug	355	2.8
Stokes	44Y90	N/A	13 Aug	24 Aug	387	N/A
Wangary	Saintly	28 Apr	13 Aug	None	406	3.11
Wanilla	44Y90	19 Apr	6 Aug	28 July	400	2.8
Yallunda Flat	Diamond	30 Apr	6 Aug	1 Aug	387	2.9

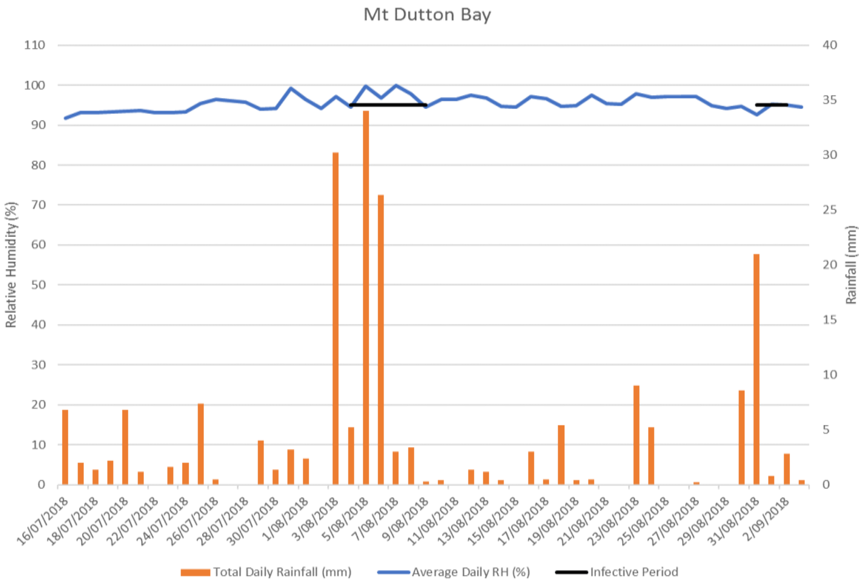
There were 'infective periods' at all sites except Wangary but the total number of hours in which infective conditions persisted differed between sites. For example, Cummins experienced two infective periods, each of relatively short duration, totalling 163 hours. Wanilla experienced 4 infective periods of longer duration, totalling 581 hours. Infective periods and duration for each site, along with rainfall and average daily relative humidity are indicated in Figure 1.

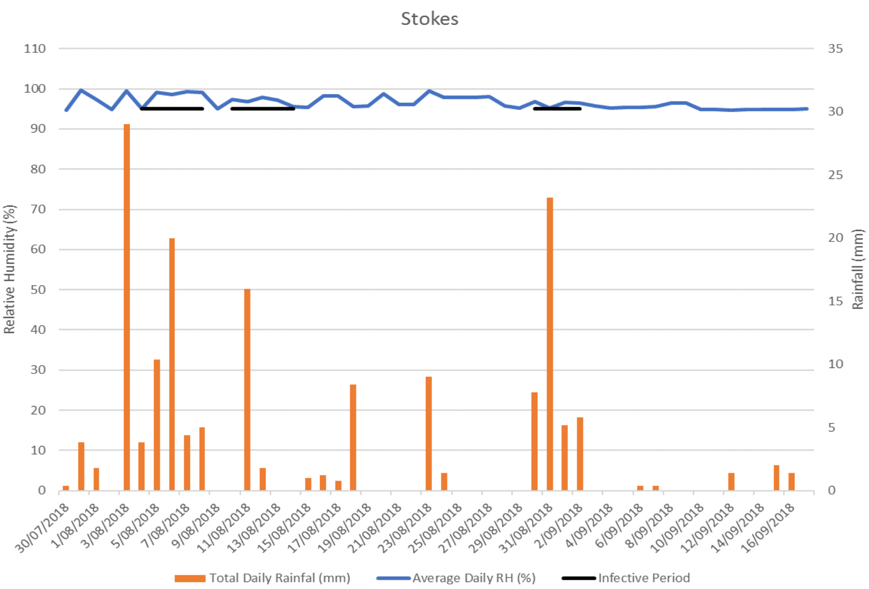

Cummins
Relative Humidity (%)
Rainfall (mm)
Daily Rainfall Total (mm)
Average Daily RH (%)
Infective Period


Kapinnie Diamond
Relative Humidity (%)
Rainfall (mm)
Total Daily Rainfall (mm)
Average Daily RH (%)
Infective Period


Kapinnie Quartz
Relative Humidity (%)
Rainfall (mm)
Total Daily Rainfall (mm)
Average Daily RH (%)
Infective Period


Mt Hope
Relative Humidity (%)
Rainfall (mm)
Daily Rainfall Total (mm)
Average Daily RH (%)
Infective Period


Mt Dutton Bay
Relative Humidity (%)
Rainfall (mm)
Total Daily Rainfall (mm)
Average Daily RH (%)
Infective Period


Stokes
Relative Humidity (%)
Rainfall (mm)
Total Daily Rainfall (mm)
Average Daily RH (%)
Infective Period

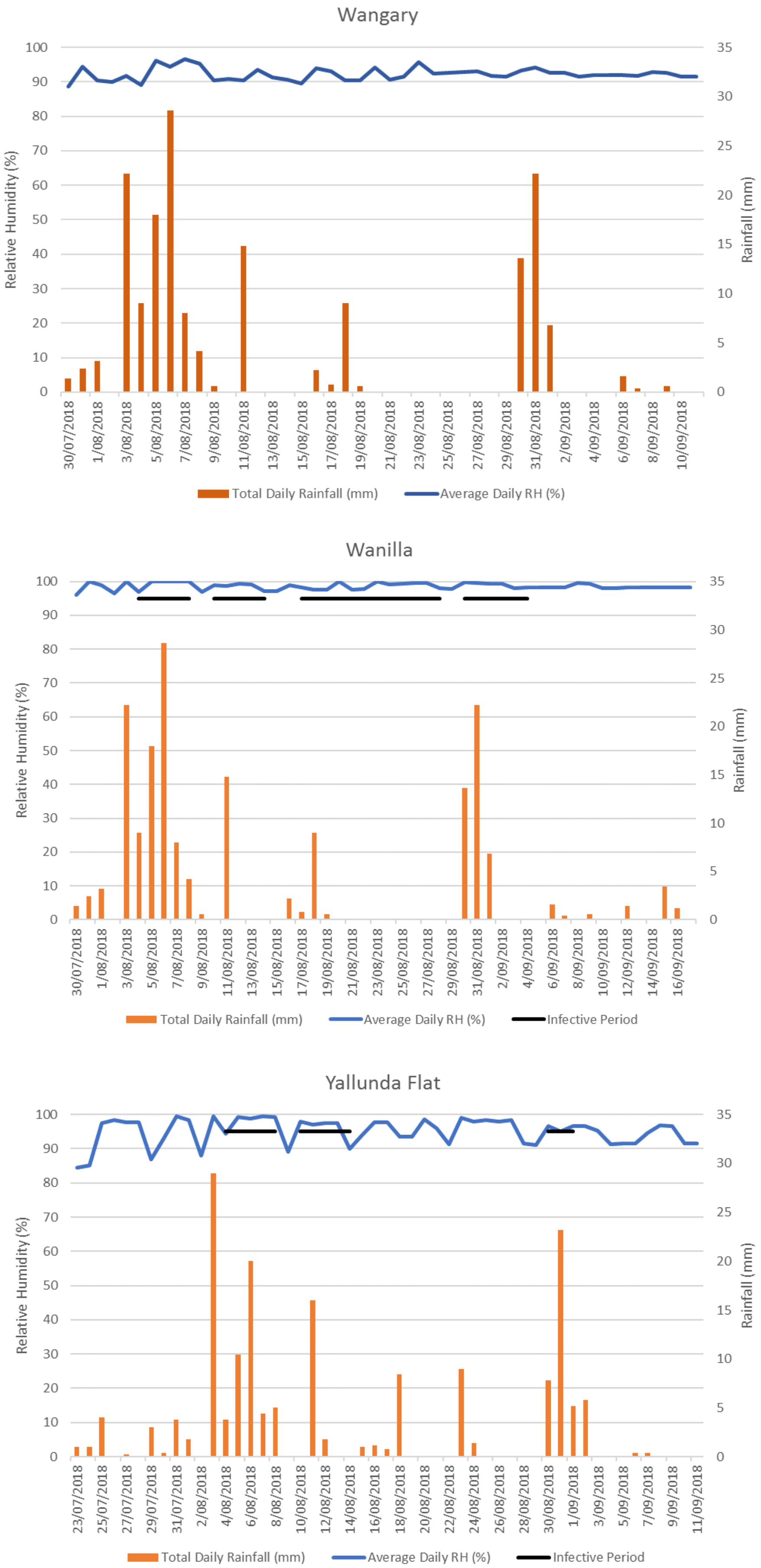


Figure 1 Relative humidity, rainfall and ‘infective periods’ throughout canola flowering periods at detailed monitoring sites on the LEP in 2018

Inoculum

As in 2017, Sclerotinia inoculum was detected at all sites monitored in 2018 (Table 2). Cummins and Mt Hope had high levels of petal infestation, with more modest petal infestation detected at most other sites. Kapinnie and particularly Mt Dutton Bay stand out as having relatively consistently low levels of petal infestation throughout the year. Spores were detected as early as 16th July at 4/5 sites sampled, and spore release generally continued through until 17th September (3/4 sites sampled at this date).

Table 2 Percentage of canola petals with Sclerotinia spores present at each sampling date. NS = not sampled at that date. Data marked * were affected by bacterial contamination and are not included in the calculation of average

Site	Sampling Date												
	10-Jul	16-Jul	23-Jul	30-Jul	6-Aug	14-Aug	21-Aug	27-Aug	3-Sep	11-Sep	17-Sep	25-Sep	Ave	Peak
Cummins	NS	100	85	10	90	80	25*	75	80	70	60	NS	72	100
Mt Dutton Bay	0	0	0	5	5	0	0*	0	5	0	NS	NS	2	5
Kapinnie D	NS	10	15	5	5	5	0*	10	25	10	NS	NS	11	25
Kapinnie Q	NS	NS	NS	NS	10	40	5*	0	15	0	0	0	9	40
Mt Hope	NS	NS	NS	NS	95	75	55*	50	45	60	35	0	51	95
Stokes	NS	NS	25	45	60	0	0*	0	10	20	15	NS	22	60
Wangary	NS	NS	30	15	15	40	0*	5	25	20	NS	NS	21	40
Wanilla	NS	85	90	5	60	45	0*	5	5	10	NS	NS	38	90
Yallunda Flat	NS	35	15	10	20	35	5*	35	55	35	NS	NS	30	55

Disease

The incidence and severity of Sclerotinia infection, as well as an estimated total yield loss for the survey site is presented below (Table 3). Disease incidence at monitoring sties ranged from 0% at Mt Hope and Kapinnie (Quartz) to 10.6% at Cummins. Disease incidence in the additional survey sites similarly ranged from 0-8.8%.

At sites where incidence was sufficiently high enough to collect Sclerotinia infected and non-Sclerotinia-infected samples for comparison, severity ranged from 0-20.5%. At Cummins, severity was 18%. Thus at Cummins, total estimated yield loss was 1.95% (10.6% incidence x 18% severity). Estimated yield loss for all other paddocks was generally low, ranging from 0-0.59%.

Table 3 Incidence and severity of sclerotinia in canola crops surveyed on the LEP in 2018. Detailed monitoring sites are denoted by †. NC = not calculated due to insufficient disease presence

Site	Variety	Sclerotinia incidence (%)	Severity (%)	Total Estimated Yield Loss (%)
Cummins†	Diamond	10.60	18	1.95
Kapinnie Diamond†	Diamond	0.80	NC	<0.5
Kapinnie Quartz†	Quartz	0.00	NC	0
Mt Dutton Bay†	44Y90	0.60	NC	<0.5
Mt Hope†	Banker	0.00	NC	0
Stokes†	44Y90	0.40	NC	<0.5
Wangary†	Saintly	3.60	9	0.32
Wanilla†	44Y90	1.80	12.5	0.23
Yallunda Flat†	Diamond	2.60	20.5	0.54
Wangary	Diamond	8.80	6.66	0.59
Kapinnie 44Y90	44Y90	0.20	NC	<0.5
Yallunda Flat	Quartz	2.80	NC	<0.5
Yeelanna	44Y90	5.60	NC	<0.5
Stokes	44Y90	0.20	NC	<0.5
Yeelanna	44Y90	1.60	NC	<0.5
Tumby Flats	44Y90	1.00	NC	<0.5
Tumby Hills	44Y90	3.00	12.86	0.39
Tumby Hills	44Y90	0.00	NC	0
Wangary Sprayed	Diamond	4.20	NC	<0.5
Wangary Unsprayed	Diamond	3.40	0	0
Wangary	Diamond	0.83	0	<0.5

Plot Trial

Disease Incidence

Fungicide application (P = <0.001) and TOS (P = <0.001) affected disease incidence, however, variety did not (P = 0.68). Average disease incidence for all TOS and spray timing treatments are presented below (Table 4). The interaction of fungicide application and TOS was significant (P = <0.001). In TOS1, disease incidence in the untreated control was 7.99%. All spray timings reduced disease incidence equally, including the full control (three fungicide applications). This suggests a single spray application from 10-50% bloom can be highly effective at reducing disease in early sown canola. However, in TOS2, disease incidence in the untreated control was just 0.68%, and no spray timing reduced this low level of disease any further.

Table 4 Average disease incidence for spray timings and TOS at Mt Hope 2018

Time of Sowing	Spray Time	Average Disease Incidence (% stems with Sclerotinia)
1	Untreated	7.99 [c]
1	10% Bloom	1.92 [ab]
1	30% Bloom	0.32 [ab]
1	50% Bloom	2.64 [b]
1	Full Control	0.54 [ab]
2	Untreated	0.68 [ab]
2	10% Bloom	0.01 [a]
2	30% Bloom	0.01 [a]
2	50% Bloom	1.48 [ab]
2	Full Control	0.01 [a]

Yield

Full fungicide protection did improve yield over the untreated control (P = 0.01), however no single fungicide treatment was any better than the untreated control (Table 5). This relationship was true for both times of sowing, with no interaction between TOS and Spray timing. This suggests that disease did influence yield, which was manageable with fungicides, however the influence in this trial was small and fungicide application was not profitable. The response was also just as great in TOS2 as in TOS1, despite a clear difference in Sclerotinia infection, which implies that the yield response to fungicides may have been related to diseases other than Sclerotinia. Predicted yields of spray timings are presented below (Table 5).

Table 5 Mean predicted yield of spray treatments across all TOS and varieties at Mt Hope in 2018

Spray Timing	Yield
UTC	3.08[a]
50% Bloom	3.16[ab]
30% Bloom	3.19[ab]
10% Bloom	3.24[ab]
Full Control	3.24[b]

What does this mean?

Paddock Monitoring & Survey

Sclerotinia is a widespread disease on LEP, with every paddock monitored showing some signs of Sclerotinia inoculum, either as lesions or as petal sample spores. Whilst not always captured within the monitoring point data, some level of Sclerotinia infection was present in all paddocks over 2017-18. Inoculum is clearly present for an extended period of time, and as early as 16th July in 2018. The Cummins monitoring site demonstrates that spores can be produced persistently for long periods, with 80% petal infestation recorded as late as 3rd September. Whilst this petal infestation does not necessarily indicate disease incidence, it does highlight the potential for infection. Furthermore, the incidence of infected plants within certain paddocks, under relatively dry, unfavourable conditions, indicates the potential for actual yield loss. However, despite this seemingly abundant inoculum and the unexpectedly high incidence in some paddocks, yield loss was, at worst, only 1.95% in a high yielding crop.

Importantly, the single predictors such as flowering date, inoculum or high relative humidity (‘infective hours’) in crop do not relate well with disease development. For example, Kapinnie D experienced 3 ‘infective periods’, totalling 246 ‘infective hours’, and yet developed very little disease (0.8%). This may be explained by considering a second variable, inoculum presence, which was relatively low (average. 11% petal infestation throughout flowering) at this site in 2018.

Whilst consideration of multiple predictors together starts to provide better explanation of disease incidence, there are still conflicting examples within the data. For example, Stokes had moderate levels of inoculum present throughout the first week of August, with 60% petal infestation on the 6th August, at which time a significant infective period occurred (4/8/18-9/8/18) and yet Stokes developed disease in only 0.40% of plants. Whilst a fungicide was applied at this site, this was well after likely infective events and is not likely to have influenced disease incidence. Conversely, at Wangary in 2018, inoculum appeared relatively low, with a 21% average petal infestation throughout flowering, and no ‘infective periods’ were recorded, yet this site developed Sclerotinia at 3.6% of plants infected – the 2nd highest of 2018 monitoring sites. The lack of a simple relationship between measures of relative humidity, petal infestation and disease expression was similar in 2017 and indicates that a more complex relationship involving a range of factors explains Sclerotinia development.

It is very likely, based on knowledge of other diseases that multiple factors operate together to cause disease. For instance, there appeared to be a pattern of increased disease in early flowering crops, despite high levels of inoculum continuing to be released later in all crops’ growth and wet conditions being present for most of August. However, this was evident only where overall inoculum release was high.

Thus, Wangary developed 3.6% disease infection compared with Kapinnie Q, where 30% bloom date was nearly two weeks later, despite both sites having a comparable inoculum load. At Mt Hope, where both a monitoring site and the fungicide trial were co-located, disease incidence was only high in the TOS1 trial treatments. This is despite the petal testing in the monitoring site confirming continued spore release at that location. Kapinnie D and Mt Dutton Bay, despite flowering the earliest of all sites had the lowest levels of inoculum and developed little disease. Cummins and Wanilla both had high inoculum pressure, and flowered quite early and, despite early fungicide applications, developed moderate levels of disease.

Further analysis of these data should be undertaken as part of a larger data set to determine whether multiple factors can be used to predict Sclerotinia disease for any given season in South Australia.

Plot Trial

Both cv. Diamond and cv. DG560TT being equally susceptible to disease is an important finding as there is a perception that cv. Diamond is significantly more susceptible to Sclerotinia than other varieties. Although only one other variety was compared in this trial, the results suggest both varieties were equally susceptible to infection.

A single fungicide application reduced Sclerotinia incidence from around 8% in early sown canola in 2018. No timing was completely effective, and all timings were equal. This demonstrates that fungicide application can effectively control Sclerotinia and that growers may have some flexibility around fungicide timing.

However, no single fungicide application at any timing improved yield in high-yielding canola in 2018. This is important in that it highlights that yield potential alone was not a good predictor of fungicide yield response in this trial, and that controlling a sporadic, dispersed disease such as Sclerotinia may not provide any yield benefit.

Despite some reduction in Sclerotinia incidence with all spray timings, only the ‘Full Control’ (< 3 spray applications) actually improved yield. The improvement was only in the order of 5% and clearly not economical given the cost of multiple fungicide applications. This yield response was also evident in TOS2, where Sclerotinia incidence was low and not affected by spray timing, which suggests that the yield response in both TOS could be related to other diseases. Diseases such as powdery mildew and Alternaria are often present in canola crops and their effects are not well documented in Australia.

Conclusion

The research conducted over 2017-2018 has demonstrated that Sclerotinia is extremely common in canola crop son the LEP, but generally at very low incidence. Yield losses in 41 commercial paddocks over these two seasons have never exceeded 2%. Furthermore, under high-yielding conditions in 2018, fungicides did reduce Sclerotinia but not provide an economically beneficial response. It is important to note that current farming systems on LEP favour the build-up of Sclerotinia inoculum and that any inoculum build-up may increase disease incidence. Furthermore, different conditions, such as mid-late April seeding or increased June and July rainfall could potentially influence disease expression.

Acknowledgments

Thank you to Dr Jenny Davidson (SARDI) and her team for confirming presence of Sclerotinia on petal samples, Ashley and Sam Ness for hosting the plot trial and monitoring site; Archie, Scott Blacker, Jarrod Doudle, Simon Giddings, Scott Mickan, Craig Skinner and Michael Slater for providing monitoring sites; David Holmes and Kaye Fergusson (SARDI) for assistance with paddock surveys.

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Contact details

Blake Gontar
Senior Researcher (Soilborne Disease Management)
SARDI
Plant Research Centre, Waite Campus
0430 597 811
Blake.gontar@sa.gov.au

IMPROVED CROP NUTRITION FOR DISEASE MANAGEMENT AND REDUCED FUNGICIDE DEPENDENCY

Blake Gontar, SARDI Port Lincoln

Key messages

- Improved crop nutrition reduced Septoria in wheat at Stokes and spot form net blotch in barley at Wangary on lower Eyre Peninsula.
- Improved crop nutrition did not reduce root disease at either site.
- At Stokes, the yield gain due to improved crop nutrition was greater under disease pressure than where disease was managed with fungicide, suggesting an interaction between nutrition and disease.

Why do the trial?

Disease is a significant cost issue for Eyre Peninsula (EP) growers, causing yield loss and increasing management inputs such as fungicides. At the same time, many crops grown on the EP also have nutrient deficiencies, particularly copper, zinc and potassium. Previous research has demonstrated that these nutrient deficiencies not only reduce growth and yield directly, but can also affect the capacity of plants to resist or tolerate disease.

While the benefits of addressing nutritional requirements are becoming better understood and adoption by growers has increased, most research is carried out under low disease conditions. It is possible that the response to improved crop nutrition will be greater under moderate disease conditions. Addressing an underlying nutrient problem could reduce the need for some fungicide application. A two-year project has been established with funding from South Australian Grains Industry Trust (SAGIT) to assess the disease management benefits of improving crop nutrition.

How was it done?

Two field experiments were established in 2018 on lower Eyre Peninsula, at Stokes and Wangary. The Stokes site had low-marginal copper and low phosphorous status, while at Wangary, potassium was low and sulphur was marginal. At Wangary, Spartacus barley was sown on 14 May, while at Stokes, Scepter wheat was sown on 15 May. At each site, six nutrient treatments were applied at seeding either with or without fungicide to manage disease. Treatments sown without fungicide were also artificially inoculated with Rhizoctonia to ensure an even and significant amount of this root disease. The experiments were designed in consultation with a statistician (Statistics for Australian Grains Industry, SAGI) and were of a randomised, complete block design with four replicates of each of the 12 treatment combinations (Table 1).

Table 6 Treatment details at Stokes and Wangary in 2018.

Stokes				Wangary				
P (kg/ha as DAP)	Cu (kg/ha as CuSO4)		Disease	K (kg/ha as MOP)		S (kg/ha as SOA)		Disease
0	0	×	Fungicide	0	×	0	×	Fungicide
15	5		Inoculated	30		20		Inoculated
30				60				

At Wangary, nitrogen and phosphorous were balanced using di-ammonium phosphate and triple superphosphate to ensure each treatment received equal amounts of these nutrients in an available form, while at Stokes, nitrogen only was balanced (with urea), as phosphorous rate was a treatment. In 'disease-free' plots, Uniform was applied to fertiliser and soil and Vibrance was applied to the seed and Prosaro applied to foliage from late tillering stage, all at the highest label rate, to achieve relatively low levels of disease. In the 'disease' plots, soil was inoculated with Rhizoctonia and foliar diseases including Septoria and yellow leaf spot at Stokes and spot form net blotch at Wangary were allowed to develop from naturally-infected stubble present in the paddock. Weed and nitrogen management throughout the year were representative of district practice, with 225 kg/ha and 175 kg/ha of urea applied at Stokes and Wangary respectively.

Tissue tests were conducted on above-ground biomass ('whole tops') sampled at late tillering to confirm any response to nutrients. Approximately forty plants were collected from each plot, with tests conducted on a single sample per treatment, bulked across replicates.

Root diseases were assessed visually for all plots at 'late-tillering' and 'full head emergence'. Forty plants per plot were assessed by collecting four 10cm lengths of row dug from both ends of each plot to a depth of 20 cm, the roots were washed and disease severity scored on a 0-5 scale (0 = no disease, 5 = all roots totally rotted). Foliar disease was assessed at 'booting' and 'early dough' growth stages by randomly sampling 20 leaves per plot and recording percentage leaf area affected.

Plots were harvested at Stokes on the 4th December and 16th November at Wangary, and yields were recorded. Yield data at Wangary could have been affected by sheep grazing the site late, during key grain formation stages.

Data were analysed using Genstat (19th Edition) in consultation with a statistician from SAGI with all treatment differences tested using ANOVA at the $\alpha = 0.05$ significance level.

What happened?

Both sites received good early rainfall around 3 May, allowing good establishment in both trials. Growing season rainfall totalled 338 mm at Stokes and 406 mm at Wangary (Cummins median GSR = 315 mm).

Tissue tests conducted on whole above-ground biomass confirmed phosphorous and copper deficiency at Stokes. All nil phosphorus treatments had low tissue P, with marginal P in the 15 kg/ha treatments and sufficient P in 30 kg/ha. Copper was deficient in plots where copper was not added, except in the nil phosphorous plots. At Wangary, all treatments had sufficient potassium but sulphur was marginal.

Root disease

Nutrient treatments did not affect root disease score at either site (Table 2), however the differences in root disease score between inoculated (no fungicide) and fungicide treatments demonstrate that the inoculation was highly effective, but the fungicide treatment was only partially effective. Inoculation with Rhizoctonia and use of fungicides was effective at creating low and high Rhizoctonia levels.

Table 7 Average root disease scores of fungicide treated or inoculated treatments on crown and seminal roots at late tillering and full head emergence at Stokes and Wangary in 2018.

	Late tillering				**Full head emergence**	
Site	Crown		Seminal		Crown	
	Fungicide-treated	Inoculated	Fungicide-treated	Inoculated	Fungicide-treated	Inoculated
Stokes	0.67	4.04	0.83	1.65	0.86	2.87
Wangary	2.09	4.05	1.77	2.95	1.56	3.36

Leaf disease

At Stokes, in late July, Septoria tritici blotch (*Zymoseptoria tritici*) and some yellow leaf spot (*Pyrenophora tritici-repentis*) began to develop in all plots including those treated with fungicide, however disease pressure was low overall. Nutrient treatments had a significant, but minor effect on early leaf disease development in the fungicide-treated plots (P = <0.001) (Table 3).

Table 8 Early leaf disease percentage at Stokes in 2018.

	Leaf Disease (%)	
Nutrient treatment	No Fungicide	Fungicide
P0C0	1.18e	0.82de
P0C5	1.11de	0.74cd
P15C0	0.96de	0.34bc
P15C5	1.21de	0.27ab
P30C0	0.94de	0.16ab
P30C5	0.85de	0.07a

By the second assessment, no nutrient effects on leaf disease were evident. The disease level in the no fungicide treatment was low, approximately 2.5% leaf area, and less than 0.01% in the plus fungicide treatments.

At Wangary, spot form net blotch began to develop in the no fungicide treatments in late July. Disease levels were low and were affected by nutrient inputs (P = <0.001). The highest level of disease was in the nil added potassium and sulphur treatments. All combinations of sulphur and potassium reduced spot form net blotch, with the highest rates of both nutrients limiting disease to 1.24% compared to 7.25% in the nil added nutrient treatments (Table 4).

Table 9 Early leaf disease percentage at Wangary was generally low but was affected by nutrient treatments without fungicide.

	Leaf Disease (%)	
Nutrient treatment	No Fungicide	Fungicide
K0S0	7.25g	0.10a
K0S20	4.88e	0.32b
K30S0	3.43d	0.11a
K30S20	3.82d	0.20ab
K60S0	5.99f	0.10a
K60S20	1.24c	0.11a

At the second assessment, nutrient treatments significantly reduced leaf disease percentage (P = <0.001), however results were inconsistent. Potassium alone at either rate did not reduce diseases compared to the control treatment. Sulphur reduced disease from 27% to 17% and the combination of sulphur 20 kg/ha and potassium 60 kg/ha reduced disease to 17%. The combination of sulphur (20 kg/ha) and potassium at the lower rate (30 kg/ha) did not reduce leaf disease percentage below the nil treatment, although did reduce disease below one other treatment without sulphur.

Table 10 Late leaf disease percentage at Wangary was affected by nutrient treatment for no fungicide treatments.

	Leaf Disease (%)	
Nutrient treatment	No Fungicide	Fungicide
K0S0	26.97cd	1.49a
K0S20	16.89b	1.17a
K30S0	25.83bcd	0.89a
K30S20	19.35bc	1.02a
K60S0	30.32d	1.44a
K60S20	16.92b	1.34a

Yield

At Stokes, both P and Cu input significantly affected yield of wheat. Copper improved wheat yield only at the highest rate of phosphorous in the inoculated treatments and appeared to reduce yield at the lowest rate of phosphorous in the fungicide treatments. Phosphorous effects were more consistent, improving yield over the nil phosphorous treatments both with inoculation and with fungicide. However, the percentage increase in yield was consistently greater for the inoculated treatments than for the fungicide treatments, suggesting an interaction with disease.

Table 11 Yield at Stokes was affected by nutrient treatment and the percentage increase in yield was greater in disease treatments than in no-disease treatments.

Treatment	Inoculated Mean Yield (t/ha)	Increase over P0C0 'Control' (%)	Fungicide-Treated Mean Yield (t/ha)	Increase over P0C0 'Control' (%)
P0C0	3.59		4.146	
P0C5	3.91	not significant (P<0.05)	3.766	-9.17
P15C0	5.27	46.45	5.949	43.49
P15C5	5.43	50.90	5.698	37.43
P30C0	5.58	55.16	6.115	47.49
P30C5	5.96	65.79	6.413	54.68
	LSD = 0.34		*LSD = 0.34*	

At Wangary, nutrient inputs did not have an effect on yield of barley. Plots treated with fungicide yielded 5.1 t/ha, while diseased plots yielded 4.07 t/ha. However, barley plots were affected by unintended grazing on two separate occasions, leading to significant variability between replicates, and it is possible this yield data does not reflect treatment effects.

What does this mean?

There were no clear benefits of nutrient inputs on root disease at either site. Root disease scores were high in inoculated plots, with generally all crown roots in all treatments at both sites displaying some disease.

Yields were still above average in disease plots, with 6 t/ha of wheat at Stokes and 4 t/ha of barley at Wangary. Visually, these plots appeared healthy throughout the growing season and only appeared affected by root disease when compared to fungicide treated plots alongside. This is an important result as it demonstrates the difficulty of relying on top growth to indicate significant root disease effects in commercial paddocks. Plants need to be dug up and roots washed and inspected to determine the presence of root diseases.

These effects also highlight the importance of the relationship between root disease effects and seasonal conditions. These crops did not experience significant moisture stress throughout the growing season which set up good yield potential. Even the high disease treatments produced yields likely to be accepted by many growers.

Figure 2 Example of plant roots at Wangary with a) low Rhizoctonia and b) very high Rhizoctonia infection.

However, under low overall foliar disease levels, there was some evidence that phosphorous influenced foliar disease at Stokes, and sulphur reduced spot form net blotch at Wangary. Whilst not significant, there did appear to be a trend towards lower foliar disease percentage with the addition of copper at Stokes too.

Yield data for this site seems to support the hypothesis that nutrient inputs can compensate for reduced root systems caused by rhizoctonia, with the overall percentage increase in yield due to nutrient inputs greater in diseased treatments than in fungicide treatments. However, this additional benefit appears to be the result of improved supply to badly affected root systems (in inoculated plots), rather than due to actual disease reduction or root stimulation.

At Wangary, where the foliar disease response to sulphur was clearer, there was no yield response to any fertiliser treatment. However, it is unclear whether this is due to effects of the unintended grazing or simply due to a lack of relationship between foliar disease and yield in this season.

The results of these experiments indicate the relationship between nutrition, root and leaf disease, and yield is highly dependent on environmental conditions, and the effect of disease on yield can be affected by nutrition. These experiments will be repeated in 2019.

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Contact details

Blake Gontar
Senior Researcher (Soilborne Disease Management)
SARDI
Plant Research Centre, Waite Campus
0430 597 811
Blake.gontar@sa.gov.au

OPTIMISED CANOLA PROFITABILITY: AN OVERVIEW OF 5 YEARS OF CANOLA AGRONOMIC RESEARCH IN SOUTH AUSTRALIA

Andrew Ware, EPAG Research (formerly SARDI)

Andrew Ware[1], Jacob Giles[1], Rohan Brill[2], Therese McBeath[3], Julianne Lilley[3] and John Kirkegaard[3].
[1]SARDI; [2]NSW DPI, [3]CSIRO.

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- Canola, variety, sowing time, phenology, risk management, nitrogen.

Take home messages
- Match sowing time to varietal phenology to flower in the optimal window and maximise biomass to maximise yield.
- Phenology information for most new varieties is now available.
- Well adapted hybrids can produce high, stable yields in the low rainfall zone.

Background
Since 2014 research to better understand the yield drivers of canola has been conducted in southern and eastern Australia in the GRDC funded Optimized Canola Profitability Project (OCP). The aim was to improve canola profitability through a better understanding of how phenology and environment can guide tactical agronomy to improve canola yield and profit. This research is targeted at low to medium rainfall zones and is a collaboration between CSIRO, NSW DPI and GRDC, in partnership with SARDI, CSU, MSF and BCG (CSP00187). The project links closely with similar GRDC supported projects in Western Australia and high rainfall zones (HRZ).

From southern Queensland, down through New South Wales, into Victoria and across to South Australia the OCP Project has conducted a range of field experiments and modelling simulations to improve canola profitability in the region. Activities have included:
- Phenology experiments, to determine the triggers for canola development, to help understand when a variety will flower in a particular environment.
- Variety x time of sowing experiments, to determine how flowering time influences canola yield and water use efficiency across a range of environments.
- Critical stress period experiments, to determine the period (growth stage) when canola yield is most vulnerable to external stresses such as water, heat or frost.

- Risk management experiments, aimed to make canola yield more stable profitable in the low rainfall zone.
- Experiments to improve the way the canola accumulates biomass cost-effectively to optimise grain yield across a range of environments. Biomass accumulation drives yield as harvest index is reasonably stable.
- Improving the ability to model canola growth and yield using APSIM. The canola model was developed some time ago with older varieties and different farmer practices. The improved model has added considerable value to field experiments.
- Improving harvest management, particularly through improved windrow timing. Despite a focus in northern NSW, the message to not windrow too early (with significant yield penalty) holds true in the southern region.

This article will discuss how findings from these activities are being integrated to help improve canola profitability.

Field experiments and modelling conducted in the first few years of the project helped to better understand the drivers of canola development (temperature, day length) in modern varieties, as well as improving the understanding how early sowing of canola influences varietal phenology (flowering time) and grain yield. This information then helped to improve the ability to simulate canola growth under Australian conditions, so that models could be used to evaluate a range of scenarios not possible in just a few years of field experiments.

One of the key findings in this phase of the project, was that canola yield was optimised by ensuring that canola started flowering in a window where the effects of heat/ drought and frost on flowers and pods were minimised. The dates for the flowering window were specific to each locality, depending on the risk of heat and/or frost events.

An example of this is the trial conducted in 2018 at Yeelanna (Figure 1). The longer season variety, Archer CL performed well relative to the other varieties when planted early (14 April), whereas shorter season variety Nuseed Diamond improved in grain yield when planted later (8 May). At the later sowing time, the lower yielding Archer treatment flowered too late (3 Sept) (Table 1) compared to the optimal start of flowering around 12 Aug, and the lower yielding Nuseed Diamond treatment flowered too early (5 July) compared to the more optimal 3 August.

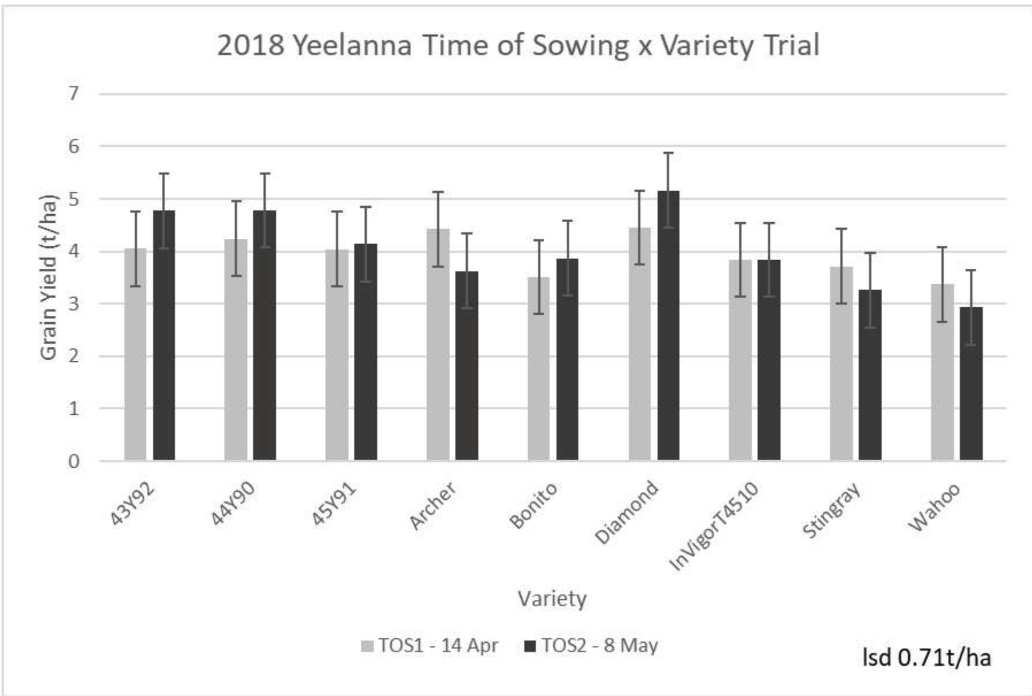

Figure 1. Grain yield (t/ha) of 2018 Yeelanna time of sowing x variety experiment with sowing dates of April 14 and May 8 (error bars = lsd).

Table 1. Start of flowering dates (when 50% of plants have at least one open flower) for the 2018 Yeelanna time of sowing x variety trial. The optimal start of flowering for Yeelanna is 19 July.

Variety	TOS1 **14-Apr**	TOS2 **8-May**
43Y92	31-Jul	16-Aug
44Y90	30-Jul	16-Aug
45Y91	7-Aug	27-Aug
Archer	12-Aug	3-Sep
Bonito	25-Jul	16-Aug
Diamond	5-Jul	3-Aug
InVigorT4510	25-Jul	16-Aug
Stingray	16-Jul	14-Aug
Wahoo	9-Aug	27-Aug

Sowing Date

Using APSIM crop modelling, meteorological data and information gathered from field experiments over the past four years, optimal start of flowering dates can be generated for any canola growing locality in Australia (some of these can be found in the e-book: https://grdc.com.au/10TipsEarlySownCanola). Once the phenology characteristics of a variety are understood (i.e. how long it will take a variety to flower in a given environment) it is possible to work backwards from the optimal start of flowering date to find an optimal sowing date (Table 2) for a locality.

Table 2. Sowing time guidelines for phenology types at three South Australian locations.

		March				April				May			
		1	2	3	4	1	2	3	4	1	2	3	4
Lameroo	**Slow**												
	Mid												
	Fast												
Hart	**Slow**												
	Mid												
	Fast												
Yeelanna	**Slow**												
	Mid												
	Fast												

Optimum sowing time

Earlier or later than optimal, or little experimental data available

Variety Phenology

The method that many of the canola breeding companies use to classify variety development is largely based on time to maturity, relative to other varieties sown at a conventional sowing time, and not measured by time to reach flowering when sown early. Also, canola varieties can rapidly change. Many of the varieties that were used in the first few years of the OCP Project are now no longer available.

To better categorise the development speed of canola varieties, particularly in relation to early sowing, and to gather information on newly released varieties, four experiments were established across Australia in 2018 (Perth - WA, Port Lincoln- SA, Wagga Wagga – NSW and Trangie – NSW). The sites were selected for their range in climatic conditions. The experiments recorded the time to reach the start of flowering (50% of plants with one open flower) from early and more conventional sowing times. Results for the Port Lincoln site are presented in Figure 2.

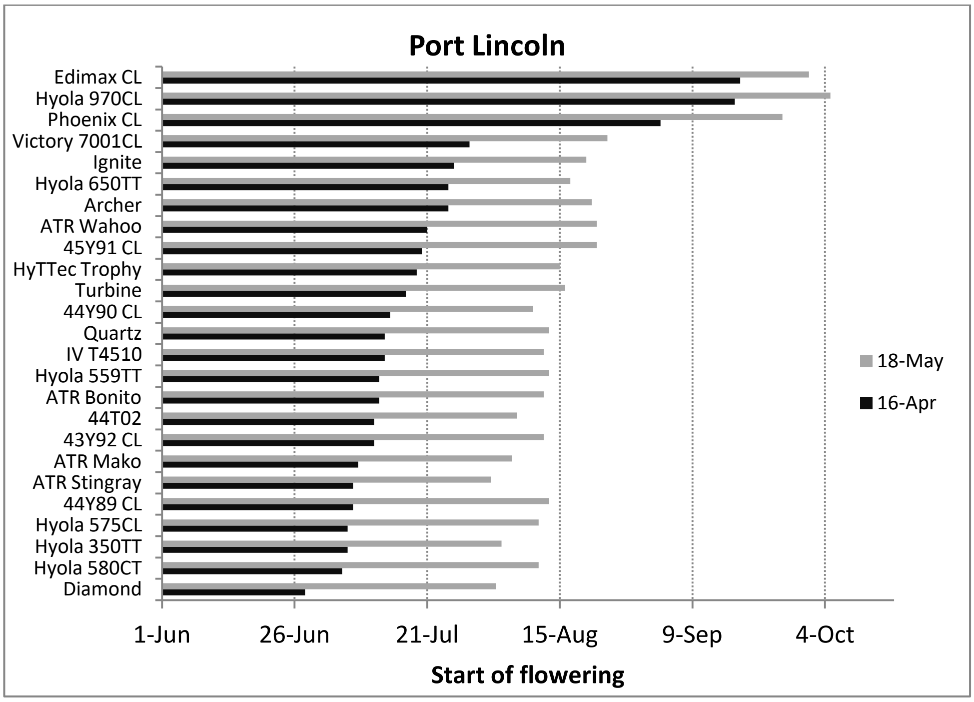

Figure 2. Date of start of flowering of canola varieties sown at two dates (16 April and 18 May) near Port Lincoln in 2018.

These data show that while most of the varieties rank similarly in their time to start flowering regardless of sowing time, there are some notable exceptions, for example, Hyola 580CT will flower at a similar time to many of the mid phenology varieties when sown in May, but flowers very quickly and outside the optimum when sown in April. Sowing early also increases the differences to flowering time, largely due to the warmer temperatures in April accelerating plant development of the varieties that are most sensitive to temperature. This means, that sowing a variety with fast phenology early will flower considerably quicker (in calendar days) than if it was sown at a more conventional time, and often outside the optimum window.

By adding the data from the four phenology trial sites conducted in 2018 to data previously collected in the optimised canola profitability project it is possible to categorise each of the modern varieties for its phenology type in early sowing situations (Table 3).

Table 3. Phenology and maturity rating of most of the modern canola varieties.

VARIETY	PHENOLOGY (time from sowing to flowering when sown early)	MATURITY (as supplied by breeding companies)	HERBICIDE TOLERANCE	OPEN POLLINATED/ HYBRID
ATR Stingray	Fast	Early	Triazine	OP
Diamond	Fast	Early	Conventional	Hybrid
Hyola 350TT*	Fast	Early	Triazine	Hybrid
Hyola 580CT*	Mid–fast	Mid–early	Imidazolinone/Triazine	Hybrid
Banker CL*	Mid–fast	Mid	Imidazolinone	Hybrid
InVigor T4510*	Mid–fast	Early mid	Triazine	Hybrid
44T02 (TT)*	Mid–fast	Early–mid	Triazine	Hybrid
43Y92 (CL)*	Mid–fast	Early	Imidazolinone	Hybrid
ATR Bonito	Mid–fast	Early to early–mid	Triazine	OP
44Y90 (CL)	Mid–fast	Early–mid	Imidazolinone	Hybrid
ATR Mako	Mid–fast	Mid–early	Triazine	OP
HyTTec Trophy*	Mid	Early to early–mid	Triazine	Hybrid
Quartz*	Mid	Mid to mid–early	Conventional	Hybrid
Turbine*	Mid	Early–mid	Triazine	Hybrid
Hyola 559TT	Mid	Mid	Triazine	Hybrid
AV Garnet	Mid	Mid to mid–early	Conventional	OP
ATR Gem	Mid	Mid–early	Triazine	OP
DG 670TT*	Mid	Mid–late	Triazine	Hybrid
45Y91 (CL)	Mid	Mid	Imidazolinone	Hybrid
SF Ignite*	Mid–slow	Mid to mid–late	Triazine	Hybrid
ATR Wahoo	Mid–slow	Mid–late	Triazine	OP
Archer	Slow	Mid–late	Imidazolinone	Hybrid
Victory 7001 (CL)	Slow	Mid–late	Imidazolinone	Hybrid
Phoenix CL*	Very slow (Winter)	Winter	Imidazolinone	Hybrid
Edimax CL	Very slow (Winter)	Winter	Imidazolinone	Hybrid
Hyola 970CL	Very slow (Winter)	Winter	Imidazolinone	Hybrid

* Varieties with three site years of data. Remaining varieties have at least five site years of data.

Matching the planned sowing time (or most common break to the season) from Table 2 with a variety that has the correct phenology (from Table 3) is now possible. For example in the Yeelanna environment on Lower Eyre Peninsula, the most common break to the season often occurs in the last week of April. If planting in the last week of April, growers in this environment have the choice of growing any variety from fast to mid phenology and have it flower in the optimal window. However, for growers at Lameroo, who may commonly get a break to the season in early May, the best chance of flowering in the optimal window and maximising yield will come from planting only fast phenology varieties.

Risk Management

Two of the factors that add considerably to canola's risk profile in the low rainfall zone is (i) the crops high demand for nitrogen and (ii) the decision of whether or not to grow a hybrid or open pollinated variety. Being able to understand how effectively canola is able to convert soil available and applied nitrogen to yield across a range of soil types in the low rainfall environment will help identify a strategy that delivers the highest yield at the lowest risk. In 2018, field experiments examining this were conducted at Karoonda, Minnipa and Lameroo. Just the Karoonda experiment will be discussed here.

The Karoonda trial was sown on 4 May across a range of soil types, typical of many Mallee type environments, ranging from dune sand, down through the mid-slope and into the swale. Varieties Stingray and Pioneer 43Y92CL were planted and nitrogen applied at differing rates early post-emergent. On the day of sowing, the sand averaged 37 kg mineral N/ha/m depth and 92 mm PAW while the mid-slope averaged 53 kg mineral N/ha/m depth and 84 mm PAW. Rainfall to end September was 114 mm compared with 257 mm average.

Table 4. Canola grain yield (t/ha) at Karoonda, 2018. Two varieties, sown across four soils types with different nitrogen strategies applied early post-emergence.

		Swale		**Mid**		**Crest**		**Dune**	
Cultivar	N Rate	Yield	LSD 0.18	Yield	LSD 0.18	Yield	LSD 0.18	Yield	LSD 0.18
Stingray	5	0.57	cd	0.58	d	0.37	e	0.35	e
Stingray	30	0.5	d	0.58	d	0.56	de	0.6	cde
Stingray	60	0.62	cd	0.75	bcd	0.75	cd	0.64	cd
Stingray	90	0.7	bc	0.78	bc	0.8	bc	0.8	bc
Stingray	120	0.8	Ab	0.91	ab	0.97	ab	0.59	cde
Stingray	150	0.74	bc	1.02	a	1.12	a	1.05	ab
43Y92	5	0.84	ab	0.7	cb	0.68	cd	0.53	de
43Y92	90	0.92	a	1.02	a	1.16	a	1.14	a

Grain yield results from this trial show that hybrid Clearfield® variety Pioneer 43Y92CL yielded higher than ATR Stingray in all soil type zones at comparable nitrogen rates. 43Y92 yield was relatively stable across all soil types (ranging from 0.92t/ha – 1.16t/ha) and produced a higher level of yield than Stingray when compared at 5 and 90 kg N/ha, suggesting a higher N use efficiency Stingray produced a positive response to N in all soil types, with the largest response to high rates on the crest and dune soils, but yield was more variable than 43Y92 across soil types.

The obvious way to reduce risk in canola production in the low rainfall zone is to reduce some of the upfront costs, such as the cost of hybrid seed. However, as results from this trial and other observations in the low rainfall zone show, the adoption of well-adapted hybrids has the potential produce high, stable, N use efficient yields that are potentially more profitable than lower cost open pollinated varieties. Previous recommendations to not grow hybrids in low rainfall environments should be reconsidered.

Conclusion

Matching sowing time with varietal phenology so that start of flowering occurs in a window where the risk of water, heat and frost stress is minimised will greatly improve the chances of maximising yield.

Phenology information on most of the currently available canola varieties, particularly their response to early sowing, is now known, and can be used to aid variety selection.

Well-adapted hybrid varieties planted in the low rainfall zones have been shown to produce high, stable canola yields in a well below average rainfall season.

Useful resources

https://grdc.com.au/Resources/GrowNotes
https://grdc.com.au/10TipsEarlySownCanola

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Contact details

Name: Andrew Ware
Business Address: EPAG Research,
7 Seaton Ave Port Lincoln, 5606
Phone: 0427 884 272
Email: andrew@epagresearch.com.au
Twitter handle: @Ware_AH

TAILORED MANAGEMENT OF SCLEROTINIA IN CANOLA WITH THE SLEROTINIACM APP

Andrew Ware, SARDI

Art Diggle, DPIRD, Kensington 6151, Australia, art.diggle@dpird.wa.gov.au
Steve Marcroft, Marcroft Grains Pathology, Horsham 3400, Australia, steve@grainspathology.com.au
Kurt Lindbeck, NSWDPI, Wagga Wagga 2650, Australia, kurt.lindbeck@dpi.nsw.gov.au
Ravjit Khangura, DPIRD, Kensington 6151, Australia, ravjit.khangura@dpird.wa.gov.au
Audrey Leo, NSWDPI, Wagga Wagga 2650, Australia, audrey.leo@dpi.nsw.gov.au
Ciara Beard, DPIRD, Geraldton 6530, Australia, ciara.beard@agric.wa.gov.au
Andrea Hills, DPIRD, Esperance 6450, Australia, andrea.hills@agric.wa.gov.au
Angela van de Wouw, School of BioSciences, University of Melbourne 3010, Australia, apvdw2@unimelb.edu.au
Andrew Ware, SARDI, Port Lincoln, 5606, Australia, andrew.ware@sa.gov.au
Susie Sprague, CSIRO Agriculture & Food, Canberra, 2600, Australia, susan.sprague@csiro.au
Jean Galloway, DPIRD, Northam 6401, Australia, jean.galloway@dpird.wa.gov.au

Key messages

- The app will support users to make the most profitable decisions about fungicide use to manage sclerotinia stem rot in canola.
- SclerotiniaCM is designed for quick and efficient use with clients in the field.
- SclerotiniaCM produces results that are tailored for individual paddocks and generates email reports right from the field.

Aims

Currently growers apply fungicide to control sclerotinia in canola crops based on previous disease severity in a paddock and current weather conditions. Advisors want more guidance on fungicide application decision making. The development of SclerotiniaCM aims to deliver an iPad and Android tablet-based app to help with spray decision to manage sclerotinia stem rot of canola. The app will provide evidence-based information that estimates returns from spraying for individual paddocks.

Method

Design

SclerotiniaCM has combined experimental data and expert knowledge to determine the probability of economic benefit of fungicide application to any canola crop in Australia. The app can be used in-season at the decision making time, it requires the agronomist to input individual paddock data, recent weather and expected weather and then produces a probability of return from fungicide application.

The app uses Monté Carlo simulation to generate the expected result from distributions of expected yield in the absence of disease, grain price, loss of yield in the absence of fungicide and efficacy of fungicide. Correlations between these factors are included in the calculation.

The app predictions and level of uncertainty were initially set based on expert opinion from leading Australian pathologists, and have subsequently been recalibrated based on available field data. It is intended that SclerotiniaCM will continually be updated to reflect new experimental results as they become available. This semi-quantitative approach to calibration of the app recognises the fact that management decisions for sclerotinia are, and must be, made each year with information that is available to each manager. Bringing the best available information to bear in an easily understood format will assist in this process.

Testing

Pre-release versions of SclerotiniaCM were used by several testers with their clients in the field in the 2018 growing season. These testers, acknowledged below, provided valuable feedback that has helped with refinements to the final design.

Results

An example

Table 1 lists input values for SclerotiniaCM for two example situations, which differ only in the target crop yield (2.5 or 1.2 t/ha). In both cases, the difference in net return resulting from a first application of foliar fungicide at 30% flowering is estimated. For situation 1 with a target crop yield in the absence of disease of 2.5 t/ha, a foliar application of fungicide would result in the mean net return of $49/ha. In 90% of years the net return would be expected to be less than $102/ha, and in 10% of years a net loss would be expected (Fig.1). For situation 2, with a target crop yield in the absence of disease of 1.2 t/ha, the mean net return is $3/ha. In 90% of years the net return would be expected to be less than $28/ha, with a loss of more than $21/ha in 10% of years (Fig.2).

Table 1. Settings for SclerotiniaCM for situations 1 and 2.

App setting	Value	App setting	Value
Situation 1 target yield (t/ha)	2.5	History of broadleaf crops	3 years in 10
Situation 1 yield range (t/ha)	1.5 – 3	History of sclerotinia yield loss	8 years in 10
Situation 2 target yield (t/ha)	1.2	Bloom stage	30%
Situation 2 yield range (t/ha)	0.7 – 1.4	Wet days in the last 3 weeks	10
Grain price ($/ha)	550	Expected wet canopy days next week	3
Grain price range ($/ha)	525 - 580	Expected wet canopy days in week after next	3
Production cost ($/ha)	350	Mitigation by spray	50%
Surface soil texture	Sandy	Spray cost ($/ha)	40

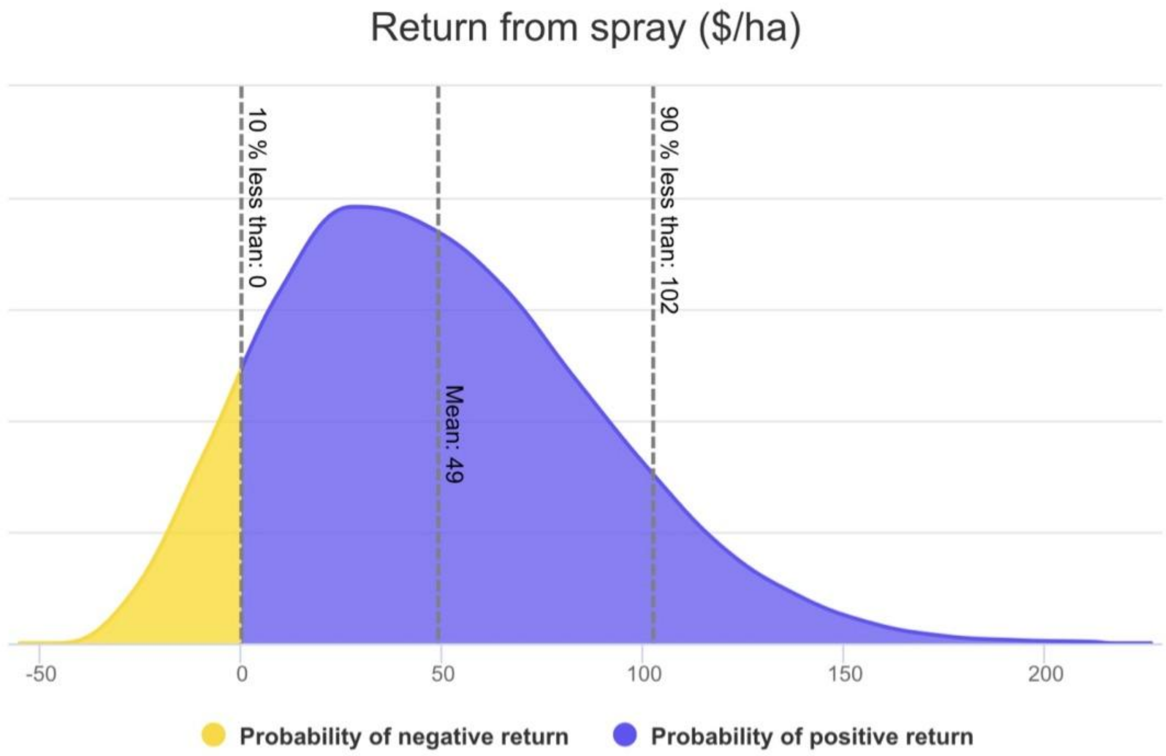

Fig.1. Probability density from SclerotiniaCM for net return from a first foliar fungicide spray at 30% bloom for situation 1 where target yield is 2.5 t/ha and all other settings are as shown in Table 1.

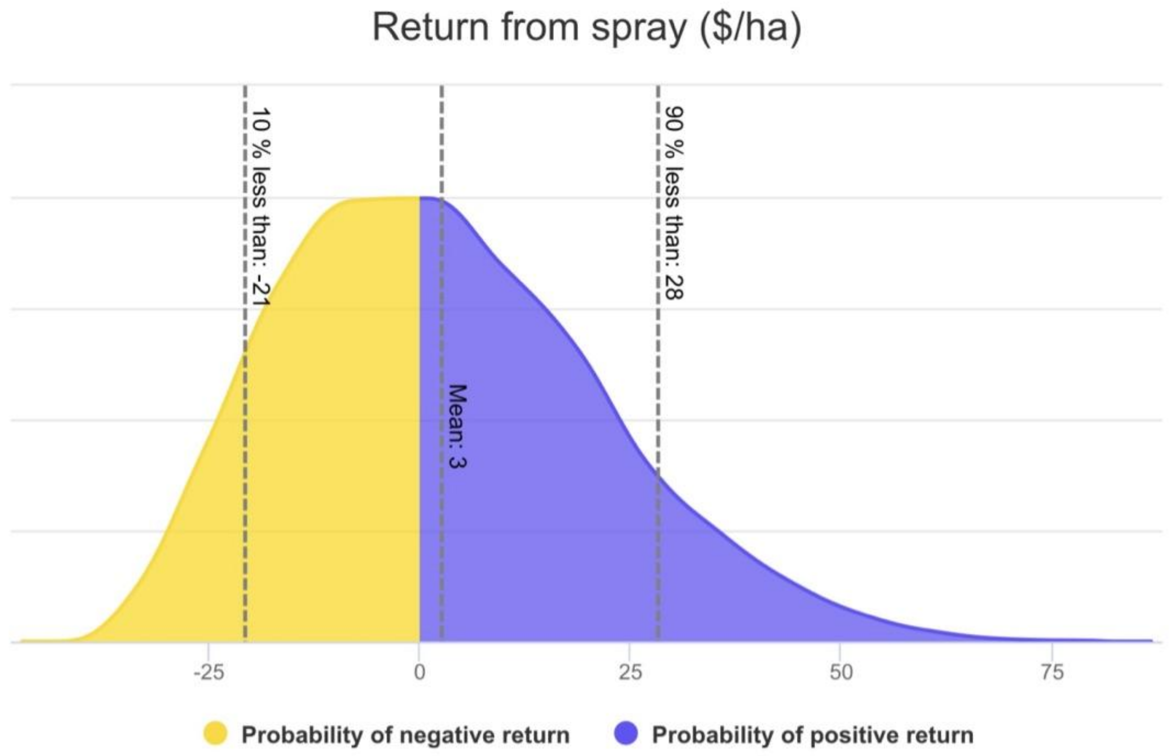

Fig.2. Probability density from SclerotiniaCM for net return from a first foliar fungicide spray at 30% bloom for situation 2 where target yield is 1.2 t/ha and all other settings are as shown in Table 1.

No spray		Spray		Difference	
Expected yield (t/ha)		Expected yield (t/ha)		Expected yield (t/ha)	
Minimum	1.7	Minimum	1.9	Minimum	0.1
Mean	**2.1**	**Mean**	**2.3**	**Mean**	**0.2**
Maximum	2.4	Maximum	2.6	Maximum	0.3
Loss to sclerotinia (t/ha)		Loss to sclerotinia (t/ha)		Loss to sclerotinia (t/ha)	
Minimum	0.16	Minimum	0.07	Minimum	-0.26
Mean	**0.32**	**Mean**	**0.16**	**Mean**	**-0.16**
Maximum	0.5	Maximum	0.26	Maximum	-0.07
Net return ($/ha)		Net return ($/ha)		Net return ($/ha)	
Minimum	602	Minimum	647	Minimum	0
Mean	**802**	**Mean**	**851**	**Mean**	**49**
Maximum	994	Maximum	1040	Maximum	103

Fig.3. The summary view from SclerotiniaCM for a first foliar fungicide spray at 30% bloom for situation 1 where target yield is 2.5 t/ha and all other settings are as shown in Table 1.

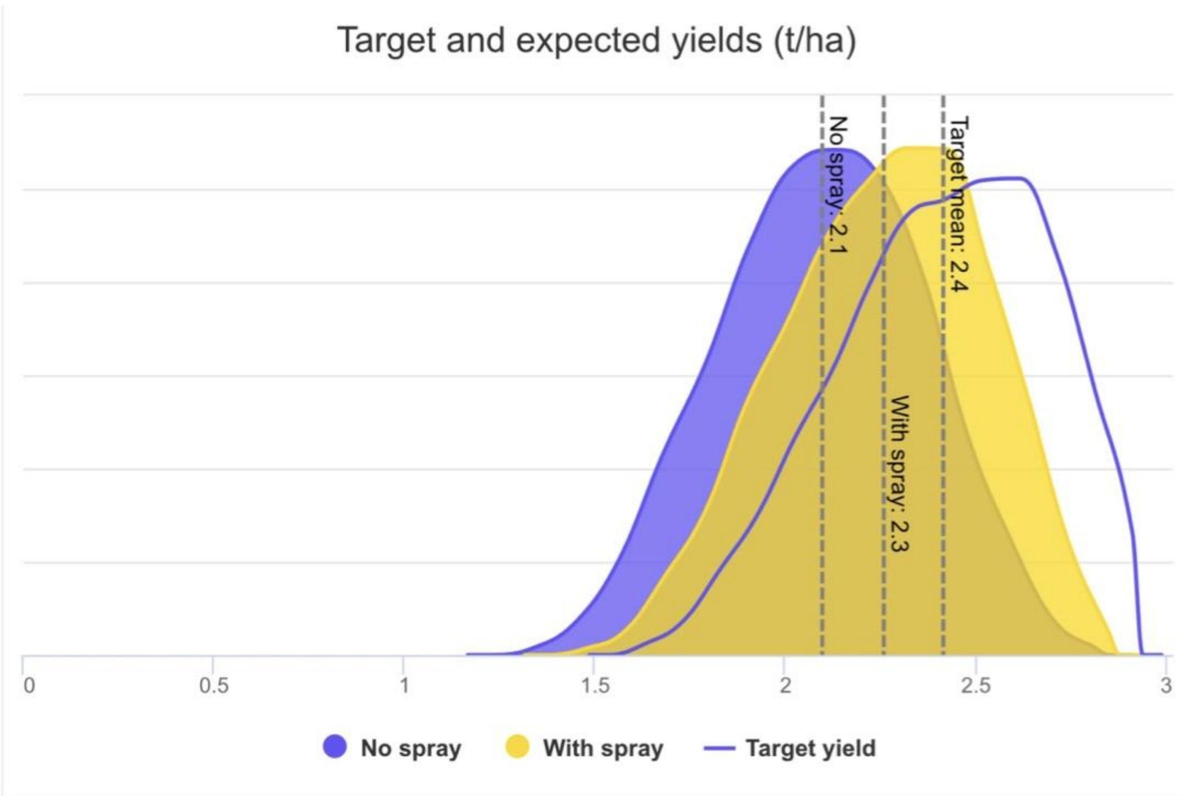

Fig.4. Probability density from SclerotiniaCM for target yield and predicted yield with and without foliar fungicide spray for a first foliar spray at 30% bloom for situation 1 where target yield is 2.5 t/ha and all other settings are as shown in Table 1.

SclerotiniaCM has several alternative views of the predicted results. Figure 3 shows the summary view for SclerotiniaCM for situation 1 where the target yield was 2.5 t/ha. SclerotiniaCM indicates a substantial positive net return both with and without application of fungicide and shows the same minimum, mean and maximum estimates of the dollar return from spraying that are shown in Figure 2. Figure 4 shows the distribution of yield that would be expected if there was no disease, and the distributions that are actually expected in the presence of disease where fungicide is or is not applied.

Feedback

Testers indicated that SclerotiniaCM was a useful aid in discussions with growers about spray decisions, and in general testers agreed with the output of the app. Most testers indicated a preference for the summary view, as shown in Figure 3, but some preferred the net return view shown in Figures 1 and 2.

A notable feature of the 2018 growing season was that actual yields for many paddocks were greater than the expected yields at early flowering. This factor will have tended to reduce the app's estimate of loss to sclerotinia, however estimated range of effects was reasonable. As a result of feedback from testers the release version of the app has a reporting function that allows results from the app to be sent to clients or stored for future reference. The release version of the app also has a comprehensive tips function to ensure that users understand all of the settings and features of the app.

Conclusion

The SclerotiniaCM app has been designed to provide site and season-specific information to grain growers to inform their management decisions. The app provides information in terms of the mean, minimum and maximum change in net return that can be expected from application of foliar fungicide. The app allows canola growers to apply their own risk preferences in making decisions, rather than recommending particular management options.

The app is delivered on tablets and has a straight-forward user interface that asks for inputs that can be readily estimated by agronomic specialists. We envisage that the main use case for SclerotiniaCM will be as an aid to conversations about disease management between growers and their advisors, and that these conversations will typically occur in the field.

Sclerotinia CM is available for download for iPads or Android tablets from the iTunes store or from Google Play.

Key words
target yield, grain price, cropping history, disease history, Monté Carlo analysis, fungicide, uncertainty, risk preference, decision tool, tablet app

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CANOLA – WHAT DISEASE IS THAT AND SHOULD I APPLY A FUNGICIDE?

Andrew Ware, SARDI

Steve Marcroft[2], Susie Sprague[1], Angela van de Wouw[3], Andrew Ware[4] and Kurt Lindbeck[5].
[1]CSIRO Agriculture & Food, Canberra, ACT; [2]Marcroft Grains Pathology, Horsham, VIC; [3]School of BioSciences, University of Melbourne, VIC; [4]SARDI, Port Lincoln, SA; [5]NSWDPI, Wagga Wagga, NSW.

GRDC project codes: UM00051, CSP00187

Keywords

- canola, phenology, flowering time, fungicide, disease control.

Take home messages

- Disease symptoms on canola are caused by a variety of pathogens. Correct identification is critical to ensure appropriate control strategies are selected. Use the GRDC Back Pocket guide or Canola: the ute guide, for disease identification.
- Blackleg and sclerotinia stem rot most commonly cause significant yield loss. Whilst other diseases can be common and prevalent, the level of yield loss associated with other disease infection is either low or has not been quantified.
- Blackleg crown canker results from infection during early seedling growth. Prior to sowing, use the BlacklegCM decision support tool to identify high risk paddocks and explore management strategies to reduce yield loss.
- Blackleg upper canopy infection is the collective term for flower, peduncle, pod, main stem and branch infection, but does not include crown canker.
- Upper canopy infection can cause yield losses of up to 30%. Yield loss is reduced by selecting cultivars with effective major gene resistance and using crop management strategies to delay the commencement of flowering to later in the growing season, especially in high disease risk areas.
- Sclerotinia stem rot in high risk situations can be controlled by fungicide application at 30% bloom (14-20 flowers on main raceme).
- Foliar fungicide application for sclerotinia control (approximately 30% bloom) can reduce UCI if it is present and causing yield loss. Unfortunately applications during flowering do not protect the pods from pod lesions. More work is required to determine robust foliar fungicide timings and economic returns.
- Blackleg pathogen populations with resistance to the triazole fungicides fluquinconazole, flutrial and a tebuconazole + priothioconazole mixture have been detected. No resistance was detected for new succinate dehydrogenase inhibitor (SDHI) and quinine-outside inhibitor (QoI) chemistries.

'Major' diseases – to spray or not to spray?

Sclerotinia

Sclerotinia is a disease that can cause substantial yield loss in some regions in some years. The decision to apply a fungicide is determined by the frequency of previous outbreaks on your farm. If sclerotinia has never been an issue then it is unlikely to occur in the future and fungicides are not warranted. If sclerotinia has occurred in the past, the following factors may help in deciding whether to apply a fungicide:

- **Spring rainfall:** Epidemics of sclerotinia stem rot generally occur in districts with reliable spring rainfall and long flowering periods for canola. Consider rainfall predictions for spring and canola crop growth stage.
- **Frequency of sclerotinia outbreaks:** Use the past frequency of sclerotinia stem rot outbreaks in the district as a guide to the likelihood of a current sclerotinia outbreak. Paddocks with a recent history of sclerotinia are a good indicator of potential risk, as well as adjacent paddocks. Also consider the frequency of canola in the paddock. Canola is a very good host for the disease and can quickly build up levels of soil-borne sclerotia.
- **Commencement of flowering:** The commencement of flowering can determine the severity of a sclerotinia outbreak. Spore release, petal infection and stem infection have a better chance of occurring when conditions are wet for extended periods, especially for more than 48 hours. Canola crops which flower earlier in winter, when conditions are cooler and wetter, are more prone to disease development in spring.
- **SclerotinaCM:** SclerotiniaCM has taken experimental data and expert knowledge to determine the probability of economic benefit of fungicide application to any canola crop in Australia. The app can be used in season at the decision making time, it requires the agronomist to input individual paddock data, recent weather and expected weather and then produces a probability of return from fungicide application.

The most yield loss from sclerotinia occurs from early infection events. Early infection is likely to result in premature ripening of plants with little or no yield. Plants become susceptible to infection once flowering commences. Research in Australia and Canada has shown that an application of foliar fungicide around the 20 to 30% bloom stage (20% bloom is 14 to 16 flowers on the main stem, 30% bloom is approx. 20 flowers on the main stem) can be effective in significantly reducing the level of sclerotinia stem infection. Most registered products can be applied up to the 50% bloom (full bloom) stage.

The objective of the fungicide application is to prevent early infection of petals while ensuring that fungicide also penetrates into the lower crop canopy to protect potential infection sites (such as lower leaves, leaf axils and stems). Timing of fungicide application is critical. A foliar fungicide application is most effective when applied before an infection event (e.g. before a rain event during flowering). These fungicides are best applied as protectants.

In general, foliar fungicides offer a period of protection of up to three weeks. After this time, the protectant activity of the fungicide is reduced. In some crops, development of lateral branch infections later in the season may occur if conditions favourable for the disease continue. The greatest yield loss occurs when the main stem becomes infected, especially early. Lateral branch infection results is less yield loss. Use high water rates and fine droplet sizes for good canopy penetration and coverage.

Blackleg crown canker

Severe crown canker is most likely to develop when plants are infected during the early seedling stage. The fungus grows from the cotyledons and leaves asymptomatically through the vascular tissues to the crown, where it causes necrosis resulting in a crown canker at the base of the plant. Yield loss results from restricted water and nutrient uptake by the plant. Protection during the seedling stage is critical to reduce crown canker severity. The risk factors for development of blackleg crown canker are well understood in Australia and include intensity of canola production, blackleg resistance of the cultivar, stubble management and rainfall. A decision support tool, BlacklegCM, is available and should be used to assess the risk for blackleg crown canker prior to cultivar selection and sowing. Versions of BlacklegCM are available for iPad or android tablets. BlacklegCM does not work on iPhones. The tool is interactive, allowing growers and advisers to determine the blackleg risk for each paddock and consider the possible economic return of different management strategies. The tool also provides in-season support for the application of foliar fungicides.

Blackleg upper canopy infection

Blackleg is able to infect all parts of the canola plant. Upper canopy infection (UCI) is a collective term that describes infection of flowers, peduncles, pods, upper main stem and branches (Figure 1). UCI has become increasingly prevalent over recent years and may be associated with earlier flowering crops because of earlier sowing of cultivars and more rapid phenological development during warmer autumns and winter. There is also evidence of delayed and prolonged release of blackleg spore release in stubble-retained systems and increased intensity of canola production. While the crown canker blackleg is well understood, the factors contributing to UCI and possible control strategies are currently under investigation. An outline of findings to date are presented below.

Figure 1. Upper canopy infection includes blackleg infection of flowers, peduncles, pods, main stems and branches.

Blackleg UCI research results

In field experiments, UCI has caused up to 30% yield loss. The impact on yield varies depending on the timing of infection and plant part infected. Flower loss from infection of flowers or peduncles is unlikely to directly reduce yield as the plant is able to compensate by producing more flowers. However, the fungus can grow into the associated branch which can then affect seed set and grain filling in surrounding pods. Infection of pods or peduncles after pod formation can result in significant yield loss. Infected branches and upper main stems can affect all developing flowers and pods above the point of infection causing a reduction in pod and seed set as well as smaller seed. Severe infection can cause stems and branches to break off, premature ripening leading to shattering or difficulty in ascertaining correct windrow timing due to maturity differences between seed affected or unaffected by blackleg.

Entry of blackleg into the plant is via the stomatal openings. Physical damage to the plant by insects, hail or frost, facilitates entry of the pathogen causing severe disease. In NSW and Victoria in 2018, splitting of stems (probably related to frost damage) and hail damage resulted in sporadic severe UCI symptoms on main stems and pods.

It is now thought that UCI infections are also systemic, causing damage to the plant's vascular tissue similar to traditional blackleg crown infections. The issue for growers is that external symptoms may appear insignificant, but internal vascular damage may cause significant yield losses. Preliminary results indicate this may be why fungicide applications on crops with few symptoms can still result in economic yield returns. Interestingly, researchers have noted that symptoms of internal vascular damage result in blackened stems post the windrowing growth stage i.e. post 100% seed colour change (see Figure 2).

Figure 2. Blackened branches caused by internal vascular damage; symptoms become visible post 100% seed colour change. These symptoms may not occur in crops that received the sclerotinia 30% bloom fungicide application.

Blackleg UCI control strategies

Genetic resistance

Effective major gene resistance prevents infection of all canola plant parts (cotyledons, leaves, stems, branches, flowers, pods). Effective major genes can thereby prevent both crown canker and blackleg UCIs. Unfortunately, most major genes present in current cultivars have been overcome by the blackleg pathogen across many canola producing regions. It is therefore crucial to know if major genes are effective or overcome in your growing region. The Blackleg Management Guide provides information that is relevant for control of blackleg crown canker.

Commencement of flowering

There is a strong relationship between the earlier onset of flowering and yield loss caused by UCI. Canola plants are particularly susceptible to stress during the early stages of flowering (Kirkegaard et al. 2018). Evidence from controlled environment and field experiments indicates that plants infected by blackleg on the upper main stems and branches during the early flowering period results in the greatest reduction of grain yield compared to crops that flower later or are infected at later growth stages. Yield loss can be due to a reduction in seed size, seeds/pod and/or pods/m^2. Oil content can also be reduced. In most regions, mid May to early August is the most conducive period for blackleg infection. By delaying the commencement of canola flowering to early August, growers may be able to avoid severe UCI infections.

Fungicides

If UCI occurs, it has been shown that sclerotinia fungicides will also reduce UCI severity and yield losses. Application of Prosaro®/Aviator® Xpro for sclerotinia control around 30% bloom can also provide protection from blackleg infection during early flowering. The 30% bloom spray may control flower, peduncle, stem and branch infections but is unlikely to provide pod protection. High levels of pod infection tend to occur in seasons with frequent late rainfall events (such as 2016) or where there is physical damage to the pods, e.g. hail (such as 2018).

'Minor' diseases – to spray or not to spray?

***White leaf spot* (*Mycosphaerella capsellae*)**

White leaf spot (WLS) is a very common disease of canola that occurs on the leaves of seedlings but can spread up the canopy if wet conditions prevail. Infection reduces leaf area which may cause reduced biomass accumulation and consequently reduce yield. There is no evidence that there is any cultivar resistance to white leaf spot in Australian commercial canola cultivars. There is no data available on yield losses from WLS.

WLS is a sporadic stubble-borne disease so it is likely to be more prevalent and severe in areas with intensive canola production. The issue for advisers is that there is no knowledge on how to predict if WLS will occur as there has been no work carried out on epidemiology. Therefore, use past infestations as a reference and monitor crops at the 4-6 leaf stage prior to considering control options. If lesions are present and wet weather is forecast, it is likely that WLS will continue to flourish. If no (or few) lesions are present and the weather is forecast to be dry, it is highly unlikely that new leaves will become infected.

Interestingly, several experiments to assess fungicide efficacy for blackleg control have also produced excellent control of WLS. Both Prosaro® and Miravis® applied for blackleg control at 4-6 leaf growth stage have provided excellent control of WLS. Miravis® is registered for WLS control, whilst Prosaro® is not registered for WLS control. Other experiments show that Jockey®Stayer applied to the seed and flutriafol amended fertiliser for blackleg control may also provide some WLS control (Van de Wouw et al. 2016). Jockey®Stayer and flutriafol are not registered for WLS control. At this stage, when applying fungicide for blackleg control at the early vegetative stage, you may also achieve WLS control.

Powdery mildew (Erysiphe cruciferarum)

Powdery mildew may be becoming more prevalent or it may be '**frequency illusion',** that is, once you start looking, you see it everywhere. Powdery mildew occurs typically post flowering and will affect all plant parts. It is a white powder covering the plant parts. There is limited data available regarding if powdery mildew causes any yield loss and very limited epidemiology data to determine which situations may increase the risk of the disease occurring. In northern NSW, this disease occurs regularly and is thought to reduce yield in some seasons. Powdery mildew on brassicas (including canola) is caused by the fungus *Erysiphe cruciferarum* and first appears as small whitish patches on the upper and lower surfaces of leaves. These spots consist of mycelia and conidia (spores), which allow the fungus to spread rapidly. The fungal patches spread under favourable conditions and form a dense white layer that resembles talcum powder. Disease outbreaks appear to be associated with dry conditions, moderate temperatures, low relative humidity and minimal rainfall. The fungus survives mainly on alternate brassica weed hosts but is also known to survive within old canola stubble.

There are no known commercial canola cultivars with resistance to powdery mildew. Overseas management of powdery mildew is achieved through application of foliar fungicides. In experiments in northern NSW, powdery mildew control with fungicides was not achieved. However, in Victoria in 2018, fungicide applications to control blackleg also controlled powdery mildew. In fact, it appears that in Victoria the blackleg fungicides are extremely efficient at powdery mildew control. In blackleg experiments, fungicide applications from 10 leaf to 50% bloom have all provided some control of powdery mildew. Control from early applications suggests that powdery mildew is present in the crop a long time before it is visible in the spring.

At this stage we do not know if or when powdery mildew will occur, we do not know what practices and how the climate or weather may influence disease severity. We also do not know if it causes any yield losses. If you are spraying during flowering for sclerotinia, you may also achieve control of powdery mildew.

Pathogens that do not require fungicide control

Downy mildew (Peronospora parasitica)

Downy mildew is often prevalent causing premature senescence of cotyledons and early true leaves. Generally, plants grow through the infection, although seedling vigour can be reduced. There is no knowledge on yield loss, but loss of vigour in canola seedlings is definitely not desirable. No fungicides are registered for downy mildew control in canola and there are no observations of control from blackleg fungicide seed treatments or foliar applications.

Alternaria

Alternaria occurs with prolonged wet weather, especially post-flowering. Alternaria pod spot can result in premature shattering resulting in yield losses. Seed retained and planted from infected crops may cause seedling blight as the disease is carried on the seed. It is recommended to only retain seed from crops unaffected by alternaria. Seed treated with fluquinconazole for blackleg control has also resulted in suppression of alternaria seedling blight. There are no fungicides registered for alternaria control in Australia and no observations that fungicides applied to control sclerotinia stem rot during flowering control alternaria pod spot. It is not known if flutriafol or SDHI seed treatments will control alternaria seedling blight.

Fungicide resistance

With the high use of fungicides comes the risk of fungicide resistance developing. We have recently screened 107 populations for resistance to all commercially available and soon to be released fungicides. The results from these screens show that 22% and 28% of populations have a high frequency of isolates resistant to the demethylation inhibitor (DMI) fungicides (fluquinconazole and flutriafol respectively), whilst only 7% of populations have a high frequency of resistance to the tebuconazole + priothioconazole mixture. No resistance was detected to any of the SDHI or QoI fungicides. We will continue to screen populations in 2019 and 2020 to monitor changes in the frequency of resistance to both the old DMI chemistries and the new SDHI and QoI chemistries.

The development of fungicide resistance to blackleg in Australia highlights the importance of fungicide use stewardship. Overseas experience informs us that the new SDHI fungicides are more likely to develop resistance than the current DMI fungicides.

Fungicide resistance screening sample submission

If you would like your 2018 canola (2019 stubble) screened for fungicide resistance, we will require 30 pieces of canola stubble from your 2018 paddock. Please email Angela Van de Wouw at angela@grainspathology.com.au for stubble collection protocol. We will provide you with fungicide resistance results for the current DMI blackleg fungicides and the new SDHIs. The service is free to growers and advisers. Costs are covered by an Australian Research Council (ARC)/industry investment.

Useful resources and references

BlacklegCM App for iPad and android tablets
www.grdc.com.au/resources-and-publications/all-publications/publications/2018/blackleg-management-guide

Canola: the ute guide https://grdc.com.au/resources-and-publications/groundcover/ground-cover-issue-27/canola-the-ute-guide

Van de Wouw et al. (2016) Australasian Plant Pathology 45: 415-423

Kirkegaard et al. (2018) Ten Tactics for Early-Sown Canola https://grdc.com.au/resources-and-publications/groundcover/groundcover-133-march-april-2018/ten-tactics-for-early-sown-canola

www.nvt.com.au

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Contact details

Steve Marcroft

Marcroft Grains Pathology

Grains Innovation Park

Natimuk Rd, Horsham, VIC 3400

03 5381 2294, 0409 978 941
Steve@grainspathology.com.au

Susie Sprague

CSIRO Agriculture and Food

Clunies Ross Street, Canberra, ACT 2600

02 62465387, 0466 643 227

Susan.Sprague@csiro.au

TRIAL RESULTS 2018

WHEAT NVT RESULTS – 2018

Adjusted trial yields in t/ha and expressed as percentage of Site mean

	Lower EP					
	Cummins		Rudall		Wanilla	
Variety Name	t/ha	%	t/ha	%	t/ha	%
Axe	-	-	2.19	96	-	-
Barham	-	-	-	-	-	-
Beckom	5.31	101	2.34	102	3.69	108
Chief CL Plus	5.42	103	2.23	97	3.61	106
Cobalt	5.36	102	2.23	98	4.09	120
Coolah	-	-	-	-	-	-
Corack	5.3	101	2.45	107	3.63	106
Cosmick	5.46	104	2.36	103	3.45	101
Cutlass	5.21	99	2.25	99	3.86	113
DS Darwin	4.9	93	2.06	90	3.2	94
DS Pascal	5.11	97	1.75	76	2.78	81
Emu Rock	5.02	95	2.35	103	3.54	103
Estoc	4.96	94	2.05	90	3.34	98
Gladius	5.02	96	2.34	103	2.98	87
Grenade CL Plus	4.94	94	2.07	91	3.08	90
Kord CL Plus	4.93	94	2.18	95	3.15	92
LRPB Arrow	5.21	99	2.26	99	3.7	108
LRPB Beaufort	-	-	-	-	-	-
LRPB Cobra	5.38	102	2.25	99	3.29	96
LRPB Havoc	5.03	96	2.44	107	3.77	110
LRPB Impala	-	-	-	-	-	-
LRPB Orion	-	-	-	-	-	-
LRPB Phantom	-	-	-	-	-	-
LRPB Scout	5.15	98	2.31	101	3.07	90
LRPB Trojan	5.54	105	2.1	92	3.36	98
Mace	5.33	101	2.44	107	3.21	94
Razor CL Plus	4.98	95	2.69	118	3.12	91
RGT Zanzibar	-	-	-	-	-	-
Scepter	5.73	109	2.63	115	4.02	118
Sheriff CL Plus	5.58	106	2.26	99	3.76	110
Shield	4.89	93	2.44	107	3.07	90
Tungsten	-	-	-	-	-	-
Vixen	5.83	111	2.66	116	4	117
Wallup	5.01	95	2	88	2.85	83
Wyalkatchem	5.14	98	2.24	98	3.68	107
Yitpi	5.01	95	1.85	81	3.32	97
Zen	5.35	102	2.13	93	4.24	124
Site Mean (t/ha)	5.26		2.28		3.42	
CV (%)	4.3		5.09		7.3	
Probability	<0.001		<0.001		<0.001	
LSD (t/ha)	0.4	8	0.2	9	0.44	13
Analysis Date	05-Dec-2018		13-Dec-2018		13-Dec-2018	
Sowing Date	15-May-2018		06-Jun-2018		17-May-2018	

BARLEY NVT RESULTS – 2018

Adjusted trial yields in t/ha and expressed as percentage of Site mean

Region	Lower EP				Upper EP			
	Cummins		Wanilla		Darke Peak		Elliston	
Variety Name	t/ha	%	t/ha	%	t/ha	%	t/ha	%
Alestar	6.17	93	5.1	97	2	81	1.81	80
Banks	6.69	101	5.37	102	2.3	93	2.02	90
Bass	6.09	92	5.2	99	1.88	76	2.11	94
Bottler	-	-	-	-	-	-	-	-
Buff	6.84	103	5.37	102	2.58	104	2.38	106
Capstan	-	-	-	-	-	-	-	-
Charger	-	-	-	-	-	-	-	-
Commander	6.89	104	4.97	95	2.51	101	1.99	89
Compass	6.5	98	5.11	97	2.57	103	2.52	112
Explorer	-	-	-	-	-	-	-	-
Fairview	-	-	-	-	-	-	-	-
Fathom	6.57	99	5.37	102	2.92	118	2.42	108
Fleet	6.27	95	5.09	97	2.55	103	2.28	101
Flinders	6.38	96	5.43	103	-	-	-	-
Gairdner	5.89	89	4.51	86	-	-	-	-
Granger	6.67	101	5.08	97	-	-	-	-
Hindmarsh	6.7	101	5.54	105	2.73	110	2.26	100
Keel	6.32	95	4.97	95	2.55	103	2.52	112
La Trobe	6.73	102	5.38	102	2.85	115	2.19	97
Maltstar	6.8	103	4.81	92	1.99	80	1.82	81
Navigator	-	-	-	-	-	-	-	-
Oxford	6.05	91	5.48	104	-	-	-	-
RGT Planet	7.54	114	5.3	101	2.03	82	2.11	94
Rosalind	7.31	110	5.71	109	2.72	110	2.24	100
Scope	6.18	93	4.67	89	2.08	84	2.11	94
Spartacus CL	6.64	100	5.49	105	2.7	109	2.16	96
Topstart	6.58	99	5.4	103	1.53	62	1.63	73
Westminster	-	-	-	-	-	-	-	-
Site Mean (t/ha)	6.63		5.25		2.48		2.25	
CV (%)	3.93		5.01		9.14		9.42	
Probability	<0.001		<0.001		<0.001		<0.001	
LSD (t/ha)	0.43	7	0.45	9	0.36	15	0.35	16
Analysis Date	22-Nov-2018		03-Dec-2018		13-Dec-2018		03-Dec-2018	
Sowing Date	15-May-2018		17-May-2018		26-Jun-2018		09-May-2018	

LENTIL NVT RESULTS – 2018

Adjusted trial yields in t/ha and expressed as percentage of Site mean

	Lower EP	
	Yeelanna	
Variety Name	**t/ha**	**%**
Nipper	2.9	89
Nugget	3.14	97
PBA Ace	-	-
PBA Blitz	3.36	104
PBA Bolt	2.73	84
PBA Flash	3.16	98
PBA Greenfield	-	-
PBA Hallmark XT	3.08	95
PBA Hurricane XT	3.24	100
PBA Jumbo	-	-
PBA Jumbo2	3.02	93

Site Mean (t/ha)	3.24	
CV (%)	8.12	
Probability	0.0069	
LSD (t/ha)	0.43	13
Analysis Date	21-Nov-2018	
Sowing Date	14-May-2018	

FIELD PEAS NVT RESULTS – 2018

Adjusted trial yields in t/ha and expressed as percentage of Site mean

	Lower EP			
Nearest Town	**Rudall**		**Yeelanna**	
Variety Name	**t/ha**	**%**	**t/ha**	**%**
Kaspa	1.43	95	2.93	97
Parafield	1.37	91	2.43	80
PBA Butler	1.55	103	3.4	112
PBA Gunyah	1.48	98	2.65	88
PBA Oura	1.44	95	2.82	93
PBA Pearl	1.59	105	3.4	113
PBA Percy	1.53	101	3.13	104
PBA Twilight	-	-	-	-
PBA Wharton	1.41	94	3.06	101

Site Mean (t/ha)	1.51		3.03	
CV (%)	5.23		6.34	
Probability	0.0094		<0.001	
LSD (t/ha)	0.13	9	0.31	10
Analysis Date	17-Nov-2018		23-Nov-2018	
Sowing Date	30-May-2018		14-May-2018	

FABA BEANS NVT RESULTS – 2018

Adjusted trial yields in t/ha and expressed as percentage of Site mean

	Lower EP	
	Cockaleechie	
Variety Name	**t/ha**	**%**
Aquadulce	-	-
Doza	-	-
Farah	3.44	93
Fiesta VF	3.45	94
Fiord	-	-
Nura	3.68	100
PBA Bendoc	3.57	97
PBA Kareema	-	-
PBA Marne	3.73	101
PBA Nanu	-	-
PBA Nasma	-	-
PBA Rana	3.42	93
PBA Samira	3.53	96
PBA Warda	-	-
PBA Zahra	3.72	101
Site Mean (t/ha)	3.69	
CV (%)	6.37	
Probability	0.0037	
LSD (t/ha)	0.41	11
Analysis Date	20-Dec-2018	
Sowing Date	14-May-2018	

LUPIN NVT RESULTS – 2018

Adjusted trial yields in t/ha and expressed as percentage of Site mean

	Lower EP	
	Ungarra	
Variety Name	**t/ha**	**%**
Jenabillup	3.06	105
PBA Bateman	2.85	98
Wonga	2.4	82
Site Mean (t/ha)	2.92	
CV (%)	7.34	
Probability	<0.001	
LSD (t/ha)	0.35	12
Analysis Date	13-Dec-2018	
Sowing Date	11-May-2018	

The NVT results have been downloaded from the GRDC website - https://www.nvtonline.com.au/

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