GRAINS RESEARCH UPDATE

BOOSTING PROFITABILITY – RESILIENT SOLUTIONS

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Dunkeld

Thursday 28 February

9.00am to 1.00pm

Sterling Place - Dunkeld Community Centre,

14 Sterling Street, Dunkeld

#GRDCUpdates

Dunkeld GRDC Grains Research Update
convened by ORM Pty Ltd.

Additional copies of the proceedings can be ordered through ORM for $25 (including postage and GST)

46 Edward Street
PO Box 189
Bendigo VIC 3552

T 03 5441 6176
E admin@orm.com.au
W orm.com.au


GRDC Grains Research Update
DUNKELD
GRDC
GRAINS RESEARCH
& DEVELOPMENT
CORPORATION

Contents

SOUTHERN/WESTERN REGION*

PREDICTA® B
KNOW BEFORE YOU SOW

PREDICTA B DNA Soilborne disease tests

*CENTRAL NSW, SOUTHERN NSW, VICTORIA, TASMANIA, SOUTH AUSTRALIA, WESTERN AUSTRALIA

Cereal root diseases cost grain growers in excess of $200 million annually in lost production. Much of this loss can be prevented.

Using PREDICTA® B soil tests and advice from your local accredited agronomist, these diseases can be detected and managed before losses occur. PREDICTA® B is a DNA-based soil-testing service to assist growers in identifying soil borne diseases that pose a significant risk, before sowing the crop.

Enquire with your local agronomist or visit http://pir.sa.gov.au/research/services/molecular_diagnostics/predicta_b

Potential high-risk paddocks:

- Bare patches, uneven growth, white heads in previous crop
- Paddocks with unexplained poor yield from the previous year
- High frequency of root lesion nematode-susceptible crops, such as chickpeas
- Intolerant cereal varieties grown on stored moisture
- Newly purchased or leased land
- Cereals on cereals
- Cereal following grassy pastures
- Durum crops (crown rot)

There are PREDICTA® B tests for most of the soil-borne diseases of cereals and some pulse crops:

- Crown rot (cereals)
- Rhizoctonia root rot
- Take-all (including oat strain)
- Root lesion nematodes
- Cereal cyst nematode
- Stem nematode
- Blackspot (field peas)
- Yellow leaf spot
- Common root rot
- Pythium clade f
- Charcoal rot
- Ascochyta blight of chickpea
- White grain disorder
- Sclerotinia stem rot

Government of South Australia
Primary Industries and Regions SA
SARDI
South Australian Research and Development Institute
GRDC
Grains Research & Development Corporation

CONTACT:
Russell Burns
russell.burns@sa.gov.au
0401 122 115

Program

9:00 am	**Welcome**	***Brett Symes,*** *ORM*
9:05 am	**GRDC welcome and update**	***GRDC representative***
9:15 am	**Hyper yielding cereals – the quest for increased yields**	***Nick Poole,*** *FAR Australia*
9:55 am	**Disentangling soil amelioration and plant nutrition effects of subsoil manuring on crop yield**	***Corinne Celestina,*** *La Trobe University*
10:35 am	***Morning tea***	
11.05 am	**Pesticides and regulatory impacts – the road ahead**	***Gordon Cumming,*** *GRDC*
11:45 am	**Cereal and soil-borne disease wrap up**	***Grant Hollaway,*** *Agriculture Victoria*
12.25 pm	**Integrated weed management (IWM) status – where to from here?**	***Peter Newman,*** *AHRI*
1.05 pm	***Close and evaluation***	***Brett Symes,*** *ORM*
1.10 pm	**Lunch**	

On Twitter? Follow **@GRDCUpdateSouth** and use the hashtag **#GRDCUpdates** to share key messages

SFS
Southern Farming Systems

Sustainable farming systems for the high rainfall zone

THE BEGINNINGS

Southern Farming Systems was founded in 1995 by a group of farmers who came together to find ways of making cropping in the high rainfall zone (HRZ) of Victoria more profitable by introducing raised bedding to minimise waterlogging.

SFS now has over 500 members in five branches; Geelong, Streatham, Hamilton, Gippsland and Tasmania.

WHO WE ARE

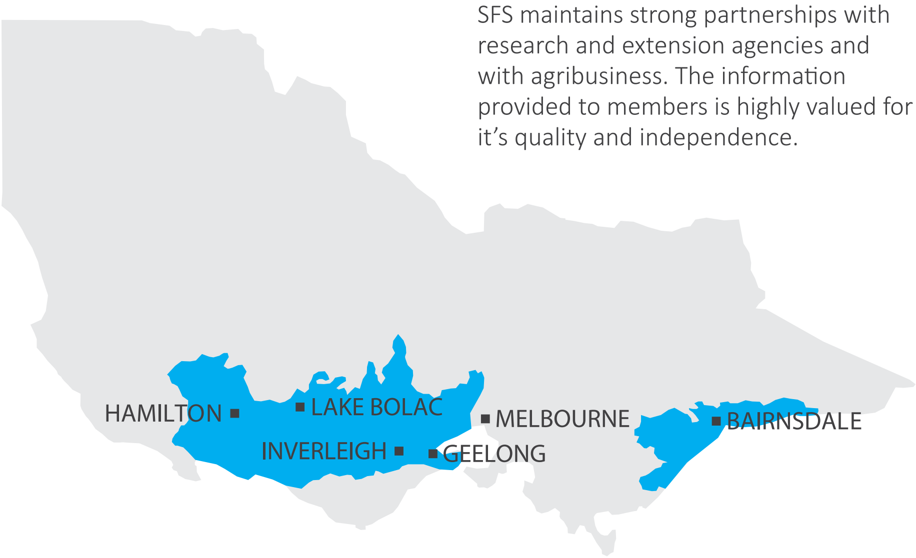
SFS is one of the largest farming system groups in Victoria, recognised as a premier source of grower driven independent research, centered on the high rainfall zones of southern Victoria.

Our objectives are to research, develop and communicate the best use of resources, new techniques and technologies for more profitable agriculture; with a specific mission to increase farm profitability and sustainability.

SFS maintains strong partnerships with research and extension agencies and with agribusiness. The information provided to members is highly valued for it’s quality and independence.

WHAT WE DO

Our extensive trials research program across the HRZ is accompanied by seasonal crop walks, technical workshops and field days throughout the season. The major field day; AgriFocus is considered a ‘must attend’ technical event for the HRZ cropping region. Held annually in October, SFS showcases a range of research trials, technical tours and demonstrations. SFS holds annual trial results meetings in March, including the release of the much acclaimed SFS annual trial results book made available to SFS members. We run a technical workshop for Agronomists annually and work collaboratively with other organisations to bring you an array of workshops throughout the year, all relevant to your farming enterprise.



SFS Branch Regions

“Innovative, relevant and profitable cropping research for HRZ farmers”

VALUE FOR YOU

SFS Membership packages are flexible and offer great value; including biannual newsletters, fortnightly e-updates, copies of our Annual Trial Results book, Free entry to all SFS field days, local crop walks and workshops, as well as access to our Members Only area of SFS website, previous trial report data, SFS weather station data and much more.

GROWER MEMBERSHIP

Membership for primary producers

COMMERCIAL MEMBERSHIP

Companies and organisations who produce commercial goods

SPONSORSHIP

Partnership opportunity with marketing and promotional advertising included

23 High Street,Inverleigh VIC 3321 03 5265 1666 office@sfs.org.au www.sfs.org.au

Current SFS and Collaborative Research Topics

CONTRACT TRIALS PROGRAM

TECHNICAL WORKSHOPS

MLA INTERN PROGRAM

NEW VARIETY EVALUATION TRIALS

MANAGING HEAVY STUBBLES IN HRZ CROPPING SYSTEMS

PROBETRAX, SOIL MOISTURE PROBE NETWORK

INTEGRATED WEED MANAGEMENT

RURAL BANK CROP CHALLENGE

SOIL ACIDITY AND LIMING

PULSE AGRONOMY

Hyper Yielding Cereal project – is there relevance to the mainland high rainfall zone (HRZ)?

Nick Poole[1], Tracey Wylie[1], Darcy Warren[1], Michael Straight[1], Kat Fuhrmann[1], Jon Midwood[2] and Ian Herbert[2].

[1]FAR Australia; [2]Southern Farming Systems (SFS).

GRDC project code: FAR 00003

Keywords

- feed wheat, feed barley, cultivars, early sowing (April), phenology, spring wheat, winter wheat, dry matter, soil fertility.

Take home messages

- Research results from the GRDC Hyper Yielding Cereals (HYC) project have set new benchmarks for the yield performance of irrigated feed wheat with plot yields in excess of 15t/ha in 2016 and in excess of 12t/ha in 2017.
- Higher final harvest dry matter is essential for higher grain yields. Crop canopies producing 30t/ha-35t/ha dry matter at harvest have produced plot yields of 15t/ha – 17t/ha in research plots, using feed grain germplasm.
- Initial screening (50 wheat and 11 barley cultivars/lines) have shown that there are four cultivar characteristics essential for April sowing in the Tasmanian HRZ;
  - The right 'time clock' or phenology is important so that the key development period of stem elongation coincides with the best environmental conditions to maximise growth and yield potential.
  - For sowing prior to ANZAC day (April 25) the research has shown that winter wheat cultivars provide much safer options for maximising yield than spring wheat cultivars.
  - Disease resistance particularly to Septoria tritici blotch (STB), leaf rust and scald.
  - Good standing power is essential for achieving yields over 8t/ha.
- Research from 2018, with mid-April sowing in south-east (SE) South Australia (Millicent), has shown that results achieved in the HYC project are relevant to the longer season mainland HRZ in south-eastern Australia.
- HYC research on feed grain germplasm in Tasmania has shown that the same cultivars are outperforming the current commercial controls grown in mid-April in SE South Australia.
- These wheat cultivars were RGT Accroc⊕, Annapurna⊕, RGT Calabro⊕, AGTW0002 and DS Bennett⊕.
- With the barley research, despite three contrasting seasons, the same three cultivars topped the yield rankings these were RGT Planet⊕, RGT Conquest and the faster developing cultivar Rosalind⊕.

Background

Despite a more suitable climate for grain production than the mainland and much higher yield potential, the average (predominantly dryland) yield of red grain feed wheat in Tasmania is still approximately 5t/ha. While this has increased relatively more than other states in the last 20 years (Source: ABARES) it is still felt to be well below the potential. The HYC project supported by GRDC and led by FAR Australia in collaboration with Southern Farming Systems (SFS) aims to make Tasmania less reliant on grain supplied from mainland Australia through increased productivity of feed grain wheat and barley. Through the collaboration of international, national, local expertise and breeders, the five-year project is working to close the gap between actual and potential yields, as well as using links with end users to promote the value of trading quality feed grains

Research

The irrigated Hyper Yielding Research Centre at Hagley in Tasmania has, over the last three years, used over 1000 experimental research plots each year to identify new cereal lines and agronomy strategies that could lift feed grain productivity in the Tasmanian HRZ. The concept of the research has been to explore whether the April sowing window can be used to maximise biomass and yield potential without giving rise to large increases to input costs.

In 2016, the first-year research results from the HYC project set new benchmarks for the yield performance of feed wheat with plot yields in excess of 15t/ha. The soft finish and high rainfall experienced were in stark contrast to 2017 when low rainfall, higher temperatures and late frosts affected the grain fill period and reduced maximum yields to 12t/ha – 13t/ha. In many ways the contrast of the 2016 and 2017 seasons has been useful in determining which new cultivars/lines perform well in both seasons. In 2018/19 at the time of going to press, wheat remained to be harvested but barley was producing yields in excess of 10t/ha for the third year in succession.

High harvest dry matters essential for higher grain yields

In order to generate higher yielding cereals, it has been essential to generate high harvest dry matters. This has been clearly observed in HYC research with some of the more promising cultivars producing the higher dry matter contents. The final harvest dry matters in 2016 HYC research for the highest yielding cultivars/lines were approximately 30t/ha – 35t/ha dry matter and showed significantly higher grain yields than the control cultivars Manning⁽ᵈ⁾, SQP Revenue⁽ᵈ⁾ and Beaufort⁽ᵈ⁾ (Figure 1). In addition to higher dry matter the same cultivars had better standing power and exhibited better resistance to STB and leaf rust.

High fertility essential for higher yields

High yield potential is strongly linked to higher fertility, where the extra nitrogen (N) required to realise higher potential is provided by the soil not by additional fertiliser. Analysis of HYC yields and grain proteins suggest that large quantities of N, exceeding applied N fertiliser, were removed from the soil to produce high yields. In 2016 yields of 14t/

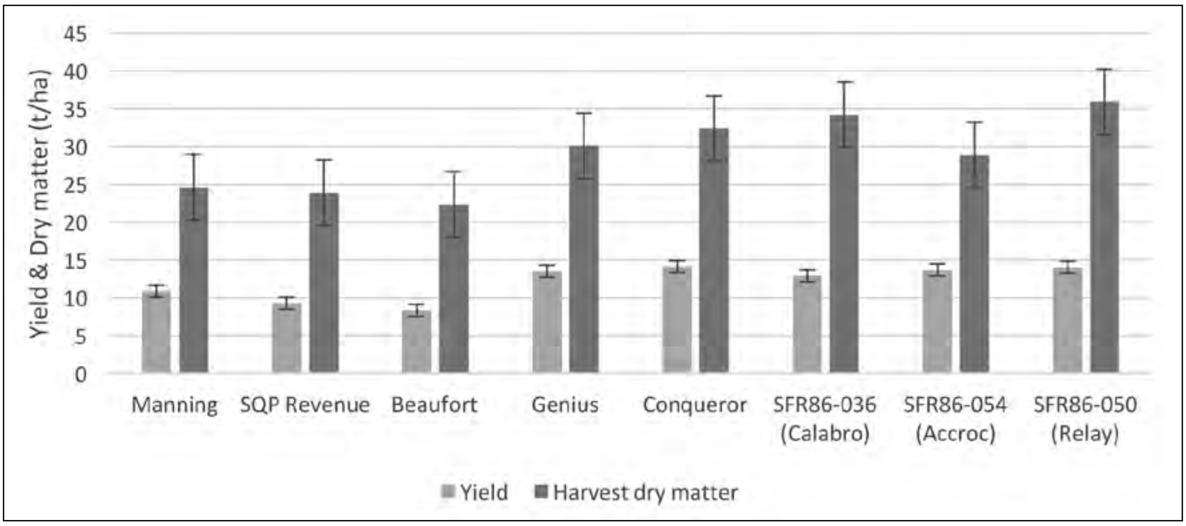


Figure 1. Influence of cultivar/line on grain yield and dry matter (t/ha) at harvest versus commercial controls sown 6 April – HYC Research 2016/17 season.

ha – 17t/ha were achieved with no more than 220kg N/ha fertiliser applied, yet N offtakes in the grain alone indicated the removal of approximately 258kg N/ha – 336kg N/ha for specific cultivars and sowing dates.

In the UK, recent analysis of independent NIAB TAG trials show similar findings to the HYC research over the last two years. Results from a large series of wheat trials indicated that high yield potential usually comes from higher fertility, where the extra N required to realise that potential is provided by the soil, such that the total applied N needn't be significantly higher than for crops with lower yield potential. The analysis of trials on wheat from the UK put forward 'that for every tonne of N fertilised grain/ha, two thirds of a tonne comes from the yield without N'. This was put forward to explain 'why the additional amounts of N required for very high yields in field trials is less than would logically be expected' (NIAB TAG 2018). Clearly the fertility of farming systems and soil organic matters are lower in Tasmania than the UK, however from the Tasmanian results the fertility of the whole farming system is a key component to achieving higher yields.

Is there any relevance of the HYC research to the mainland HRZ?

With far less emphasis on breeding for yield in HRZ regions of Australia, does the research on germplasm and agronomic strategies in Tasmania have any relevance to the mainland? 2018 results from the SA Crop Technology Centre at Millicent run by FAR Australia in collaboration with SARDI and funded by Landmark and the wider industry would suggest the answer is yes.

Mid-April sowing (18 April) suggested that winter wheat cultivars were more suitable to secure the yield potential of this sowing date than spring wheats which developed too quickly (Table 1). The sowing date was too early for the spring wheat cultivars resulting in significant frosting, particularly where cultivars were grown ungrazed (high and standard management).

There was a significant interaction between cultivar and management with spring wheat cultivars benefitting from simulated grazing and the winter wheats showing a yield penalty from grazing. With less frosting in spring the wheat cultivars, under simulated grazing, retarded the development resulting in a partial escape from some of the frosting effects with late flowering. In addition, cultivars identified as high yielding in Tasmanian HYC trials have topped the 2018 Crop Technology Centre results. These wheat cultivars were RGT Accroc, Annapurna, RGT Calabro, AGTW0002 and DS Bennett$^{(b)}$.

High input management (five fungicides (seed treatment and four foliar sprays) and 200kg N/ha of applied N) did not significantly increase grain yields over the standard management approach based

Table 1. Grain yield (t/ha) under three management levels, 2018 Crop Technology Centre, Millicent, SA.

Cultivar	Management Level						
	High Input Yield t/ha		Standard Input Yield t/ha		'Grazed' Input t/ha		Mean
Manning$^{(b)}$ (Winter control)	9.23	efg	9.33	efg	8.36	h	8.97
Beaufort$^{(b)}$ (Spring control)	7.83	hi	7.53	i	8.04	hi	7.80
DS Pascal$^{(b)}$ (Spring)	5.27	l	6.02	jk	6.43	j	5.91
Annapurna (Winter)	10.61	a	10.61	a	9.12	fg	10.11
Conqueror (Winter)	9.13	fg	9.05	g	9.25	efg	9.14
RGT Accroc (Winter)	10.49	ab	10.52	ab	9.27	efg	10.09
RGT Calabro (Winter)	10.23	abc	10.05	a-d	8.36	h	9.55
AGTW0002 (Winter)	9.53	d-g	10.44	ab	9.67	c-f	9.88
Trojan$^{(b)}$ (Spring)	5.49	kl	5.59	kl	6.23	j	5.77
DS Bennett$^{(b)}$ (Winter)	10.01	bcd	9.81	cde	9.58	d-g	9.80
LSD Cultivar p = 0.05	0.33 t/ha	P val	<0.001				
LSD Management p=0.05	0.88 t/ha	P val	0.450				
LSD Cultivar x Man. P=0.05	0.57 t/ha	P val	<0.001				

Winter – winter wheat, Spring – spring wheat, 'Grazed' Management – simulated grazing with mechanical defoliation.

Yield figures followed by different letters are considered to be statistically different (p=0.05), for example a yield of 9.33 efg is considered statistically different to 8.36 h but not to a yield of 9.13 fg.

Plot yields: To compensate for edge effect a full row width (22.5cm) has been added to either side of the plot area (equal to plot centre to plot centre measurement).

Table 2. Approximate date of pseudo stem erect (GS30), mid flowering (GS65) under standard management, dry matter (DM) removed in simulated grazing (mechanical defoliation) management at GS30 and grain yield reduction associated with grazing, 2018 Crop Technology Centre, Millicent, SA				
Phenology (GS30 and GS65), Dry matter removal (GS 30) and yield decrease with grazing				
Cultivar	Date GS30	Date GS65	DM * Kg/ha GS30	Yield reduction (t/ha)
Manning(PBR) (Winter control)	21 Aug	7 Nov	2195	0.97
Beaufort(PBR) (Spring control)	27 Jun	2 Oct	337	+0.51
DS Pascalv (Spring)	27 Jun	5 Oct	261	+0.41
Annapurna (Winter)	21 Aug	24 Oct	2054	1.49
Conqueror (Winter)	9 Aug	12 Nov	1200	+0.20
RGT Accroc (Winter)	13 Aug	24 Oct	1475	1.25
RGT Calabro (Winter)	28 Aug	30 Oct	2197	1.69
AGTW0002 (Winter)	1 Aug	18 Oct	954	0.77
Trojan(PBR) (Spring)	27 Jun	25 Sep	322	+0.64
DS Bennett(PBR) (Winter)	1 Aug	18 Oct	1045	0.23

** Provisional data means presented with no statistical analysis in the express results*

on three foliar fungicides and a 120N total. Higher yielding cultivars were associated with higher test weights and larger grain size (data not shown).

Simulated grazing showed a considerable range of dry matter offtakes dependent on the date at which the cultivar reached growth stage (GS)30 (start of stem elongation). With later developing winter wheat cultivars that reached GS30 in late August, dry matter offtakes exceeded 2000kg/ha. However, these cultivars gave greater grain yield reductions as a result of simulated grazing (Table 2). With slightly faster developing winter wheat cultivars such DS Bennett(PBR), which reached GS30 in early August, the dry matter offtake associated with grazing gave only a slight yield reduction in grain yield but dry matter offtake closer to 1000 kg/ha.

In conclusion, the HYC research trials have identified new cultivars and techniques that have set new benchmarks for yield performance in feed wheat with plot yields in excess of 15t/ha and barley yields over 11t/ha. In addition, 2018 research at the SA Crop Technology Centre in Millicent has found that the same lines identified as high fliers in Tasmania have been performing well in the South Australian HRZ.

Come and view the HYC research at the main Hyper Yielding Cereal Project Field Day in Tasmania on Thursday November 14 2019!

Acknowledgement

The research undertaken as part of these projects is made possible by the significant contributions of growers and agronomists through trial cooperation and provision of diseased plant materials for the isolate collection as well as the support of the GRDC, the author would like to thank them for their continued support.

Contact details

Nick Poole
FAR Australia
23 High St, Inverleigh, Victoria 3221
0499 888 066
nick.poole@faraustralia.com.au

Darcy Warren
FAR Australia
23 High St, Inverleigh, Victoria 3221
0455 022 044
darcy.warren@faraustralia.com.au

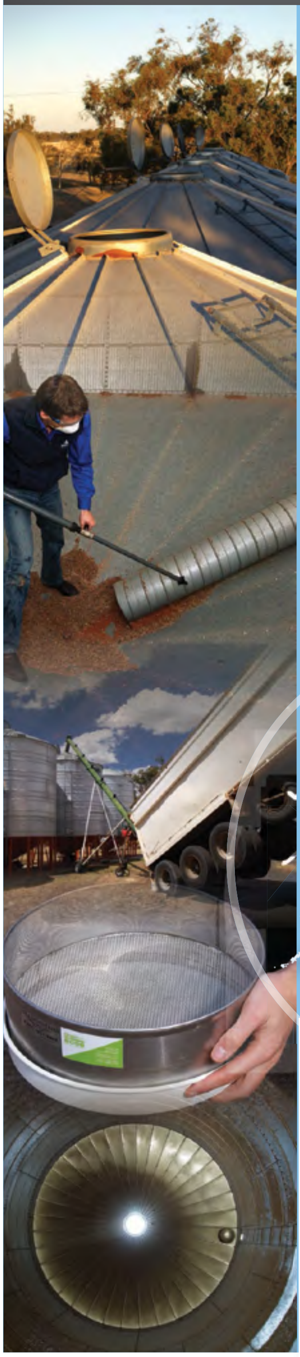
Return to contents

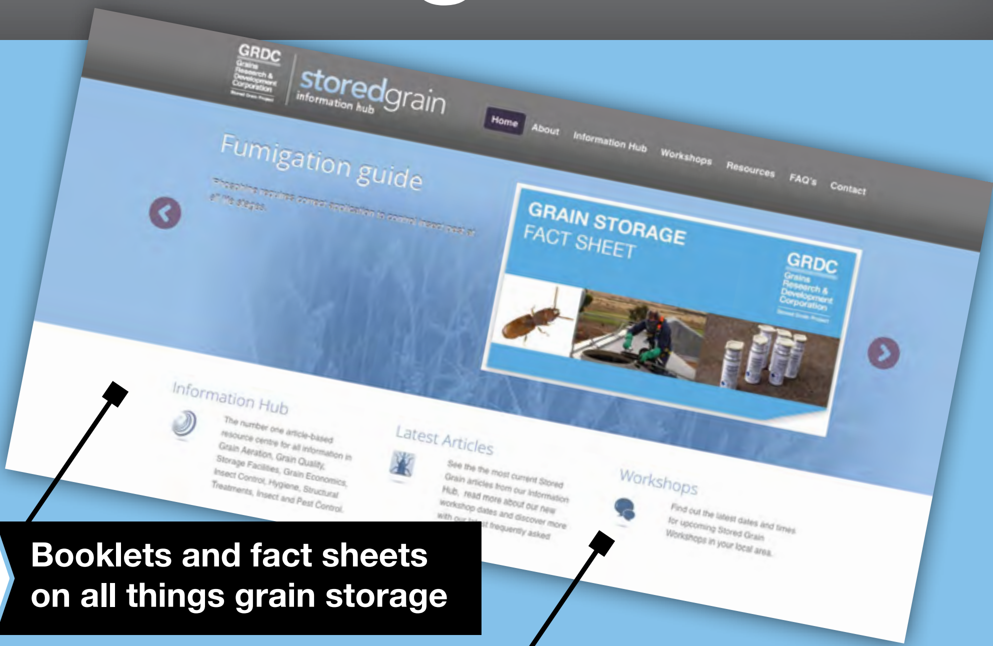
Notes

GET THE LATEST STORED GRAIN INFORMATION ONLINE

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION
STORED GRAIN PROJECT

storedgrain.com.au





Booklets and fact sheets on all things grain storage

Workshops in all regions covering topics such as:

- Economics of on-farm storage
- Grain storage hygiene
- Aeration cooling or drying
- Managing high moisture
- Fumigation
- Insect pest management
- Managing different storages
- Storage facility design
- Storing pulses and oilseeds

Call the National Grain Storage Information Hotline **1800 WEEVIL** (1800 933 845) to speak to your local grain storage specialist for advice or to arrange a workshop

Download the new storedgrain app to get the latest information and storage recording tool on your iPhone or iPad

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION
STORED GRAIN PROJECT

www.grdc.com.au | www.storedgrain.com.au | 02 6166 4500

Disentangling soil amelioration and plant nutrition effects of subsoil manuring on crop yield

Corinne Celestina[1], Jon Midwood[2], Stuart Sherriff[3], Sam Trengove[3], James Hunt[1] and Ashley Franks[1].

[1]La Trobe University; [2]Southern Farming Systems; [3]Trengove Consulting.

GRDC project codes: Grains Industry Research Scholarship GRS11004, TRE0002, SFS00019, CSP00111.

Keywords

- subsoil manuring, nitrogen, amelioration.

Take home messages

- Crop yield responses to subsoil manuring could be due to the nutrients contained in the poultry litter (i.e. improved soil fertility) or the amelioration of a (sub)soil constraint (e.g. soil structural improvements).
- To separate these effects and attribute yield responses correctly, experiments must have appropriate control treatments: a surface applied amendment control and a synthetic fertiliser nutrient control.
- Experiments were carried out across eight sites in Victoria and South Australia that were constrained by subsoils that were sodic, alkaline, boron toxic and/or low in organic matter.
- Evidence from 15 site x years suggests that an increased nutrient supply (particularly nitrogen (N)) drove the crop response to subsoil manuring under the conditions of this study.

Background

In the medium and high rainfall zones of south-eastern Australia, naturally dense clay subsoils are thought to limit dryland crop yields by restricting the movement of air and water and limiting root growth, especially those that have high levels of sodicity. Subsoil manuring is a technique that has been developed to increase yields on these soil types through deep incorporation of nutrient-rich organic matter. Significant and prolonged grain yield increases have been reported after subsoil manuring with 20t/ha of organic amendments such as lucerne pellets or poultry litter (Gill et al. 2008; Sale 2014).

However, it is unknown whether these yield increases are due to the amelioration of subsoil constraints (e.g. sodicity, alkalinity or boron toxicity), the nutrients supplied by the amendment, or some combination of both factors. Because of the large amounts of nutrients contained in amendments such as poultry litter, subsoil manuring can potentially have both an amelioration and fertilisation effect on crop yield. In order to separate these effects and attribute yield responses correctly, experiments require appropriate design with specific treatments.

Design of subsoil manuring experiments to correctly attribute yield responses

The complete set of treatments required to separate the nutrition and amelioration effects of subsoil manuring on crop yield is shown in Table 1.

The deep incorporation of organic amendments (i.e. subsoil manuring) needs to be compared to a surface-applied amendment control and a synthetic fertiliser control, where the same rate of total nutrients and same type of amendment is applied to both the subsoil and the soil surface. These treatments allow attribution of yield increases to either subsoil amelioration or mineral nutrition

<table>
<caption>Table 1. Tillage and amendment treatments needed to separate effects of subsoil manuring on yield due to increased nutrition or amelioration of a soil constraint (adapted from Celestina et al. 2019).</caption>
<tr><th rowspan="2"></th><th rowspan="2"></th><th colspan="3">Amendment treatment</th></tr>
<tr><th>No amendment</th><th>Organic amendment</th><th>Synthetic fertiliser</th></tr>
<tr><td rowspan="2">Tillage treatment</td><td>No tillage/surface broadcast</td><td>Full control</td><td>Surface applied control</td><td>Surface applied nutrient control</td></tr>
<tr><td>Deep tillage for subsoil incorporation</td><td>Tillage control</td><td>Subsurface amendment ('subsoil manuring')</td><td>Deep nutrient control</td></tr>
</table>

by separating the carbon or biological effect of the amendment (e.g. an improvement in subsoil structure) from the fertiliser effect of the added nutrients. If subsoil manuring is ameliorating the physicochemical constraints in the subsoil then the deep placement of organic amendment should increase crop yields over and above those achieved with surface broadcast amendment or synthetic fertiliser placed on the surface or in the subsoil.

There are several difficulties with this comparison due to differences in the amounts and release rates of nutrients in the different amendments. The nutrient rates in the synthetic fertiliser treatment are matched to the total nutrient content of the chicken litter. Very high rates of fertiliser N, P & K are rapidly soluble and may have toxic effects on the crop; despite this, no symptoms of toxicity were reported in the experiments described below. In addition, applying the amendments to the soil surface or the subsoil will affect how quickly they are broken down and nutrients released. These factors will inevitably confound the results of these experiments to some degree, but the most appropriate design is the balanced two-way factorial experiment with ±deep tillage and ±amendments described in Table 1.

Methods

Eight field experiments were conducted on a range of soil types across the medium and high rainfall zones of south-eastern Australia between 2014 and 2016. The experiments, located at Westmere (Victoria) and Hart, Bute and Clare (South Australia), tested the treatments described in Table 1. Experiments compared the surface and deep placement of 20t/ha poultry litter and included an inorganic fertiliser treatment where macronutrient rates and placement were matched to total nutrient levels contained in the poultry litter (kg/ha: 594-634 N, 103-295 P, 266-406 K, 83-92 S). All sites received basal N, P and S at seeding and in-crop N every year.

The eight experimental sites used in this study covered four soil types and all had subsoil constraints that were thought to limit crop yields (Table 2). Every site, except for the Chromosol at Clare West, had moderate to high exchangeable sodium percentage (ESP) indicative of sodic, dispersive subsoils (ESP > 6%). Alkalinity and boron toxicity were present in the South Australian soils, and all eight sites had very low soil organic carbon below the topsoil layers.

A range of annual crops (canola, wheat, barley and lentil) were sown at the eight sites between 2014 and 2016 (Table 3). Seasonal conditions were dry across all sites in 2014 and 2015, with some significant heat events during 2015. The 2016 season was very wet but there was no waterlogging reported at any of the sites. The experiments at Clare East and West were destroyed by a bushfire in 2015.

Table 2. Description of soil types and subsoil constraints at the eight sites used in this study. ESP, exchangeable sodium percentage; SOC, soil organic carbon.

Site	Soil type	Description of constraints
Westmere	Sodosol	Duplex soil, gilgai microrelief, bleached A2 buckshot horizon. High ESP (15-26%) and low SOC below 25 cm.
Hart East	Calcarosol	Gradational clay loam. Moderate to high ESP (10-15%), high pH and low SOC below 30 cm.
Hart West	Calcarosol	Loam. High ESP (11-38%), pH and boron and low SOC below 30 cm.
Bute Northwest	Calcarosol	Transitional cracking clay. High ESP (24-42%), pH and boron and low SOC below 30 cm.
Bute Mid	Calcarosol	Loam. High pH and low SOC below 30 cm, high ESP (16-28%) and boron below 60 cm.
Bute Southeast	Vertosol	Grey cracking clay. High ESP (22-36%), pH and boron and low SOC below 30 cm.
Clare East	Vertosol	Black cracking clay. Low SOC below 30 cm, moderate ESP (8-12%) below 60 cm, moderate boron below 90 cm.
Clare West	Chromosol	Duplex loam over red clay. Low SOC below 60 cm.

Table 3. Crops sown and seasonal conditions at the eight sites used in this study. GSR, growing season rainfall.				
Site	Year	Crop	Rainfall (mm)	
			GSR (Apr-Nov)	Annual (Jan-Dec)
Westmere	2014	Canola	304	368
	2015	Wheat	249	356
	2016	Barley	557	670
	Median		*315*	*502*
Hart East and West	2015	Wheat	332	414
	2016	Lentil	375	520
	Median		*310*	*422*
Bute Northeast, Mid and Southeast	2015	Wheat	243	309
	2016	Barley	458	696
	Median		*293*	*375*
Clare East and West	2015	Wheat	454	545
	2016	Wheat	788	978
	Median		*471*	*638*

Over 15 sites x years, subsoil manuring did not increase grain yields compared with any other treatments and there were no amendment × placement interactions on crop yield that would be indicative of amelioration of subsoil constraints.

The grain yields of amendments applied to the subsoil by deep ripping and those broadcast on the soil surface were the same (Figure 1). In other words, there was no benefit of deep placement of poultry litter or fertiliser over surface broadcasting the same amendment. Hence, it is likely that subsoil manuring was either not effective at overcoming any constraints present at these sites or the constraints were not evident in the seasons experienced.

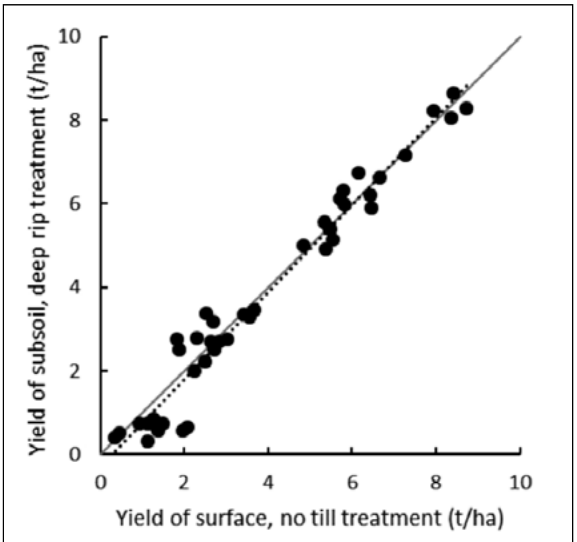


Figure 1. Relationship between grain yield of surface applied, no-till treatment and subsoil applied, deep ripped treatment. R^2 = 96% (adapted from Celestina et al. 2018).

Yields achieved with poultry litter and yields achieved with matched synthetic fertiliser were also equivalent (Figure 2), indicating that both amendments were similar in terms of their medium to longer term fertiliser effect on the crop. These results also suggest that the carbon or microbial component of the organic amendment does not have any advantage over chemical fertiliser in terms of improving crop yields.

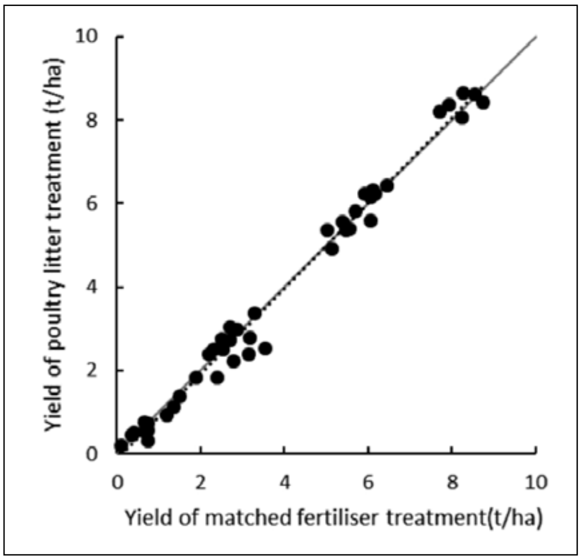


Figure 2. Relationship between grain yield of synthetic fertiliser treatment and poultry litter treatment. R^2 = 99% (adapted from Celestina et al. 2018).

Positive grain yield responses to the addition of 20t/ha poultry litter or equivalent synthetic fertiliser occurred only when grain protein levels were <10.6% (Figure 3), indicating that yield increases

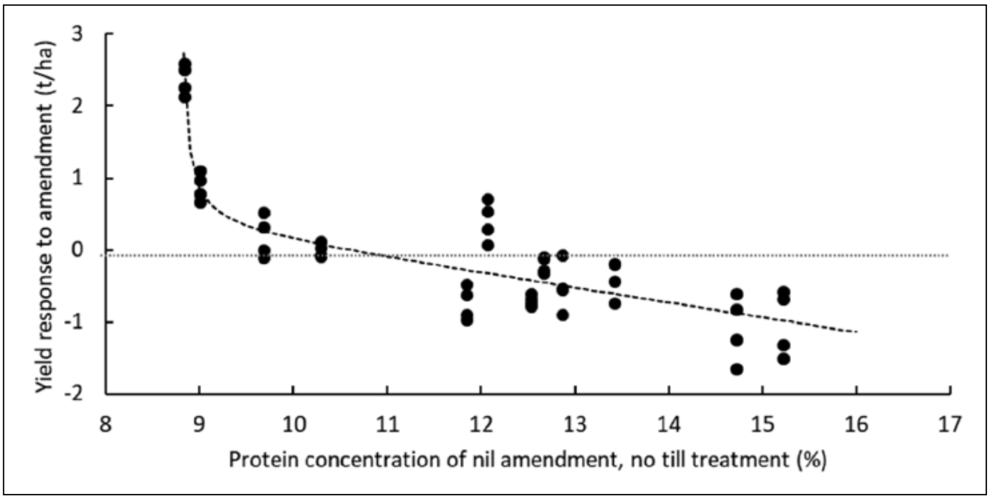


Figure 3. Difference in cereal yield between addition of amendment (poultry litter or matched fertiliser) and the full control of no till, no amendment, in relation to grain protein concentration of the full control. R^2 = 84% (adapted from Celestina et al. 2018).

were likely due to alleviation of N deficiency. Apart from one site year, at all sites where fertiliser was applied to ensure N was non-limiting, crop yields did not increase as a result of the application of any amendments. Haying off (i.e. noticeably reduced yield and increased grain protein) was frequently observed when N supplied by the poultry litter or fertiliser amendments exceeded the requirements of the crop. In addition, grain protein and canola oil responses indicated a substantial and long-lasting (2-3 years) N-fertiliser effect of both the poultry litter and synthetic fertiliser treatments.

Conclusion

Under the conditions of this study, differences in crop yield were attributed to nutrients (particularly N) in the amendment, and not amelioration of the subsoil. Yield responses to subsoil manuring across the eight field sites in this study were in accordance with crop yield responses to N fertiliser. Yield increases occurred in seasons with high water-limited yield potential and/or low soil mineral N and fertiliser N supply (such as at Clare East and West in 2016), and yield responses were negative or negligible in seasons with low water-limited yield potential and/or where supply of soil mineral and fertiliser N exceeded the water-limited demand of the crop (such as at Westmere in 2015).

References

Celestina C, Hunt JR, Sale PWG, Franks AE (2019). Attribution of crop yield responses to application of organic amendments: A critical review. Soil & Tillage Research 186, 135–145. doi:10.1016/j.still.2018.10.002.

Celestina C, Midwood J, Sherriff S, Trengove S, Hunt J, Tang C, Sale P, Franks A (2018). Crop yield responses to surface and subsoil applications of poultry litter and inorganic fertiliser in south-eastern Australia. Crop & Pasture Science 69, 303–316. doi:10.1071/CP17439.

Gill JS, Sale PWG, Tang C (2008). Amelioration of dense sodic subsoil using organic amendments increases wheat yield more than using gypsum in a high rainfall zone of southern Australia. Field Crops Research 107, 265–275. doi:10.1016/j.fcr.2008.02.014.

Sale PWG (2014). Validating subsoil manuring in the high rainfall zone. Final report for GRDC Project ULA000008. La Trobe University, (Bundoora, VIC).

Acknowledgements

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

The authors would also like to acknowledge the staff at Southern Farming Systems and Hart Field Site Group who carried out the field experiments described in this paper.

Contact details

Corinne Celestina
La Trobe University, AgriBio Centre for AgriBiosciences, Bundoora, VIC 3086
c.celestina@latrobe.edu.au
@c_celestina

Return to contents

Notes

GRDC
GROWNOTES

SPRAY APPLICATION GROWNOTES™ MANUAL

SPRAY APPLICATION MANUAL FOR GRAIN GROWERS

The Spray Application GrowNotes™ Manual is a comprehensive digital publication containing all the information a spray operator needs to know when it comes to using spray application technology.

It explains how various spraying systems and components work, along with those factors that the operator should consider to ensure the sprayer is operating to its full potential.

This new manual focuses on issues that will assist in maintaining the accuracy of the sprayer output while improving the efficiency and safety of spraying operations. It contains many useful tips for growers and spray operators and includes practical information – backed by science – on sprayer set-up, including self-propelled sprayers, new tools for determining sprayer outputs, advice for assessing spray coverage in the field, improving droplet capture by the target, drift-reducing equipment and techniques, the effects of adjuvant and nozzle type on drift potential, and surface temperature inversion research.

It comprises 23 modules accompanied by a series of videos which deliver 'how-to' advice to growers and spray operators in a visual easy-to-digest manner. Lead author and editor is Bill Gordon and other contributors include key industry players from Australia and overseas.

Spray Application GrowNotes™ Manual – go to: https://grdc.com.au/Resources/GrowNotes-technical
Also go to https://grdc.com.au/Resources/GrowNotes and check out the latest versions of the Regional Agronomy Crop GrowNotes™ titles.

GRDC™
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Australian agvet chemical review program in perspective

Gordon Cumming.

Grains Research and Development Corporation (GRDC).

Keywords

- crop protection, agvet, chemicals, APVMA, regulations, review, reconsideration.

Take home messages

- The Australian agvet regulatory system is a scientific, evidence-based risk assessment process which is highly recognised internationally.
- Agvet chemicals are nominated for review based on key criteria of concern including human health (toxicology and occupational health and safety), environment, residues and trade, target crop safety and efficacy.
- The greatest direct influence that grain growers can have on retaining their access to agvet chemicals is to only use chemicals for their registered or permitted use and closely adhering to all label directions for use.
- Maintenance of access to agricultural chemicals for broadacre use is reliant on growers showing strong stewardship in following label directions for use.

Background

The Australian Pesticides and Veterinary Medicines Authority (APVMA) is the Australian Government regulator of agricultural and veterinary (agvet) chemical products. It is responsible for the regulation of agvet chemicals into the Australian market place and needs to be satisfied that the intended use does not harm the health and safety of people, animals and crops, the environment, and trade. It does this through:

- Evidence-based evaluation and approval of active constituents and the registration of agvet chemical products.
- The review of certain agvet chemicals of concern to ensure that they continue to meet contemporary scientific standards.

For an agvet chemical product to legally be manufactured, imported, supplied or sold in Australia, it must be registered by the APVMA. The registration process involves scientifically evaluating the safety and efficacy (effectiveness) of a product in order to protect the health and safety of people, animals, plants and the environment.

The APVMA looks to new data, information and science when considering the ongoing safety of a registered product, the full range of risks and how human exposure can be minimised through instructions for use and safety directions.

The assessment determines whether the agvet product, when used in accordance with the label or permit directions for use, would have a harmful effect on human health, occupational health and safety, the environment or trade.

The APVMA's approach to chemical risk assessment

All products registered for use in Australia have been through a robust chemical risk assessment process and are safe when used as per the label instructions.

As Australia's agvet chemical regulator, it is the role of the APVMA to consider all relevant scientific material when determining the likely impacts on human health and worker safety including long term and short-term exposure to users and residues in food before registering a product.

It is the role of the regulator to determine whether products used according to label instructions could result in a level of exposure that poses an unacceptable risk.

Consistent with regulators in other countries, the APVMA uses a risk-based, weight-of-evidence assessment, which considers the full range of risks, including studies of cancer risks, and how human exposure can be minimised through instructions for use and safety directions.

Chemical risk assessment = hazard assessment + exposure assessment

Hazard assessment: Is an assessment of the data related to the intrinsic toxicity potential of an active constituent and/or formulated product.

Exposure assessment: Is an assessment of the likely exposure of humans and environmental organisms that takes into account how the chemical product is to be used, the type and formulation of the product, and the crops or animals to be treated.

Australian Chemical Review Program

The APVMA considers a wide range of scientific data submitted by registrants in support of an application to approve an active constituent or to register a product containing that active constituent. The Chemical Review Program reconsiders the registration of agvet chemicals in cases where credible new scientific information has been generated after a product has been registered that suggests the existence of previously unknown risks to human health, worker safety, the environment, trade and/or product performance has been identified.

If this happens, the APVMA can initiate a reconsideration process (commonly called a chemical review) to assess the identified risk(s) and determine whether changes are needed to ensure that the product can continue to be used safely and effectively.

Chemical reconsiderations are managed under the auspices of the APVMA's Chemical Review Program, which was established in 1995.

The APVMA may undertake a reconsideration to scientifically reassess the risks and determine whether regulatory changes are necessary. Depending on the review's findings, active constituents and the products containing them might:

- be confirmed as safe and appropriate for the registered use(s).
- be restricted in use, by making label amendments to limit the situations in which product(s) may be used, or;
- have its registration suspended pending specific action or cancelled or be withdrawn voluntarily from the market by the registrant(s).

The reconsideration process incorporates legislative, administrative and scientific elements that contribute to the final decision to affirm, vary, suspend or cancel a registration. As a result, reconsiderations can be complex, have high resource requirements and long timeframes.

Prior to 2014, chemical reconsiderations were not time limited—the timeframe of individual reviews was determined by the scope and specific details of the review. For this reason, the time that it has taken to complete individual reviews has been highly variable, ranging from less than six months for the most straightforward label review to more than 10 years for some of the more technically complex and large reviews. The average time taken to complete a review has been just over three years.

From 1 July 2014, chemical reviews will be completed within a prescribed timeframe — under current legislation, a reconsideration must be completed within a maximum of 57 months.

Listing of agricultural chemical reviews

Over the more than 20 years that the Chemical Review Program has been in place, a total of 63 reviews have been completed, with 13 chemicals currently under active review. An additional 19 chemicals have been identified for review prioritisation (Table 1).

Of the 13 chemicals currently under review, eight have broadacre grains registrations as highlighted in Table 1.

Of the 63 completed chemical reviews, 10 had broadacre grains registrations and are listed in Table 2 with a brief description of the regulatory decisions which resulted in:

- Registrations cancelled of two products (endosulfan and fenthion).

- Label amendments/variations of four products (atrazine, dimethoate, diuron, omethoate).
- No changes to broadacre cropping use patterns of four products (bifenthrin, bromoxynil, carbendazim, glyphosate).

A full description of the review status details and regulatory decision(s) for all current and completed chemical reviews is available on the APVMA website.

Listing of chemical reviews: https://apvma.gov.au/chemicals-and-products/chemical-review/listing

Prioritisation of chemicals nominated for review

Agvet chemicals nominated for review by the APVMA are given an order of priority according to the level of concern that led to the nomination.

The APVMA and its external advisory agencies use a scoring process to prioritise nominated chemicals for review, based on key criteria of concern including human health (toxicology and occupational health and safety), environment, residues and trade, target crop safety and efficacy. The priority for each chemical nomination is determined by assessing it against each of the criteria and evaluating the outcomes.

Human health (toxicology and occupational health and safety)

Chemicals that are nominated for review are assessed for their effect on human health against the following criteria:

- Special concerns
  - o demonstrated or potential adverse effects in humans.
- Acute and chronic risk.
- Scheduling of the chemical.
- Exposure to the chemical from food.
- Regulatory action taken overseas (for example, Canada, the European Union, the United Kingdom, the United States of America).
- Hazardous substances.
- Other toxicity (health hazard).
- Industrial exposure in Australia.
- Form of concentrated chemical (includes formulated products).
- Exposure to working strength chemical (mixing, loading or application).
- Frequency of application.
- Post-application exposure (handling of treated crops and animals).
- Toxicity.
- User exposure.

Environment

Chemicals that are nominated for review are assessed for their effect on the environment against the following criteria:

- Environmental exposure
  - o form and method of application.
  - o volume of use (kilograms per annum).
  - o scale of use (hectares per annum).
  - o persistence (soil or aquatic half-life).
  - o bioaccumulation potential.
  - o mobility or leaching potential.
- Environmental toxicity.
- Aquatic toxicity.
- Terrestrial bird or mammalian toxicity.
- Terrestrial plant toxicity.
- Other non-target organisms.
- Sensitivity of receiving environment.
- Demonstrated adverse effects.
- Regulatory action taken overseas on environmental grounds (for example, the US Environmental Protection Agency, the Canadian Pest Management Regulatory Agency or the European Union).

Residues and trade

Chemicals that are nominated for review are assessed for their impact on residues and trade against the following criteria:

- Absence of maximum residue limits (MRLs).
- Reported incidents of residue violations.
- Reported incidents of adverse effects on trade.
- Compatibility with other countries' MRLs.
- International regulatory action.
- Residues resulting from use according to the label and the appropriateness of existing directions (for example, hydroponics versus field use).

Note: Dietary exposure is considered under human health.

Target crop safety

Chemicals that are nominated for review are assessed for their effect on target crop safety against the following criteria:

- Reported incidents of phytotoxicity and adverse interactions with target crops.
- Reported incidents of adverse effects to treated target animals.

Efficacy

Chemicals that are nominated for review are assessed for their efficacy against the following criterion:

- Lack of efficacy (confirmed report(s) of serious incident(s) of chemical failure; substantial incidents of chemical failure).

Chemicals nominated for reconsideration

Identifying and nominating chemicals for review is an ongoing process. The APVMA regularly assesses chemicals nominated for review to ensure the highest risks are being targeted based on up-to-date scientifically based information.

The reconsideration process is initiated when new scientific information raises concerns relating to the safety or effectiveness of the chemical.

The formal legislative process commences when the APVMA decides it is necessary to undertake a reconsideration and issues a legal notice to holders placing their approvals and registrations under review.

The APVMA follows a consultative process with the public, industry and federal and state government agencies to seek input on prioritising chemicals, or types of chemicals, that have been identified for review.

Currently, five chemicals have now been prioritised for detailed scoping prior to commencement of reconsideration. The remainder are to be prioritised for reconsideration after the first five have commenced the reconsideration process.

Currently there 13 chemicals or types of chemicals under review and 19 chemicals the APVMA had identified for future review. Five of these are currently being scoped prior to commencement of the review process.

More information on the chemicals under review, nominated and prioritised for reconsideration is available from: https://apvma.gov.au/node/10876

Table 1. Current chemicals with reviews in progress, those that have be prioritised (1 to 5) for future reviews and those that have been identified for review but not yet prioritised.

Current reviews in progress	Prioritised		Yet to be prioritised
	Priority	Chemical	Chemical
2,4-D[1 2 3 *]	1	Dithiocarbamates [1 2 *]	Acephate [1 2]
Chlorpyrifos [1 3 *]	2	Second generation anti-coagulant rodenticides [1 2 3]	Amitrole [1 2 *]
Diazinon [1 2 3]	3	Cyanazine and Simazine [2 3 *]	Carbofuran [1 2 3 *]
Diquat [1 2 3 *]	4	Phorate [1 3]	Chlorothalonil [1 2 3 *]
Fenitriothion [1 2 3 *]	5	Metal phosphides (only those used for grain treatment) [1 2 *]	Dicofol [1 2 3]
Fipronil [1 2 3 *]			Fenutatin Oxide [1 2 3]
Maldison [1 2]			Hexazinone [3 *]
Methidathion [1 2]			Levamisole [1 2]
Methiocarb [1 2 3 *]			Methomyl [1 2 3]
Molinate [1 2 3]			Permethrin [1 2 *]
Neomycin [1]			Picloram [2 3 *]
Paraquat [2 3 *]			Propargite [1 3]
Procymidone [1 2 *]			Triazole fungicides [1 2 *]
			Trichlorfon [1]

Reason for reconsideration

[1] Public health: Includes a consideration of mammalian toxicology and the risk to people from exposure to residues in food.

[2] Worker safety: Includes a consideration of mammalian toxicology and the risk to people using chemical products, re-entering treated areas and handling treated materials.

[3] Environmental safety: Includes a consideration of ecotoxicology, environmental fate and the risk to organisms from exposure to chemicals in the environment during use and remaining in the environment after use.

** Registered use in broadacre grain cropping.*

Table 2. Agvet chemicals with broadacre grains registrations for which reviews are completed with a brief description of the regulatory decision.

Chemical	Regulatory decision
Atrazine	Label variation.
	Specifically, these changes were to further reduce the risk of atrazine entering waterways, update the information on withholding periods and additional information on weed resistance reporting.
Bifenthrin	Related only to those products containing bifenthrin at 80g/L or 100g/L for which a 500mL pack size had been approved.
	Registration cancellation of 500mL packs with active concentration greater than 80g/L.
Bromoxynil	Changes to withholding period for grazing and cutting for stock food.
Carbendazim	Removal of horticultural and ornamental crops from label.
	Revised safety directions and added birth defects warning statement and male infertility in laboratory animals' statement.
	Re-entry intervals added to label instructions.
Dimethoate	Cancellation of home garden products.
	Restriction of pastures, fodder and oilseed uses to early crop emergence stages only.
Diuron	Label variations to remove or amend those uses where risk from runoff cannot be managed.
	Removal of some horticultural crops and non-agricultural situations.
Endosulfan	All registrations cancelled 11 October 2010.
Fenthion	All registrations cancelled 15 October 2015.
Glyphosate	In May 1997, following the review, the APVMA introduced additional restrictions on the use of glyphosate in or around waterways to limit the potential risks to the aquatic environment.
Omethoate	Removed all use patterns on food producing crops.
	Removed all use patterns for the use of omethoate on crops fed to food producing animals.
	Use restricted to bare earth barrier spray outside of crop.

The cost of registration, reconsideration and its impact on chemical availability

The number of research-based companies involved in the discovery of new chemistries has been declining. In part this is due to the increasing costs of the discovery and development of new pesticides. The average cost to bring a new active ingredient to market from 2010-2014 was an estimated US$286 million – approximately US$134 million more than in 1995.

It is harder and harder to find new active ingredients, despite the fact that chemical companies are screening more molecules than ever before. Only one in 160,000 active ingredients discovered today will pass the rigorous testing requirements to become a registered pest management product.

The additional costs associated with product defence, when a chemical goes through the reconsideration process, can be extremely high if additional data is required to meet current regulatory scientific requirements/standards. A registrant investment decision takes into consideration these additional costs. For older, generic products such expenditure may never be recovered from the market place.

Conclusion

The greatest direct influence that grain growers can have on retaining access to agvet chemicals is to ensure that there are no adverse experiences. This can be achieved by using chemicals for their registered use and closely adhering to all label directions for use including application timing, rates, spray drift mitigation statements and withholding periods.

Failure to do so can result in exceeding of MRLs in commodities, the potential for environmental damage and human health risks. These outcomes then put additional regulatory focus on those agvet chemicals, adding to the body of evidence that may then result in a negative review for the grains industry, leading to further use restriction or cancellation of registrations.

Maintenance of access to agricultural chemicals for broadacre use is reliant on growers showing strong stewardship in following label directions and supporting registrants who invest in new use patterns, both with new actives and old off patent (generic actives).

Useful resources

Australian Pesticides and Veterinary Medicine Authority (APVMA): https://apvma.gov.au/

APVMA: Chemical Review: https://apvma.gov.au/

Contact details

Gordon Cumming
Grains Research and Development Corporation (GRDC)
0428 637 642
gordon.cumming@grdc.com.au

Return to contents

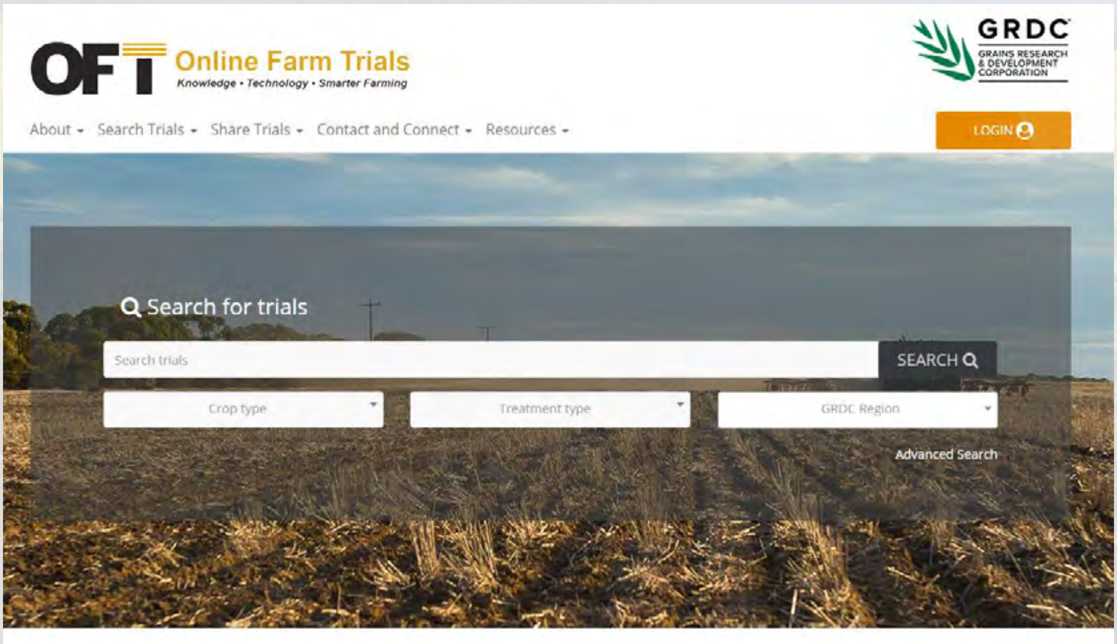
Notes

GRDC ONLINE FARM TRIALS

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

- **Access** trials data and reports from across Australia
- **Share** your grains research online
- **View** seasonally relevant collections of trials
- **Search** by GRDC programs
- **Refer** to location specific soil and climate data
- **Compare** results from multiple trials to identify trends

Looking for relevant and freely accessible information on issues such as crop nutrition, disease control or stubble management in your region? Online Farm Trials (OFT) contains more than 6000 trial projects, 80% of which are publically available, from across Australia on a wide variety of crop management issues and methods. Use OFT to discover relevant trial research information and result data, and to share your grains research online.



www.farmtrials.com.au **@onlinefarmtrial**

CeRDI Federation UNIVERSITY • AUSTRALIA

Cereal foliar and root disease update 2019

Grant Hollaway[1], Mark McLean[1], Joshua Fanning[1], Melissa Cook[1], Alan McKay[2] and Steven Simpfendorfer[3].

[1]Agriculture Victoria, Horsham; [2]SARDI, Adelaide; [3]NSW DPI, Tamworth.

GRDC project codes: DAV00129, DAV00128, DAN00175, DAS00137, DAW00245, DAV00144, DAV00136

Keywords

- yellow leaf spot, rust, septoria, stubble borne disease, root lesion nematodes, crown rot, cereal cyst nematode, net blotch.

Take home messages

- Proactive disease management can minimise losses associated with root and foliar diseases.
- Avoiding highly susceptible varieties where possible provides effective disease control.
- Identifying paddocks at risk of root disease prior to sowing using PREDICTA® B testing enables strategies to minimise yield loss to be implemented.

Background

Dry conditions during 2018 meant cereal diseases were generally of limited concern. However, Agriculture Victoria (AgVic) field trials still measured yield losses of 12% due to foliar diseases and more than 50% due to crown rot, highlighting the importance of effective disease management strategies.

Cereal disease management in 2019

Cereal diseases will require proactive management prior to and during the 2019 season. Often, following dry seasons where diseases had limited impact, there is a temptation to be complacent about preventative disease management strategies, especially when cash flows are constrained. However, 2016 should serve as a reminder of how challenging disease management can be in a wet season following the dry season of 2015.

The widespread early summer rain across Victoria (December 2018) will likely support a green bridge (volunteer cereals growing over summer/ autumn) that will carry over rust and viral diseases to provide early infection of crops in 2019. Likewise, dry conditions during 2018 will have limited the breakdown of stubble. This is likely to increase the carryover of stubble borne pathogens (e.g. crown rot, yellow leaf spot (YLS) and net blotch fungi) into 2019, even from cereal crops grown in 2017.

For 2019, a disease management plan that considers variety rating (consult a current disease guide) and inoculum loads within a paddock (consider stubble and soilborne diseases and cropping history) and the district (consider the green bridge) should be adopted. A fungicide strategy should then be developed for each crop based on the identified risks. Diseases can be cost effectively controlled when a proactive management approach is used.

Wheat foliar diseases

In general, wheat foliar diseases had minimal impact on wheat production during 2018. Septoria tritici blotch (STB) required management in the Western District, but did not progress under drier conditions in the Wimmera. Stripe rust and leaf rust appeared late in the 2018 season, but did not affect crop yield. There were no reports of stem rust in Victoria during 2018.

Rust in wheat

Widespread rain across Victoria in the early summer (December 2018) will support the growth of volunteer cereals that will act as a green bridge to carry rust inoculum over into the 2019 season. Rust is most severe in seasons following wet summers where there are large areas of uncontrolled cereal volunteers (green bridge).

Rust carryover can be reduced by removing volunteer cereals in paddocks by the end of February, thus providing a break in the life cycle of rusts from one season to the next. Removing volunteers also provides benefits for water storage, general management of weeds and other pests and diseases such as aphids and viruses.

Following a wet summer, it is important that increased attention is given to the management of cereal rusts. Where possible, avoid susceptible varieties to the three rusts (consult a current Cereal Disease Guide) and develop plans for rust management during 2019. At sowing, use of the fungicide flutriafol on fertiliser or fluquinconazole on seed has proven successful in delaying the onset of stripe rust epidemics in seasons where a significant green bridge risk existed.

Septoria tritici blotch

Septoria tritici blotch (STB) is currently the most important foliar disease of Victorian wheat crops. It is most severe in the high rainfall zone and widespread in the Wimmera, but did not develop to damaging levels in 2018 due to the dry spring. AgVic, with support from GRDC, assesses National Variety Trial (NVT) lines for their reaction to STB in the field at Hamilton to ensure new varieties have current Victorian relevant ratings.

An integrated approach that incorporates crop rotation (avoiding paddocks with infected wheat stubble), variety selection (avoid susceptible varieties) and in-crop fungicide application can provide effective suppression of STB. Identification of pathogen strains with partial resistance to common fungicides highlights the need to adopt an integrated control approach that is not solely reliant on fungicides.

Yellow leaf spot

Yellow leaf spot (YLS) is a common stubble borne foliar disease of wheat that is favoured by growing susceptible varieties and stubble retention practices. Previous studies by AgVic have demonstrated yield losses of up to 23%. Partial disease control which significantly reduces the level of yield loss in susceptible varieties is achieved with the application of a foliar fungicide (i.e. Prosaro®, (prothioconazole/tebuconazole)) at both stem elongation (Z31) and flag leaf emergence (Z39).

During 2017 and 2018, AgVic conducted field experiments near Horsham to compare fungicides and fungicide combinations for their ability to control YLS in comparison to a disease-free and an unsprayed control (Table 1). YLS infection was established by applying 1kg of infected wheat stubble to each plot. Disease severity, measured as percentage leaf area affected (%LAA), was assessed multiple times between mid-tillering (Z25) and mid anthesis (Z65). In 2018, no assessments were done post mid ear emergence (Z55) due to dry conditions. Grain yield and quality were also measured from harvest samples.

The effect of fungicide treatments on YLS severity during an average rainfall season in 2017 (393mm total) and a below average season in 2018 (204mm total) are shown in Table 2. Overall, no fungicide provided suppression comparable to the low disease treatment in either season, demonstrating that fungicides should not be

Table 1. Fungicide products applied at Z31 + Z39 (except Uniform® applied to fertiliser), active ingredients, rate and application method, and controls tested for suppression of YLS at Horsham during 2017 and 2018.

Treatment	Application	Rate of application (g ai/ha)	Example trade names
No Fungicide	-	-	Nil
Disease free	Multiple foliar fungicide	63/63	Low disease
Azoxystrobin/metalaxyl-M	Fertiliser	129/50	Uniform®
Azoxystrobin/cyproconazole	Foliar	160/64	Amistar® Xtra, Titan Azoxystrobin Extra®
Propiconazole	Foliar	125	Tilt®, Bumper®
Tebuconazole	Foliar	125	Orius®
Prothioconazole/tebuconazole	Foliar	63/63	Prosaro®
Azoxystrobin/epoxiconazole	Foliar	63/63	Radial®
Tebuconazole/azoxystrobin	Foliar	126/76	Veritas®

relied on for complete suppression of YLS. Of the fungicide products, propiconazole (e.g. Bumper®) and the prothioconazole/tebuconazole combination (Prosaro®) provided the greatest disease suppression in 2017. During 2018, propiconazole (e.g. Bumper®), and combinations of azoxystrobin/epoxiconazole (Radial®) and tebuconazole/azoxystrobin (Veritas®) provided significant suppression of YLS, comparable to the prothioconazole/tebuconazole combination (Prosaro®).

There were significant improvements to grain yield and quality following fungicide application during 2017 (Table 3), but not 2018 (data not shown). During 2017, propiconazole (e.g. Bumper®) and the prothioconazole/tebuconazole combination (Prosaro®) provided significant grain yield improvements over the nil control and the greatest grain quality improvements, comparable to the low disease control. This demonstrated that there were benefits to timely fungicide application with some products during a favourable season. Other

Table 2. Percentage leaf area affected by YLS in wheat variety Phantom⚅ on two occasions and AUDPC following different fungicide treatments at Horsham during 2017 and 2018.

	2017			2018		
	Disease severity (%)		AUDPC [A]	Disease severity (%)		AUDPC
Treatments	Z32	Z65		Z34	Z39	
Disease free	1.2 a	27.5 a	803 a	5.8 a	14.7 a	537 a
Propiconazole	13.0 b	29.3 ab	1594 b	15.3 bc	24.5 cd	989 bc
Prothioconazole/tebuconazole	16.7 bc	27.8 a	1742 bc	13.0 b	17.8 ab	833 b
Tebucoanzole/azoxystrobin	21.0 cde	32.7 abc	2035 cd	17.7 bcde	22.0 bc	1024 bcd
Azoxystrobin/cyproconazole	21.2 cde	34.2 bcd	2108 cde	21.2 def	26.2 cde	1234 de
Azoxystrobin/epoxiconazole	20.2 bcd	36.2 cde	2161 cdef	16.3 bcd	20.3 abc	954 bc
Azoxystrobin/metalaxyl-M	31.0 f	34.2 bcd	2491 ef	22.7 efg	25.3 cde	1228 de
Tebuconazole	24.5 def	38.5 de	2314 def	20.0 cdef	23.0 bc	1103 cd
No Fungicide	28.2 ef	40.3 e	2556 f	27.7 g	29.7 de	1458 f
P value	<.001	<.001	<.001	<0.001	<0.001	<0.001
LSD	7.82	5.53	439.7	5.22	6.44	224.2

Values that do not share the same letter in lowercase superscript are significantly different from each other and can be compared within columns only.

[A] AUDPC = Area under disease progress curve, denoting the cumulative disease severity over the growing season.

Table 3. Grain yield and loss plus grain quality of wheat variety Phantom⚅ in response to fungicide treatments to control YLS at Horsham during 2017.

	Grain yield		Grain quality	
Treatments	(t/ha)	Loss (%)	Screenings (%) [A]	Retention (%) [B]
Disease free	6.0 a	-	9 a	73 a
Propiconazole	5.8 abc	5 n.s	10 ab	71 abc
Prothioconazole/tebuconazole	5.7 abcd	5 n.s	9 a	73 a
Tebucoanzole/azoxystrobin	5.6 bcde	7	10 bc	70 abcd
Azoxystrobin/cyproconazole	5.5 cde	8	10 bc	70 bcd
Azoxystrobin/epoxiconazole	5.5 cdef	9	11 bc	68 cd
Azoxystrobin/metalaxyl-M	5.3 def	12	11 c	69 bcd
Tebuconazole	5.2 ef	14	11 c	67 de
Nil	5.2 ef	13	13 d	64 ef
P value	<.001		<.001	<.001
LSD	0.40		1.39	3.13

General analysis of variance with Fishers protected LSD used for analysis.

Letters in lowercase superscript can be compared within columns only.

n.s = non-significant differences from low disease control.

[A] Screenings = % of grain less than 2.2 mm wide. [B] Retention = % of grain greater than 2.5mm wide.

fungicides products did not provide significant yield improvements, but did provide improvements to grain quality, compared to the nil treatment.

The findings from this study were comparable to previous studies that showed that foliar fungicide application at Z31 and Z39 can provide significant improvements to grain yield and quality during seasons favourable to the development of YLS, where yields are average or greater. However, fungicides did not provide economic benefit during dry seasons. Where possible, use variety and paddock selection to minimise risk from YLS as this will be more effective.

Barley foliar disease management

Foliar diseases had little impact on barley crops in Victoria during 2018 due to the dry conditions. Spot form (SFNB) and net form of net blotch (NFNB) and scald were at low levels while leaf rust and powdery mildew were generally absent.

Net form of net blotch

Net form of net blotch (NFNB) is becoming an important foliar disease of barley due to the cultivation of susceptible varieties such as RGT Planet⁽ᵈ⁾ and in some regions, Fairview⁽ᵈ⁾ and Oxford⁽ᵈ⁾. Field experiments at Horsham during 2017 showed grain yield losses of up to 22% (2t/ha), as well as grain quality losses in a high yielding season (approx. 8 t/ha) with good spring rainfall.

Field experiments conducted near Horsham (Wimmera) and Birchip (Mallee) during 2018 determined grain yield and quality loss in three barley varieties with different levels of resistance to NFNB and one very susceptible old breeding line, VB9613. Two treatments were applied: 1) No disease - fungicide treatment which had Systiva® applied to seed and foliar applied Prosaro® at stem elongation (Z31) and flag emergence (Z39) to determine grain yield and quality potential, and 2) Disease treatment, which had no fungicide application and 1kg of NFNB infected barley stubble added, to determine loss.

The Horsham trial was in a paddock with good sub-soil moisture, supporting grain yields of approximately 4.5t/ha, despite growing season rainfall being well below average. Scald infection was present in Fathom⁽ᵈ⁾, Commander⁽ᵈ⁾ and RGT Planet⁽ᵈ⁾, which may have affected grain yield slightly. Up to 24% of leaf area was affected by NFNB in the very susceptible line VB9613. This resulted in a 12% reduction in grain yield (Table 4) and losses in grain plumpness and weight, demonstrating the importance of not growing very susceptible varieties as they can have losses during any season with good yield potential. NFNB developed late in the season in the susceptible to very susceptible (SVS) rated RGT Planet⁽ᵈ⁾, but did not cause grain yield loss and only caused minor grain quality loss. This contrasted with the Horsham site during 2017, where RGT Planet⁽ᵈ⁾ had 22% grain yield loss and significant grain quality losses. This highlights that seasonal conditions are important to disease development and that NFNB is unlikely to be an issue during dry seasons except if a very susceptible variety (VS) is grown.

Fathom⁽ᵈ⁾ (moderately resistant to moderately susceptible (MRMS)) and Commander⁽ᵈ⁾ (moderately susceptible (MS)) had little or no NFNB infection and no losses to grain yield or quality, showing that MS or better rated varieties can be sufficient to avoid loss due to NFNB in low disease pressure seasons.

The Birchip site had less than 5% of leaf area affected by NFNB (data not shown) and grain yield was less than 0.7t/ha in all varieties and treatments (data not shown), indicating that water was the main limiting factor to yield. This demonstrated the importance of reviewing disease management plans during the season and not unnecessarily applying fungicides in such a dry season.

Red leather leaf of oats

Red leather leaf is a common stubble and seed-borne foliar disease of oats caused by the fungus *Spermospora avanae*. To date, there has been little

Table 4. NFNB severity, grain yield and quality loss of three barley varieties and one VS rated breeding line at Horsham during 2018.

	NFNB Severity (%) 18/10 (Z85)	Grain yield loss (t/ha)[A]	Grain quality loss (%)[A]		
			Retention (>2.2 mm)	Screenings (<2.2 mm)	Weight (g)
Fathom⁽ᵈ⁾ (MRMS)	0.2	0.3 (7%)^{ns}	0	0	0
Commander⁽ᵈ⁾ (MS)	0.8	0.2 (4%)^{ns}	1ns	0	0
RGT Planet⁽ᵈ⁾ (SVS)	5.0	0.1 (2%)^{ns}	1*	0	2^{ns}
VB9613 (VS)	23.8	0.5 (12%)*	7*	1*	5*

*=Significant difference between the fungicide and disease treatments at 0.05. ns = Not significant.

research to determine its impact on oat production or identify effective control strategies. AgVic conducted separate variety yield loss and fungicide experiments near Horsham during 2018 to help develop management strategies.

The yield loss experiment consisted of four milling grade varieties (Table 5) with different resistance ratings to red leather leaf, with six replicates each of two treatments: 1) Disease free - three fungicide applications to minimise disease, and 2) Disease - no fungicide and 1kg of red leather leaf infected oat stubble applied to determine loss.

Despite the low rainfall during 2018, the oats yielded 3-4t/ha with up to 18% red leather leaf infection by season's end. Kowari$^{\Phi}$ and Bannister$^{\Phi}$ both had significant grain yield loss in infected plots (Table 5). Kowari$^{\Phi}$ also lost grain quality, which is a potential concern for milling oat growers. No grain yield or quality loss was measured for Williams$^{\Phi}$ or Mitika$^{\Phi}$, most likely due to crop maturity in relation to disease development.

These findings demonstrate that red leather leaf caused grain yield and quality loss in milling oats, even during a dry season. Losses were variable between varieties and are likely to be greater during wetter seasons that favour disease development later in the season.

Fungicides

To evaluate fungicide strategies for the management of red leather leaf in oats, three fungicide applications timings (Z25, Z31 and Z39) were compared with an untreated control in the susceptible oat variety Mitika$^{\Phi}$. Disease severity was assessed six times (27 July, 6 and 23 August, 5 and 11 September and 2 October) during the growing season and grain yield and quality measured. There was no significant effect of fungicide on grain yield or quality, so this data has not been presented.

Red leather leaf symptoms were first observed during mid-July which developed rapidly during late August and early September (Figure 1) in response to wet weather. There was little disease development during the spring months due to dry conditions. Red leather leaf suppression varied between foliar fungicide timings with application at tillering (Z25) providing the best suppression (Figure 1) and application at stem elongation (Z31) was the next most effective. This was due to fungicide application coinciding with the onset of early disease development in 2018. Foliar fungicide at flag leaf emergence (Z39) was less effective, due to the application being after the majority of disease had already developed.

Red leather leaf develops rapidly, given the right conditions. As a result, multiple fungicide applications may be required. Further studies are required to provide more robust management recommendations to oat growers.

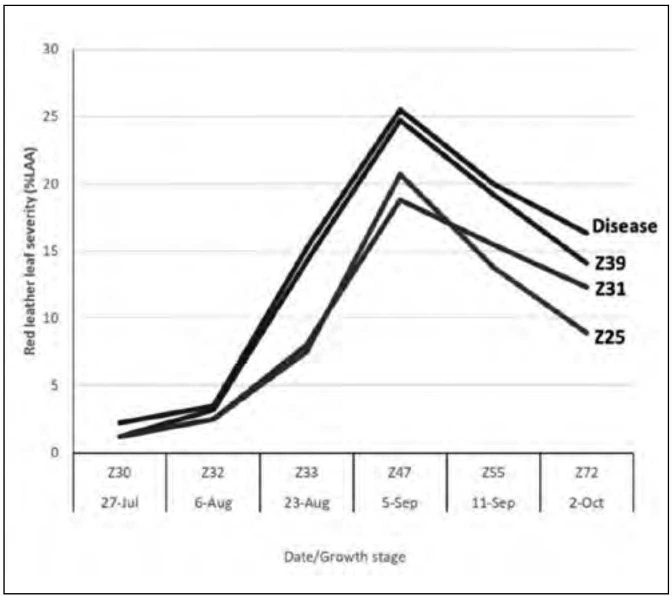


Figure 1. Red leather leaf development in susceptible oat variety Mitika$^{\Phi}$ in response to application of foliar fungicide, propiconazole (125 g ai/ha) at different growth stages in comparison to a no fungicide, disease treatment.

Table 5. Red leather leaf severity, grain yield and quality loss of four milling oat varieties at Horsham during 2018.

Variety	Red leather leaf severity (%LAA)[A] 2 Oct (Z72)		Grain yield		Grain quality loss (%)[B]		
	Dis.	Fung.	t/ha	Loss	Retention (>2.5mm)	Screenings (<2.2mm)	Grain weight
Kowari$^{\Phi}$ (MRMS)	17.8	12.7	3.0	0.3 (10%)*[B]	9*	4*	2*
Bannister$^{\Phi}$ (MS)	13.3	6.9	4.0	0.5 (12%)*	1^{ns}	2^{ns}	1^{ns}
Williams$^{\Phi}$ (MS)	9.4	11.5	3.5	0	0	0^{ns}	0
Mitika$^{\Phi}$ (S)	16.1	12.6	3.0	0	1^{ns}	0^{ns}	2^{ns}

[A] %LAA = percentage of leaf area affected.

*[B] *=Significant difference between the fungicide and disease treatments at 0.05. ns = Not significant.*

Soilborne diseases

Yield losses caused by root diseases often go unrecognised as symptoms are below ground and even if their effects become apparent, there are no in-crop management solutions available. A PREDICTA® B test taken before planting provides an effective way to detect paddocks at risk of root diseases and enables management strategies to be implemented.

Recent economic studies demonstrated annual average yield losses of 7% and 1% due to crown rot and root lesion nematodes, respectively, across Victoria and South Australia (SA). Within individual situations, however, field trials during 2018 in Victoria demonstrated yield losses from crown rot of 42% and 65% in bread and durum wheat crops, respectively (Table 6), demonstrating how damaging this disease can be.

Crown rot

Crown rot is now possibly the most important disease affecting wheat crops in Victoria and nationally. A recent study of 1502 PREDICTA® test results from across Victoria and SA (2015-2017) found that 36% of paddocks tested had a medium or high level of crown rot inoculum prior to sowing. Annual average yield losses across all wheat crops in Victoria and SA were estimated to be 6.6% with losses up to 10% in seasons conducive to crown rot. Field trials conducted by AgVic have demonstrated that in paddocks where crown rot is present, yield losses greater than 30% can occur.

The extent of yield loss caused by crown rot is related to the level of inoculum present in the paddock at planting, the seasonal conditions and variety susceptibility (Table 6). Hence, growers can use a PREDICTA® B test to establish the level of risk present in a paddock prior to sowing and implement appropriate management strategies if necessary.

Seasonal conditions have a large influence on the yield loss caused by a given level of crown rot infection (Table 6). For example, during the wet season of 2016, the medium crown rot inoculum levels caused no yield loss, but during the driest season (2018) the same level of inoculum caused a 35% reduction in grain yield in the susceptible variety Cobra$^{\oplus}$.

Cereals vary in their extent of yield loss in the presence of crown rot. As shown in Table 6, during 2015 at the high inoculum level, yield loss in the bread wheat Emu Rock$^{\oplus}$ (MS) was 12%, while in the bread wheat Cobra$^{\oplus}$ (S) was 35% and the durum wheat WID802 (VS) was 63%. This clearly shows the benefit of avoiding highly susceptible varieties in paddocks with medium to high levels of crown rot inoculum.

In paddocks with high levels of crown rot, it is best to avoid growing cereals. Previous work has shown that cereals increased inoculum levels, while

Table 6. Effect of seasonal conditions, increasing crown rot inoculum levels at planting and varietal susceptibility on yield loss with yield potential and growing season (April to October) rainfall at Horsham during the years 2015 to 2018.

Year	Yield Loss (%)			Yield Potential (t/ha)	GSR (mm) Apr-Oct
	Crown Rot Level (g/m row)				
	Low (0.25)	Medium (1.0)	High (2.0)		
Bread Wheat, cv. Emu Rock$^{\oplus}$ (MS to crown rot)					
2015	0	15	12	3.15	142
2016	0	0	0	6.55	374
2017	0	0	0	4.44	303
2018	0	0	0	2.53	187
Bread Wheat, cv. Cobra$^{\oplus}$ (S to crown rot)					
2015	18	29	35	3.14	142
2016	0	0	0	7.24	374
2017	0	9	17	4.12	303
2018	0	35	42	2.36	187
Durum Wheat, cv. WID802 (VS to crown rot)					
2015	19	50	63	3.10	142
2016	0	0	0	7.69	374
2017	0	12	25	4.32	303
2018	0	22	65	2.52	187

broadleaf break crops (e.g. canola and pulses) and fallow decreased inoculum levels of crown rot. In general, a two-year break from cereals is required to reduce medium to high inoculum levels to a low level. A three-year break may be required following the dry season of 2018 due to the decreased decomposition of cereal stubble.

Rhizoctonia root rot

The dry 2018 season will have favoured the build-up of *Rhizoctonia solani* AG8 levels within paddocks. Significant summer rainfall will decrease inoculum levels if volunteer cereals and summer weeds (green bridge) are effectively controlled. The impact of rhizoctonia root rot on crops sown in 2019 will be reduced if the season breaks early and crops establish in warmer soil. Rhizoctonia is most damaging when root growth is restricted either by cold soils, compaction layers or lack of moisture. Crops that establish well can still be affected in mid-winter when soil temperatures drop below 10°C at which point Rhizoctonia can attack the crown roots causing uneven growth and reduced tiller number, rather than classic bare patch symptoms.

If growing cereals in 2019, a PREDICTA® B test can be used to identify paddocks at risk. If Rhizoctonia is present at high levels, control summer weeds and autumn green bridge and consider rotating to a non-cereal crop. If a cereal is to be grown, wheat is more tolerant than barley and early sowing in the seeding window with banding of nitrogen (N) below the seed to facilitate rapid root growth can also limit early impacts. Ensure good crop nutrition, with particular attention to trace elements, and increase seeding rates to reduce impact of lost tillers from Rhizoctonia damage to crown roots.

Consider fungicide seed treatments to protect the roots. Rainfall is needed to move fungicides into the root zone as roots outside the fungicide zone are not protected. Seed treatments tend to protect the seminal roots, whereas liquid streaming Uniform® above and below the seed can protect crown and seminal roots and tends to produce larger yield responses in above average rainfall seasons.

Root lesion nematodes

The root lesion nematodes (RLN), *Pratylenchus neglectus* and *P. thornei* are widespread in Victorian cropping paddocks. A recent study of 1,965 PREDICTA® B test results from across Victoria and SA (2013-2017) found that RLNs were present in 92% of paddocks with approx. 10% of paddocks having a medium or high test result. This report estimated the annual average yield loss across all wheat crops in Victoria and SA to be 1% with losses up to 2% in seasons conducive to losses from RLNs. Field trials conducted by AgVic and SARDI have demonstrated that in paddocks where RLNs are present, yield losses greater than 10% can occur.

Using data collected from many field trials conducted in Victoria and SA, the PREDICTA® B risk categories were updated for RLNs (Table 7). These revised risk categories reflect that yield losses due to RLNs do not occur in all seasons and our improved understanding of the extent of yield losses that they cause.

Table 7. Revised *P. thornei* and *P. neglectus* PREDICTA® B risk categories for Victoria and SA for seasons that range in their conduciveness for yield loss in intolerant varieties.

Risk Category	RLN /g soil	Seasonal Conditions and Frequency[A]		
		Conducive 40%	Intermediate 30%	Non-conducive 30%
		Yield Loss %		
Pratylenchus thornei				
BDL[B]	<0.1	0	0	0
Low	0.1-14	0-5	0-2	0
Medium	15-60	5-20	2-10	0
High	>60	20-40	10-20	0
Pratylenchus neglectus				
BDL	<0.1	0	0	0
Low	0.1-24	0-5	0-2	0
Medium	25-100	5-20	2-10	0
High	>100	20-40	10-20	0

[A] *Conducive and non-conducive season are those where yield loss does and does not occur, respectively, due to the nematodes. The historical frequency of these occurrences is provided as percentages. The conditions that favour yield loss are not understood.*

[B] *BDL, below detection level.*

To keep nematode densities below yield limiting thresholds, it is important to grow varieties with a MR/MS or better resistance rating. If susceptible varieties are grown, it is important they are rotated with resistant crops or varieties and nematode densities monitored using a pre-sowing PREDICTA® B test. If medium to high nematode densities are present, consider growing resistant crops or varieties. Consult current Cereal and Pulse Disease Guides for the latest RLN resistance ratings as it is important to check the resistance rating of varieties due to varietal variation within crops for resistance/ susceptibility to RLN species.

Bunts and smuts

Seed treatments provide cheap and effective control of bunt and smut diseases. Seed should be treated every year as bunt and smut can increase rapidly, resulting in unsaleable grain. Good coverage of seed is essential and clean seed should be sourced if a seed lot is infected. Fertiliser treatments do not control bunt and smuts, so seed treatments are still required.

Conclusion

In the absence of proactive disease control, yield losses due to diseases can be greater than 20%. It is, therefore, important that plans are developed to effectively manage wheat diseases this season.

Useful resources

Current Victorian Cereal Disease Guide: http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/cereal-disease-guide

Acknowledgements

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

Funding for this work was provided by the Victorian Government (Agriculture Victoria) and the GRDC through the GRDC projects DAV00129, DAV00128, DAV00144, DAV00136, DAN00175 and DAW00245.

Thanks to Agriculture Victoria’s Cereal Pathology Team: Graham Exell, Jordan McDonald, Tom Pritchett, Jon Baker, Laura Roden, Luise Sigel, Jennifer Cutajar and Winnie Liu Heang. Thanks also to the Birchip Cropping Group for field trials within the Victorian Mallee.

Contact details

Grant Hollaway
Agriculture Victoria, Private Bag 260,
Horsham 3401, Victoria
03 5362 2111
grant.hollaway@ecodev.vic.gov.au
@Grant_Hollaway

Return to contents

Notes

GRDC

NATIONAL VARIETY TRIALS™

NVT apps

CANOLA | WHEAT | DURUM | BARLEY | CHICKPEA | FABA BEAN | FIELD PEA | LENTIL | LUPIN | OAT | SORGHUM

Long Term Yield Reporter

New web-based high speed Yield Reporting tool, easy-to-use means of accessing and interpreting the NVT Long Term MET (Multi Environment Trial) results.

Crop Disease Au App

Access to current disease resistance ratings & disease information.

Long Term Yield App

NVT

Easy access to the analysed NVT Multi Environment Trial (MET) data.

www.nvtonline.com.au

Available on the App Store

Google play

We are getting new herbicides — do we need to worry about diverse weed management now?

Peter Newman.

Australian Herbicide Resistance Initiative /WeedSmart.

Keywords

- new herbicides, herbicide resistance, cross resistance.

Take home messages

- We know that ryegrass and other weeds can be beaten by 'driving down' the seed bank using a diverse range of tools. Many growers who have been on this program for a decade or more are having a win. It is not easy, but we can win, however, it takes more than herbicides alone.

Introduction

Growers have been told for years that there are no new herbicides on the horizon to fix herbicide resistance problems, but alas, some new herbicides are on the way. It is possible that there will be several new herbicides on the market in the coming years, possibly even a new mode of action. Do we need to continue on the path of adopting diverse weed management practices, including herbicide and non-herbicide tools, or will the new products fix the problems?

You will probably guess that I will suggest that there is a need to use a diverse range of weed control tools, and below are a few reasons why I believe that diversity is still the answer. Do not get me wrong — I support new herbicides and am excited about the opportunity they bring. I believe we can get the best out of them by continuing to adopt some non-herbicide tools to add to the farming system.

EP162 – metabolic cross resistance

Last year, I saw the most alarming herbicide resistance data during my 25 year long career. Below is an excerpt from the Australian Herbicide Resistance Initiative (AHRI) insight, August 2018, summarising this data.

AHRI insight #105

A population of ryegrass from Eyre Peninsula, South Australia called EP162 may just be the world's most herbicide resistant ryegrass population. It has been confirmed resistant to all of the pre-emergent herbicides – Avadex®, Arcade®, trifluralin, propyzamide and Sakura®, as well as two lesser known herbicides, EPTC and thiobencarb. It was sampled in 2014 during the random survey led by Peter Boutsalis from the University of Adelaide with GRDC investment, just two years after the release of Sakura® in Australia. You guessed it, metabolic cross resistance is at play. Paraquat and the triazines still work on this population, but that is it!

Unpredictable pattern of cross resistance

A random survey in the South East of South Australia, also by Peter Boutsalis and team, found many more populations of ryegrass with multiple cross resistance to a range of pre-emergent herbicides, and the perplexing thing is that there is no predictable cross resistance pattern.

The only herbicide that was spared was Edge® (propyzamide), but the bad news is that EP162 may be the first ryegrass population in the world with confirmed propyzamide resistance. This is the subject of further research.

This is the research by the team of Chris Preston, Peter Boutsalis, David Brunton and Gurjeet Gill from the University of Adelaide with GRDC investment.

This is the worst herbicide resistance news that I have seen in my 25 year long career simply due to the fact that so many herbicides are failing simultaneously.

What does this mean for new herbicides?

Previously, new herbicides were tested on susceptible weeds. Now the new herbicides not only need to kill the susceptible weeds, they need to kill cross resistant monsters like those detailed above. The cross resistance pattern to the herbicides is completely unpredictable. How would a herbicide company feel about bringing out a product with a label claim that 'this product might kill your weeds, depending on its cross resistance status'? This makes for a very challenging environment for the chemical companies. On the upside, there is the ability to test new products against the 'cross resistant monsters' before they come to market.

Test

Herbicide resistance testing has never been very popular, and at times it has been hard to see the value of the test because it often just confirmed what was already suspected. Not anymore. Testing will become a high priority in years to come. Growers will need to know if the pre-emergent herbicides they are applying will work. Given that the cross resistance pattern is completely unpredictable, the only way will be to test — a lot.

My case for the need to continue with diverse weed management

1. Some weed populations will be resistant to the new herbicides before they are even released to market.
2. Pre-emergent herbicide + crop competition = high level control. The best pre-emergent herbicides give approx. 90% control of ryegrass. Adding crop competition can boost this into the high 90s.
3. Late germinating weeds. Weeds have adapted to germinate late to avoid knockdown and pre-emergent herbicides. Crop competition, stopping seed set and harvest weed seed control are needed to tackle these.
4. Keep the cost down. New herbicides are not cheap. If the life of low cost, off patent herbicides can be extended, growers can contain herbicide costs and use new, more expensive herbicides strategically and in mixes with older products.
5. EP162.
6. There is no sign of a new knockdown herbicide that I am aware of. We need to keep glyphosate and paraquat working.
7. Growers need to be confident about the future of cropping. If they feel in control of their weed seed bank, through the use of a diverse range of tools, they can be confident that they will be able to maintain a profitable cropping rotation, regardless of what resistance issues they face.

Want a little more information about diverse weed control? Check out the WeedSmart Big 6 at www.weedsmart.org.au

Summary

We know that ryegrass and other weeds can be beaten by 'driving down' the seed bank using a diverse range of tools. Many growers who have been on this program for a decade or more are having a win. It is not easy, but we can win, however, it takes more than herbicides alone.

Contact details

Peter Newman
Planfarm
Geraldton
08 9964 1170
petern@planfarm.com.au

Return to contents

Notes

Notes

THE 2017-2019 GRDC SOUTHERN REGIONAL PANEL

JANUARY 2019

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

CHAIR - JOHN BENNETT

Based at Lawloit, between Nhill and Kaniva in Victoria's West Wimmera, John, his wife Allison and family run a mixed farming operation across diverse soil types. The farming system is 70 to 80 percent cropping, with cereals, oilseeds, legumes and hay grown. John believes in the science-based research, new technologies and opportunities that the GRDC delivers to graingrowers. He wants to see RD&E investments promote resilient and sustainable farming systems that deliver more profit to growers and ultimately make agriculture an exciting career path for young people.

M 0429 919 223 **E** john.bennett5@bigpond.com

DEPUTY CHAIR - MIKE MCLAUGHLIN

Mike is a researcher with the University of Adelaide, based at the Waite campus in South Australia. He specialises in soil fertility and crop nutrition, contaminants in fertilisers, wastes, soils and crops. Mike manages the Fertiliser Technology Research Centre at the University of Adelaide and has a wide network of contacts and collaborators nationally and internationally in the fertiliser industry and in soil fertility research.

M 0434 765 574
E michael.mclaughlin@adelaide.edu.au

PETER KUHLMANN

Peter is a farmer at Mudamuckla near Ceduna on South Australia's Western Eyre Peninsula. He uses liquid fertiliser, no-till and variable rate technology to assist in the challenge of dealing with low rainfall and subsoil constraints. Peter has been a board member of and chaired the Eyre Peninsula Agricultural Research Foundation and the South Australian Grain Industry Trust.

M 0428 258 032 **E** mudabie@bigpond.com

JON MIDWOOD

Jon has worked in agriculture for the past three decades, both in the UK and in Australia. In 2004 he moved to Geelong, Victoria, and managed Grainsearch, a grower-funded company evaluating European wheat and barley varieties for the high rainfall zone. In 2007, his consultancy managed the commercial contract trials for Southern Farming Systems (SFS). In 2010 he became Chief Executive of SFS, which has five branches covering southern Victoria and Tasmania. In 2012, Jon became a member of the GRDC's HRZ Regional Cropping Solutions Network.

M 0400 666 434 **E** jmidwood@sfs.org.au

FIONA MARSHALL

Fiona has been farming with her husband Craig for 21 years at Mulwala in the Southern Riverina. They are broadacre, dryland grain producers and also operate a sheep enterprise. Fiona has a background in applied science and education and is currently serving as a committee member of Riverine Plains Inc, an independent farming systems group. She is passionate about improving the profile and profitability of Australian grain growers.

M 0427 324 123 **E** redbank615@bigpond.com

ROHAN MOTT

A fourth generation grain grower at Turriff in the Victorian Mallee, Rohan has been farming for more than 25 years and is a director of Mott Ag. With significant on-farm storage investment, Mott Ag produces wheat, barley, lupins, field peas, lentils and vetch, including vetch hay. Rohan continually strives to improve productivity and profitability within Mott Ag through broadening his understanding and knowledge of agriculture. Rohan is passionate about agricultural sustainability, has a keen interest in new technology and is always seeking ways to improve on-farm practice.

M 0429 701 170 **E** rohanmott@gmail.com

RICHARD MURDOCH

Richard along with wife Lee-Anne, son Will and staff, grow wheat, canola, lentils and faba beans on some challenging soil types at Warooka on South Australia's Yorke Peninsula. They also operate a self-replacing Murray Grey cattle herd and Merino sheep flock. Sharing knowledge and strategies with the next generation is important to Richard whose passion for agriculture has extended beyond the farm to include involvement in the Agricultural Bureau of SA, Advisory Board of Agriculture SA, Agribusiness Council of Australia SA, the YP Alkaline Soils Group and grain marketing groups.

M 0419 842 419 **E** tuckokcowie@internode.on.net

MICHAEL CHILVERS

Michael runs a collaborative family farming enterprise at Nile in the Northern Midlands of Tasmania (with property also in northern NSW) having transitioned the business from a dryland grazing enterprise to an intensive mixed farming enterprise. He has a broad range of experience from resource management, strategic planning and risk profiling to human resource management and operational logistics, and has served as a member of the the High Rainfall Zone Regional Cropping Solutions Network for the past six years.

M 0409 974 556 **E** fchilvers@bigpond.com

KATE WILSON

Kate is a partner in a large grain producing operation in Victoria's Southern Mallee region. Kate and husband Grant are fourth generation farmers producing wheat, canola, lentils, lupins and field peas. Kate has been an agronomic consultant for more than 20 years, servicing clients throughout the Mallee and northern Wimmera. Having witnessed and implemented much change in farming practices over the past two decades, Kate is passionate about RD&E to bring about positive practice change to growers.

M 0427 571 360 **E** kate.wilson@agrivision.net.au

ANDREW RUSSELL

Andrew is a forth generation grain grower and is currently the Managing Director and Shareholder of Lilliput AG and a Director and Shareholder of the affiliated Baker Seed Co - a family owned farming and seed cleaning business. He manages the family farm in the Rutherglen area, a 2,500 ha mixed cropping enterprise and also runs 2000 cross bred ewes. Lilliput AG consists of wheat, canola, lupin, faba bean, triticale and oats and clover for seed, along with hay cropping operations. Andrew has been a member of GRDC's Medium Rainfall Zone Regional Cropping Solutions Network and has a passion for rural communities, sustainable and profitable agriculture and small business resilience.

T 0417 401 004 **E** arussell@lilliput-ag.com.au

LUCY BROAD

Lucy Broad is the General Manager of the Grains Research and Development Corporation's (GRDC) Grower Communication and Extension business group. Lucy holds a Bachelor of Science in Agriculture, majoring in agronomy, and prior to working at the GRDC spent the last 13 years as Director and then Managing Director of Cox Inall Communications and Cox Inall Change, Australia's largest and leading public relations agency working in the Agribusiness and Natural Resource Management arena. Her entire career has been in communications, first with the Australian Broadcasting Corporation and then overseeing communications and behaviour change strategies for clients across the agriculture, natural resource management, government and not-for-profit sectors.

T 02 6166 4500 **E** lucy.broad@grdc.com.au

2017–2019 SOUTHERN REGIONAL CROPPING SOLUTIONS NETWORK (RCSN)

JANUARY 2019

The RCSN initiative was established to identify priority grains industry issues and desired outcomes and assist the GRDC in the development, delivery and review of targeted RD&E activities, creating enduring profitability for Australian grain growers. The composition and leadership of the RCSNs ensures constraints and opportunities are promptly identified, captured and effectively addressed. The initiative provides a transparent process that will guide the development of targeted investments aimed at delivering the knowledge, tools or technology required by growers now and in the future. Membership of the RCSN network comprises growers, researchers, advisers and agribusiness professionals. The three networks are focused on farming systems within a particular zone – low rainfall, medium rainfall and high rainfall – and comprise 38 RCSN members in total across these zones.

REGIONAL CROPPING SOLUTIONS NETWORK SUPPORT TEAM

SOUTHERN RCSN CO-ORDINATOR: JEN LILLECRAPP

Jen is an experienced extension consultant and partner in a diversified farm business, which includes sheep, cattle, cropping and viticultural enterprises. Based at Struan in South Australia, Jen has a comprehensive knowledge of farming systems and issues affecting the profitability of grains production, especially in the high rainfall zone. In her previous roles as a district agronomist and operations manager, she provided extension services and delivered a range of training programs for local growers. Jen was instrumental in establishing and building the MacKillop Farm Management Group and through validation trials and demonstrations extended the findings to support growers and advisers in adopting best management practices. She has provided facilitation and coordination services for the high and medium rainfall zone RCSNs since the initiative's inception.

M 0427 647 461 **E** jen@brackenlea.com

LOW RAINFALL ZONE CO-LEAD: BARRY MUDGE

Barry has been involved in the agricultural sector for more than 30 years. For 12 years he was a rural officer/regional manager in the Commonwealth Development Bank. He then managed a family farming property in the Upper North of SA for 15 years before becoming a consultant with Rural Solutions SA in 2007. He is now a private consultant and continues to run his family property at Port Germein. Barry has expert and applied knowledge and experience in agricultural economics. He believes variability in agriculture provides opportunities as well as challenges and should be harnessed as a driver of profitability within farming systems. Barry was a previous member of the Low Rainfall RCSN and is current chair of the Upper North Farming Systems group.

M 0417 826 790 **E** theoaks5@bigpond.com

LOW RAINFALL ZONE AND MEDIUM RAINFALL ZONE LEAD: JOHN STUCHBERY

John is a highly experienced, business-minded consultant with a track record of converting evidence based research into practical, profitable solutions for grain growers. Based at Donald in Victoria, John is well regarded as an applied researcher, project reviewer, strategic thinker and experienced facilitator. He is the founder and former owner of JSA Independent (formerly John Stuchbery and Associates) and is a member of the SA and Victorian Independent Consultants group, a former FM500 facilitator, a GRDC Weeds Investment Review Committee member, and technical consultant to BCG-GRDC funded 'Flexible Farming Systems and Water Use Efficiency' projects. He is currently a senior consultant with AGRIvision Consultants.

M 0429 144 475 **E** john.stuchbery@agrivision.net.au

HIGH RAINFALL ZONE LEAD: CAM NICHOLSON

Cam is an agricultural consultant and livestock producer on Victoria's Bellarine Peninsula. A consultant for more than 30 years, he has managed several research, development and extension programs for organisations including the GRDC (leading the Grain and Graze Programs), Meat and Livestock Australia and Dairy Australia. Cam specialises in whole-farm analysis and risk management. He is passionate about up-skilling growers and advisers to develop strategies and make better-informed decisions to manage risk – critical to the success of a farm business. Cam is the program manager of the Woady Yaloak Catchment Group and was highly commended in the 2015 Bob Hawke Landcare Awards.

M 0417 311 098 **E** cam@niconrural.com.au

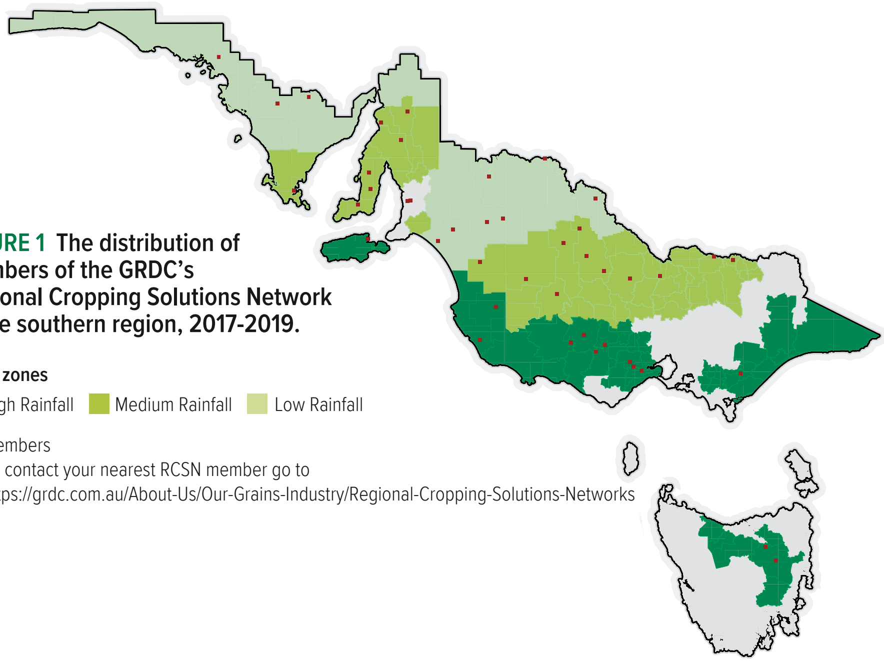


FIGURE 1 The distribution of members of the GRDC's Regional Cropping Solutions Network in the southern region, 2017-2019.

RCSN zones

High Rainfall Medium Rainfall Low Rainfall

Members

To contact your nearest RCSN member go to https://grdc.com.au/About-Us/Our-Grains-Industry/Regional-Cropping-Solutions-Networks

KEY CONTACTS

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

SOUTHERN REGION

ADELAIDE
Level 1
187 Fullarton Road
DULWICH SA 5065

P: +61 8 8198 8400
southern@grdc.com.au

APPLIED RESEARCH AND DEVELOPMENT GROUP

SENIOR REGIONAL MANAGER
Craig Ruchs
Craig.Ruchs@grdc.com.au
M: +61 4 7771 0813

BUSINESS SUPPORT TEAM LEADER
Amanda Kendall
Amanda.Kendall@grdc.com.au
P: +61 8 8198 8402

CONTRACTS AND TEAM ADMINISTRATOR
Claire West
Claire.West@grdc.com.au
P: +61 8 8198 8401

CONTRACT ADMINISTRATOR
Mark Waterhouse
Mark.Waterhouse@grdc.com.au
P: +61 8 8198 8406

MANAGER AGRONOMY, SOILS AND FARMING SYSTEMS (Agronomy & Farming Systems)
Andrew Etherton
Andrew.Etherton@grdc.com.au
M: +61 4 0850 5566

MANAGER AGRONOMY, SOILS AND FARMING SYSTEMS (Soils & Nutrition)
Stephen Loss
Stephen.Loss@grdc.com.au
M: +61 4 0841 2453

MANAGER WEEDS
Jason Emms
Jason.Emms@grdc.com.au
M: +61 4 3954 9950

GENETICS AND ENABLING TECHNOLOGIES GROUP

SENIOR MANAGER ENABLING TECHNOLOGIES
Tom Giles
Tom.Giles@grdc.com.au
M: +61 4 1788 9860

MANAGER NATIONAL VARIETY TRIALS
Rob Wheeler
Rob.Wheeler@grdc.com.au
M: +61 4 0114 8935

CONTRACT ADMINISTRATOR
Cindy Hall
Cindy.Hall@grdc.com.au
P: +61 8 8198 8400

GROWER EXTENSION AND COMMUNICATIONS GROUP

GROWER RELATIONS MANAGER
Darren Arney
Darren.Arney@grdc.com.au
M: +61 4 4787 7178

GROWER RELATIONS MANAGER
Courtney Ramsey
Courtney.Ramsey@grdc.com.au
M: +61 4 2827 4018

GROWER RELATIONS MANAGER
Randall Wilksch
Randall.Wilksch@grdc.com.au
M: +61 4 3776 9098

COMMUNICATIONS MANAGER
Sharon Watt
Sharon.Watt@grdc.com.au
M: +61 4 0967 5100

BUSINESS AND COMMERCIAL GROUP

HEAD OF BUSINESS DEVELOPMENT
Ron Osmond
Ron.Osmond@grdc.com.au
M: +61 4 000 0264

MANAGER BUSINESS DEVELOPMENT AND COMMERCIALISATION
Fernando Felquer
Fernando.Felquer@grdc.com.au
M: +61 4 1351 1412


EXPERT SUPPORT AT YOUR FINGERTIPS
GRDC COMMUNITIES
BE PART OF YOUR GRDC COMMUNITY
Connect with experts in crop nutrition, field crop diseases and stored grain.
Visit our website for resources and videos to support your cropping decisions.
communities.grdc.com.au
Follow us on Twitter @aucropnutrition @auscropdiseases
NEED TECHNICAL SUPPORT? TRY OUR FREE ONLINE SERVICE
ASK AN EXPERT
GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION
AGRICULTURE VICTORIA
NSW GOVERNMENT
Department of Primary Industries

Acknowledgements

The ORM team would like to thank those who have contributed to the successful staging of the Dunkeld GRDC Grains Research Update:

- The local GRDC Grains Research Update planning committee that includes both government and private consultants and GRDC representatives.

- Partnering organisation: Southern Farming Systems (SFS).

GRDC
GRAINS RESEARCH
& DEVELOPMENT
CORPORATION

Prefer to provide your feedback electronically or 'as you go'? The electronic evaluation form can be accessed by typing the URL address below into your internet browsers:

www.surveymonkey.com/r/Dunkeld-GRU

To make the process as easy as possible, please follow these points:

- Complete the survey on one device
- One person per device
- You can start and stop the survey whenever you choose, **just click 'Next' to save responses before exiting the survey**. For example, after a session you can complete the relevant questions and then re-access the survey following other sessions.

2019 Dunkeld GRDC Grains Research Update Evaluation

1. Name [ ]

ORM has permisssion to follow me up in regards to post event outcomes.

2. How would you describe your main role? *(choose one only)*

- ❑ Grower
- ❑ Agronomic adviser
- ❑ Farm business adviser
- ❑ Financial adviser
- ❑ Communications/extension
- ❑ Grain marketing
- ❑ Farm input/service provider
- ❑ Banking
- ❑ Accountant
- ❑ Researcher
- ❑ Student
- ❑ Other* (please specify) [ ]

Your feedback on the presentations

For each presentation you attended, please rate the content relevance and presentation quality on a scale of 0 to 10 by placing a number in the box (**10 = totally satisfactory, 0 = totally unsatisfactory**).

3. Hyper yielding cereals – the quest for increased yields: *Nick Poole*

Content relevance [ ] /10 Presentation quality [ ] /10

Have you got any comments on the content or quality of the presentation?

[ ]

4. Disentangling soil amelioration and plant nutrition effects of subsoil manuring on crop yield: *Corinne Celestina*

Content relevance [ ] /10 Presentation quality [ ] /10

Have you got any comments on the content or quality of the presentation?

[ ]

5. Pesticides and regulatory impacts – the road ahead: *Gordon Cumming*

Content relevance [ ] /10 Presentation quality [ ] /10

Have you got any comments on the content or quality of the presentation?

[ ]

6. Cereal and soil-borne disease wrap up: *Grant Hollaway*

Content relevance [ ] /10 Presentation quality [ ] /10

Have you got any comments on the content or quality of the presentation?

[ ]

7. Integrated weed management (IWM) status – where to from here? *Peter Newman*

Content relevance ☐ /10 Presentation quality ☐ /10

Have you got any comments on the content or quality of the presentation?

Your next steps

8. Please describe at least one new strategy you will undertake as a result of attending this Update event

9. What are the first steps you will take?

e.g. seek further information from a presenter, consider a new resource, talk to my network, start a trial in my business

Your feedback on the Update

10. This Update has increased my awareness and knowledge of the latest in grains research

Strongly agree	Agree	Neither agree nor Disagree	Disagree	Strongly disagree
❑	❑	❑	❑	❑

11. Overall, how did the Update event meet your expectations?

Very much exceeded	Exceeded	Met	Partially met	Did not meet
❑	❑	❑	❑	❑

Comments

12. Do you have any comments or suggestions to improve the GRDC Update events?

13. Are there any subjects you would like covered in the next Update?

Thank you for your feedback.