Eyre Peninsula Farming Systems

2008 SUMMARY

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PIRSA_PS 080745

Foreword

ABB is again proud to sponsor the Eyre Peninsula Farming Systems Summary.

This publication, which presents summaries of the numerous trials that are carried out during the year, is important in ensuring the future of the agricultural industry. It is essential reading for growers across Eyre Peninsula and much of the rest of South Australia.

As one of Australia's leading agribusinesses, ABB Grain is committed to supporting sustainable farming practices and research and development into new techniques. We are happy to support a publication such as this which provides growers with the tools necessary to learn from and build upon their own knowledge to continue sustainable farming.

ABB continues to invest significantly in research and development to ensure it remains innovative and to support the sustainability of the grains industry. This commitment includes research into developing new malting and feed barley varieties. The company is also investing in the development of drought tolerant and resistant grain varieties.

The past season was again a challenging one for growers. It is hoped these challenges will be met by continuing to provide support to growers and rural communities and ensuring the sustainable future of Australian agriculture.

I congratulate those who were involved in the research carried out over the year – not only for their hard work and dedication but for their commitment to this industry.

I wish you all the best for the coming season.

Michael Iwaniw
Managing Director
ABB Grain Ltd

Foreword

On behalf of the GRDC I am pleased to welcome you to the 2008 Eyre Peninsula Farming Systems (EPFS) Summary.

Once again, the summary provides an excellent and effective presentation of information relevant to grain growers and mixed farmers on the Eyre Peninsula and beyond.

The grains industry is going through rapid change and is operating in increasingly volatile markets and growing conditions. 2008 was a particularly challenging year for grain growers. Crops were planted when grain prices and input costs, including fuel and fertiliser, were at record highs and, after a season of variable conditions, harvesters were racing storm clouds to beat unseasonal rain and the threat of crops being downgraded.

The highly volatile financial markets are also affecting the grains industry. The fluctuating futures market and, more recently, foreign exchange markets and access to credit are making it increasingly difficult to implement effective risk management decisions. It is hoped that the recent GRDC publication *2009 planning guide for farmers with limited finances* developed within the Low Rainfall Collaboration project will help growers with little financial freedom plan a low-cost/low-risk strategy designed to return a modest profit while maximising the chances of the business continuing.

In these uncertain times it is critical that all those involved in grains research, development and extension work closely together to ensure that our collective efforts deliver outputs in the short, medium and longer term to help growers maintain profitability and sustainability.

To remain profitable and competitive in this environment growers need access to the best information, advice and technology available. The GRDC works with growers, research agencies, agribusiness consultants, marketers and government to deliver RD&E outcomes to growers. This collaborative effort is required to get the best outcome for growers. On the Eyre Peninsula this effort is made possible with the continued support from SARDI, the University of Adelaide, SAGIT, SANTFA, EPNRM and local graingrowers.

But how do GRDC investments translate to on-farm benefits to grain growers and how do we measure these returns to our stakeholders? There are some obvious areas of the GRDC's contribution, including the development of new grain varieties or investment in better farming practices, including precision agriculture, better nutrient management and conservation farming. It is essential that the effectiveness of the GRDC's research, development and extension investments is analysed to ensure it delivers benefits to growers in a cost effective way.

At the end of the day, farming is complex and the GRDC is working with, and on behalf of, growers to provide the best information, research and technology to ensure our industry is competitive, profitable and sustainable.

I hope you find the articles useful and hope that you have a less frustrating season in 2009.

STUART KEARNS

Manager,
Validation & Integration
GRDC

Eyre Peninsula Farming Systems 2008 Summary

Editorial Team

Naomi Scholz	SARDI, Minnipa Ag Centre, (MAC)
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All article submissions are reviewed by the Editorial Team prior to publication for scientific merit and to improve readability, if necessary, for a farmer audience.

This manual was compiled by PIRSA Publishing Services
March 2009

Front cover
Main photo: Harvest time at MAC
Left to Right: Launch of the EPFS 3 project, Strip grazing trial at MAC, EPARF Board members.

Back cover
Top to bottom: Emma McInerney and Alison Frischke inspect the strip grazing trial at MAC. Farmers at the Central EP sticky beak day, 2008. Farmers looking a lupins at the Crossville sticky beak day, 2008. The MAC Team.

Inside back cover
Photos from various Eyre Peninsula agricultural events in 2008.

Cover design
PIRSA Publishing Services

ISBN 978-1921399-24-4

PIRSA_PS_080745

Minnipa Agricultural Centre Update

Hi Everyone,

This year the Eyre Peninsula Farming Systems Summary 2008 is proudly supported by ABB Grain Ltd, Grains Research & Development Corporation (GRDC) through the Eyre Peninsula Farming Systems project and the National Landcare Program via the No-till project. We would like to thank the sponsors for their contribution to Eyre Peninsula (EP) for research, development and extension and enabling us to extend our results to all farm businesses on EP and beyond in other low rainfall areas.

2008 has been a busy and sometimes unsettling year at Minnipa Ag Centre (MAC). 2008 saw the end of the EP Farming Systems 2 project, the EP Grain & Graze project and Sam Doudle (Leader Minnipa Agricultural Centre) called it a day. *Ed's note: Good luck with your new endeavours Sam, you will be sorely missed!* Hopefully by seeding 2009 Sam will have been replaced and we will be back in full swing again.

Some of the highlights for 2008 include the finalisation of the Department of Climate Change funded project *Exploring adaptive responses in dryland cropping systems to increase robustness to climate change*. A summary of the report demonstrating the resilience of farming businesses on Eyre Peninsula and the ability to cope with climate change can be found in the 'Sharing Information' section.

The MAC Annual Field day was again a great success, with approximately 170 farmers, researchers and agribusiness representatives having the opportunity to hear some great speakers and topics, although it wasn't the greatest weather. Thanks to our sponsors and those that came along and supported the day.

2008 has been a year of catch-up, consolidation and finalisation of long term projects, as well as a number of new project applications being written.

Current funded projects include:

- Eyre Peninsula Farming Systems 3 – Responsive Farming Systems, GRDC funded, researcher Alison Frischke.
- Eyre Peninsula Grain & Graze, EPNRM/Caring for our Country funded, coordinator Naomi Scholz.
- Developing robust and lower risk farming systems by understanding the impact of soil carbon on Rhizoctonia disease suppression, SAGIT/EPARF funded, researcher Amanda Cook.
- Soil compaction in agricultural soils of Eyre Peninsula, SAGIT funded, researcher Cathy Paterson.
- Protecting Soil by Increasing Adoption of No-till on EP, NLP/SANTFA funded, researcher Michael Bennet.
- All the variety trials (wheat, barley, canola, peas etc.), coordinated by Leigh Davis.

We are also developing a new Grain & Graze (mixed cropping/livestock) project on Eyre Peninsula, and an extension to the Disease Suppression SAGIT project has been submitted for funding.

Dates to remember for this year include the MAC Annual Field Day on 16 September. Also look out for profitability workshops and more free integrated pest (crop bugs) management workshops.

Thanks for your support at farmer meetings, sticky beak days and field days. Without strong farmer involvement and support, we lose our relevance to you and to the industries that provide a large proportion of the funding to make this work possible. I look forward to seeing you all at farming system events throughout 2009, and here's hoping for a much better season too!

Naomi Scholz

Project Manager
Eyre Peninsula Farming Systems and Eyre peninsula Grain & Graze

DATES TO REMEMBER

- ❑ EPARF Field Day: Wednesday 29 July 2009
- ❑ MAC Annual Field day: Wednesday 16 September 2009

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Eyre Peninsula Agricultural Research Foundation 2008 Report

EPARF
EYRE PENINSULA
Agricultural Research Foundation Inc.

Peter Kuhlmann, Chairman

Current Board: Peter Kuhlmann, Dean Willmott, Matt Dunn, Brent Cronin, Simon Guerin, Craig James, Geoff Thomas, Andy Bates, Simon Maddocks, Glenn McDonald, Naomi Scholz and executive officer Dot Brace.

Members: Currently 197 members

Role of EPARF:

- To advise and assist MAC management in strategic direction and decisions, define research priorities and negotiate funding opportunities through the EPARF Project Management and MAC Farm sub-committees
- Seek sponsorship and provide a pathway to contribute to positive outcomes for Eyre Peninsula farmers
- Maintain a relationship with our research funders and sponsors
- Utilise our reserve to leverage other funds
- Provide a service to our members

Finance: EPARF is a foundation with income from membership, sponsorship and reimbursements. Its expenditure is on administration support and meeting expenses, leveraging and services to members. In 2008 we chose not to hold a specific EPARF Field Day and invested in the new SAGIT Carbon in Farming Systems project and to take the Water Use Efficiency and Soil Suppression roadshow around the district to showcase our researchers and their data.

2008/09 SPONSORS:

Gold

- AGCO Auto Guide – Navigation system deal
- ABB – EP Farming Systems Summary
- AWB – Farming Systems Competition Paddocks
- GPS Ag – GPS unit and steering kits

Silver

- Glencore, Rabobank, Bank SA, Elders, Nufarm, Calcookara Stud, ABB Fertilisers

Bronze

- Bayer Crop Science, Kotzur Silos, Letcher & Moroney

EPFS 3: After more than a year of communicating, negotiating, writing applications and revising priorities and budgets, a third EP farming system project was funded by GRDC. Funding was cut to only half of the previous project but for a five year term. This project is focusing on water use efficiency and carbon and nitrogen interactions.

Low Rainfall Farming Systems Collaboration Group: The event this year was hosted by the Birchip cropping Group and a total of six EPARF members attended with the Minnipa staff. We attended the Manangatang GRDC updates and field day, updated each other on our projects, shared ideas on how to measure WUE gains, networked and had a look over the Birchip Field site.

Natural Resource Management: The EPNRM board met at Minnipa with EPARF members and MAC staff to improve the integration of natural resource management with primary production. The NRM board share a similar vision for Grain and Graze 2 (profitability while protecting the environment and enhancing the community). They are keen to be partners when G&G starts up again using 'Caring for Country Funds'. I envisage EPARF and EPNRM will be partners in several projects in the future.

Grain and Graze 2: Eyre Peninsula has been selected to be part of a smaller program starting in July 2009.

Certified Seed Production: A review was done of the certified seed enterprise. Positives include utilising the existing infrastructure; Minnipa reputation; can showcase the new releases on a paddock scale and utilising out of season labour. Negatives include relatively low production; seasonal risk; the quick turnover of varieties; lower demand; carryover risk and the borderline profitability.

We are looking at developments and several options before deciding on the future of this enterprise.

GRDC Board Visit: EPARF members and senior staff met with the GRDC board based in Canberra and delivered an impressive presentation before a field tour of the farm.

Sam 2: SARDI are going to continue to support Sam's replacement as the leader based at Minnipa. EPARF saw the opportunity to seek a person who can also do some high level research as well to add value to our current work. SARDI are seeking a 'Senior Scientist - Dryland Farming Systems' to be based at Minnipa.

2008 Retiring members:

Jim Egan has been serving MAC for a long time in the role of overseeing the variety trials including oilseeds, pulses and cereals. In recent times Jim has been the way EPARF and LEADA keep updated on each others activities.

Bruce Heddle has resigned after many years of valuable local service to the Eyre Peninsula Research Advisory Committee, Minnipa Ag Centre Committee and Minnipa Research Foundation which became EPARF, Eyre Peninsula Farming System Management Committee, and the MAC Farm Advisory Committee. Bruce's distinctive voice, his depth of experience and great insight into farming systems will be sorely missed.

Sam Doudle arrived at Minnipa in 1999 as the Eyre Peninsula Farming Systems Project Coordinator and with her people skills, commitment and enthusiasm quickly created the standard of excellence that the other farming system projects in Australia could only hope for. Sam's ability to communicate with funding bodies, staff and the farming community has been a huge benefit to Eyre Peninsula. Her most notable legacy is the widely sought after EPFS annual summary.

Thanks: A special thank you for Sam and Naomi for being able to maintain a well run functional research program after an incredibly trying year with another poor season and major funding cutbacks.

Thanks to Dot for her commitment as executive officer and the support of our EPARF board, we have had a successful year considering the circumstances.

Thank you all for your continued support of agricultural research in our dryland environments through contributing ideas, attending field days or hosting research sites. Our membership base is an important factor when we are seeking funding for Eyre Peninsula research. Your membership is important to us.

EPARF Board members at the Minnipa Agricultural Centre annual field day, 2008

Eyre Peninsula Agricultural Research Foundation Members 2008

Atkinson	Phillip	KIMBA SA
Baillie	Terry	TUMBY BAY SA
Baldock	Graeme	KIMBA SA
Baldock	Heather	KIMBA SA
Barns	Ashley	WUDINNA SA
Bates	Andy	STREAKY BAY SA
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Beinke	Lance	KIMBA SA
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Berg	Ben	COOTRA EAST SA
Blumson	Bill	SMOKY BAY SA
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Cronin	Jim	STREAKY BAY SA
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Cummins	Lyn	LOCK SA
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Deakin	Richard	KIELPA SA
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Duncan	John	WIRRULLA SA
Dunn	Matthew	RUDALL SA
Dutschke	Richard	LOCK SA
Dutschke	Dennis	LOCK SA
Eatts	Austen	KIMBA SA
Edmonds	Graeme	WUDINNA SA
Edmonds	John	WUDINNA SA
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Elleway	Ray	KIELPA SA
Endean	Jim	MINNIPA SA
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Francis	Brett	KIMBA SA
Freeth	John	KIMBA SA
Freeth	Thomas	KIMBA SA
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Fromm	Jerel	MINNIPA SA
George	Leighton	MINNIPA SA
Grund	John	KIMBA SA
Grund	Gary	KIMBA SA
Guerin	Simon	PORT KENNY SA
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Haagmans	John	ELLISTON SA
Hamence	Les	WIRRULLA SA
Harris	John	KIMBA SA
Heath	Basil	PORT LINCOLN SA
Heddle	Bruce	MINNIPA SA
Hegarty	Kieran	WARRAMBOO SA
Herde	Bill	RUDALL SA
Hitch	Max	PORT LINCOLN SA
Hitchcock	Peter	LOCK SA
Hitchock	Nathan	LOCK SA
Holman	Kingsley	LOCK SA
Hood	Ian	PORT KENNY SA
Hood	Mark	PORT KENNY SA
Horgan	John	STREAKY BAY SA
Horgan	Mark	STREAKY BAY SA
Howard	Tim	CEDUNA SA
Hurrell	Leon	KIMBA SA
Jericho	Neville	MINNIPA SA
Jericho	Marcia	MINNIPA SA
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Kaden	Paul	COWELL SA
Kaden	Tony	COWELL SA
Kelsh	Craig	PORT KENNY SA
Kitson	Stacey	WUDINNA SA
Kobelt	Rex & Myra	CLEVE SA
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Koch	Jeffrey	KIMBA SA
Kuhlmann	Peter	GLENELG SOUTH SA
Kwaterski	Robert	MINNIPA SA
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LeBrun	Dion	TUMBY BAY SA
LeBrun	Maria	TUMBY BAY SA
LeBrun	Leonard	TUMBY BAY SA

Lee	Howard	STREAKY BAY SA
Lienert	Bill	KIMBA SA
Lienert	Matt	KIMBA SA
Lienert	Nick	KIMBA SA
Lienert	Roger	ARNO BAY SA
Longmire	Andrew	SALMON GUMS WA
Longmire	Jeffrey & Caroline	LOCK SA
Lymn	Chris	WUDINNA SA
Lymn	Allen	WUDINNA SA
Lynch	Brenton	STREAKY BAY SA
Lynch	Christopher	STREAKY BAY SA
Lynch	Bradley	STREAKY BAY SA
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Phillis	Jamie	UNGARRA SA
Polkinghorne	Andrew	LOCK SA
Pope	Lindsay	WARRAMBOO SA
Pope	Mark	WARRAMBOO SA
Pope	Ben	WARRAMBOO SA
Preiss	Kevin	ARNO BAY SA
Prime	Peter	WHARMINDA SA
Prime	Andrew	WHARMINDA SA
Prime	Chris	WHARMINDA SA
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Ramsey	Teresa	KIMBA SA
Ranford	Ben	CLEVE SA
Rayson	Colin	KIMBA SA
Rayson	Peter	KIMBA SA
Redden	Scott	KIMBA SA
Rehn	Michael	COWELL SA
Rehn	Gavin	ARNO BAY SA
Rodda	Martin	KIMBA SA
Rule	Craig	STREAKY BAY SA
Ryan	Martin	KIMBA SA
Sampson	Kane	WARRAMBOO SA
Sampson	Allen	KIMBA SA
Schmucker	Terry	KYANCUTTA SA
Schmucker	Thomas	KYANCUTTA SA
Schmucker	Andrew	KYANCUTTA SA
Scholz	Nigel	WUDINNA SA
Scholz	Neville	WUDINNA SA
Scholz	Gareth	MINNIPA SA
Scholz	Lyle	YANINEE SA
Scholz	Greg	WUDINNA SA
Schwarz	Noel	CEDUNA SA
Seal	Brook	KIMBA SA
Shipard	Sam	PENONG SA
Simpson	John	WUDINNA SA
Smith	Bryan	COORABIE SA
Story	Rodger	COWELL SA
Story	Suzanne	COWELL SA
Thomas	Geoff	BLACKWOOD SA
Trezona	Neville	STREAKY BAY SA
Trowbridge	Shane	CEDUNA SA
Turnbull	Mark	CLEVE SA
Turnbull	John	CLEVE SA
Van der Hucht	Peter	WUDINNA SA
van Loon	Tim	WARRAMBOO SA
Veitch	Simon	WARRAMBOO SA
Watson	Peter	WIRRULLA SA
Webb	Paul	COWELL SA
Webber	Ken	PORT LINCOLN SA
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Wilkins	Gregor	YANINEE SA
Wilkins	Barry	YANINEE SA
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Williams	Dene	KIMBA SA
Williams	Michael	KIMBA SA
Willmott	Dean	KIMBA SA
Willmott	Peta	KIMBA SA
Woolford	Michael	CLEVE SA
Woolford	Graham	KIMBA SA
Woolford	Barb	KIMBA SA
Woolford	Simon	KIMBA SA
Woolford	Peter	KIMBA SA
Woolford	James	KIMBA SA
Zacher	Michael	LOCK SA
Zerk	Michael	LOCK SA
Zerna	Allan	COWELL SA

Support low rainfall agricultural research by becoming a 2009 EPARF Member

EPARF
EYRE PENINSULA
Agricultural Research Foundation Inc.

For most of us growers 2008 was yet another financially challenging year. Please continue your membership to support EPARF and the contribution it delivers to our community. The value of research is essential to keep our industry profitable and sustainable and never has it been more important. We must continue to demonstrate that we are committed to our own future to ensure continuing support from our funders and sponsors in these difficult times.

Our membership base has been one of the great strengths of the Foundation and it has given us credibility with both funders and sponsors.

In 2008 our capital base has been used as leverage to support a project on Eyre Peninsula on "Robust and low risk farming systems by determining the impact of soil carbon on C & N cycling, microbial activity and disease suppression". Funds have also been used as a reserve to cover the timely capital purchases of a replacement harvester and a 2 cm GPS unit (both to compliment our tramlining and precision agriculture work). In spring, EPARF held regional workshops on research results from Eyre Peninsula regarding disease suppression, WUE and PAW. Your membership fees also support the EPARF committee in their management role at the Minnipa Agricultural Centre.

The 2009 EPARF members' day is planned for late July on "Improving the efficiency of farming and cost saving ideas".

Membership form

Fees are $110 for the first member, plus $55 per additional members involved in the farm business or entity. These amounts are GST inclusive.

THANK YOU FOR YOUR VALUABLE SUPPORT OF LOW RAINFALL AGRICULTURAL RESEARCH

Payment options:

- post a cheque (payable to *Eyre Peninsula Agricultural Research Foundation*),
- in cash at the EPARF Minnipa counter
- or direct debit BSB: 105 -171 Acc: 017659740 (please include full name details)

EPARF will forward your tax invoice/receipt upon payment

Please forward your payment and completed details to:

EPARF
Minnipa Agricultural Centre
PO Box 31 MINNIPA SA 5654

Individual Member **$110 (GST Inc)** **$**

Name:

....

Additional Member **$ 55 (GST Inc)** **$**

Name(s):

....

....

Total $

CONTACT DETAILS FOR THIS MEMBERSHIP

Business Name:

ABN:

Mailing Address:

Phone: Fax:

Mobile:

Email Address:

(please include your email address for member information distributions throughout the year)

2008 Eyre Peninsula Seasonal Summary

Neil Cordon and Kieran Wauchope

Rural Solutions SA, Port Lincoln

On a significant area of Eyre Peninsula, 2008 crop production returns did not cover variable costs, which has increased the financial pressures in low to medium rainfall districts.

A major issue with farmers is coming to grips with grain marketing systems which includes deregulation, freight charging, silo closures, pricing schemes, quality grades and business procedures. This year has seen more farmers opting to either store grain on farm and/or use the warehouse facilities through the silo system, which indicates reluctance to sell at current prices, and a preparedness to market their grain once the harvest pressure is off.

Higher fertiliser prices leading into 2008 and two previous years of diminished returns saw application rates slashed to levels rarely seen on Eyre Peninsula. This strategy is understandable in the current climate however matching nutrient inputs to crop removal should be an initial objective.

Western Eyre Peninsula

For the third consecutive year this district had the potential for a good season, however nature and commodity prices resulted in another challenging season.

- January, Feburary and March were typical summer months, hot, dry and windy. April was a kaleidoscope of weather conditions ranging from periods of warm fine days, cold nights, odd windy days and showers late in the month. Oats were sown dry for early pasture feed and the late April rains saw general seeding operations underway. Below average and variable rainfall distribution during May and June enabled seeding to be completed by mid June with some farmers reducing their intended crop sowings. The majority of seeding was completed in poor soil moisture status including subsoil supply. Strong winds regularly blasted newly emerging crops, especially on the light sandy rises. These areas never recovered and were prone to sand blasting throughout the year. Average to above average rains in July and August improved crop growth dramatically with the more favourable areas stretching from south of Minnipa through to Streaky Bay, Mt Cooper, Elliston, Mt Damper, Wudinna and Kyancutta. The area north and west of Minnipa through to Bookabie were most affected by poor rainfall distribution. Well below average rainfall together with warming temperatures and strong winds during stem elongation, head development, flowering and grain filling severely reduced crop yields. Most harvest was completed before the above average November and December rains which limited harvest downgrading due to sprouting, however promotion of summer weeds (including self sown cereals) and deterioration of stock feed will have detrimental effects for 2009.
- All districts received below average annual rainfall and well below average growing season recordings. Rainfall (mm) at selected centres (growing season in brackets) was Streaky Bay 295 (224), Penong 296 (151), Ceduna 217 (150), Mt Cooper 366 (262), Minnipa 241 (133), and Elliston 358 (264).
- Crop growth was slow, patchy and retarded, generally caused by uneven soil moisture, wind erosion, native weevil damage and lower fertiliser inputs.
- Cereal yields varied widely throughout the district and within individual farms ranging from not worth reaping through to 2.5 t/ha. A district average would range from 0.6 t/ha to 1.0 t/ha.
- The limited area sown to field peas and canola had poor yields and the higher risk of growing these crops may see less farmers plant risky productive pastures.
- Grain quality was a mixed bag depending on time of sowing, variety, soil type and sowing rate. Barley had more issues with quality than wheat with very high screening levels, especially the varieties Flagship and Keel, whilst Maritime and SloopSA are significantly better. Yitpi appeared to have consistently higher screenings than the other wheat varieties.
- Agronomic issues during the year included native weevils, mice, frost, stripe rust and rhizoctonia however their incidence was more localised than widespread.
- Unlike the previous two seasons paddock feed became critically scarce throughout the year, with quality varying widely until the stubbles came online. The lack of feed supply began from the poor (feed) start to the season compounded by limited spring rainfall, and cropping systems which adopt a 100% weed control mentality and wider rows. Hand feeding continued through to August and farmers culling of stock were above normal levels whilst prices were reasonably sound.

Eastern Eyre Peninsula

The farming community in this area of Eyre Peninsula came into 2008 on a financial knife-edge, most probably at a level higher than other areas of the region. With seasonal conditions similar to that experienced further to the west, some areas were not able to have an exceptional year whilst others rarely had any periods of great optimism.

- Farmers experienced a typical summer being hot, dry and windy with the opening rains late in April. Dry sowing started in some areas, especially oats for early feed but around Darke Peak the wetter conditions enabled a more general seeding to commence. High fertiliser prices and limited cash flow saw a reduction in nutritional inputs. Most seeding was completed by mid June however windy weather, limited ground cover and moisture limitations hindered crop emergence, crop vigour and produced significant crop damage. Districts that struggled throughout the season were around Cowell, Buckleboo, Wharminda and Rudall whilst Lock, Tuckey, Darke Peak and Kimba were the more favourable areas. As for Western EP, well below average rainfall together with warming temperatures and strong winds during stem elongation, head development, flowering and grain filling severely reduced crop yields. Most harvest was completed before the above average November and December rains which limited harvest down grading due to sprouting however promotion of summer weeds (including self sown cereals) and deterioration of stock feed will have detrimental effects for 2009.

- All districts received below average annual rainfall and well below average growing season recordings. Rainfall (mm) at selected centres (growing season in brackets) was Kimba 255 (193), Cleve 296 (230), Lock 290 (218), Cowell 183 (123) and Wharminda 264 (185).
- Frost affected some very early sown crops, which led them to be cut for hay. Other agronomic issues during the year included stripe rust and rhizoctonia, however their incidence was more localised than widespread.
- Cereal yields varied widely throughout the district and within individual farms ranging from not worth reaping through to 2.5 t/ha. A district average would range from 0.6 t/ha to 1.4 t/ha.
- Break crop yields ranged from 0.2 t/ha to 1.0 t/ha for field peas and up to 1.0 t/ha for canola.
- Grain quality was a mixed bag depending on time of sowing, variety, soil type and sowing rate. Barley had more issues with quality than wheat with very high screening levels, especially the varieties Flagship and Keel, whilst Maritime and SloopSA were significantly better.
- Stock feed was limited through to June, however by August pastures had bulked up resulting in little supplementary feeding and slowing stock sales. Pastures and early sown cereal feed crops were cut for hay with the majority for on-farm domestic use.

Lower Eyre Peninsula

The season got off to a reasonable start again and with good rain and growing conditions in July and August optimism was raised, only to be crushed by hot, windy and dry conditions in September. This, in conjunction with the resulting poor grain quality, reduced gross margins severely and left some wondering why they were in the game.

Stock feed was generally adequate throughout the year with many sowing cereals dry, allowing perennial pastures to be rested. Some of the coastal areas were short of feed until the season broke.

- Most regions received below average rainfall, but the higher than average rainfall for November and December made the season look average; records from selected centres in millimetres (growing season in brackets) were: Port Lincoln 524 (409), Cummins 324 (223), Yeelanna 321 (243), Mt Hope 371 (295), Tumby Bay 238 (150) and Koppio 409 (311).
- January, February and March were typical with warm to hot temperatures, but rainfall was well below average and hence subsoil moisture was limited at the start of the season. The standard paddock activities took place with gypsum spreading, snail cabling/rolling and a little summer weed spraying.
- April and May brought almost average rains for most areas except for north of Tumby Bay along the coast. This resulted in good growth of the dry sown cereals for stock feed and allowed stock to be kept off pastures. There was also some early sowing of canola, wheat, barley and beans for grain in the southern parts. For those in the more reliable areas there was a slight increase in area sown to canola due to the higher prices and good conditions.
- Good growing conditions prevailed in June but no significant falls were received and most regions were on decile 2. The northern coastal areas were very dry and some crops were already dying. Strong winds caused significant soil erosion in parts and damaged crops.
- Good rains and mild temperatures were received and optimism increased in most parts. Some farmers delayed second applications of nitrogen as there was limited subsoil moisture. Rust was detected further north on the peninsula and farmers either rushed in and sprayed all susceptible varieties or held off to see how far it progressed.
- After a great July/August and huge amounts of vegetative growth, several hot windy days came in September. These hit during the crucial flowering and grain fill stages and depleted any soil moisture reserves and cruelly damaged yield potential. All areas were now on a decile 1. Farmers in the drier parts cut crops on the heavier soils for hay while others used them for stock feed.
- Whether it was the financial situation farmers were in or the increasing awareness of IPM, many began to rely on natural predators to control invading insects rather than spraying at the first sign of damage.
- When crops were ready for harvest the rain decided to arrive, southern parts received up to 50 mm while the central and coastal areas received 30 mm in November.
- Not all areas had bad results for harvest with those around Wanilla and Wangary recording some of their best yields and still reapt good quality grain.
- There was however huge variability in grain yields and quality of all crop types, across region, farm and even paddocks.
- Canola yields were approximately 1.6 t/ha around Cummins, up to 3 t/ha near Wanilla and just under 1 t/ha on the east coast. Oils were generally low (41-42%), but some lucky farmers achieved just under 47%.
- Barley yields were down to 0.3 t/ha around Lipson and up to 4.5 t/ha near Cummins. Some farmers received malt grades, but the majority received feed quality (down to feed 4) due to screenings, causing significant issues with marketing.
- Wheat yields varied from 1.2 t/ha to 4 t/ha and quality of the grain reapt before the December rains was good. The majority of the grain reapt after the rain however was dropped to feed, as most of it was shot.
- Farmers were generally happy with their lupins (averaging 1.6-2 t/ha), but many were disappointed with their beans (averaging 1-1.4 t/ha).

Acknowledgement

Sue Rumbelow: Business Support Consultant, RSSA, Streaky Bay for her assistance with data collection and record keeping.

Understanding Trial Results and Statistics

Jim Egan

SARDI, Port Lincoln

Interpreting and understanding replicated trial results is not always easy. We have tried to report trial results in this book in a standard format, to make interpretation easier. Trials are generally replicated (treatments repeated two or more times) so there can be confidence that the results are from the treatments applied, rather than due to some other cause such as underlying soil variation or simply chance.

The average (or mean)

The results of replicated trials are often presented as the average (or mean) for each of the replicated treatments. Using statistics, means are compared to see whether any differences are larger than is likely to be caused by natural variability across the trial area (such as changing soil type). The size of the LSD can then be used to compare the means. For example, in a trial with four treatments, only one treatment may be significantly different from the other three – the size of the LSD is used to see which treatments are different.

The LSD test

To judge whether two or more treatments are different or not, a statistical test called the Least Significant Difference (LSD) test is used. If there is no appreciable difference found between treatments then the result shows "ns" (not significant). If the statistical test finds a significant difference, it is written as "P=0.05". This means there is a 5% probability or less that the observed difference between treatment means occurred by chance, or we are at least 95% certain that the observed differences are due to the treatment effects. Statistical analysis indicates that there is a fertiliser treatment effect on yields. P=0.05 indicates that the probability of such differences in grain yield occurring by chance is 5% (1 in 20) or less. In other words, it is highly likely (more than 95% probability) that the observed differences are due to the fertiliser treatments imposed.

The size of the LSD can then be used to compare the means. For example, in a trial with four treatments, only one treatment may be significantly different from the other three – the size of the LSD is used to see which treatments are different. In our example, the control and fertiliser treatments 1 and 2 are the same (all followed by "a"). Despite fertilisers 1 and 2 giving apparently higher yields than control, we can't dismiss the possibility that these small differences are just due to chance variation between plots. All three fertiliser treatments also have to be accepted as giving the same yields (all followed by "b"). But fertiliser treatment 3 can be accepted as producing a yield response over the control, indicated in the table by the means not sharing the same letter.

Results from a replicated trial

An example of a replicated trial of three fertiliser treatments and a control (no fertiliser), with a statistical interpretation, is shown in Table 1.

Table 1 Mean grain yields of fertiliser treatments (four replicates per treatment)

Treatment	Grain yield (t/ha)
Control	**1.32 a**
Fertiliser 1	**1.51 a,b**
Fertiliser 2	**1.47 a,b**
Fertiliser 3	**1.70 b**
Significant treatment difference	*P≤0.05*
LSD (P=0.05)	*0.33*

Statistical analysis indicates that there is a fertiliser treatment effect on yields. P≤0.05 indicates that the probability of such differences in grain yield occurring by chance is 5% (1 in 20) or less. In other words, it is highly likely (more than 95% probability) that the observed differences are due to the fertiliser treatments imposed.

The LSD shows that mean grain yields for individual treatments must differ by 0.33 t/ha or more, for us to accept that the treatments do have a real effect on yields. These pairwise treatment comparisons are often shown using the letter as in the last column of Table 1. Treatment means with the same letter are not significantly different from each other. The treatments that do differ significantly are those followed by different letters.

In our example, the control and fertiliser treatments 1 and 2 are the same (all followed by "a"). Despite fertilisers 1 and 2 giving apparently higher yields than control, we can't dismiss the possibility that these small differences are just due to chance variation between plots. All three fertiliser treatments also have to be accepted as giving the same yields (all followed by "b"). But fertiliser treatment 3 can be accepted as producing a yield response over the control, indicated in the table by the means not sharing the same letter.

On-farm testing – Prove it on your place!

Doing an on-farm trial is more than just planting a test strip in the back paddock, or picking a few treatments and sowing some plots. Problems such as paddock variability, seasonal variability and changes across a district all serve to confound interpretation of anything but a well-designed trial.

Scientists generally prefer replicated small plots for conclusive results. But for farmers such trials can be time-consuming and unsuited to use with farm machinery. Small errors in planning can give results that are difficult to interpret. Research work in the 1930's showed that errors due to soil variability increased as plots got larger, but at the same time, sampling errors increased with smaller plots.

The carefully planned and laid out farmer un-replicated trial or demonstration does have a role in agriculture as it enables a farmer to verify research findings on his particular soil type, rainfall and farming system, and we all know that "if I see it on my place, then I'm more likely to adopt it". On-farm trials and demonstrations often serve as a catalyst for new ideas, which then lead to replicated trials to validate these observations.

The bottom line with un-replicated trial work is to have confidence that any differences (positive or negative) are real and repeatable, and due to the treatment rather than some other factor.

To get the best out of your on-farm trials, note the following points:

- Choose your test site carefully so that it is uniform and representative - yield maps will help, if available.
- Identify the treatments you wish to investigate and their possible effects. Don't attempt too many treatments.
- Make treatment areas to be compared as large as possible, at least wider than your header.
- Treat and manage these areas similarly in all respects, except for the treatments being compared.
- If possible, place a control strip on both sides and in the middle of your treatment strips, so that if there is a change in conditions you are likely to spot it by comparing the performance of control strips.
- If you can't find an even area, align your treatment strips so that all treatments are equally exposed to the changes. For example, if there is a slope, run the strips up the slope. This means that all treatments will be partly on the flat, part on the mid slope and part at the top of the rise. This is much better than running strips across the slope, which may put your control on the sandy soil at the top of the rise and your treatment on the heavy flat, for example. This would make a direct comparison very tricky.
- Record treatment details accurately and monitor the test strips, otherwise the whole exercise will be a waste of time.
- If possible, organise a weigh trailer come harvest time, as header yield monitors have their limitations.
- Don't forget to evaluate the economics of treatments when interpreting the results.
- Yield mapping provides a new and very useful tool for comparing large-scale treatment areas in a paddock.

The "Crop Monitoring Guide" published by Rural Solutions SA and available through PIRSA district offices has additional information on conducting on-farm trials.

2008 Trials Sown but not Harvested or Reported

Soil Water Evaporation

Effect of Soil Type on Evaporation Rate
Minnipa, B. Kwaterski

Soil moisture content of three different soil types (deep sand, sandy loam, loam) were measured for 12 weeks to quantify the effects of soil type on the rate of evaporation.

Not reported as we are still analysing the data.

Stubble Cover Effects on Evaporation Rate
Minnipa Agricultural Centre

Soil moisture was monitored for 12 weeks on small plots with five rates of stubble cover (nil, paddock residue – standing, paddock residue - lying, 1/2 x paddock residue and 3 x paddock residue) to quantify the effect of different rates of stubble cover and it's orientation on the rate of evaporation.

Not reported as we are still analysing the data.

Low Rainfall Juncea Canola Breeding

Miltaburra, Mudges

Trials to evaluate Conventional Juncea Canola, Clearfield Juncea Canola and Triazine Tolerant juncea Canola breeding lines.

Not harvested because of zero emergence.

Low Rainfall Bean Breeding

Minnipa Agricultural Centre

Evaluation of current bean varieties and breeding lines.

Not harvested because of short growth and no yield potential.

Low Rainfall Canola Breeding, Juncea Agronomy trials

Minnipa Agricultural Centre

Nitrogen Rate, Seeding Rate, Herbicide Tolerant Clearfield Canola, Conventional Canola, S4 Early Conventional Canola, Resown Nitrogen Rate Clearfield Canola, S2 Mustard, S4 Early Conventional Canola, Early Triazine Tolerant Canola and Time of Sowing trials.

Not harvested because poor emergence and no yield potential.

Breeding Boron Tolerance in Barley

Minnipa Agricultural Centre

Trial to evaluate boron tolerance in barley lines.

Not harvested because of poor growth from severe drought stress.

Some Useful Conversions

Area
1 ha (hectare) = 10 000 m^2 (square 100 m by 100 m)
1 acre = 0.4047 ha (1 chain (22 yards) by 10 chain)
1 ha = 2.471 acres

Mass
1 t (metric tonne) = 1000 kg
1 imperial tonne = 1016 kg
1 kg = 2.205 lb
1 lb = 0.454 kg

A bushel (bu) is traditionally a unit of volumetric measure defined as 8 gallons.
For grains, one bushel represents a dry mass equivalent of 8 gallons.
Wheat = 60 lb, Barley = 48 lb, Oats = 40 lb

1 bu (wheat) = 60 lb = 27.2 kg
1 bag = 3 bu = 81.6 kg (wheat)

Volume
1 L (litre) = 0.22 gallons
1 gallon = 4.55 L
1 L = 1000 mL (millilitres)

Speed
1 km/h = 0.62 miles/h, 10 km/h = 6.2 miles/hr,
15 km/h = 9.3 miles/h
10 km/h = 167 m/minute = 2.78 m/second

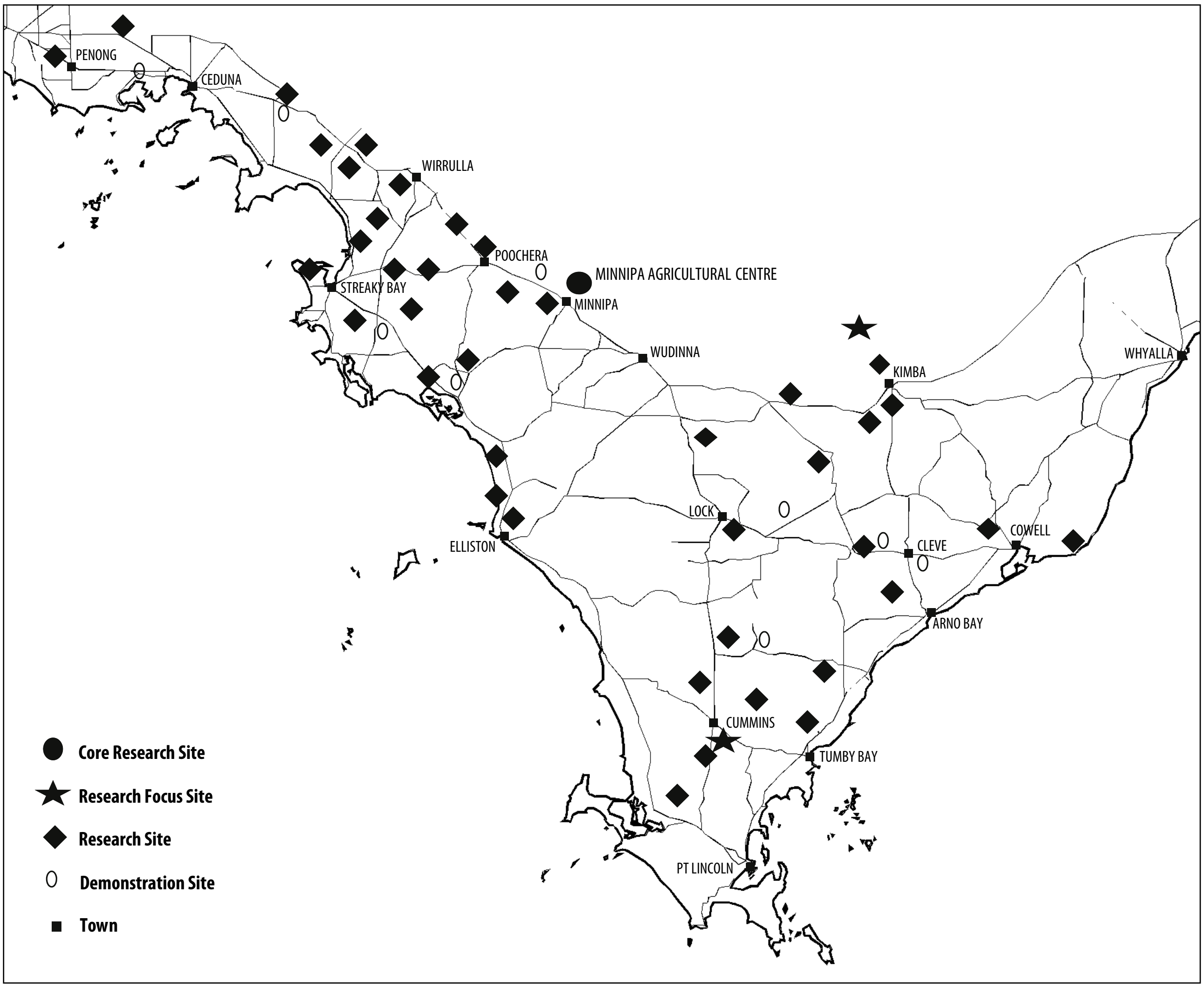
Pressure
10 psi (pounds per sq inch) = 0.69 bar = 69 kPa (kiloPascals)
25 psi = 1.7 bar = 172 kPa

Yield
1 t/ha = 1000 kg/ha

Yield approximations

Wheat	1 t = 12 bags	1 t/ha = 5 bags/acre	1 bag/acre = 0.2 t/ha
Barley	1 t = 15 bags	1 t/ha = 6.1 bags/acre	1 bag/acre = 0.16 t/ha
Oats	1 t = 18 bags	1 t/ha = 7.3 bags/acre	1 bag/acre = 0.135 t/ha

Eyre Peninsula
Agricultural Research Sites 2008



SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Section editor:
Cathy Paterson
SARDI
Minnipa Agricultural Centre

Cereals

The total 2008 production figures for Eyre Peninsula were approximately 842,000 t of wheat, 377,000 t of barley, 11,500 t of oats and 5,100 t of triticale. There was an increase in total production of wheat and barley compared to 2007, while oats and triticale decreased.

Triticale Variety Yield Performance at Eyre Peninsula sites
2008 yields (t/ha) and long term (2001-2008), expressed as % of Tahara's yield

Variety	2008 grain yield as % Tahara				Long Term average across sites			
					Lower Eyre		Upper Eyre	
	Greenpatch	Minnipa	Streaky Bay	Wharminda	% Tahara	# trials	% Tahara	# trials
Bogong		123		137			105	5
Canobolas		76		123			102	5
Hawkeye		115		86	113	3	104	8
Jaywick	NO	94	NO	74	110	3	103	8
Rufus	VALID	122	VALID	101	103	6	101	16
Speedee	RESULT	135	RESULT	103	102	8	100	21
Tahara		100		100	100	9	100	24
Tickit		95	DROUGHTED	111	100	9	102	24
Tobruk							98	6
Treat		114		96	98	9	99	18
Yukuri								
Tahara yield (t/ha)		0.32		0.35	3.38		1.22	
Date sown	27 May	22 May	29 May	29 May				
Soil type	LS	LiSCL	SL	S				
Apr-Oct rainfall (mm)	387	139	109	180				
pH (water)	5.5	8.6	8.6	6.9				
Site stress factors		de,dl,ht	de,dl	de,dl				

Abbreviations
Soil types: *S=sand, C=clay, L=loam, F=fine, K=coarse, M=medium, Li=light, H=heavy, / =divides topsoil from subsoil*
Site stress factors: *de=pre-flowering moisture stress, dl=post flowering moisture stress, ht=high temperatures during flowering/grain fill*

Data source: *SARDI/GRDC & NVT (long term data based on weighted analysis of sites)*
Data analysis by GRDC funded National Statistics Group

SA Wheat Variety Yield Performance at Eyre Peninsula Sites *2008 and long term predicted performance, expressed as % of Yitpi's yield*

Variety	Upper, Eastern and Western Eyre Peninsula										Mid and Lower Eyre Peninsula					
	2008 (% Yitpi)							Long Term average across sites			2008 (% Yitpi)			Long Term average across sites		
	Kimba	Minnipa	Mitchelville	Nunjikompita	Penong	Streaky Bay	Warramboo	t/ha	as % Yitpi	# trials	Cummins	Rudall	Ungarra	t/ha	as % Yitpi	# trials
AGT Scythe	113	107	100	110	125	105	117	1.32	101	36	103	111	98	2.90	103	18
Annuello								1.19	91	26	102	93	88	2.79	99	21
Axe	192	107	110	126	128	92	131	1.35	103	29	109	105	101	2.91	104	15
Bullet	145	99	110	101	99	88	125	1.29	99	5	104	106	97			
Catalina	131	89	113	103	106	87	95	1.30	99	15	102	106	100	2.84	101	9
Correll	136	100	120	103	122	103	100	1.35	103	22	103	100	92	2.91	103	12
Derrimut	81	84	113	97	106	89	91	1.30	99	22	105	104	100	2.93	104	12
Espada	134	99	111	105	115	93	101	1.37	105	15	103	112	106	3.03	108	9
Excalibur	100	98	115	109	112	97	105	1.34	102	60				2.86	102	27
Frame	66	86	79	109	76	88	80	1.23	94	60	98	98	98	2.68	95	27
GBA Ruby	126	103	110	103	123	88	120	1.30	99	23	97	100	94	2.86	102	12
Gladius	130	98	112	125	131	92	108	1.38	106	22	104	112	101	3.01	107	12
Guardian	95	90	115	133	111	93	110	1.32	101	15	109	116	102	2.97	106	9
Janz	65	88	88	97	89	82	74	1.18	90	60	96	91	81	2.68	95	27
Krichauff	114	92	118	94	112	91	109	1.32	101	60				2.82	100	21
Kukri	69	80	94	104	94	80	87	1.20	92	60				2.61	93	24
Lincoln	154	105	125	152	133	109	136	1.35	103	11	103	111	98	2.93	104	6
Magenta	85	89	113	108	104	96	99	1.29	98	22	101	107	93	2.88	102	12
Peake	94	96	118	119	116	87	112	1.33	101	22	104	110	99	2.90	103	12
Pugsley	86	91	80	96	85	89	81	1.28	98	60	102	107	94	2.90	103	27
Wyalkatchem	141	115	111	106	137	102	115	1.34	102	52	106	116	106	3.03	108	24
Yitpi	100	100	100	100	100	100	100	1.31	100	60	100	100	100	2.81	100	27
Young	142	98	117	103	116	87	107	1.34	102	29	104	116	107	2.93	104	15
Yitpi yield (t/ha)	0.27	0.73	1.04	0.28	0.26	1.80	0.51				3.21	2.21	2.18		2.81	
Durums																
Hyperno											108	100	111			
Caparoi											100	95	120			
Kalka											95	96	133			
Saintly											109	101	104			
Tamaroi											100	100	100			
Tamaroi yield (t/ha)											2.99	1.60	1.02			
Date sown	20 May	22 May	20 May	26 May	28 May	29 May	19 May				30 May	22 May	28 May			
Soil type	SCL	LiSCL	LS	LiSCL	SL	SL	SL/SCL				CL	S	CL			
Apr-Oct rainfall (mm)	173	139	118	136	153	229	145				217	188	248			
pH (water)	8.8	8.6	8.6	8.3	8.8	8.6	8.6				8.4	8.5	8.3			
Site stress factors	de,dl,bg	de,dl,ht	de,dl,ht	de,dl,ht	de,dl,ht		de,dl,ht				dl	bt,dl,yls	de,dl			

Abbreviations
Soil type: *S=sand, L=loam, C=clay, Li=light, M=medium, H=heavy, F=fine*
Site stress factors: *bg=barley grass, de= pre flowering moisture stress, dl=post flowering moisture stress, f= frost, ht=high temp stress at flowering, yr=stripe rust, yls=yellow leaf spot*

Data source: *SARDI/GRDC & NVT (long term data based on weighted analysis of sites, 2000-2008)*
Data analysis by GRDC funded National Statistics Group

SA Barley Variety Yield Performance

2008 and long term, 20001-2008, expressed as t/ha and % of Schooner's yield

Variety	Lower Eyre Peninsula					Upper Eyre Peninsula							
	2008 (t/ha)		Long Term average across sites			2008 (t/ha)					Long Term average across sites		
	Cummins	Wanilla	t/ha	as % Schooner	# trials	Darke Peak	Elliston	Minnipa	Streaky Bay	Whar-minda	t/ha	as % Schooner	# trials
Barque	102	99	3.83	106	16	87	109	157	135	96	1.91	106	41
Baudin	104	100	3.73	104	16	52	96	91	108	98	1.78	99	36
Buloke	111	109	3.99	111	12	65	106	100	103	99	1.88	105	26
Commander	111	108	4.01	111	16	62	106	40	101	97	1.86	104	36
Flagship	101	102	3.75	104	16	82	107	130	122	95	1.84	103	36
Fleet	111	116	4.09	114	12	88	117	103	136	96	2.00	112	26
Gairdner	99	98	3.67	102	18	54	88	75	107	93	1.74	97	36
Hannan	113	108	3.87	108	6	63	111	90	117	109	1.89	105	12
Hindmarsh	118	118	4.20	117	6	90	111	147	127	95	2.07	116	12
Keel	119	111	3.95	110	18	91	123	180	145	103	1.99	111	41
Lockyer	114	111	4.00	111	6	68	118	81	106	93	1.90	106	5
Maritime	107	109	3.93	109	14	73	102	98	100	106	1.87	104	33
Roe	105	106	3.87	108	4	88	106	113	116	114	1.92	107	17
Schooner	100	100	3.60	100	18	100	100	100	100	100	1.79	100	41
Sloop	107	103	3.62	101	18	79	106	126	108	99	1.76	98	41
Sloop SA	101	106	3.65	101	18	97	102	104	114	93	1.80	100	41
SloopVIC			3.55	99	10						1.70	95	24
Vlamingh	110	97	3.75	104	10	58	102	43	85	72	1.71	95	21
Yarra	109	105	3.97	110	14	73	109	133	134	104	1.93	108	31
Schooner's yield (t/ha)	4.01	4.13		3.60		1.11	2.57	0.53	0.84	0.84		1.79	
Date sown	30 May	27 May				22 May	26 May	23 May	11 June	29 May			
Soil type	CL	SL/SCL				S	SL	LiSCL	SL	S			
Apr-Oct rainfall (mm)	217	295				156	282	139	109	180			
pH (water)	8.4	6.2				6.8	8.2	8.6	8.6	6.9			
Site stress factors	dl	de,dl				dl,bt	dl	de,dl,ht	de,dl	ds,de,dl			

Data source: *SARDI/GRDC & NVT (long term data based on weighted analysis of sites)*
Data analysis by GRDC funded National Statistics Group

SA Oat Variety Yield Performance

2008 and long term (2000-2008), expressed as a % of Echidna's yield

Variety	2008			Long Term average across sites within region (2000-2008) as % Echidna and Number of trials			
	Greenpatch	Minnipa	Nunjikompita	Lower Eyre		Upper Eyre	
				% Echidna	# trials	% Echidna	# trials
Echidna			100	100	9	100	17
Euro			118	96	9	100	17
Kojonup			103	102	3	92	5
Mitika	NO	NO	146	103	9	98	17
Mortlock	VALID	VALID	125	88	8	88	14
Possum	RESULT	RESULT	151	103	9	102	17
Potoroo			145	102	9	105	17
Quoll		DROUGHTED		100	8	99	15
Yallara			144	98	5	100	10
Echidna yield (t/ha)			0.45	3.37		1.30	
Date sown	27 May	23 May	26 May				
Soil type	LS	LiSCL	LiSCL				
Apr-Oct rainfall (mm)	5.5	8.6	8.3				
pH (water)	387	139	136				
Stress factors		de,dl,ht	de,dl,ht				

Data source: *NVT, GRDC and SARDI Crop Evaluation and Oat Breeding Programs (long term data based on weighted analysis of sites)*
Data analysis by GRDC funded National Statistics Group

Abbreviations
Soil type: *S=sand, C=clay, L=loam, F=fine, K=coarse, M=medium, Li=light, H=heavy, / =divides topsoil from subsoil*
Site stress factors: *bt= boron toxicity, de=moisture stress pre flowering, dl= post flowering moisture stress, ds=dry at seeding, f=frost , ht=high temp stress at flowering*

District Cereal Trials and Demos

Neil Cordon[1], Michael Bennet[2] and Amanda Cook[2]

[1]Rural Solutions SA Port Lincoln, [2]SARDI Minnipa Agricultural Centre

Research

Demo

Try this yourself now

Location
Cowell
Bevan Siviour
Franklin Harbour Ag Bureau

Rainfall
Av annual: 400 mm
Av GSR: 256 mm
2008 Total: 236 mm
2008 GSR: 142 mm

Yield
Potential: 1.0 t/ha (W), 1.4 t/ha (B)

Paddock History
2007: Pasture
2006: Oats
2005: Wheat

Soil Type
Reddish brown clay loam

Location
Elliston
Stewart Gunn
Mt Cooper Ag Bureau

Rainfall
Av Annual: 415 mm
Av GSR: 335 mm
2008 Total: 376 mm
2008 GSR: 293 mm

Yield
Potential: 3.7 t/ha (W), 4.1 t/ha (B)

Paddock History
2007: Peas
2006: Wheat
2005: Grass free pasture

Soil Type
Reddish brown loam

Key messages

- **Axe, Peake, Gladius and Espada performed better than Wyalkatchem at Franklin Harbour.**
- **Derrimut, Young, Correll and Guardian performed better than Wyalkatchem at Mount Cooper.**
- **Evaluate historic trial data and yields from 2008 together with agronomic characteristics when selecting a new variety for a faming system.**

Why do the trials?

These trials were identified as a priority by the local Ag Bureaus and other farmer groups, to compare current cereal varieties with those not commonly grown in the district. It also enables cultivars to be compared in an environment different to the SARDI NVT cereal evaluation sites on Eyre Peninsula.

FRANKLIN HARBOUR CEREAL DEMO

How was it done?

Twelve wheat varieties were sown @ 60 kg/ha in demonstration strips on 23 May with 13 kg N/ha and 14 kg P/ha (18:20 @ 70 kg/ha).

What happened?

The trial was sown into damp soil and established well. Most varieties achieved the grain quality specifications in 2008, except Frame and Carnamah. The season was tough resulting in plants setting lower yield potential and all grain being filled.

The highest gross income this season was achieved by Correll with no fertiliser (but this is not recommended), Axe, Peake, Gladius, Espada and Carnamah.

MT COOPER CEREAL DEMO

How was it done?

Eleven wheat and seven barley varieties were sown @ 80 kg/ha and 75 kg/ha respectively, in demonstration strips on 29 May with 15 kg N/ha and 16 kg P/ha (18:20 @ 80 kg/ha). Grain yield and quality were measured using a small plot harvester.

What happened?

The plots were sown into damp soil with good growing conditions through to August, but dry conditions later in the season limited potential.

The varieties which achieved the grain quality specifications in 2008 were Yitpi, Wyalkatchem, Derrimut, Espada, Frame, Correll and Guardian. This season resulted in high grain yield potential being set by the plants, which failed to fill given dry conditions resulting in high levels of screenings. The highest gross income was achieved by Derrimut, Young, Correll, Guardian then Wyalkatchem. All barley varieties failed to achieve reasonable quality and were classified as feed, which limited profitability in 2008.

What does this mean?

The varieties which performed better than Wyalkatchem at Franklin Harbour in 2008 were Axe, Peake, Gladius and Espada. At Mount Cooper Derrimut, Young, Correll and Guardian performed better than Wyalkatchem in 2008. These varieties may be considered as new potential varieties within your system provided their other characteristics fit your requirements. Derrimut and Young may be a concern however, with their borderline screenings at the Mt Cooper site.

The possible raising of wheat test weight minimums to 76 kg/hL for 2009 harvest would see the majority of wheat varieties at Mount Cooper failing to achieve the standards, with exception of Wyalkatchem, Young and Frame. At Franklin Harbour most varieties would meet the standards except Carnamah, Derrimut, Correll and Frame.

Acknowledgments

Thanks to the farmer co-operators Stewart Gunn and Bevan Siviour for their time and land, and SARDI Minnipa Agricultural Centre and Port Lincoln teams for assisting in the trial management and harvesting. ABB Grain, CropCare Seed Technologies and SARDI Barley supplied seed.

Table 1 Grain quality of Wheat at Franklin Harbour Ag Bureau site 2008

Variety	Grade	Protein (%)	Screenings (%)	Test Weight (kg/hL)	Yield (t/ha)	Gross Income ($/ha)
Correll (no fertiliser)	AH	14.4	1.0	76.4	0.37	191
Axe	AH	13.4	3.0	77.1	0.68	172
Peake	AH	13.4	3.7	78.2	0.64	162
Gladius	AH	14.2	1.8	76.8	0.58	148
Espada	APW	14.1	1.8	77.0	0.60	147
Carnamah	AGP	13.1	2.4	71.6	0.60	133
Correll	AH	14.8	2.2	74.0	0.52	130
Yitpi	AH	14.3	0.7	79.7	0.47	120
Derrimut	AH	13.8	1.5	75.7	0.46	116
Wyalkatchem	APW	13.4	0.7	79.2	0.46	114
Guardian	APW	13.3	2.6	79.3	0.39	96
Frame	AGP	14.7	2.0	72.7	0.41	90

** Gross income is yield x price (with quality adjustments) delivered to ABB Cowell.*

Table 2 Yield, grain quality and gross income of cereals at Mt Cooper 2008

Variety	Grade	Protein (%)	Screenings (%)	Test Weight (kg/hL)	Yield (t/ha)	Retention (%>2.5mm)	Gross Income ($/ha)
Derrimut	AH	12.0	4.8	75.5	2.55		691
Young	AH	13.1	5.3	77.6	2.55		688
Correll	AH	13.1	2.0	75.3	2.41		653
Guardian	APW	13.3	1.4	74.2	2.40		634
Wyalkatchem	APW	13.2	1.5	76.4	2.37		626
Axe	AGP	13.0	8.9	75.5	2.47		590
Espada	APW	13.3	2.2	74.8	2.20		581
Frame	APW	13.8	1.2	76.8	2.18		576
Peake	AGP	12.8	5.8	74.2	2.35		562
Yitpi	AH	13.7	1.1	77.9	2.00		542
Gladius	AGP	13.6	2.3	72.0	2.21		528
Sloop SA	F2		22.0	74.1	2.58	34.9	328
Hindmarsh	F3		56.6	70.9	2.97	6.6	324
Fleet	F3		26.1	69.1	2.72	19.5	296
Commander	F3		27.8	72.0	2.45	18.2	267
Keel	F4		61.9	67.4	2.89	6.7	223
Maritime	F3		35.8	68.6	2.31	14.9	178

** Gross income is yield x price (with quality adjustments) delivered to ABB Witera (F3+F4 delivered to Pt Lincoln).*

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

GRDC Grains Research & Development Corporation

Elliston District Wheat Trial

Joanne Crouch and Brian Purdie

SARDI, Port Lincoln

Research

Extension

Trial Information

Location
Elliston
Nigel and Debbie May

Rainfall
Av Annual: 410 mm
Av GSR: 340 mm
2008 Total: 387 mm
2008 GSR: 281 mm

Yield
Potential: 3.5 t/ha (W)
Actual: 2.3 t/ha

Paddock History
2007: Grassy pasture
2006: Barley
2005: Grassy pasture

Soil Type
Sandy loam

Plot size
1.5 m x 10 m x 3 reps

Yield Limiting Factors
Dry spring

Key messages

- **The top yielding group of varieties in the 2008 trial was Espada (2.59 t/ha), Yitpi (2.48 t/ha) and Derrimut (2.47 t/ha).**
- **Espada, Yitpi and Derrimut also had the highest gross incomes with $632/ha, $628/ha and $626/ha respectively.**
- **Corell has yielded best on average over three years of testing (108% of Yitpi), with Axe on 105% then Gladius and Wyalkatchem on 102% of Yipti.**

Why do the trial?

The wheat variety comparison trial was established adjacent to the Elliston NVT barley trial site in response to interest from local growers, to assist their wheat variety choices.

How was it done?

- Treatments: 11 commercial wheat varieties (Table 1).
- Sowing date: 26 May 2008.
- Fertiliser: Sown with 23:16:00 + 2.5% Zn @ 100 kg/ha.
- Herbicides, trace elements & insecticides: Knockdown spray of Roundup Power Max @ 1 L/ha, plus Striker @ 50 ml/ha with pre-sowing Boxer Gold @ 2.5 L/ha and Chlorpyrifos @ 200 ml/ha. In-crop sprays of LVE MCPA @ 500 ml/ha, Mn @ 1.5 L/ha, Cu @ 150 g/ha, Ally @ 4 g/ha, Fastac @ 200 ml/ha and Dimethoate @ 400 ml/ha.
- Measurements: Grain yield and quality.

What happened?

Good rain in April and follow–up rain in May allowed for near optimum sowing time on 26 May. Excellent rains were also received during July and August with the total for the two months being 173 mm. These advantageous conditions were followed by a very dry spring with rainfall totalling only 14 mm during September and October. This was followed by 37 mm in early November.

Under these weather conditions, the wheat yields were considerably lower than the potential yields. The mean yield of all varieties was 2.3 t/ha, with a potential wheat yield of 3.5 t/ha, based on the growing season rainfall (April to October) in 2008.

Espada in its debut entry to the Elliston trial program, led the yield rankings, with a yield of 2.59 t/ha (Table 1). Its yield was not different from the next group of Yitpi and Derrimut (2.48 and 2.47 t/ha), but was higher than the rest of the varieties compared in this trial.

Screenings ranged from 0.6% for Guardian up to 5.0% for Frame, while grain protein ranged from 12.3% for Yitpi and Peake to 13.8% for Young (Table 1).

The top three yielding varieties were also the top income earners after their respective qualities were considered, with Espada reaching $632/ha and Yitpi and Derrimut $628/ha and $626/ha respectively (Table 1).

Cereals

Table 1 Yield and quality results of wheat varieties at Elliston, 2008

Variety	Grain Yield (t/ha)		Screenings (%)	Moisture (%)	Protein (%)	Test Weight (kg/hL)	Pay Grade	Gross Income* ($/ha)
Espada	2.59	A	0.9	12.9	13.0	81.0	APW1	632.19
Yitpi	2.48	AB	2.1	13.1	12.3	76.6	H2	628.48
Derrimut	2.47	ABC	1.5	13.0	12.9	80.8	H2	626.37
Young	2.35	BCD	1.3	12.9	13.8	78.8	H1	607.37
Frame	2.33	BCD	5.0	13.5	12.9	81.0	APW1	567.21
Axe	2.26	CDE	1.7	12.9	13.2	79.0	H1	584.74
Gladius	2.25	DE	2.8	13.0	12.5	81.2	H2	571.34
Wyalkatchem	2.19	DE	3.1	12.9	12.6	80.0	APW1	533.65
Peake	2.16	DE	0.8	12.9	12.3	79.6	H2	548.67
Guardian	2.14	DE	0.6	13.4	13.1	80.8	APW1	522.99
Correll	2.10	E	1.8	13.0	13.2	81.6	H1	543.83
Mean	2.30		2.0	13.0	12.9	80.0		
LSD (P=0.05)	*0.22*							
cv %	*5.52*							

** Gross income is yield x price (with quality adjustments) delivered to Elliston, 8 December 2008.*

Table 2 shows the long term data for the Elliston district wheat trials from 2006 to 2008, expressed as a percentage of Yitpi each year. Despite Correll's poor performance in 2008, it has been the highest average yielder over the last three years at this site, with an average of 108% of Yitpi's long term yield. Axe and Espada closely followed Correll with 105% of Yitpi's yield (but note there has only been one year of testing of Espada at this site) then Gladius and Wyalkatchem with 102% of Yitpi's yield.

What does this mean?

The top yielding variety Espada is a sister line to Gladius. It is agronomically similar to Gladius, but features improved leaf rust resistance, slightly better yellow leaf spot and *Septoria tritici* resistance and higher yield potential in higher rainfall environments. Unlike Gladius which is classified as a Hard wheat, Espada has APW quality and is susceptible to black point.

Yitpi and Derrimut, which both yielded similarly to Espada, are both Hard wheats. Due to their protein levels being under 13%, they both fell into the pay grade H2, making their gross incomes slightly below that of Espada, whose higher yield compensated for the lower quality pay grade.

Derrimut has shown a yield potential similar to Yitpi, particularly in higher rainfall districts. It has CCN resistance and good levels of resistance to stem and leaf rust, MS to stripe rust and MS/S to yellow leaf spot. It has moderate grain size, short plant height and is midseason flowering.

After the top group of Espada, Yitpi and Derrimut, came a group of seven varieties with statistically similar yields, i.e. Young, Frame, Axe, Gladius, Wyalkatchem, Peake and Guardian.

Young is an early maturing Hard wheat with CCN resistance, which is also resistant and moderately resistant to stem and leaf rust but is now rated moderately susceptible to the new stripe rust strain. It has similar grain plumpness to Janz and is susceptible to dry finishes.

As expected, both Gladius and Axe gave similar yields in these seasonal conditions. Gladius is a widely adapted, early to mid flowering variety and Axe is a vigorous growing, very early flowering variety that is well suited to very dry, sharp finishes. Both these varieties lack CCN resistance, which needs to be considered in areas where CCN is a problem.

Peake is a new variety released in 2007 with AH quality, developed by Nugrain and Sunprime. Peake is medium short strawed, mid maturing variety (5-6 days earlier than Yitpi) and is suitable for growing in medium to high rainfall zones where it has shown high yield potential. Peake is MR-MS to stem and stripe rust and R to leaf rust. Peake is also CCN resistant, boron tolerant and is MS-S to yellow leaf spot and S to *Septoria tritici* blotch.

Guardian was developed and released from Longreach Plant Breeders in 2006 and is derived from Krichauff, with improved quality (eligible for APW grade in SA). It is resistant to CCN and has moderate resistance to stem rust, but is moderately susceptible to stripe and leaf rust and susceptible to yellow leaf spot. Its early vigour and height are similar to Janz. While further evaluation is needed, it may be an option for districts where risk of stripe rust is low.

The lowest yielding variety in the 2008 trial was Correll, although this has the highest average long term yields at the site. There was only 0.49 t/ha that separated the highest yielding variety, Espada and Correll. Correll is a Hard wheat, released from AGT in 2006 that is derived from Yitpi and is agronomically similar but with improved stem rust resistance and black point tolerance. It is seen as an alternative to Yitpi, to reduce the stem rust risk currently posed with Yitpi. Correll has shown to be similar in yield, grain size and plumpness to Yitpi, but averages around 2-3 kg/hL lower test weight and is 2 to 5 days earlier flowering, and even more when very early sown.

For complete and detailed notes on all varieties refer to the SARDI Crop Harvest Report in the February/March edition of Grain Business or on the NVT website, www.nvtonline.com.au. Results of the NVT wheat trials can also be accessed from the NVT website and are included in the NVT tables in the cereals section.

Acknowledgements

Thanks to Nigel and Debbie May for making their land available for these trials. Thanks also to Craig Povey at AWB, Port Lincoln for providing the receival standard information.

Table 2 Grain yield of wheat varieties in Elliston trials, 2006–2008

Variety	2008	2007	2006	Average
	Yield as % Yitpi			
Axe	91	103	120	105
Correll	85	104	136	108
Derrimut	100	99		100
Espada	105			105
Frame	94	83	95	91
Gladius	91	112	103	102
Guardian	87	96	120	101
Peake	87			87
Pugsley		100	98	99
Wyalkatchem	88	102	115	102
Yitpi	100	100	100	100
Young	95	96	111	101
Yitpi (t/ha)	2.48	2.21	0.98	1.89

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DROUGHT RESPONSE SOUTH AUSTRALIA
AGT Australian Grain Technologies

Wheat Seed for Eyre Peninsula

Dan Vater, Haydn Kuchel and Steve Jefferies
Australian Grain Technologies Pty Ltd

Information

Cereals

Key messages

- **AGT improves grower access to seed of new wheat varieties.**
- **AGT adopts new Affiliate model.**
- **AGT appoints Minnipa Agriculture Centre and Modra Seeds as AGT Affiliates to provide high quality seed of new AGT wheat varieties to EP growers and retailers.**
- **AGT expands Seed Sharing model to improve grower access to the benefits of new varieties and improve new variety adoption rates.**
- **AGT launches new variety Mace in WA.**

AGT Affiliates

AGT recently reviewed its pathway of new varieties to market. This review involved consultation with growers, advisors, seed producers and retailers and has led to a significant change in the way in which AGT manages the delivery of new varieties to growers. Until recently AGT was a fully integrated breeder, foundation seed producer and a seed wholesaler. AGT would produce seed under contract and in turn sold this seed to retailers, or other wholesalers, who in turn sold it on to growers, or other retailers, with an additional margin.

AGT has now decided to focus its resources on breeding and foundation seed production, leaving broad scale seed production, processing, wholesaling and retailing to those with the expertise and appropriate infrastructure to undertake this more efficiently and therefore at lower cost to growers.

AGT has entered into a relationship with carefully selected seed producers, and processors who have skills and experience in producing high quality wheat seed at low cost for EP growers and other retailers. AGT's EP Affiliates are Minnipa Agriculture Centre, Minnipa and Modra Seeds, Ungarra.

Under this system, AGT will receive no income from the sale of seed to growers, that is, no seed margin or seed royalty is included in the transaction. AGT's breeding resources come from end point royalties alone.

Seed Sharing

Eyre Peninsula growers who have purchased seed of Correll, Gladius, Espada, or Axe from a recognised seed retailer have been offered the legal right, under the terms of a Licence Agreement, to sell or trade grain from these varieties to another grower for use as seed under AGT's new Seed Sharing model. This model was created to improve grower access to new varieties and essentially provides a legal licence for growers to trade seed with other growers. This model was first introduced during the 2007 season with Correll and Gladius and proved to be very popular. AGT is now extending this offer to include Espada and Axe. So far this year a large number of transactions between growers have been registered, showing strong support for the new system.

It is important to note that no seed can be legally traded without the return of a completed AGT Seed Sharing License Agreement. The sale or trade of seed without a completed and returned License Agreement is an infringement of Australian law under the Plant Breeders Rights ACT of 1994.

To ensure maintenance of seed purity, a grower who wishes to sell or trade seed of these varieties must have first purchased the original seed source from a recognised seed retailer. Growers are not obliged to sell seed of these varieties to other growers, AGT has simply offered these growers the legal right to do so.

New Variety Mace released in WA

In October 2008 at Cunderdin, Western Australia, AGT launched a new wheat variety Mace. Mace is derived from Wyalkatchem, a very popular variety on EP. The announcement of the release of this variety in WA has therefore drawn considerable interest from EP growers and agronomists.

Mace is derived from a cross between Wyalkatchem and Stylet. Stylet is a Trident derivative with improved grain yield and quality that was withdrawn from commercial release due to several consecutive rust pathotype changes that rendered the variety susceptible and therefore did not meet industry agreed minimum disease standards for release in SA.

Mace has proven to be higher yielding than Wyalkatchem, is rated as moderately tolerant to boron and is rated moderately resistant to moderately susceptible to CCN. While it looks similar to Wyalkatchem it is a little taller. Mace carries good levels of resistance to both leaf and stem rust including the stem rust race which attacks Wyalkatchem. Mace carries the Yr17 stripe rust resistance gene which provides complete resistance to the only commonly found race of stripe rust in WA, aptly named the "WA race". A mutation of this race has lead to the development of the "WA +Yr17" race which was first observed in SA in 2007.

Mace is susceptible to this race and therefore fails to meet the agreed industry standards for rust resistance in SA (Wyalkatchem also fails to meet this standard). For this reason, AGT has proceeded with the release of Mace in WA and not SA.

While Mace is slightly more susceptible than Wyalkatchem to the "WA+Yr17" stripe rust race it is more resistant to many other stripe rust races including the "Jackie" race which was the dominant race in eastern Australia in 2008. Unlike Wyalkatchem, Mace is moderately resistant to the common races of stem rust found in Australia. AGT believes Mace offers EP growers a number of additional benefits over Wyalkatchem which may warrant it being considered as an exception to the industry agreed minimum disease standards. AGT will be making a submission to the minimum disease standards exceptions committee in early 2009 for consideration for its release to SA growers. If approved, AGT will provide pure seed of Mace to AGT Affiliates (see previous page) for 2009 planting and under this scenario, the variety would be broadly available to SA growers for 2010 planting.

AGT
Australian Grain Technologies

Types of work in this publication

The following table shows the major characteristics of the different types of work in this publication. The Editors would like to emphasise that because of their often un-replicated and broad scale nature, care should be taken when interpreting results from demonstrations.

Type of work	Replication	Size	Work conducted by	How analysed
Demo	No	Normally large plots or paddock size	Farmers and agronomists	Not statistical, trend comparisons
Research	Yes, usually 4	Generally small plot	Researchers	Statistics
Survey	Yes	Various	Various	Statistics or trend comparisons
Extension	N/A	N/A	Agronomists and researchers	Usually summary of research results
Information	N/A	N/A	N/A	N/A

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Section editor:

Amanda Cook
SARDI
Minnipa Agricultural Centre

Break Crops

The 2008 production figures for Upper Eyre Peninsula were approximately 8,500 t of peas, 3,000 t of lupins, 400 t of beans and 2,000 t of canola. Lower Eyre Peninsula produced approximately 8,000 t of peas, 24,000 t of lupins, 7,000 t of beans and 45,000 t of canola
(PIRSA Crop Production Estimates Dec 2008).

SA Field Pea Variety Trial Yield Performance at Eyre Peninsula sites
2008 yields (t/ha) and long term (2000-2008), yields expressed as a % of Kaspa's yield

Variety/line	Lower Eyre Peninsula				Upper Eyre Peninsula		
	2008		2000–2008		2008	2000-2008	
	Rudall	Yeelanna	% Kaspa	Trial #	Minnipa	% Kaspa	Trial #
Bundi	1.14	1.95	99	9	No Valid Result	102	5
Kaspa	1.00	1.8	100	15		100	7
Parafield	0.99	1.8	97	15		98	7
Sturt	1.25	1.48	101	13	Droughted	103	7
SW Celine	1.13	1.51	103*	7			
Yarrum	1.00	1.76	104	9		102	5
OZP0601	1.32	1.93					
OZP0602	1.13	1.94					
OZP0703	1.15	1.95					
Kaspa's yield (t/ha)	1.00	1.80	2.23	15		1.48	7
Date sown	23 May	28 May			19 May		
Soil type	SL	LSCL			L		
Apr-Oct rainfall (mm)	200	231			139		
pH (water)	8	6.7			8.4		
Site stress factors	dl,ht	dl,ht			de,dl,ht		

Soil type: *S = sand, C = clay, L = loam*
Site Stress Factors: *dl=post flowering moisture stress, de=pre flowering moisture stress, ht=high temperatures during flowering/pod fill*
**Varieties have only had limited evaluation years at these sites, treat with caution*
Data source: *SARDI/PBA/GRDC & NVT trials (long term data based on weighted analysis of sites)*
More information: *Larn McMurray (08) 8842 6265 or email mcmurray.larn@saugov.sa.gov.au*

Early season maturity canola trials 2008 and long term averages

Variety	2008 LONG TERM AVERAGE ACROSS SITES		
	Tooligie (t/ha)	Upper Eyre Peninsula	
		(t/ha)	# trials
Conventional			
AG Muster	0.94	1.23	2
AV Garnet	1.03		
Hyola 50	0.95	1.47	2
Hyola 571CL	0.87		
Pioneer 43C80	0.84		
Pioneer 44C73	0.80	1.25	3
Pioneer 44C79	0.70		
Tarcoola	0.88	1.31	2
TT			
ATR Cobbler	0.71		
ATR Stubby	0.71	1.16	2
ATR409	0.44		
BravoTT	0.77		
CB Boomer	0.65	1.13	2
CB Tanami	0.80		
Hurricane TT	0.64		
Rottnest TTC	0.58		
Tawriffic TT	0.73		
TornadoTT	0.68		
Date sown	8 May		
Soil type	SL		
Apr-Oct rainfall (mm)	198		
pH (water)	8.4		
Site stress factors	de, dl		
Blackleg			

Abbreviations
Soil type: *Soil type: S=sand, L=loam, C=clay, Li=light, M=medium, H=heavy, F=fine*
Site stress factors: *de=moisture stress preflowering, dl=moisture stress post flowering, w=weeds, lo=lodging, sh-shattering, pe=poor establishment, s=sulphur deficiency, ap=aphids, hd=herbicide damage, bl=blackleg, wind=wind loss, ls=late sown, sn=snails, f=frost, db=diamond back moth*
Blackleg data: *Polygenic variety: BravoTT, Sylvestris variety: Surpass 501TT*
% average blackleg infection

Data source: NVT & SARDI/GRDC (long term data based on weighted analysis of sites, 2000-2008)
Data analysis by GRDC funded National Statistics Group
More information: Trent Potter (08) 8762 9132 or email potter.trent@saugov.sa.gov.au

Mid season maturity canola trials 2008 and long term averages

Variety	LOWER EYRE PENINSULA		LOWER EYRE PENINSULA	
	Mt Hope (t/ha)	Yeelanna (t/ha)	(t/ha)	# Trials
Conventional				
AV Garnet	2.22	No	1.81	6
AV Sapphire	1.47	valid	1.44	17
Hyola 50	1.86	data	1.81	7
Hyola 76	1.46		1.64	4
TT				
ATR Barra	-	0.66	1.29	5
ATR Cobbler	1.44	0.96	1.39	4
ATR Marlin	1.34	0.56	1.32	6
ATR409	1.34	0.52	1.27	6
BravoTT	1.60	0.82	1.40	8
CB Argyle	1.42	0.72	1.35	4
CB Boomer	-	-	1.20	2
CB Tanami	-	-		
Flinders TTC	1.49	0.69	1.28	6
Hurricane TT	1.52	0.79	1.33	2
Monola 76TT	1.35	0.66	1.31	2
Monola 77TT	1.27	0.71	1.36	2
Rottnest TTC	1.50	0.74	1.33	4
Storm TT	1.46	0.73	1.32	4
Tawriffic TT	1.41	0.65	1.37	4
ThunderTT	1.67	0.71	1.32	8
TornadoTT	1.69	0.61	1.30	8
TTRIUMPH Jardee	-	0.77		
Clearfield				
Hyola 571CL	1.67	No	1.31	2
Pioneer 43C80	1.45	valid	1.16	2
Pioneer 44C73	1.63	data	1.25	4
Pioneer 44C79	1.61		1.16	2
Pioneer 45Y77	1.28		1.19	4
Pioneer 46Y78	1.34		1.31	4
Pioneer 46Y81	1.25		1.21	2
Date sown	11 May	11 May		
Soil type	S	SCL		
Apr-Oct rainfall (mm)	296	218		
pH (water)	5.4	8.1		
Site stress factors	dl	de, dl		
Blackleg	19.1, 22.8	3.8, 1.3		

Abbreviations
Soil type: *Soil type: S=sand, L=loam, C=clay, Li=light, M=medium, H=heavy, F=fine*
Site stress factors: *de=moisture stress preflowering, dl=moisture stress post flowering, w=weeds, lo=lodging, sh-shattering, pe=poor establishment, s=sulphur deficiency, ap=aphids, hd=herbicide damage, bl=blackleg, wind=wind loss, ls=late sown, sn=snails, f=frost, db=diamond back moth*
Blackleg data: *Polygenic variety: BravoTT, Sylvestris variety: Surpass 501TT*
% average blackleg infection

Data source: NVT & SARDI/GRDC (long term data based on weighted analysis of sites, 2000-2008)
Data analysis by GRDC funded National Statistics Group
More information: Trent Potter (08) 8762 9132 or email potter.trent@saugov.sa.gov.au

SA Chickpea Variety Trial Yield Performance at Eyre Peninsula sites

2008 and long term (2000-2007~), yields expressed as a % of Howzat's (desi) and Genesis 090's (kabuli) yields.

Variety	2008		2000-2007 LONG TERM RAINFALL ZONE DATA									
	Eyre Peninsula		<350 mm		350-425 mm		425-500 mm		>500 mm		All zones	
	Cockaleechie	Rudall**	% Howzat	Trial #	% Howzat	Trial #	% Howzat	Trial #	% Howzat	Trial #	% Howzat	Trial #
Desi trials												
Genesis 508			87	5	88	8	90	6	91*	3	89	22
Genesis 509	89	100	97	9	98	8	99	6	100	5	98	28
Genesis 079#	97	103			104	4	103*	3			103	8
Genesis 090#	92	58	97	5	97	8	98	6	98*	3	97	22
Howzat	100	100	100	20	100	14	100	10	100	8	100	52
Sonali	91	118	95	5	96	8	97	6	97*	3	96	22
CICA0503	95	109										
Howzat's yield (t/ha)	2.19	0.67	0.88	20	1.6	14	2.18	10	2.11	8	1.51	52

Kabuli trials			% Gen. 090	Trial #	% Gen. 090	Trial #	% Gen. 090	Trial #	% Gen. 090	Trial #	% Gen. 090	Trial #
Almaz	87		74	8	80	10	82	6	80	6	80	30
Genesis 079	128		111	9	107	12	104	10	103	7	106	38
Genesis 090	100		100	11	100	13	100	10	100	7	100	41
Genesis 114	85		82	8	85	10	85	6	86	6	85	30
Nafice	82		71	8	77	10	79	6	78	6	77	30
Genesis 090's yield (t/ha)	1.65		1.03	11	1.59	13	2.25	10	1.88	7	1.64	41
Date sown	21 May	23 May										
Soil type	SCL	SL										
Apr-Oct rainfall (mm)	293	200										
pH (water)	5.9	8										
Site stress factors	dl	de, dl, ht										

 # Kabuli line

Soil type: *S = sand, C = clay, L = loam, H = heavy, M = medium, Li = light, / = over*
Site Stress Factors: *de = pre flowering moisture stress, dl = post flowering moisture stress, ht = high temperatures during flowering/pod fill*
~2008 long term figures not available at time of print
Data source: *SARDI/PBA/GRDC & NVT trials (long term data based on weighted analysis of sites)*

****Varieties have only had limited evaluation years at these sites, treat with caution***
***** = Low yield due to drought, use caution.***

SA Lentil Variety Trial Yield Performance at Eyre Peninsula sites

2008 yields and long term (2000-2008) yields expressed as a % of Nugget's yield

Variety/line	2008		2000-2008 Long term rainfall zone data*					
	Eyre Peninsula		Low*		Medium*		High*	
	Rudall**	Yeelanna	% Nugget	Trial #	% Nugget	Trial #	% Nugget	Trial #
Aldinga	136	116	94	36	94	63	92	57
Boomer	118	137	102	19	103	25	103	28
Digger	-	-	95	39	96	61	94	55
Nipper	113	120	95	27	96	46	95	46
Northfield	97	100	89	43	89	67	89	63
Nugget	100	100	100	44	100	67	100	63
CIPAL411	159	160	105	23	105	36	104	37
CIPAL415	162	115	103	23	103	36	101	35
Nugget's yield (t/ha)	0.39	0.92	1.19		1.52		1.77	
Date sown	23 May	29 May						
Soil type	SL	LSCL						
Apr-Oct rainfall (mm)	200	231						
pH (water)	8	6.7						
Site stress factors	dl, ht	dl, ho, ht						

Soil type: *S = sand, C = clay, L = loam*
Site Stress Factors: *dl = post flowering moisture stress, ht = high temperatures during flowering/pod fill, ho = hayed off excessive biomass*
** Lentil yields are heavily influenced by rainfall and length of growing season, zones are based on rainfall and yield potential of sites.*
Example sites in zones are: Low = Lameroo, Rudall; Medium = Melton, Yeelanna; High = Riverton, Mundulla
Data source: *SARDI/PBA/GRDC & NVT trials (long term data based on weighted analysis of sites)*
***** = Low yield due to drought, use caution.***

Lupin Variety Yield Performance at Eyre Peninsula sites

2008 yields (t/ha) and long-term (2000-2008) yields expressed as % of Mandelup's yield

Variety	LOWER EYRE PENINSULA			UPPER EYRE	
	2007	2000-2008		2000-2008	
	Wanilla	% of Mandelup	No. Trials	% of Mandelup	No. Trials
Coromup	2.31	97	6		
Jenabillup	2.26	104	6		
Jindalee	1.85	91	27	90	7
Mandelup	2.20	100	23	100	6
Moonah	2.25	93	23	91	7
Wonga	1.94	91	26	92	7
Mandelup's yield (t/ha)	2.20	2.59		1.54	
Date sown	10 May				
Soil type	S				
pH (water)	7.0				
Apr-Oct rainfall (mm)	295				
Site stress factors	dl				

Soil type: *S=sand*
Site stress factors: *dl=post flowering moisture stress*
Results from 2008 NVT trials at Tooligie, Ungarra not released due to low yields and/or high variability.
Data source: *SARDI/GRDC & NVT. 2000-2008 MET data analysis by National Statistics Program.*
More information: *Jim Egan (08) 8688 3424 or email egan.jim@saugov.sa.gov.au*

Faba Bean Variety Yield Performance at Eyre Peninsula sites
2008 (t/ha) and long-term (2000-2008) yields, expressed as % of Farah's yield)

Variety/Line	LOWER EYRE PENINSULA				UPPER EYRE PENINSULA		
	2008		2000-2008		2008	2000-2008	
	Cockaleechie	Cummins	% of Farah	No. Trials	Rudall	% of Farah	No. Trials
Doza	2.05	1.66	94	3	0.90		
Farah	2.14	2.10	100	9	0.87	100	8
Fiesta	2.32	1.98	100	10	0.93	99	10
Fiord	2.51	2.29	96	10	1.21	93	10
Manafest	1.80		87	10	0.76	90	9
Nura	2.52	2.05	97	10	0.94	96	10
Farah's yield (t/ha)	2.14	2.10	2.01		0.87	1.50	
Date sown	22 May	24 May			23 May		
Soil type	SCL				SL		
pH (water)	5.9				8.0		
Apr-Oct rainfall (mm)	293	217			200		
Site stress factors	dl	dl, ht	de, dl, ht		de, dl		

Soil type: *S=sand, C=clay, L=loam*
Site stress factors: *de=pre-flowering moisture stress, dl=post-flowering moisture stress*
Data source: *SARDI/GRDC, NVT and PBA - Australian Faba Bean Breeding Program. 2000-2008 MET data analysis by National Statistics Program.*
More information: *Jim Egan (08) 8688 3424 or email egan.jim@saugov.sa.gov.au*

Types of work in this publication

The following table shows the major characteristics of the different types of work in this publication. The Editors would like to emphasise that because of their often unreplicated and broad-scale nature, care should be taken when interpreting results from demonstrations.

Type of work	Replication	Size	Work conducted by	How analysed
Demo	**No**	**Normally large plots or paddock size**	**Farmers and agronomists**	**Not statistical, trend comparisons**
Research	**Yes, usually 4**	**Generally small plot**	**Researchers**	**Statistics**
Survey	**Yes**	**Various**	**Various**	**Statistics or trend comparisons**
Extension	**N/A**	**N/A**	**Agronomists and researchers**	**Usually summary of research results**
Information	**N/A**	**N/A**	**N/A**	**N/A**

Canola and Juncea Canola for Low Rainfall Areas in 2009

Trent Potter[1] **and Wayne Burton**[2]

[1]SARDI, Struan, [2]DPI Victoria, Horsham

Research Information

Variety selection

The choice of most suitable canola variety for any situation will often follow a consideration of maturity, herbicide tolerance, blackleg resistance and early vigour together with relative yield and oil content. In relation to some of these issues the following points can be made:

- The weed species expected may dictate the need for a herbicide tolerant production system (e.g. triazine tolerant or Clearfield). Remember that a triazine tolerant variety will incur a yield and oil penalty when grown in situations where they are not warranted.
- Varietal blackleg resistance and/or fungicide use should be considered, particularly when rotations are close, although blackleg is less of a factor in low rainfall systems.

The following are early or early-mid flowering varieties that may be suitable for lower rainfall areas.

New varieties released in 2008

Triazine tolerant (TT) varieties

Hurricane TT New release (coded PacT2202). Early-mid maturing variety. Pacific Seeds indicate good yield, oil and protein content. Ideally fits low to medium rainfall areas, exhibits good vigour. Blackleg rating MR provisional. First year of testing in NVT in 2007. Bred and marketed by Pacific Seeds.

Tawriffic TT (coded BLN3697TT).An Early-Mid, Triazine Tolerant Canola variety developed by the Canola Alliance. Tawriffic TT has a blackleg rating of MR-MS (provisional) and is medium in height. The Canola Alliance have indicated that Tawriffic TT has high yield and oil potential. Marketed by PlantTech Pty Ltd.

CLEARFIELD® (imidazolinone tolerant) varieties

44C79 New release (coded NS6082BI). Early maturing, similar to 44C73. Pioneer indicate good vigour, high yield and oil content. Blackleg rating is MR-MS (provisional). Targeted to replace 44C73. Limited seed quantities in 2008. Bred and marketed by Pioneer Hi-Bred Australia.

New varieties for 2009

A number of new varieties will be marketed for 2009 sowings. Information about new varieties has been provided by the seed companies. In most cases, entries have only come into NVT trials in 2008.

CLEARFIELD® (imidazolinone tolerant) varieties

43C80 (coded NS6108BI). Early maturing variety. Pioneer indicate good early vigour, good yield and moderate oil content. Blackleg rating MS (provisional). Suited to low rainfall areas and potentially as a late sowing option in medium-high rainfall areas. Tested in SA NVT trials in 2008. Limited seed quantities in 2009. Bred and marketed by Pioneer Hi-Bred.

Hyola 571CL (tested as K9209). Early-mid maturing hybrid with similar maturity to 45Y77. Pacific Seeds indicate excellent early vigour, with good oil and yield potential. Blackleg resistance R (provisional). Tested in SA NVT trials in 2008. Bred and marketed by Pacific Seeds.

CLEARFIELD® (imidazolinone tolerant) Juncea canola

Oasis CL New release (coded J05Z-08920). First herbicide tolerant Clearfield Juncea canola. Blackleg rating R (provisional). Seed quality as good as, or slightly better than Dune. Limited seed quantities for 2009. Bred by DPI Victoria and Viterra (Canada). Marketed by Pacific Seeds. An EPR applies.

SaharaCL (tested as J05Z-08960). Early maturing juncea canola, earlier than Oasis CL. Pacific Seeds indicate exceptional vigour. Blackleg resistance R (provisional). An End Point Royalty (EPR) applies. Tested in SA NVT trials in 2008. Bred by DPI Victoria and Viterra (Canada). Marketed by Pacific Seeds.

The following varieties are being outclassed with limited seed available in 2009

- Monola™ 75TT, Rivette, Skipton and WarriorCL

The following varieties will be withdrawn for 2009

- Rocket CL, 44C11, 44C73, 45C75, 46C04, 46C76, AG-Outback, AG-Spectrum, AV-Opal, AV-Sapphire, Rainbow, ATR-Beacon, ATR-Signal, ATR-Stubby, ATR-Summitt

Grain quality

Grain quality data from trials conducted in the South East in 2007 are presented as all entries were only tested at these sites (Table 1). Many of the newer varieties have improved oil content over older varieties, but consider oil content amongst the other factors when choosing a new canola variety.

Blackleg resistance

The blackleg rating system for all canola varieties has been changed from the numerical one to a descriptive scale (Tables 4 and 5), conforming to the systems used for other major winter crops.

Table 1 Grain quality (oil, protein and glucosinolate content) of canola sown at Keith in 2007

Conventional and Clearfield			
Entry	**Oil** (%)	**Protein** (%)	**Glucosinolates** (%)
AV Jade	46.8	21.5	6
Rivette	45.5	22.0	7
Hyola 50	45.5	20.7	6
Tarcoola	44.9	21.7	9
Warrior CL	43.7	21.6	8
44Y06	43.6	21.3	7
AG Spectrum	43.5	21.1	7
AG Outback	43.5	20.9	8
AG Muster	43.4	20.8	10
Dune	43.4	23.9	11
44C73	43.2	21.3	6
ATR Stubby	40.9	21.8	8
Triazine tolerant			
Entry	**Oil** (%)	**Protein** (%)	**Glucosinolates** (%)
Tawriffic TT	44.8	21.9	7
ATR409	43.7	22.5	9
ATR Banjo	43.6	24.4	11
TornadoTT	43.6	23.2	6
Hurricane TT	43.5	23.2	8
ATR Cobbler	43.3	22.8	11
Surpass501TT	42.7	23.6	7
BravoTT	42.3	23.1	12
Rottnest TTC	41.9	22.3	9
ATR Beacon	41.8	23.7	10
ATR Stubby	41.6	23.0	10
CB Boomer	41.1	25.0	7
CB Tanami	40.5	22.6	13

Table 2 Grain yield at Tooligie 2008 NVT trials

Variety	Conventional and CL varieties (t/ha)	% site mean	TT varieties (t/ha)	% site mean
AG Muster	0.94	105	-	-
ATR Cobbler	-	-	0.71	101
ATR Stubby	-	-	0.71	101
ATR409	-	-	0.44	62
AV Garnet	1.03	116	-	-
BravoTT	-	-	0.77	109
CB Boomer	-	-	0.65	93
CB Pilbara	-	-	0.77	110
CB Scaddan	-	-	0.79	113
CB Tanami	-	-	0.80	114
CB Telfer	-	-	0.84	120
Hurricane TT	-	-	0.64	91
Hyola 50	0.95	107	-	-
Hyola 571CL	0.87	97	-	-
43C80	0.84	94	-	-
44C73	0.80	90	-	-
44C79	0.70	78	-	-
Rottnest TTC	-	-	0.58	83
Tarcoola	0.88	99	-	-
Tawriffic TT	-	-	0.73	104
TornadoTT	-	-	0.68	97
Site Mean (t/ha)	**0.89**		**0.70**	
CV (%)	**9.46**		**11.86**	
LSD (P=0.05)	***0.14***	***15***	***0.13***	***18***

Table 3 Grain yield of TT canola at Minnipa 2008

Variety	kg/ha	% site mean
CB Telfer	214	146
CB Tanami	206	141
ATR Cobbler	181	123
CB Boomer	159	108
CB Pilbara	158	108
CB Scadden	139	95
BravoTT	133	91
Hurricane TT	131	90
Tawriffic TT	130	89
Rottnest TTC	125	85
ATR Stubby	119	81
TornadoTT	117	80
ATR409	93	64
Site mean (kg/ha)	**146.4**	
CV%	**12.28**	
LSD (P=0.05)	***29.6***	

Table 4 2009 Blackleg resistance ratings *Published by the Canola Association of Australia*

Conventional Varieties	2009 Rating	2009 Provisional Rating	Reduced Resistance
Variety			
Hyola 50	R		
Hyola 76	R		
AV-Garnet	MR		
AV-Jade	MR		
AV-Opal	MR		
Hyola 61	MR-MS		
Tarcoola	MR-MS		
46C04	MR-MS		
AG-Spectrum	MR-MS		Reduced Resistance
ATR-Signal	MR-MS		
AV-Sapphire	MR-MS		
AG-Muster	MS		
Skipton	MS		
Rivette	MS-S		
Triazine Tolerant Varieties			
Tornado TT	MR		
ATR-409	MR		
Hurricane TT	MR		
Triumphjardee	MR		
ATR-Marlin	MR		Reduced Resistance
CB™ Trilogy	MR		
Storm TT	MR		
Rottnest TTC	MR		
Tawriffic TT	MR		
CB™Scadden	MR	Provisional rating	
CB™ Argyle	MR		Reduced Resistance
Thunder TT	MR-MS		Reduced Resistance
ATR-Barra	MR-MS		
Flinders TTC	MR-MS		Reduced Resistance
Bravo TT	MR-MS		Reduced Resistance
ATR-Summitt	MS		
ATR-Banjo	MS		Reduced Resistance
ATR-Cobbler	MS		
CB™Telfer	MS	Provisional rating	
CB™ Tanami	MS-S		Reduced Resistance
CB™Pilbarra	MS-S	Provisional rating	
CB™ Boomer	MS-S		Reduced Resistance
ATR-Stubby	S		Reduced Resistance
CB™ Trigold	S-VS		
CLEARFIELD® Varieties			
46Y81 (CL) hybrid	R-MR		
46Y78 (CL) hybrid	MR		
45Y77 (CL) hybrid	MR		
Rocket CL	MR		
Warrior CL	MR-MS		
44C79 (CL)	MR-MS	Provisional rating	
43C80 (CL)	MS	Provisional rating	
45C75 (CL)	MS		
46C76 (CL)	MS		Reduced Resistance
44C73 (CL)	MS-S		Reduced Resistance
CLEARFIELD® Juncea Canola Varieties			
Oasis CL	R	Provisional rating	
Sahara CL	R		
High stability Oil Varieties			
Monola NMC131	R		
V3001	R-MR		
V3002	R-MR		
Monola NMC130	R-MR		Reduced Resistance
Triazine Tolerant High Stability Oil Varieties			
Monola 75TT	R-MR		
Monola 76TT	R-MR		
Monola 77TT	MR		
Conventional Juncea Canola Varieties			
Dune	R		

Table 5 Standard Disease Ratings – Canola

Uniform Rating	For Growers: What do I see?	For Growers: What do I do?
Resistant (R)	• Some lesions on cotyledons and leaves. • Some internal infection at the base of the plant when cut near maturity.	Do not sow into canola stubble from the previous year. Separate your crop by 500 m from the previous year's stubble. Fungicide use is unlikely to be economic.
Resistant – Moderately Resistant (R-MR)	• Lesions on cotyledons and leaves. • Some internal infection at the base of the plant when cut near maturity. • Some external cankering.	Do not sow into canola stubble from the previous year. Separate your crop by 500 m from the previous year's stubble. Fungicide use is unlikely to be economic.
Moderately Resistant (MR)	• Lesions on cotyledons and leaves. • Internal infection at the base of the plant when cut near maturity. • Some external cankering. • Some plant death in high disease pressure situations.	Do not sow into canola stubble from the previous year. Separate your crop by 500 m from the previous year's stubble. In high disease risk situations fungicide use may be of economic benefit.
Moderately Resistant to Moderately Susceptible (MR-MS)	• Lesions on cotyledons and leaves. • Internal infection at the base of the plant when cut near maturity. • External cankering. • Plant death will be easily found in high disease pressure situations.	Do not sow into canola stubble from the previous year. Separate your crop by 500 m from the previous year's stubble. In moderate to high disease risk situations fungicide use may be of economic benefit.
Moderately Susceptible (MS)	• Lesions on cotyledons and leaves. • Internal infection at the base of the plant when cut near maturity. • External cankering. • Plant death will be easily found in moderate to high disease pressure situations.	Avoid high disease pressure. Do not sow into canola stubble from the previous year. Separate your crop by 500 m from the previous year's stubble. In moderate disease risk situations fungicide use is likely to be of economic benefit.
Moderately Susceptible to Susceptible (MS-S)	• In low disease pressure situations some lesions on cotyledons and leaves may be found. · Low levels of internal infection. · Low levels of external canker. · Occasional plant death. • If sown in moderate disease pressure situations plant death is likely to be severe.	Recommended for low disease pressure regions only (i.e. low rainfall areas). Do not sow into canola stubble from the previous year. Separate your crop by 500 m from the previous year's stubble. In moderate disease risk situations fungicide use may be of economic benefit.
Susceptible (S)	• In low disease pressure situations some lesions on cotyledons and leaves may be found. · Low levels of internal infection. · Low levels of external canker. · Occasional plant death. • If sown in moderate disease pressure situations plant death is likely to be severe.	Recommended for low disease pressure regions only (i.e. low rainfall areas). Do not sow into canola stubble from the previous year. Separate your crop by 500 m from the previous year's stubble. Fungicide use is unlikely to be economic at high or low disease risk situations. If blackleg is causing yield loss consider a more resistant variety in future years.
Susceptible to Very Susceptible (S-VS)	• In low disease pressure situations some lesions on cotyledons and leaves may be found. · Low levels of internal infection. · Low levels of external canker. · Occasional plant death. • If sown in moderate disease pressure situations plant death is likely to be very severe.	Recommended for low disease pressure regions only (i.e. low rainfall areas). Do not sow into canola stubble from the previous year. Separate your crop by 500 m from the previous year's stubble. Fungicide use is unlikely to be economic at high or low disease risk situations. If blackleg is causing yield loss consider a more resistant variety in future years.
Very Susceptible (VS)	• In low disease pressure situations some lesions on cotyledons and leaves may be found. · Low levels of internal infection. · Low levels of external canker. · Occasional plant death. • If sown in moderate disease pressure situations plant death is likely to be extremely severe.	Recommended for low disease pressure regions only (i.e. low rainfall areas). Do not sow into canola stubble from the previous year. Separate your crop by 500 m from the previous year's stubble. Fungicide use is unlikely to be economic at high or low disease risk situations. If blackleg is causing yield loss consider a more resistant variety in future years.

Table 6 Average yield and quality data of juncea canola conventional variety "Dune" from multi-location trials in SA and Vic 2004 and 2005, compared with AG-Outback, a traditional canola variety for low rainfall areas*

Variety	Yield (t/ha)		Oil content (%)	Meal protein content (%)
Year	2004	2005	2004	2004
Dune	1.33	0.95	37.5	40.5
AG-Outback (control)	1.33	0.95	36.1	39.1

** Data from Culgoa, Vic. for 2005 removed from dataset due to high level of variability. 2005 sites: Lameroo and Minnipa, SA; Walpeup and Beulah, Vic.*

Juncea canola for low rainfall environments

This year three juncea canola varieties will be available in south eastern Australia; the conventional variety Dune (released on a small scale in 2007 and 2008) and new Clearfield varieties called OasisCL and SaharaCL. Both cultivars are being marketed by Pacific Seeds under an End Point Royalty system). Due to limitations of seed, there will only be further yield evaluation and demonstration paddocks of these new varieties on the Eyre Peninsula in 2009. Commercial production will be limited to NSW and Vic for 2009.

These are Australia's first canola quality Brassica juncea varieties, with major changes to both the oil and meal quality from traditional table mustard. The varieties were bred by Victorian DPI and Viterra, in Canada, and partly funded by the GRDC.

Juncea canola has a number of advantages over traditional canola in low rainfall areas, including faster ground covering ability, better heat and drought tolerance and shatter tolerance - thus it does not need windrowing (saving around $25/ha).

Future breeding priorities include further development of herbicide tolerant varieties with high yield, improved quality, good blackleg resistance and good adaptation. The first triazine tolerant advanced breeding lines will be in multi-location trials in 2008 and were tested on Eyre Peninsula, with first cultivars hopefully available in 2011. Hybrids and other herbicide tolerances are also currently being developed and will continue to be selected in low rainfall systems across Australia.

Juncea canola lines tend to yield the same or more than traditional canola in situations where canola yields are equal or less than 1.5 t/ha. Dune is the first conventional line to meet all the quality criteria and was first tested in multi-site trials in 2004 and 2005 (Table 6).

Limited data was obtained in 2006. OasisCL, SaharaCL (Clearfield varieties) and Dune (conventional variety) were tested in multi-location trials in 2007 with encouraging results obtained (Table 7).

No breeding or advanced trial data is available for 2008 from Minnipa or Miltaburra sites due to the high level of variability within the trials or trials not being harvested due to the drought. New advanced breeding lines and released varieties will be further evaluated in 2009 at Minnipa, Miltaburra and Lock sites. Demonstration blocks of the new Clearfield juncea canola varieties will also be sown on larger scale in 2009.

Results from some sites comparing canola and juncea canola in 2008 are included in Table 8. At the lower rainfall sites at Lameroo and Hopetoun, juncea canola yielded similar to the better canola varieties. In higher yielding sites in NSW, SaharaCL produced higher grain yields than canola at Coonamble and similar grain yields to the best canola varieties at Tamworth.

***Table 7** Average yield and quality data of juncea canola varieties from multi-location trials in SA and Vic 2004 and 2005*, compared with AG-Outback, a traditional canola variety for low rainfall areas*

Variety	Yield (t/ha)	Oil content (%)
Dune	0.46	39.4
OasisCL	0.63	41.0
SaharaCL	0.58	39.6
AG-Outback (control)	0.38	38.2
Tarcoola (control)	0.37	40.1

**2007 sites: Lameroo and Minnipa, SA; Beulah and Horsham, Vic; Bellata, NSW.*

***Table 8** Yield (t/ha) of canola and juncea canola varieties in 2008*

Variety	Lameroo, SA	Hopetoun, Vic	Coonamble, NSW	Tamworth, NSW	Average
44C79	0.34	0.48	1.73	1.67	1.05
AG-Outback	0.38	0.61	1.84	2.37	1.30
AV-Opal	0.25	0.73	1.65	1.75	1.10
Dune*	0.32	0.56	1.75	2.20	1.21
Hyola50	0.31	0.70	0.81	1.78	0.90
SaharaCL*	0.38	0.72	2.28	2.10	1.37
OasisCL*	0.38	0.71	2.10	1.95	1.28
Tarcoola	0.36	0.80	1.30	1.86	1.08
Site mean (t/ha)	**0.33**	**0.61**	**1.75**	**1.67**	
CV%	**12.90**	**11.10**	**9.64**	**11.97**	
LSD (P=0.05)	***0.08***	***0.13***	***0.33***	***0.39***	

**juncea canola varieties*

Grains Research & Development Corporation

SAGIT

State Government Victoria Department of Primary Industries

Adaptive Peas at Minnipa 2008

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Research

Searching for answers

Location
Minnipa
Minnipa Agricultural Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2008 Total: 251 mm
2008 GSR: 139 mm

Yield
Potential: 607 kg/ha (P)
Actual: trials 220 kg/ha, commercial crop failed

Paddock History
2007: Barley grazed
2006: Wheat

Soil Type
Red sandy loam
Boron (60-120cm):
High B site: 21.4 – 34.5mg/kg
Low B site: 13.2 – 15.1 mg/kg

Plot Size
10 m x 1.44 m x 3 reps

Environmental Impacts
Soil Health
Soil structure: low residue cover
Disease levels: cereal break
Chemical use: standard pulse crop
Soil Nutrients: add soil N
Tillage type: no-till
Compaction risk: low
Water Use
Runoff potential: low
Effluent run-off risk: nil
Resource Efficiency
Energy/fuel use: extra for baling, but no harvest costs

Continues

Key messages

- **Field peas with a dual purpose (grain and hay/silage/green manuring) potentially offer growers in low rainfall environments a way of managing some of the risk of production.**
- **Field pea lines with improved tolerance to soil boron in glasshouse experiments have been identified and are now being evaluated in the field to determine what this improvement means to production.**
- **Seasonal conditions in 2008 did not favour field pea production and both grain and dry matter yields were low. Despite this several lines performed better for these traits than the commercial lines at a high boron field site.**
- **Findings require further validation across years.**

Why do the trials?

A blanket approach to farming is no longer as easy as it used to be, and together growers, plant breeders and agronomic researchers are exploring ways for farming to be more flexible, adaptive and ultimately economic, to suit soil type and seasonal variation.

In recent years Pulse Breeding Australia (PBA) field peas has been screening early generation breeding lines in glasshouse experiments to identify improved tolerance to soil boron. These experiments have been conducted in soil boxes containing light sandy loam soils with the addition of boron at 10 mg/kg. Current field pea varieties Kaspa and Parafield are rated susceptible in these experiments. The performance of field peas rated as tolerant to soil boron (in these glasshouse experiments) under high boron field conditions is currently not known. Upper EP has a vast area of soils that have inherently high boron, sometimes as shallow as 30–40 cm. Performance of field peas on these soil types is unreliable and grain yields produced are often uneconomical. In 2008, a trial was sown at Minnipa that evaluated pea breeding lines ranging in tolerance to boron for their ability to perform under high field soil boron levels. The same lines were also evaluated at Minnipa on a low boron soil type for direct comparison.

PBA field peas have also identified a number of lines with high dry matter production (forage types). In low rainfall environments like the upper Eyre Peninsula peas are vulnerable to high grain yield loss from moisture stress, high temperatures and frost during the flowering and grain fill stages. Field peas which have a dual purpose option, i.e. have higher dry matter production compared with conventional varieties while maintaining moderate to high grain yields, are being investigated to spread grower risk to variable seasonal conditions. Forage type field peas will still provide the break effect in rotation and may reduce risk to growers by providing grain, hay or green manure options depending upon the seasonal outcome. Advanced PBA breeding lines exhibiting good early vigour, high dry matter production and boron tolerance are being evaluated for grain and dry matter yield potential and being compared against grain only pea varieties under low rainfall conditions.

Greenhouse gas emissions (CO_2, NO_2, methane): standard
Social/Practice
Time (hrs): usual baling time
Clash with other farming operations: baling time, before harvest
Economic
Cost of adoption risk: low
Market stability risk: current hay prices

How was it done?

Two trial sites were chosen in paddock N9 at Minnipa Agricultural Centre, which also hosted the PBA breeding trials with the remainder of the paddock sown to peas. The high boron site had soil boron levels ranging from 21.4–34.5 mg/kg from 60–120 cm deep, while the lower boron site had levels of 13.2–15.1 mg/kg at the same depth. The forage trial was sown at the low boron site.

All trials were sown on 22 May after 16 mm rain. Varieties were sown at approximately 90 kg/ha, with 70 kg/ha 18:20 except the forage pea trial which was sown with nil fertiliser. This was not of concern given that 0–10 cm soil Colwell P levels were 39 ppm and the soil is generally not P responsive. All trials received standard weed management practices.

18 varieties were chosen for each trial and replicated three times.

Measurements included final dry matter production (forage trial only), plant density, grain yield and 100 g weight.

What happened?

Extremely low growing season rainfall (56% of long term average) was recorded at Minnipa in 2008. Field pea plant growth and genetic expression was greatly suppressed in all trials. Plant growth and pod set in the low boron and forage pea sites were affected by variable levels of residual stubble cover across the trials, which added to the high variability found in the results from these trials.

Boron tolerant trial

Very low grain yields occurred at both sites and there was no genetic difference between varieties at the low boron site. In the high boron site two highly tolerant boron lines were significantly higher yielding than Parafield, 02-262-3 and 02-356-5 (Table 1).

Break Crops

Table 1 Grain yield and weight of boron tolerant PBA breeding lines and susceptible commercial field peas varieties on contrasting soils for boron toxicity, Minnipa 2008

Variety/Line	Boron tolerance #	Low Boron Site			High Boron Site		
		Grain yield		g/100 seeds	Grain yield		g/100 seeds
		t/ha	% Parafield		t/ha	% Parafield	
Kaspa	S	0.12	71	11.74	0.20	95	11.2
Parafield	S	0.17	100	13.52	0.21	100	13.4
02-082-7	-	0.13	76	12.23	0.22	108	11.5
02-262-3	HT	0.20	120	12.36	0.38	181	13.4
02-308-6	HT	0.12	70	12.5	0.21	101	12.2
02-356-5	HT	0.15	93	12.72	0.31	148	12.7
02-438-8	HT	0.11	67	11.83	0.24	118	11.7
03H061-04HO2001	HT	0.11	65	13.12	0.21	101	12.3
03H067-04HO2004	HT	0.10	63	12.5	0.20	98	10.9
OZP0804 (03H160-04HO2001)	HT	0.08	49	10.46	0.21	100	10.3
03H192-04HO2004	HT	0.08	51	12.63	0.20	97	13.6
03H267-04HO2009	-	0.11	64	12.12	0.19	92	12.1
03H318-04HO2020	HT	0.10	62	11.82	0.24	113	10.9
03H330-04HO2004	HT	0.12	72	12.02	0.24	115	12.0
03H330-04HO2010	HT	0.14	84	10.55	0.24	114	10.9
03H382-04HO2003	HT	0.10	61	10.82	0.16	75	9.9
03H382-04HO2007	HT	0.07	45	12.1	0.17	82	11.4
OZP0802 (02-048-12)	HT	0.11	67	12.05	0.17	81	11.3
Site mean yield (t/ha)		**0.12**		**12.1**	**0.22**		**11.8**
CV %		**24.6**		**5.6**	**20.1**		**3.7**
LSD (P=0.05)		***ns***		***1.15***	***0.08***		***0.78***

 # derived from glasshouse pot experiments using boron at 10 ppm

Table 2 Grain yield and weight, plant dry matter at maturity and plant density of dual purpose PBA field pea breeding lines and commercial checks, Minnipa 2008

Variety/Line	Grain yield		g/100 seeds	Dry matter		Plant
	t/ha	% Parafield		t/ha**	% Parafield	density field pl. per sq.m
Kaspa	0.20	102	12.8	1.31	110	52.52
Morgan	0.14	75	12.1	0.76	64	40.93
Parafield	0.19	100	14.5	1.19	100	51.07
02-099-2	0.20	106	11.9	0.86	72	49.09
03A158P-04CH2001	0.15	79	14.6	1.18	99	32.52
03A261P-04CH2001	0.09	46	14.6	0.93	78	41.97
03H003P-04H02001	0.17	91	14.1	0.98	83	52.52
03H014P-04H02008	0.19	100	15.9	1.20	101	38.17
03H033P-04H02008	0.30	157	14.4	1.40	118	49.61
03H080P-04H02002	0.28	144	15.1	1.04	88	43.97
03H082P-04H02004	0.16	83	11.3	0.84	70	38.31
03H348P-04H02011	0.18	93	13.9	0.95	80	47.91
03H548P-04H02003	0.28	148	13.9	1.16	97	37.36
03H554P-04H02015	0.26	135	18.1	1.30	109	50.00
03H556P-04H02010	0.17	86	12.8	0.90	76	49.53
03H556P-04H02014	0.16	82	14.2	1.24	105	32.95
03H562P-04H02008	0.35	183	13.1	1.46	123	51.71
94-425*2b	0.07	36	11.7	0.72	60	26.81
Site mean yield (t/ha)	**0.20**		**13.8**	**1.10**		**43.7**
CV %	**26.5**		**5.1**	**6.89**		**22.3**
LSD (P=0.05)	***0.09***		***1.19***	***0.22***		***16.7***

*** derived from grams per plant figures*

Both of these were the earliest flowering lines in the experiment (approximately seven days earlier flowering than Parafield) which may have favoured their performance.

Forage and dual purpose pea trial

Grain yields (0.2 t/ha) and dry matter yields (1.1 t/ha) were very low and site variability high, partly due to the variable stubble cover which occurred after sowing. Therefore expression of genetic potential in this environment was suppressed and interpretation of varietal performance difficult. The line with the highest grain yield 03H562P-04H02008 also had higher dry matter production than Parafield (Table 2). Late maturing types which are currently recommended as forage options, eg. Morgan and 94-425*2b, had poor grain and dry matter yields, indicating that they were poorly adapted to the seasonal conditions.

What does this mean?

Adverse seasonal conditions restricted plant growth and genetic expression. However some advanced PBA lines with high boron tolerance had improved performances over Parafield for grain yield on a high boron site and also for a combination of dry matter and grain yield in a low rainfall environment. Further evaluation will be required over seasons to confirm the relevance of these findings.

In other PBA trials across Australia last year a number of the highly boron tolerant lines were observed to 'hang on later' into the season retaining green plant tissue levels for longer than the intolerant lines. Further work is required to understand how the improved tolerance to boron in the glasshouse experiments relates to performance in environments with inherent high soil boron levels. Further work is also required to understand the key characteristics required in field peas to provide high biomass production in low rainfall environments, as traditional high biomass types performed poorly at Minnipa last year.

Acknowledgements

Thanks to Leigh Davis, Willie Shoobridge, Wade Shepperd and Kaye Brace for their assistance in sowing, managing, sampling and harvesting the trial.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

GRDC Grains Research & Development Corporation

Heat Stress Tolerance in Pulses

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SARDI, Waite

Key messages

- **Pulse Breeding Australia (PBA) is actively engaged in generating new germplasm tolerant to heat stress caused by hot winds in Spring.**
- **New sources of heat stress tolerance are identified in faba beans and field peas tested under field conditions.**
- **Field peas and faba beans tolerant to heat stress will yield better.**

Why do the trial?

Climate change has been predicted for the 21st century that will occur on a global scale as the mean air temperature rises due to increased concentration of carbon dioxide and other trace greenhouse-effect gases in the atmosphere (IPCC, 2001). The global mean temperature increased by 0.6° C between 1990 to 2000 and is predicted to increase by another 1.4 to over 5° C by 2100 due to climate change (Houghton et al., 2001; McCarthy et al., 2001).

Since agriculture and forestry are industries that are engaged in production through utilisation of natural environment, productivity is highly susceptible to climate changes. Consequently there are concerns over the effects of climate changes brought about by greenhouse effects. Plants suffer the ups and downs of temperature of their environment, while animals often regulate their temperature, either by movement or metabolism. Therefore global warming and climate change may affect plants more than animals, and there are indications that plants experience substantial damage from higher temperature stress. Estimates range up to 17% decrease in crop yield for each degree Celsius increase in average growing season temperature (Lobell and Asner, 2003).

In consideration of these circumstances, although considerable research has been conducted to evaluate the effects of global warming on agriculture (Rosenzweig and Parry, 1994), efforts are needed to search for specific and practical approaches to enhance plant tolerance to high-temperature environments in Australia. In Australia, the major pulse crops are field pea, chickpea, faba bean and lentil. Each of these pulses is adapted to different, hence complementary, cropping environments. Climate change is likely to have severe impact on pulse crops especially at anthesis, flowering and close to grain maturity stages, and heat stress can effect some plant processes more than others. Extreme temperatures may affect many processes, but the most important effects are those that are first encountered as temperatures rise above optimum for plant growth. Therefore, the main objectives of this research are to identify heat tolerant accessions or landraces at reproductive stages under controlled heat stress conditions, and to develop new heat tolerant germplasm and parent lines through advanced backcrossing of field peas and faba beans.

How was it done?

A diverse set of 40 accessions (world collections and landraces) of field pea (Table 1) and 23 accessions of faba bean (Table 2) were grown in the glasshouse till flowering. At flowering, all the reproductive stages were tagged so that after heat stress treatment, data can be recorded on each and every reproductive stage individually. All the plants were then transferred to the heat chamber (Figure 1) where temperatures were set at 40° C day (16 hours) and 30° C night (8 hours) for 72 hours. Once the heat treatment was completed all the plants were removed from the heat chamber and were shifted to the glasshouse. Four days after treatment, symptom data was recorded on all the tagged reproductive stages of field pea (Figure 2) and faba bean (Figure 3), and at maturity, yield component data was recorded.

What happened?

Out of 40 accessions of field pea, only seven accessions were recorded as tolerant (T) types (Table 1, tolerant accessions in **bold**) and now are being used in the crossing program with Kaspa to develop heat tolerant germplasm and parent lines. For faba bean, there was no tolerant accession in this set of diverse collections but six accessions were recorded as moderately tolerant (MT) types (Table 2, moderately tolerant accessions in **bold**). These accessions are now being used in further crosses to develop improved heat tolerant lines of faba beans. Selections were further made through another cycle of heat stress screening under controlled conditions and sixselections each of faba bean (SARDI 40–45) and field pea (SARDI 50–55) were planted under field conditions in 2008.

Field trials

Two field trials, one each of faba bean and field pea were conducted at Balaklava in South Australia to validate the heat stress tolerance germplasm. There were six selections each of faba bean and field pea sown on 23 June and data were recorded at flowering and podding stages. A heat wave was observed on 27 September, 11 and 12 October and 17 and 18 October when maximum temperatures were above 30°C (Table 3).

Initial data analysis has shown that one selection of faba bean (SARDI 42) is tolerant to heat stress at both flowering and podding stages. Field pea data is being analysed.

What does this mean?

The frequency of hot winds in spring time is increasing, therefore pre-emptive breeding for heat stress tolerance is a key factor for a sustainable pulse industry in Australia. The identification of heat tolerant germplasm by searching through a wide collection of world germplasm is a major break through in developing future field pea and faba bean varieties tolerant to heat waves (hot winds), which our farmers experience in either early or late spring, almost every year. The new heat tolerant varieties will have the genetic ability to tolerate hot winds at flowering and podding stages, enabling them to have better production.

Figure 1 Controlled heat chamber with simulated heat stress condition

Figure 2 Reproductive stages of a field pea with scoring key

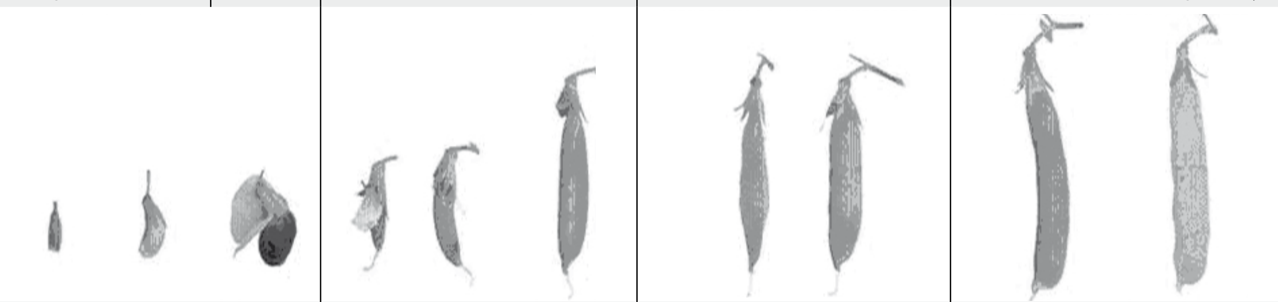
201	202	203	204	205
Visible buds (not opened)	Opening flowers	Pods set (visible fertile node)	Pods fully formed (swelling) (small immature seed within)	Green pods fill (Medium to maximum size fill pod cavity)
				
201-202: visible buds, first open flower		**203: Pod set**	**204: Pod fill**	**205: Mature pod**
1. No visible symptoms of heat damage		1. No visible symptoms of heat damage	1. No visible symptoms of heat damage	1. No visible symptoms of heat damage
2. Inflorescence has died or dropped		2. Pod has died or dropped	2. Pod has dried or stopped swelling or dropped	2. Pod has dried (leathery shape)

Figure 3 Reproductive stages of a faba bean with scoring key

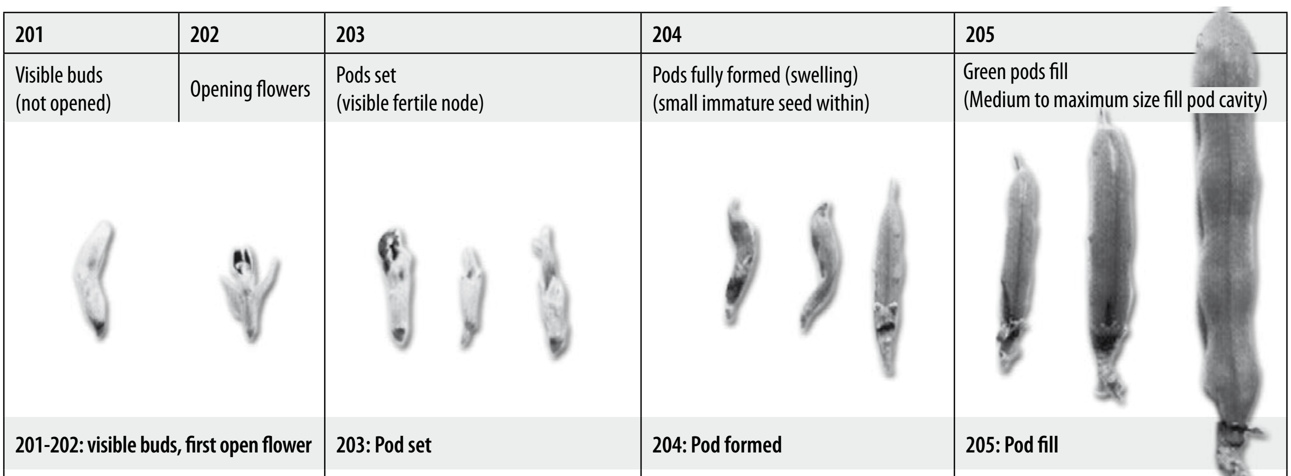
201	202	203	204	205
Visible buds (not opened)	Opening flowers	Pods set (visible fertile node)	Pods fully formed (swelling) (small immature seed within)	Green pods fill (Medium to maximum size fill pod cavity)
				
201-202: visible buds, first open flower		**203: Pod set**	**204: Pod formed**	**205: Pod fill**
1. No visible symptoms of heat damage		1. No visible symptoms of heat damage	1. No visible symptoms of heat damage	1. No visible symptoms of heat damage
2. Inflorescence has died or dropped		2. Pod has died or dropped	2. Pod has dried or stopped swelling or dropped	2. Pod has dried (leathery shape)

Table 1 Diverse set of 40 accessions of field pea screened for heat tolerance

1	53 MAR	MT
2	92 SYR	MT
3	**32 MEX**	**T**
4	**5804 SYR**	**T**
5	5811SYR	MT
6	**13TUN**	**T**
7	5809 SYR	MT
8	5814SYR	MT
9	5845SYR	MT
10	PS3135	MT
11	5807SYR	MT
12	**2091SYR**	**T**
13	**21DZA**	**T**
14	4024SYR	MT
15	**5812SYR**	**T**
16	**5808SYR**	**T**
17	20 IRN	S
18	22 IRN	S
19	27 TJK	S
20	67 SDN	S
21	69 SDN	S
22	76 SDN	S
23	202 ETH	S
24	103 SYR	S
25	1847 SYR	S
26	4015 SYR	S
27	4016 SYR	S
28	4124 SYR	S
29	4229 SYR	S
30	4243 SYR	S
31	4247 SYR	S
32	5805 SYR	S
33	5810 SYR	S
34	5813 SYR	S
35	5815 SYR	S
36	5817 SYR	S
37	5818 SYR	S
38	5819 SYR	S
39	5846 SYR	S
40	5847 SYR	S

Table 2 Diverse set of 23 accessions of faba bean screened for heat tolerance

1	636/1 TUN	S
2	1832 ISR	S
3	484 IRQ	S
4	810/2 SUD	S
5	**1012 SUD**	**MT**
6	**1032 SUD**	**MT**
7	**1034 SUD**	**MT**
8	1187/1 EGY	S
9	**1419/1 EGY**	**MT**
10	1442 EGY	S
11	1445/4 IRQ	S
12	1569/2 GRE	S
13	1605/1 EGY	S
14	1772 EGY	S
15	1783 TUN	S
16	**1799/1 SUD**	**MT**
17	**1835 ISR**	**MT**
18	1837/2 ISR	S
19	1839/1 SUD	S
20	11546/4 LIBIA	S
21	CAIRO	S
22	Fiesta	S
23	Fiord B2	S

Table 3 Rainfall and maximum temperature recorded at Balaklava 2008

Date	Temp °C (max)	Rain (mm)
27 Sep	35	0
04 Oct	21	7
11 Oct	30	0
12 Oct	33	0
17 Oct	33	0
18 Oct	36	0

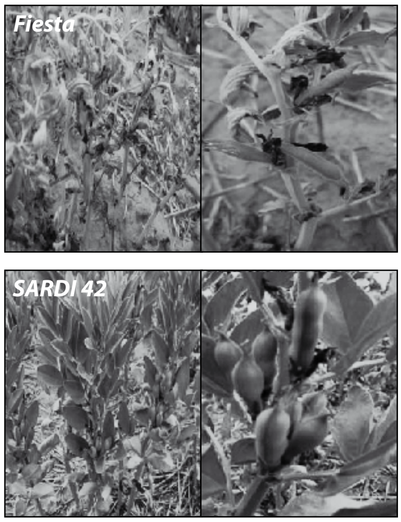


Figure 4 Heat tolerant and susceptible lines of faba bean under field conditions

Acknowledgements

Pulse Germplasm Enhancement team at SARDI would like to thank GRDC and Pulse

Breeding Australia for funding the project, and the Australian Temperate Field Crops Collection (ATFCC) and pulse breeders for their valuable inputs and supplying the germplasm. Larn McMurray and his team are acknowledged for their support in conducting the field trail at Balaklava.

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Improving Field Pea Management Practices in Low Rainfall Regions

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Best practice

Location
Minnipa
Minnipa Agricultural Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2008 Total: 251 mm
2008 GSR: 139 mm

Yield
Potential: 607 kg/ha (P)
Actual: trials 220 kg/ha, commercial crop failed

Paddock History
2007: Barley grazed
2006: Wheat

Soil Type
Red sandy loam

Plot Size
10 m x 1.44 m x 3 reps

Environmental Impacts
Soil Health
Soil structure: low residue cover
Disease levels: cereal break
Chemical use: standard pulse crop
Soil nutrients: add soil N
Tillage type: no-till
Compaction risk: low
Water Use
Runoff potential: low
Effluent run-off risk: nil
Resource Efficiency
Greenhouse gas emissions (CO_2, NO_2, methane): standard
Social/Practice
Time (hrs): usual baling time
Clash with other farming operations: baling time, before harvest
Economic
Cost of adoption risk: low
Market stability risk: current hay prices

Key messages

- **Early sowing of field pea is essential for economic yields in dry years in low rainfall environments, providing frost, weed and blackspot risks are considered.**
- **Sowing field peas on the season break will increase blackspot risk, however exposure to risk can be reduced through the use of the blackspot predictive tools (Blackspot Manager and DIRI) and careful paddock selection.**
- **Early flowering Kaspa pea types, like OZP0602, when available will provide greater stability of yield across seasons in low rainfall environments.**

Why do the trials?

This agronomic management research, funded by SAGIT, aims to identify best sowing time and fungicides strategies in new pea varieties to maximise yields and also to provide replicated trial data to the SARDI blackspot disease prediction model to improve its reliability in low rainfall regions.

How was it done?

Following on from the 2007 pea time of sowing experiment at Minnipa, a replicated agronomic pea time of sowing trial with three varieties (Alma, Kaspa and Parafield) and one breeding line (OZP0602), three fungicide treatments (nil, P-Pickel T seed dressing plus 2 kg/ha of mancozeb, and 2 L/ha of chlorothalonil at fortnightly intervals) was sown on 20 May (average) and 13 June (late) at Minnipa in 2008. Varieties were sown at approximately 90 kg/ha, with 18:20 @ 70 kg/ha. Similar trials with three times of sowing and additional fungicide treatments were also sown at Hart (medium rainfall) and Turretfield (high rainfall).

Measurements included flowering date and duration, disease infection levels, grain yield and 100 g weight.

What happened?

Pea plant growth and grain yield were very low at Minnipa due to extreme drought conditions. The earlier sowing date was higher yielding (0.2 t/ha) than the later sowing date (0.05 t/ha) however results were too low and variable to allow useful comparison of variety performance. Similarly the drought conditions lead to no disease infection. Relevant results and findings from the Hart (medium low rainfall) and Turretfield (medium high rainfall) experiments in the Mid North of SA are presented below and discussed in relation to the 2007 findings from all three sites.

Disease ratings

Disease levels (blackspot) reached moderate levels in the Turretfield and Hart experiments during winter but failed to progress further during spring due to a lack of rainfall and dry conditions. As in 2007, delayed sowing reduced the amount of blackspot infection and this effect continued throughout the growing season.

Disease spread and intensity was found to start earlier in the old conventional leaf type variety Alma. This variety continued to have greater levels of disease at both infected sites during the season. The other three lines evaluated, i.e. Kaspa, WA2211

Table 1 Effect of sowing date and cultivar on blackspot disease severity and grain yield at three sites in SA, 2008

Site	Sow date	Foliar black spot % plot severity, ( )=sqrt %plot sev.					Grain yield (t/ha)				
		Alma	Kaspa	WA 2211	OZP 0602	Mean	Alma	Kaspa	WA 2211	OZP 0602	Mean
Turretfield	9 May	8.7 (2.9)	4.9 (2.2)	5.4 (2.2)	3.8 (1.9)	5.7 (2.3)	1.57	2.25	1.80	2.25	1.96
Rated 31 July	30 May	3.3 (1.7)	2.1 (1.3)	1.1 (1)	1 (0.8)	1.9 (1.2)	1.74	2.20	1.76	2.43	2.03
	20 June	0.1 (0.1)	0 (0.1)	0 (0)	0 (0)	0 (0.1)	1.59	2.12	2.06	2.09	1.96
	Mean	4 (1.6)	2.3 (1.2)	2.1 (1)	1.62 (1)		1.63	2.19	1.87	2.25	
LSD (P = 0.05)		*(0.35)#*					*0.28 (0.15 same sow date)*				
Hart	1 May	6.8	5.8	5	3.2	5.2	1.21	1.38	1.11	1.51	1.30
Rated 23 July	21 May	2.3	1.1	0.8	0.6	1.2	1.20	1.25	1.18	1.47	1.28
	8 June	0.7	0.1	0.2	0.1	0.3	1.09	1.11	1.13	1.26	1.15
	Mean	3.3	2.4	2	1.3		1.17	1.24	1.14	1.42	
LSD (P = 0.05)		*1.2*					*0.17 (0.1 same sow date)*				
							Alma	Kaspa	Parafield	OZP 0602	Mean
Minnipa	20 May	ND	ND	ND	ND	ND	ns	ns	ns	ns	0.22
Rated 6 Aug	13 June	ND	ND	ND	ND	ND	ns	ns	ns	ns	0.05
	Mean						0.12	0.13	0.14	0.16	
LSD (P = 0.05)							*0.07 (sow date) (0.03 var.)*				

ns = not significant, ND = No disease present, # = not evaluated at this site

and OZP0602, all generally had the same initial level of disease infection but disease progressed at different rates during the season. In general Kaspa had higher levels than WA2211 which in turn had higher levels than OZP0602 (Table 1). These results indicated that improved genotypes for blackspot resistance do exist and are being progressed through Pulse Breeding Australia.

Grain Yield

There was no significant benefit of early sowing across all varieties in 2008 at Turretfield and Hart, unlike in 2007 when dry late winter and early spring conditions favoured early sowing and the early maturing varieties. However grain yield of individual varieties responded differently to changes in sowing dates (Table 1).

A combination of factors were responsible for the variable results. Winter rainfall and growing conditions at Turretfield and Hart were highly favourable for plant growth. However, early sowing

Table 2 DIRI blackspot predictions at each trial sites x treatment, using historical weather data

Site	Sowing Date	Disease severity (1-5, where 5=100% infection)			
		DIRI predicted values			Observed disease 2008
		Seasonal rainfall amount			
		Low	Medium	High	
Hart	1 May	2.6	3.31	3.94	3.11
Hart	21 May	2.28	2.89	3.55	2.35
Hart	8 Jun	1.27	2.51	3.03	2.00
Turretfield	9 May	1.24	2.19	3.02	2.10
Turretfield	30 May	0.91	1.96	2.76	1.40
Turretfield	20 Jun	0.45	1.31	2.29	0.50
Minnipa	20 May	1.75	2.31	2.65	0.60
Minnipa	13 Jun	1.32	2.19	2.67	0.00
		New Model DIRI predicted values			
Minnipa	20 May	0	0.51	1.08	0.60
Minnipa	13 Jun	0	0.00	0.00	0.00

Break Crops

incurred higher disease levels, increased vegetative production and plant lodging. The latter was particularly evident at the higher rainfall site of Turretfield and in the older conventional type variety Alma. Further to this, earlier sown crops with larger biomass (canopies) 'hayed off' prematurely during the dry spring due to their greater moisture requirement. Also confounding interpretation of results in 2008 were the frequent occurrence of low (< 2 degrees C) and high temperature (> 28 degrees C) climatic events during September and early October.

These temperature events had a variable effect upon variety performance and sowing date due to large differences in the flowering patterns which occurred between varieties and sowing dates in 2008.

Grain yields of the late flowering variety Kaspa decreased at both sites as sowing date was delayed (Table 1). This result also occurred in the 2007 experiments and has prompted the wide spread earlier commercial sowings of this variety in recent years. Alma was the lowest yielding variety at both sites and showed a variable response to changes in sowing date, making it difficult to optimise Alma's grain yield through manipulation of sowing date. The early flowering Kaspa type line, OZP0602, was the highest yielding variety at both sites (15% higher yielding than Kaspa at Hart and 3% at Turretfield). At both sites OZP0602 was higher yielding than Kaspa when sown at the mid sowing time but similar yielding to Kaspa at the early sowing time. OZP0602 may not need to be sown as early as Kaspa to maximise yields, providing a safer option when sowing needs to be delayed due to disease, frost, weed or excessive growth issues.

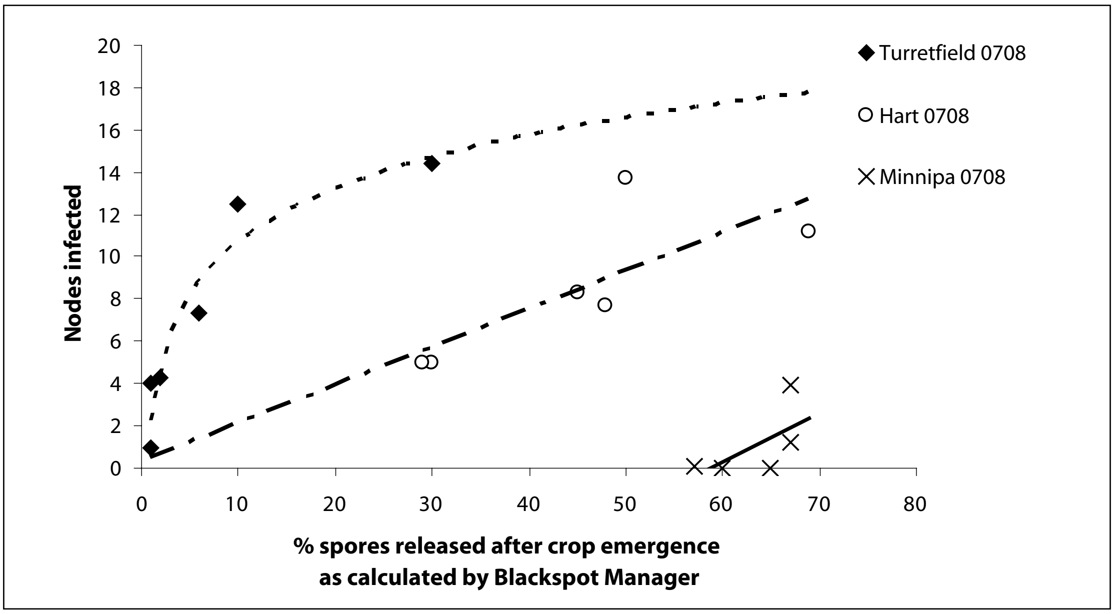

Figure 1 Relationship between final blackspot severity and Blackspot Manager spore release predictions at 3 sites over 2 years in SA

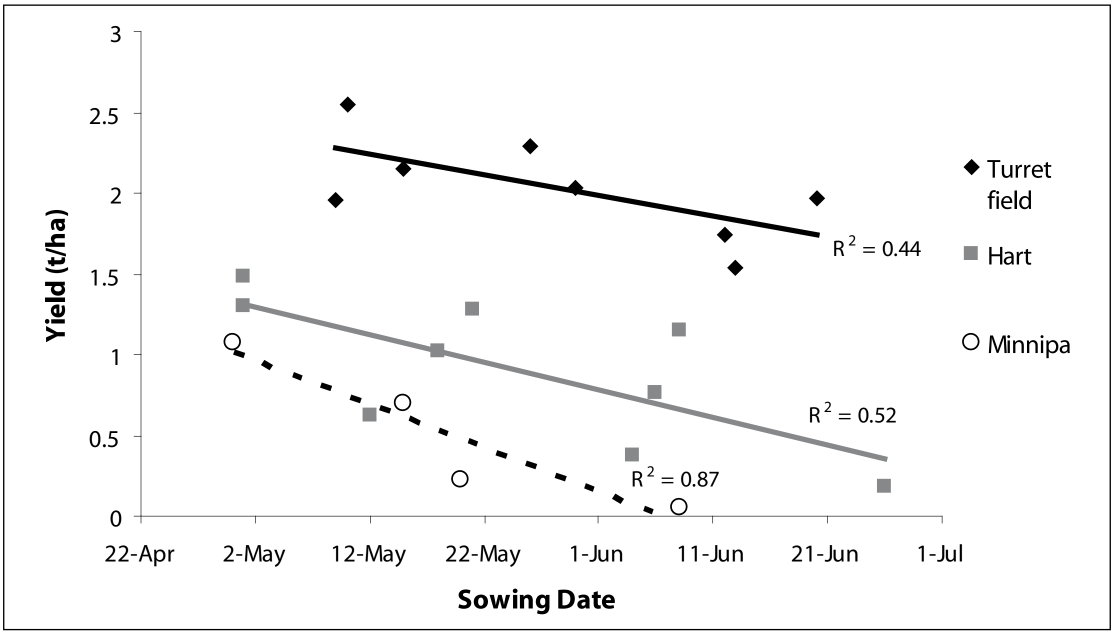

Figure 2 Effect of sowing date on grain yield of field peas at three sites in SA, 2006-2008

Model validation

The final disease severity in each trial was compared against disease levels predicted by the blackspot predictive model DIRI. The values calculated by DIRI for Hart and Turretfield trials were correlated with real disease data. The observed disease was lower than predicted by the model but still fell within the 10-90 decile range (Table 2). The predictions for Minnipa were much higher than was realised in the field trial. This confirms earlier research that the upper Eyre Peninsula region behaves differently to the rest of South Australia's pea growing areas and requires a separate blackspot model to predict disease levels. A new model for DIRI was generated for the Upper Eyre Peninsula region using historical data and this predicted zero blackspot for Minnipa. Further data is required to confirm that this new model is appropriate for this region.

These trials were also used to validate 'Blackspot Manager', a DAFWA model that predicts the release of airborne spores of blackspot from pea stubble. The relationship between the model's spore release predictions and observed disease severity differed for each site as shown in Figure 1. At Turretfield, blackspot severity increased rapidly even at low spore release percentages while at the drier sites a greater percentage of spores was needed to produce severe disease levels. Currently the advice with 'Blackspot Manager' is to sow after 50% of spores have been released. Research in Victoria has associated 5% yield loss with every 10% stem infection. Hence, in average seasons, the yield losses associated with 50% spore release would be 30% at Kingsford and 14% at Hart. Consequently in high rainfall areas this sowing advice may need to be altered to 75-90% of spore release. Further data is required to validate this result, particularly as these trials were conducted in dry seasons not conducive to blackspot.

What does this mean?

Early sowing has maximised yields of field peas over the last three years at field sites in SA representing low, medium and high rainfall pea growing areas (Figure 2). Early sowing has been paramount for economical field pea production in low rainfall areas over this period and continues to be the best management strategy for successful production providing consideration for black spot, weeds and frost risk occurs. Providing management strategies like using rotational gaps of at least four years and not sowing pea crops next to neighbouring pea stubbles are implemented, it is likely greater yield loss will occur from delayed sowing than from blackspot infection across seasons in low rainfall environments.

OZP0602 shows high yields, wide adaptation and suitability to SA conditions, particularly to low and medium rainfall areas where it may not need to be sown as early as Kaspa to maximise yields, providing a safer option where sowing needs to be delayed due to disease, frost, weed or excessive growth issues.

The information from this project has validated and updated the blackspot models, Blackspot Manager and DIRI. These are important tools that assist consultants and growers to make the management decisions to reduce the risk of blackspot and have become highly relevant with the current trend to early sowing of field peas.

Similar spore release predictions from 'Blackspot Manager' can result in varying blackspot risks in different rainfall regions and sowing dates should be adjusted according the regional risk.

DIRI is an accurate model of the blackspot risk associated with different sowing dates and agronomic practices in the medium and high rainfall regions of South Australia, however a separate model is required for the low rainfall regions. Data from the Minnipa trial in 2007 and 2008 have been used to develop a new model, but further evaluation is required to confirm that it is appropriate for this region.

Acknowledgements

This agronomic trial work was funded by the South Australian Grains Industry Trust (SAGIT) and SARDI. Thankyou to Leigh Davis for his assistance with the management of the trial work at MAC.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

GRDC Grains Research & Development Corporation

SAGIT

Break Crops

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Section 3

Section editor:

Nigel Wilhelm

SARDI

Minnipa Agricultural Centre

No-till

No till

Research

No-Till on Stony Soils

Michael Bennet

SARDI and SA No-Till Farmers Association, Minnipa Agricultural Centre

Almost ready

Location
Port Kenny
Wayne Little
Mt Cooper Ag Bureau

Rainfall
Av Annual: 299 mm
Av GSR: 299 mm
2008 Total: 294 mm
2008 GSR: 311 mm

Yield
Potential: 2.4 t/ha (W), 2.8 t/ha (B)

Paddock History
2007: Pasture
2006: Pasture
2005: Wheat

Soil Type
Calcareous clay loam and shallow limestone ridge

Plot size
20 m x 1.5 m x 4 reps

Yield Limiting Factors
Rainfall

Key messages

- **Greater yields on stony soil than deeper soil at Port Kenny in 2008!**
- **No-till treatments yielded at least as well as the full cut treatment.**

Why do the trial?

No-tillage in stony soil can be a challenge, particularly when using knife point based systems with spring tines. The challenge of maintaining seed placement, whilst minimising damage to machinery is significant. This is the second year of trials investigating options for no-till sowing in stony soils. Previous results can be found in EPFS Summary 2007, pg 174.

How was it done?

The trial was sown at Port Kenny using a 6 row plot seeder set on 254 mm row spacing. Wyalkatchem wheat was sown @ 60 kg/ha with 70 kg/ha of 18:20.

The trial was sown into excellent moisture conditions on 11–12 June over a stone rolled limestone ridge and a calcareous clay loam, so a comparison of seeding systems could be made over both soil types.

Emergence and seed placement were assessed three weeks after seeding. Yield was measured with a small plot harvester, with grain retained for quality analysis.

A greater variety of treatments were used in 2008 than in 2007. They included the K-Hart disc, Rock Hopper, Agpoint, Agmaster, Sweeps, Conservapak and DBS systems. The Canadian Atom Jet point and two other variations were included in the trial in 2008 (Figure 1). The basic Atom-Jet point is designed to deliver seed through the front of the point, to the bottom of the working depth. The Bourgault point used in the trial is a variation of the Atom-Jet design, but incorporates an interchangeable cast point, rather than a hardened steel and tungsten point like the Atom-Jet. The third variation of this design used is manufactured by Atom-Jet for the Australian market as the "Mallee Point" which is intended to provide some cultivation under the seed.

All treatments except the DBS, Conservapak and K-Hart disc systems were sown using Flexi-Coil 350 lb trip tines.

What happened?

The moist conditions at seeding followed through to emergence and helped establish vigorous early growth in the trial. Moist conditions post sowing resulted

Figure 1 Left to right: Rock Hopper, Atom-Jet Rhizo, Atom-Jet, Bourgault front delivery point

in less emergence penalties for treatments which had very shallow seed placement.

There were no visual differences between the various treatments in terms of the amount of stone dislodged from the soil and brought to the surface in the seeding operation, except for the discs which left the surface in an undisturbed state.

Depth of seed placement ranged from 19 mm in the K-Hart disc treatments through to 65 mm in the sweeps treatment. Treatments 3, 9, 10, 11 and 14 resulted in shallower seed placement on the stony soil than the deeper soil. This reduced seed depth did not result in an emergence penalty in the moist conditions in 2008. Other treatments were able to maintain similar seeding depth across both soil types. The K-Hart disc, Bourgault and Conservapak systems were exceptional at maintaining seed depth over both soil types.

The addition of snake chains (Treatment 8) did not increase seed depth, nor lead to an increase in crop establishment compared to Agmor boots at this site. Snake chains however could still provide useful furrow backfill in situations where it is more critical, particularly when seed depth is shallow over stone.

Seed placement with the Atom-Jet Mallee point was deeper than the standard Atom-Jet design. The design may need further refinement to include a furrow closure device to ensure that the seed does not end up at the bottom of the furrow like the standard Atom-Jet. The advantage of the Atom-Jet design is that the point does not need to work deep in the stony conditions to achieve adequate seed placement. A significant improvement in point and boot longevity compared to conventional no-till designs could be anticipated with this design.

No differences in emergence were measured on the deep soil, however several differences were observed on the stony soil. The Agmaster flexi boot system and Atom-Jet gave superior emergence to the Agmaster wing point, Rock hopper, Agpoint and Conservapak systems. The Atom-Jet was the only no-till system which gave improved emergence over the full cut sweeps treatment.

The trial finished on very little moisture, with the stony soil out-yielding the deeper soil. A number of factors could have contributed to this outcome in a season with such a dry finish. Firstly, loss of water to evaporation could have been reduced as the stone scattered over the soil surface may have acted as a mulch. Secondly, with a high percentage of stone in the soil, the stony soil would have had less capacity for holding water in the surface layers. With reduced water holding capacity, water would have moved deeper down the profile following rainfall events, where it would have been less prone to evaporation. The soil would have also held less unavailable water (being sandier), resulting in more water available to the crop. However, many stony soil types have insufficient soil to hold enough moisture to sustain the crop through dry spells, which is why they are the often the first to suffer in dry seasons.

Increasing sowing speed from 6 to 9 km/h was not detrimental to seed depth, emergence or final grain yield, although is likely to have a significant impact on machinery wear and overall downtime at seeding.

There were no differences in yield measured on the deep soil. All treatments on the stony soil yielded greater than the wing point design. The Agmaster point + Agmor boot + snake chains yielded more than using the Agmaster point + Agmor boot working deep, Bourgault front delivery point, Atom-Jet Mallee point and the wing point sowing system.

Differences between seeding systems persisted through the season to grain quality. Although many of the differences were not statistically significant, they determined the final marketing grade of the grain. Treatments 1, 2, 4, 7, 8, 10, 12 and 14 exceeded a gross income of $350/ha on the stony soil. Treatments 4, 5, 9, 12 and 13 exceeded a gross income of $300/ha on the deep soil at Port Kenny. Overall many of the differences in gross income evened out between the stony and deep soil, however treatments 1, 2, 4, 7, 8 and 12 averaged over $330/ha across both soil types.

What does this mean?

Most of the no-till treatments performed at least as well as the full cut system in 2008. The challenges of no-till sowing into stony soils can be overcome, however adapting some machinery can be expensive, but well worth the effort.

The Atom-Jet design shows great promise for growers who have a significant proportion of stony soils on their property. Not requiring a boot at the back of the point like most designs means there is less to go wrong, however it is expensive if you happen to lose one! The lack of sub-seed tillage with this system could exacerbate potential Rhizoctonia activity. The Port Kenny site had no visual symptoms of Rhizoctonia in 2008.

The K-Hart disc performed well in 2008, which is an option for growers to reduce their downtime at seeding as well as reduce the amount of stone brought to the surface by tines.

Table1 Seeding system impact on wheat performance on stony and deep soil at Port Kenny in 2008

Treatment	Opener	Technology	Other sowing treatments	Sowing speed (km/h)	Seed Depth (mm)		Emergence (plants/m^2)		Yield (t/ha)	
					Soil	Stone	Soil	Stone	Soil	Stone
1	K-Hart	Disc		6 km/h	24	19	143	133	1.12	1.38
2	K-Hart	Disc		9 km/h	23	21	125	124	1.05	1.40
3	Rock Hopper	Agmor			33	26	128	117	1.14	1.41
4	Agpoint	Agmor			33	28	129	117	1.24	1.38
5	Agmaster	Agmor	Wing Point		29	26	94	96	1.16	1.11
6	Agmaster	Agmor			33	28	118	151	1.12	1.39
7	Agmaster	Agmor		9 km/h	34	29	148	145	1.28	1.36
8	Agmaster	Agmor	10 mm Snake Chains		32	25	138	123	1.18	1.50
9	Agmaster	Agmor	Work Deep		39	26	144	144	1.21	1.32
10	Sweeps	Agmor	Star Harrows		65	53	151	122	1.10	1.35
11	Agmaster	Flexi Boot			36	27	166	150	1.16	1.34
12	Atom-Jet	Front delivery			45	40	169	155	1.20	1.41
13	Atom-Jet	Front delivery	Mallee Point		58	42	123	148	1.19	1.28
14	Bourgault	Front delivery			30	30	150	146	1.11	1.32
15	Conservapak				55	54	141	99	1.03	1.29
16	DBS				46	40	131	138	1.11	1.41
LSD (P=0.05)					*7*	*7*	*ns*	*32*	*ns*	*0.16*

Table 2 Seeding system impact on wheat quality and gross income on stony and deep soil at Port Kenny in 2008

Treatment	Opener	Technology	Other sowing treatments	Sowing speed (km/h)	Test Weight (kg/hL)		Screenings (%)		Protein (%)		Gross Income* ($/ha)		
					Soil	Stone	Soil	Stone	Soil	Stone	Soil	Stone	Average
1	K-Hart	Disc		6 km/h	74.2	75.1	1.3	1.5	13.9	13.5	299	369	334
2	K-Hart	Disc		9 km/h	74.3	74.0	1.4	1.5	13.9	13.6	289	373	331
3	Rock Hopper	Agmor			72.3	73.6	1.7	1.5	13.7	13.7	283	349	316
4	Agpoint	Agmor			72.9	74.6	1.4	1.6	13.9	13.4	308	369	339
5	Agmaster	Agmor	Wing Point		73.9	73.0	1.9	1.6	13.7	13.6	309	276	293
6	Agmaster	Agmor			73.9	73.0	1.4	1.7	13.9	13.8	299	344	321
7	Agmaster	Agmor		9 km/h	73.9	73.9	1.2	1.7	13.7	13.3	341	363	352
8	Agmaster	Agmor	10mm Snake Chains		72.3	73.3	1.5	1.6	13.7	13.7	292	373	332
9	Agmaster	Agmor	Work Deep		73.8	73.3	1.6	1.6	13.8	13.5	300	328	314
10	Sweeps	Agmor	Star Harrows		73.0	73.9	1.5	1.4	13.6	13.8	273	361	317
11	Agmaster	Flexi Boot			73.5	73.7	1.4	1.5	13.6	13.6	287	332	310
12	Atom-Jet	Front delivery			74.4	75.0	1.7	1.5	13.8	13.6	319	377	348
13	Atom-Jet	Front delivery	Mallee Point		74.0	73.7	1.8	2.0	13.9	13.5	317	318	318
14	Bourgault	Front delivery			74.0	74.4	1.3	1.7	14.0	13.8	295	352	324
15	Conservapak				74.0	73.3	1.9	1.9	13.9	14.0	276	318	297
16	DBS				75.1	72.6	1.7	1.8	13.7	13.5	295	349	322
LSD (P=0.05)					*ns*	*ns*	*0.4*	*ns*	*ns*	*ns*			

**Gross income is calculated yield x price (for grade achieved) delivered to ABB Witera 8 January 2009.*

Hydraulic tines are an obvious choice for growers looking to optimise their seeding success in stony soils. Growers have overcome serious delays at seeding time through downtime with the use of hydraulic tines. There was no advantage in wheat performance in 2008 for hydraulic tines except for how the Conservapak maintained optimum seed depth across both soil types. This advantage may pay great dividends in other circumstances.

Breakout characteristics of tines can have a significant impact on how well they perform in stone. The tip of the knifepoint needs to be behind the pivot point of the tine. If this is not the case, when the point strikes an obstacle like a rock, it will dig deeper before it begins lifting out to jump over the barrier. This places greater force at the point of impact as well as a greater recoil speed upon re-entry. The breakout pressure works best if it increases to a maximum (to keep the tine in the ground while sowing), however reduces as the tine lifts out over an obstacle.

Regardless of seeding system chosen for stony soil, it is critical to optimise seed placement on deep soil as well as provide adequate backfill on shallow ground to maintain seed depth, resulting in an acceptable result on all soil types. The seeding system also needs to be robust enough to take the wear of sowing into stone.

Acknowledgements

Thanks to SANTFA sponsors, CASE IH, Flexi-Coil, Agmaster, K-Hart, Atom-Jet, Agpoint and Kelbro Machinery for trial equipment. Thanks to Matthew Cook for braving his tines in the stony conditions again! Thanks to Jack Desbiolles for help with trial design. Thanks to Jon Hancock, Craig and Jess Brands, Leigh Davis and Brenton Spriggs for trial assistance. Special thanks to Wayne Little for the use of his land for the trial. Thanks also to all the growers who had input in to the treatments for this trial.

Brome and Barley Grass Control

Michael Bennet
SARDI and SA No-Till Farmers Association, Minnipa Agricultural Centre

Research

No till

Key messages

- **Trifluralin can provide useful control of low levels of brome and barley grass.**
- **No crop damage was observed this season from Metribuzin/ Diuron mixes applied pre-sowing.**

Why do the trial?

Grassy weeds continue to challenge growers across upper Eyre Peninsula. Brome grass is an issue across many regions, however the past three dry seasons has favoured barley grass, which is becoming an issue of greater importance. Brome grass control trial results from other seasons can be found in EPFS Summary 2004, pg 145 and EPFS Summary 2005, pg 146. Two herbicide trials were grown to compare the grass weed control of various herbicides and compare crop safety and grain yield on wheat at Penong and barley at Mangalo.

How was it done?

The trials received a base rate of Trifluralin (0.8 L/ha at Penong and 1 L/ha at Mangalo), to which other herbicides were added to investigate their impact on weed control. The target weeds were brome grass and barley grass.

Herbicide treatments were applied pre-sowing using a hand boom calibrated to deliver 70 L/ha with 11001 Turbodrop Airmix nozzles producing a medium/coarse droplet spectrum.

The Mangalo trial was sprayed and sown on 30 May and Penong was sprayed and sown on 2 June.

Both sites were sown using knife points and press wheels on 230 mm row spacing with the herbicides incorporated by sowing (IBS).
Both sites were sown into pasture paddocks with minimal residue remaining after grazing in 2007.

Penong was sown with 50 kg/ha of Wyalkatchem wheat, and Mangalo was sown with Barque barley @ 50 kg/ha.

Both sites were monitored for crop and weed emergence post-sowing. Potential weed seed set was gauged by assessing seed heads/m^2 prior to harvest.

What happened?

Mangalo

None of the herbicides applied at Mangalo depressed barley emergence.

All of the herbicides applied reduced barley and brome grass seed head emergence. However, only 200 g/ha Metribuzin reduced barley and brome grass head emergence more than the base rate of Trifluralin.

The level of weed control obtained with Trifluralin alone did not increase barley yield. All other mixes of herbicides resulted in greater barley yield than the control. Treatment 5 (200 g/ha Metribuzin + 1 L/ha Trifluralin) was the only treatment to yield higher than 1 L/ha Trifluralin.

Penong

Dry conditions post sowing at Penong appeared to prevent the full activation of Diuron or Metribuzin herbicides. As a consequence there was no crop damage from these treatments but

Try this yourself now

Location
Penong
Sam and Bill Shipard
Charra Ag Bureau

Rainfall
Av Annual: 318 mm
Av GSR: 215 mm
2008 Total: 328 mm
2008 GSR: 179 mm

Yield
Potential: 1.5 t/ha (W)
Actual: 0.6 t/ha

Paddock History
2007: Pasture
2006: Wheat
2005: Barley

Soil Type
Grey calcareous sand

Plot size
13 m x 3 m x 4 reps

Yield Limiting Factors
Rainfall

Location
Mangalo
Brendan Crettenden
Franklin Harbour Ag Bureau

Rainfall
Av Annual: 340 mm
Av GSR: 260 mm
2008 Total: 169 mm
2008 GSR: 132 mm

Yield
Potential: 1.2 t/ha (B)
Actual: 0.9 t/ha

Continues

Paddock History
2007: Wheat
2006: Pasture
2005: Barley

Soil Type
Siliceous sand over clay

Plot size
13 m x 3 m x 4 reps

Yield Limiting Factors
Rainfall

also very limited extra grassy weed control early in the season.

All of the herbicides reduced barley grass seed head emergence, however none of the extra herbicides added to Trifluralin were able to improve weed control over and above the base rate of Trifluralin.

At the Penong site, brome grass seed head emergence and final wheat yields were the same across all treatments.

The gross income result of the base rate of Trifluralin at both sites was better than the no spray treatment. All herbicides (except Treatment 7 at Mangalo) improved gross income over the base rate of Trifluralin for both sites.

What does this mean?

Metribuzin and Diuron have much greater requirements for moisture to activate the chemical than Trifluralin. This is why in both trials there were only small improvements in weed control offered by the addition of other herbicides to the base rate of Trifluralin. These herbicides can be extremely effective with adequate soil moisture post-sowing, however can be ineffective without it.

These herbicides are unlikely to provide adequate control in the face of a high background population of grass weeds. Utilisation of rotation and pasture/crop topping in addition to these pre-sowing herbicide options will be the most effective form of grass weed control where populations of grass weeds are substantial.

The success of IBS herbicide usage in no-till systems requires the herbicide to be present and active in the inter-row. Managing soil throw, particularly from the back rows of the seeder is very important. Crops seeded from the front tines of the machine must not be buried with soil from the back tines, because this will bury the seed too deep and also cause soil with concentrated herbicide to be left in the crop row. If there is excessive soil throw, then uneven germination may result, as well as stunted crop growth from all but the back rows of the seeder.

Diuron and Metribuzin can cause significant crop damage if certain conditions prevail post sowing. A large rainfall event can wash these soluble herbicides into the bottom of the press wheel furrow which can cause a reduction in crop emergence and reduced crop vigour. A significant wind event on light sands can have a similar effect with herbicide concentrated on top of the emerging crop.

Metribuzin and Diuron are not registered for application in no-till systems pre-sowing. This trial was to indicate potential efficacy and

Table 1 Grass weed control and barley yield with various herbicides at Mangalo, 2008

Treatment	Diuron (g/ha)	Metribuzin (g/ha)	Trifluralin (L/ha)	Barley plants /m^2	Barley grass heads/m^2	Brome grass heads/m^2	Yield (t/ha)	Cost ($/ha)	Gross Income* ($/ha)
1	140		1	179	17.8	17.8	0.80	8.80	103
2	280		1	161	32.2	9.6	0.86	10.65	110
3	420		1	162	22.2	4.4	0.88	12.45	110
4		100	1	183	19.3	5.9	0.81	10.70	102
5		200	1	137	3.0	0	0.96	14.40	120
6	140	100	1	162	16.3	8.1	0.87	12.50	109
7	280	100	1	149	31.9	8.9	0.90	14.35	111
8	280	200	1	153	10.4	1.5	0.84	18.00	100
9			1	153	28.9	14.1	0.76	7.00	99
10		No spray		166	86.7	52.2	0.58	0.00	81
LSD (P=0.05)				*ns*	*22.1*	*13.9*	*0.20*		

**Gross income is yield x price (Feed 1 barley @ $140/t) less herbicide costs.*

crop safety with various rates and combinations of herbicides. Check your herbicide label prior to usage.

Acknowledgements

Thanks to Sam and Bill Shipard at Penong, Darren and Brendan Crettenden at Mangalo for the use of their land for the trials. Thanks to Andy Bates for monitoring the Penong trial while the author was awaiting twins in Adelaide! Thanks to Jess Brands, Brenton Spriggs, Wade Shepperd and Willie Shoobridge for technical assistance.

Many of the herbicide mixes used in these trials are off label and for research purposes only to indicate potential efficacy and crop safety. Check the label prior to applying herbicides.

No till

Table 2 Grass weed control and wheat yield with various herbicides at Penong, 2008

Treatment	Diuron (g/ha)	Metribuzin (g/ha)	Trifluralin (L/ha)	Barley plants /m^2	Barley grass heads/m^2	Brome grass heads/m^2	Yield (t/ha)	Cost ($/ha)	Gross Income* ($/ha)
1	140		0.8	113	103	10	0.55	7.40	143
2	280		0.8	110	82	11	0.59	9.25	153
3	420		0.8	125	97	7	0.53	11.05	137
4		100	0.8	128	93	13	0.52	9.30	134
5		200	0.8	135	50	9	0.54	13.00	140
6	140	100	0.8	127	53	9	0.55	11.10	136
7	280	100	0.8	121	74	11	0.50	12.90	126
8	280	200	0.8	136	47	14	0.58	16.65	149
9			0.8	123	79	8	0.54	5.60	134
10		No spray		128	176	11	0.51	0.00	126
LSD (P=0.05)				*ns*	*40*	*ns*	*ns*		

**Gross income is yield x price (APW $258.50 and GP $248.50) less herbicide costs.*

Cereal Crop Competition vs Ryegrass

Michael Bennet

SARDI and SA No-Till Farmers Association, Minnipa Agricultural Centre

Research

Almost ready

Location
Edillilie
LEADA

Rainfall
Av Annual: 450 mm
Av GSR: 340 mm
2008 Total: 372 mm
2008 GSR: 291 mm

Yield
Potential: 3.6 t/ha (W)
Actual: 2.9 t/ha

Paddock History
2007: Peas
2006: Barley
2005: Wheat

Soil Type
Buckshot loam over clay

Plot size
12 m x 1.5 m x 4 reps

Yield Limiting Factors
Early finish

Key messages

- **Increased seeding rates in wheat halved ryegrass seed set.**
- **Increasing seeding rates in wheat above 300 plants/m^2 reduced grain yield.**
- **Wyalkatchem yielded well despite high ryegrass pressure.**

Why do the trial?

Annual ryegrass *(Lolium rigidium)* is a weed of concern for most growers across Eyre Peninsula. It is a particular problem when the populations develop herbicide resistance, which is currently more prevalent on lower Eyre Peninsula. This trial compared four commercial wheat varieties at low, moderate and high seeding rates to assess their competitive ability with annual ryegrass. This follows on from research reported in the EPFS Summary 2006, pp 182–183.

How was it done?

The trial was sown on 6 June using Cummins Ag Service's DBS plot seeder set on 300 mm row spacing. The trial was sprayed pre-sowing with 1.5 L TriflurX and 1.6 L Avadex Xtra. Four varieties, Wyalkatchem, Correll, Espada and Gladius were each sown to target plant populations of 180, 300 and 450 plants/m^2. Crop and weed emergence were assessed 21 days after seeding. Ryegrass seed set was assessed by collecting ryegrass from each plot, cleaning the seed and making an estimate of viable seed set.

The site was sown with 80 kg/ha of 18:20 followed with 70 kg/ha of urea broadcast in July.

What happened?

As with most districts, crops at Edillilie failed to reach the potential yield set up in winter. The crop had grown a dense canopy with yield potential significantly higher than what was achieved at harvest. Ryegrass within the trial had also set itself up for impressive seed set potential. With the sharp dry finish to the season, the ryegrass had to quickly fill whatever seed it could before it died from lack of moisture, as the crop was also using whatever moisture remained as quickly as it could.

There was potential for significantly greater seed set of ryegrass given a moderate spring rainfall. The harsh spring resulted in many of the potential seeds shrivelled or aborted. Despite the weather and the crop competition, there was a modest increase to the ryegrass seedbank.

Increasing the seed rate of Wyalkatchem from 180 plants/m^2 to 300 plants/m^2 resulted in a halving of weed seed production. In 2006, the same seeding rate increase resulted in a 60% reduction in ryegrass seed set. Increasing sowing rate from 300 to 450 plants/m^2 reduced weed seed set in 2006, however this did not further reduce weed seed set in 2008.

Gladius was the most competitive of varieties tested, followed by Correll and Wyalkatchem. Espada was the least competitive variety in 2008. Gladius sown at 180 plants/m^2 was more competitive than Wyalkatchem (Table 3) and Espada but similar to Correll at a similar seeding rate (Table 1).

Across all wheat varieties, those sown at 450 plants/m^2 yielded less grain than at a population of 180 plants/m^2. There was no difference in yield of wheat sown between 180 and 300 plants/m^2 (Table 2).

Averaged over all sowing rates, Wyalkatchem had the highest yield, 2.82 t/ha. Espada and Gladius had a similar yield of 2.61 and 2.51 t/ha respectively. Correll yielded less than the other three varieties with 2.37 t/ha.

Grain quality and final grade were impacted by variety choice and seeding rate. Correll and Gladius had reduced test weight which resulted in a GP rating. Espada made APW, except when sown at 450 plants/m^2. Wyalkatchem was consistent with quality, reaching the APW grade across all sowing rates.

What does this mean?

Crop competition is an effective form of weed control when combined in an integrated approach with other methods. Crop competition alone is not enough to win the war against annual ryegrass. Despite the 300 mm row spacing, the crop was very effective on reducing the impact of ryegrass seed set, but not to levels which would have reduced the seed bank.

Ryegrass seed set was very low compared to 2006 where seed set ranged between 400 and 1,200 seeds/m^2. Just as the crop had much greater yield potential than what was realised, so did the ryegrass. Many of the ryegrass tillers died rather than fill out viable seeds.

A season more suitable for grain growing is likely to be also more suitable for increasing ryegrass seed set. If 2008 had had a kinder finish to the season, the seed set may have been in the order of ten fold of what was measured. It will be great to see a season more suited to ryegrass, so at least it will be a decent harvest for wheat! Growers still need to keep on

Table 1 Sowing rate and variety effect on annual ryegrass (ARG) establishment, seed set and wheat grain yield

Seed Rate	180 plants/m^2			300 plants/m^2			450 plants/m^2		
Variety	ARG plants/m^2	ARG Seeds/m^2	Grain Yield (t/ha)	ARG plants/m^2	ARG Seeds/m^2	Grain Yield (t/ha)	ARG plants/m^2	ARG Seeds/m^2	Grain Yield (t/ha)
Correll	26	176	2.51	29	65	2.34	30	106	2.26
Espada	28	355	2.67	59	74	2.61	18	120	2.56
Gladius	31	120	2.54	51	65	2.58	24	68	2.41
Wyalkatchem	30	255	2.91	48	103	2.81	21	85	2.75

Table 2 Sowing rate effect on annual ryegrass establishment, seed set and wheat grain yield

Sowing rate (plants/m^2)	ARG Plants/m^2	ARG Seeds/m^2	Grain Yield (t/ha)
180	29	226	2.66
300	47	77	2.59
450	23	95	2.50
LSD (P=0.05)	*18*	*44*	*0.11*

Table 3 Variety effect on wheat grain yield and ryegrass seed set

Variety	Grain Yield (t/ha)	ARG Seed set (seeds/m^2)
Correll	2.4	115
Espada	2.6	183
Gladius	2.5	84
Wyalkatchem	2.8	148
LSD (P=0.05)	*0.11*	*50*

top of their weeds in order to avoid 'blow outs' in numbers when we do have a good season.

Gross income declined with increased seeding rates. A yield reduction was measured for most varieties at higher seeding rates, which when combined with the cost of seed, had an impact on profitability. In an overall farming system however, the benefit of more than halving ryegrass seed set (in the instance of Wyalkatchem) by increasing seed rate from 180 to 300 plants/m^2 is important and may justify at least some of the cost of extra seed.

The benefits that high seeding rates offer in terms of reducing ryegrass seed set needs to be balanced against grain quality risks, which are likely to be higher in a system incorporating greater soil reserves of nitrogen, such as legume based pasture systems.

With tougher test weight standards (>74 kg/hL) being introduced for the 2009/10 season, achieving grain weight is a real concern for growers. None of the grain tested from the Edillilie trial would have reached this new standard for APW or Hard quality.

Acknowledgements

Thanks to Shane Nelligan for the use of his land for the trial. Cummins Landmark for assistance sowing the trial. SANTFA, SARDI and the National Landcare Programme for funding the work. Jess Brands, Trent Brace, Leigh Davis and Brenton Spriggs for technical assistance. Thanks to Michael Treloar as well as the LEADA committee and Lower EP growers for input to the project.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

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Table 4 Effect of seeding rate on grain quality yield and gross income at Edillilie, 2008

Variety	Seed Rate (Seeds/m^2)	Screenings (%)	Test Weight (kg/hL)	Protein (%)	Grade	Grain Yield (t/ha)	Gross Income* ($/ha)
Correll	180	6.3	72.2	13.3	GP	2.51	577
Correll	300	8.4	71.1	13.2	GP	2.34	522
Correll	450	9.9	69.6	13.4	GP	2.26	480
Espada	180	3.4	76.0	12.6	APW	2.67	683
Espada	300	4.6	74.1	12.7	APW	2.61	651
Espada	450	6.5	73.0	13.0	GP	2.56	552
Gladius	180	4.1	73.8	13.0	GP	2.54	586
Gladius	300	5.5	72.3	13.0	GP	2.58	578
Gladius	450	7.3	69.7	13.2	GP	2.41	516
Wyalkatchem	180	2.9	75.8	12.5	APW	2.91	745
Wyalkatchem	300	3.7	74.1	12.2	APW	2.81	702
Wyalkatchem	450	4.7	75.2	12.2	APW	2.75	667

**Gross Income is calculated by yield x price (delivered to Pt Lincoln 10/12/08) less seed costs @ $300/t.*

Effect of Seeding Systems and Herbicides on Crop Establishment and Ryegrass Control

Research

Sam Kleemann & Peter Boutsalis
University of Adelaide, Rosewothy Campus

No till

Almost ready

Location
Roseworthy
Roseworthy Campus

Rainfall
Av Annual: 430 mm
Av GSR: 320 mm
2008 Total: 329 mm
2008 GSR: 255 mm

Paddock History
2007: Faba beans

Soil Type
Sandy clay loam over medium calcareous clay

Plot size
1.5 m x 8 m x 4 reps

Key messages

- **New pre-emergence herbicides provided effective control of annual ryegrass under both knife point and disc systems.**
- **Good crop safety was observed with pre-emergence herbicides under knife-points; however, herbicide damage was evident under discs and was due to shallow seeding depth.**

Why do the trial?

Increasing frequency of populations of annual ryegrass resistant to trifluralin is of growing concern to farmers across the southern Australian wheat-belt. Given the importance placed on trifluralin for controlling ryegrass under current farming practices, there is an urgent need to identify alternative pre-emergence herbicide options. Consequently a trial was undertaken to evaluate the efficacy and crop safety of alternative pre-emergence herbicides under knife-point and disc seeding systems.

How was it done?

The trial, established at Roseworthy Campus, was sown to Correll wheat @ 90 kg/ha on 4–5 June. Herbicide treatments were:

Triflur-X @ 2.0 L/ha

Triflur-X @ 1.5 L/ha plus
Avadex Xtra @ 1.6 L/ha

Triathlete @ 2.0 L/ha

Boxer-Gold @ 2.5 L/ha

Bay-191 @ 118 g/ha

Untreated

The treatments were applied using an all-terrain vehicle at a spray volume of 100 L/ha and incorporated by sowing. An untreated control was used to determine background weed populations. Seeding systems were chosen on the basis of extent of soil disturbance and included:

- Austil single undercut disc (zero disturbance)
- K-Hart V disc + yetter rippled coulter (low disturbance)
- Conserva-Pak knife-point with vertical shank (intermediate disturbance)
- 16 mm narrow knife-point with C shank (intermediate disturbance)

All treatments received 100 kg/ha of 18:20 fertiliser and were sown on 25 cm spacings with press wheels. Seeding speeds were 12 km/h for disc treatments and 8–9 km/h for tine systems. As the previous crop was faba beans, stubble levels across the site were low (<2 t/ha).

Ryegrass populations were assessed 6 weeks after sowing by counting the number of plants in three randomly placed quadrats (25 cm × 25 cm) in each plot. Assessments of wheat density were made by counting the number of plants in a 1 m length of a crop row at three locations in each plot. Seeding depth was estimated for each seeding system by randomly sampling 50 wheat seedlings from each herbicide untreated plot.

What happened?

Crop establishment

Excellent crop safety with pre-emergence herbicides was shown under narrow-point, Conserva-Pak and K-Hart seeding systems (Figure 1). In contrast, crop establishment was reduced with herbicides Triflur-X (54% of the untreated

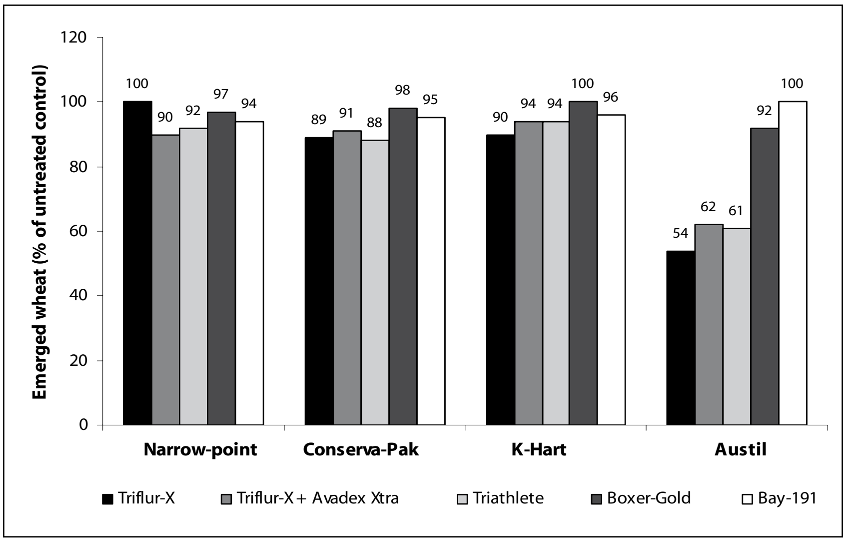

Figure 1 Effect of seeding systems and pre-emergence herbicides on wheat emergence (% of untreated control). Untreated mean wheat density = 170 plants/m²

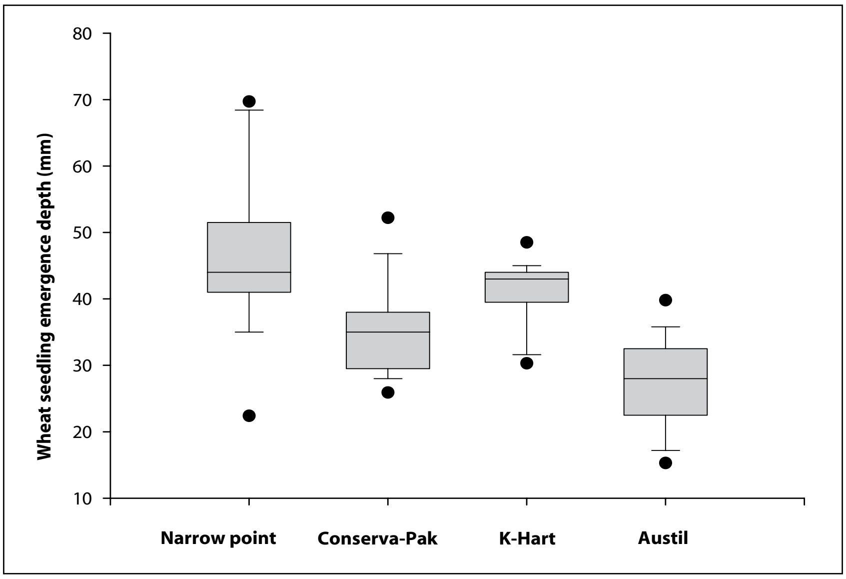

Figure 2 Effect of seeding systems on depth of seeding (mm). Horizontal line within each box-plot represents median seedling depth, with dots representing minimum and maximum depth

control), Triflur-X + Avadex Xtra (62%) and Triathlete (61%) under the low soil disturbance Austil disc system. Herbicide damage with the Austil system was a combination of shallow seeding depth (Figure 2) and limited displacement of herbicide from the seed furrow. In combination this can result in seedlings germinating in close proximity to the concentrated herbicide band, reducing establishment. Importantly, new pre-emergence herbicides Boxer Gold and Bay-191 were safe on the emerging wheat crop, regardless of the seeding system. However, it is noteworthy that soil conditions at and following herbicide application were dry and less conducive to herbicide mobility and consequent crop damage.

Ryegrass control

Similar levels of ryegrass control (72 to 88%) were obtained with the pre-emergence herbicides under both knife-point and disc systems (Figure 3). Ryegrass control was highest (88%) when herbicide Triathlete was incorporated by the Conserva-Pak system. Interestingly, ryegrass control with Triflur-X (72%), Triflur-X + Avadex Xtra (81%) and Triathlete (77%) was not compromised under the low soil disturbance Austil disc system. Poor ryegrass control may have been expected with these treatments as they all contain trifluralin, a volatile active ingredient that requires soil incorporation to maintain soil activity. Although soil surface conditions were dry and not ideal for herbicide activation, herbicides Boxer Gold and Bay-191 provided effective ryegrass control across seeding systems (73 to 84%). Furthermore, residual activity of Bay-191 reduced growth and root development of ryegrass survivors (Figure 4). This would significantly reduce the capacity of ryegrass to compete with the crop and would also reduce seed production by the ryegrass.

What does this mean?

These results have shown that new pre-emergence herbicides Boxer Gold and Bay-191 provided a safe and effective alternative to trifluralin for controlling ryegrass in wheat established under both knife-point and disc systems under the conditions of this trial. However, further research is required to evaluate these seeding system × herbicide interactions across a number of ryegrass populations, soil types, environments and conditions around seeding.

Boxer Gold is currently available (released 2008) with Bay-191 and Triathlete likely to be available within the next few years. It is also worth keeping in mind that while Triathlete (trifluralin + cinmethylin) provides another option, it may not be suited in situations where ryegrass has strong resistance to trifluralin. In any circumstance growers should take a long-term approach to weed management, and endeavour to keep weed numbers low. A diverse rotation of crops, herbicides, and non-chemical strategies should be employed to prolong the life of existing and new chemical groups.

Acknowledgements

Grains Research and Development Corporation for providing project funding. We also thank Jack Desbiolles and Dean Thiele for their assistance in trial preparation and Bayer, Nufarm and Syngenta for supplying herbicides.

Grains Research & Development Corporation

No till

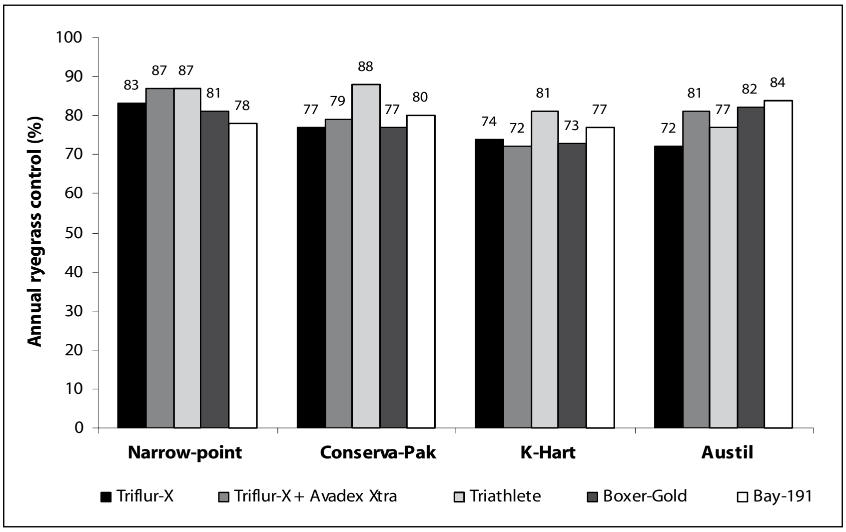

***Figure 3** Effect of seeding systems and pre-emergence herbicides on percentage (%) ryegrass control. Untreated mean ryegrass density = 237 plants/m2*

***Figure 4** Effect of new pre-emergence herbicide Bay-191 on ryegrass growth and root development (right)*

Herbicides for Dry Sowing of Wheat

Michael Bennet

SARDI and SA No-Till Farmers Association, Minnipa Agricultural Centre

Research

Try this yourself now

Location
Buckleboo
BIG FIG

Rainfall
Av Annual: 306 mm
Av GSR: 220 mm
2008 Total: 153 mm
2008 GSR: 105 mm

Yield
Potential: 0.6 t/ha (W)
Actual: 0.4 t/ha

Paddock History
2007: Oaten hay
2006: Oaten hay
2005: Wheat

Soil Type
Red clay loam

Plot size
3 m x 15 m x 4 reps

Yield Limiting Factors
Rainfall

Key messages

- **All herbicides provided effective control of brome grass and barley grass in wheat this season.**
- **Crop safety in wheat was achieved by all herbicide mixes in 2008.**

Why do the trial?

Growers are gaining confidence with earlier sowing than the "traditional" sowing strategy of waiting for a germination of weeds after the opening rain. Better grain yields are almost always achieved on paddocks sown earlier than what was considered the traditional optimum sowing date in mid May.

Dry sowing is a strategy that enables some paddocks to be sown prior to the opening rains. These paddocks can then take advantage of the complete growing season. It also reduces the time pressure on growers at seeding as a portion of the program has already been completed.

As part of the increased adoption of dry sowing, many growers are eager to know what herbicides might fit into a dry sowing scenario. This trial compared the efficacy and crop safety of various pre-sowing herbicide mixes on grassy weeds in a dry sowing situation for wheat, and followed the treatments through to final grain yield.

How was it done?

The trial was dry sown at Buckleboo on 24 April using a commercial DBS no-till seeder on 304 mm row spacing. Yitpi wheat was sown @ 40 kg/ha with 30 kg/ha of 10:22. Herbicide treatments were applied pre-sowing using a hand boom calibrated to deliver 70 L/ha with 11001 Turbodrop Airmix nozzles producing a medium/coarse droplet spectrum. The trial was sown into an un-grazed oat hay stubble with minimal stubble levels on the surface.

The trial was assessed for crop emergence on 9 May. Grass weed establishment was assessed on 1 July. Barley grass was very competitive on the controlled traffic bare wheel tracks, so a separate assessment was made for barley grass numbers on 10 October. Grain yields for each plot were taken at crop maturity using a plot header and sub-samples kept for quality analysis.

What happened?

The trial site only remained dry for two days post sowing, as the first major rainfall of 11 mm fell between 26-27 April. A follow up rain of 12 mm fell between 16–18 May.

Crop establishment was not adversely affected by any of the herbicides applied pre-sowing but the light and sporadic nature of the opening rains in 2008 may have helped.

Table1 Grassy weed and wheat growth with different herbicides pre sowing at Buckleboo

Treatment	Treatment	Cost ($/ha)	Wheat plants/m²	Barley Grass plants/m²	Brome Grass plants/m²	Ryegrass plants/m²	Barley Grass heads/m² in wheel tracks	Wheat Yield (t/ha)
1	1 L Trifluralin	5.5	116	6.9	0.5	0.5	104	0.43
2	1.5 L Trifluralin	8.5	112	9.3	2.3	1.4	222	0.42
3	1.5 L Trifluralin + 500 g Diuron*	14.0	118	3.7	1.4	1.4	129	0.44
4	1.5 L Trifluralin + 1 kg Diuron*	20.0	114	6.5	1.9	0.9	101	0.46
5	1.5 L Trifluralin + 1.6 L Avadex	30.0	97	6.5	0.0	2.8	153	0.41
6	1.5 L Trifluralin + 180 g Metribuzin*	14.0	102	1.9	1.9	2.3	103	0.45
7	1.5 L Trifluralin + 280 ml Cinmethylin*	N/A	95	7.4	0.9	0.0	164	0.44
8	1.9 L Trifluralin + 360 ml Cinmethylin*	N/A	108	3.2	1.9	1.4	124	0.43
9	1.5 L Trifluralin + 30 g Logran*	10.5	110	4.2	0.5	0.0	47	0.47
10	1.5 L Trifluralin + 1.5 L Boxer Gold	26.5	120	6.0	0.9	0.5	149	0.43
11	2.5 L Boxer Gold	30.0	101	8.8	0.5	0.9	103	0.45
12	280 ml Cinmethylin*	N/A	105	11.6	2.3	0.9	236	0.45
13	3 L Trifluralin	16.5	104	4.2	2.3	0.0	85	0.46
14	Untreated	0	108	20.4	7.4	4.6	178	0.36
LSD (P=0.05)			*ns*	*7.6*	*2.7*	*ns*	*96*	*ns*

**Treatments marked with asterix are off label and for experimental usage only. Prices are as at seeding 2008, exclusive of GST.*

All herbicide mixes reduced barley grass emergence. However, the herbicide mixes (per ha) of (1.5 L Trifluralin + 180 g Metribuzin), (1.9 L Trifluralin + 360 mL Cinmethylin) and (1.5 L Trifluralin + 500 g Diuron) were more effective at reducing barley grass emergence than 280 mL Cinmethylin alone.

Barley grass dominated the bare wheel tracks in the controlled traffic system, 1.5 L Trifluralin + 30 g Logran offered better control than all other herbicide treatments. Logran provided longer lasting control than the other herbicide treatments which gave good early control.

Ryegrass numbers across the site were very low and no differences were measured between the herbicide treatments.

Brome grass levels were low across the site, however all herbicides were effective in reducing brome grass emergence compared to the untreated area.

Herbicide treatments had no impact on final grain yield. Despite the higher grass weed burden in the untreated plots, there were no differences in yield compared to the cleaner plots this season. However, the resulting weed burden next year will be greater in the plots with less effective control.

Grain quality was unaffected by the herbicide treatments. The final grade of wheat harvested was AGP, with a test weight of 71.6 kg/hL, protein 14% and screenings 8%. A greater weed infestation may have resulted in treatments being downgraded due to weed seed contamination.

What does this mean?

Despite the lack of herbicide damage found at Buckleboo, there are serious risks with applying herbicides pre-seeding when dry sowing. The main risk involves the herbicide treated soil in-filling the seeding furrow. This is a particular issue with seeding rigs that use press wheels. This can happen either through wind erosion on sandy soils, or a heavy rainfall event can also wash herbicides back into the crop row, or from soil throw from adjacent seeding rows. Stubble cover will improve the stability of the press wheel furrow and therefore reduce the associated risks of herbicide damage in a dry sowing situation and will also reduce soil throw.

The more soluble herbicides such as S-Metolachlor, Metribuzin and Diuron are the most likely herbicides to cause a reduction in crop emergence if a heavy downpour occurs post-sowing. Crop safety should increase with wider (>250 mm) row spacings.

Weed levels in a controlled traffic bare wheel track scenario need close monitoring to ensure that there are no weed blowouts for the following crops. Some growers who incorporate their header in the controlled traffic system manage this at harvest by directing chaff to the wheel tracks to create a mulch over their weeds. Another option is to apply an increased rate of herbicide to the wheel tracks.

The mixture of Logran with Trifluralin provided very effective weed control at the Buckleboo site. This site has had minimal usage of group B chemicals in the past, which means that resistance has not had a chance to build up. Resistance to the group B chemicals can build up with as little as three applications, which would result in this mixture being less effective.

When selecting paddocks for dry sowing cereal crops, choose paddocks with a low grass weed burden so that herbicides with less crop safety don't need to be used. Dry sowing without good weed control can be the weak link in a whole farming system, where clean paddocks can end up with heavy grassy weed burdens for seasons to come.

At Buckleboo, there was no yield loss associated with poor weed control. The site was clean early in the season, with weeds emerging well after the crop. It is likely that if follow up rains occurred in spring the weed impacts in the untreated plots would have been more severe.

The cheapest option for herbicide selection this season at Buckleboo was to not apply any herbicide at all. This however would result in a significant increase of weeds to the seedbank. The cheapest herbicide was 1 L Trifluralin which was quite effective on the three main target weeds at the site. Given a similar circumstance of low weed burden and the current financial pressure, it would be difficult for a grower to justify using expensive alternative chemicals like Avadex or Boxer Gold. However a higher weed burden may validate their use.

Resistance to Trifluralin is gaining momentum as we continue to use this herbicide as a primary source of initial weed control at sowing. Mixing Trifluralin with other modes of action will reduce the selection pressure on this herbicide, and although this comes at an increased initial cost it should lead to increased longevity of the herbicide.

Acknowledgements

Thanks to the Buckleboo Farm Improvement Group for their enthusiasm. Michael Schaefer for the use of his machinery and land. National Landcare Program and SANTFA for funding. Nufarm for supplying Avadex and Cinmethylin. Trent Brace, Jess Brands, Cathy Paterson and Brenton Spriggs for technical assistance. Thanks to Ashley Barns, WCT Wudinna for providing pricing information.

Products used:

- Trifluralin – 480 g/L Trifluralin
- Avadex – 500 g/L Tri-Allate
- Logran – 750 g/kg Trisulfuron
- Diuron – 900 g/kg Diuron
- Boxer Gold – 800 g/L Prosulfocarb + 120 g/L S-Metolochlor
- Metribuzin – 750 g/kg Metribuzin
- Cinmethylin – An experimental product from Nufarm which is likely to be released as a mix with Trifluralin.

Many of the herbicide mixes used in this trial are off label and for research purposes only to indicate potential efficacy. Use herbicides according to label directions.

Managing Water Repellent Sands

Michael Bennet
SARDI and SA No-Till Farmers Association, Minnipa Agricultural Centre

Research

No till

Searching for answers

Location
Wharminda
Wharminda/Arno Bay Ag Bureau

Rainfall
Av Annual: 322 mm
Av GSR: 222 mm
2008 Total: 221 mm
2008 GSR: 145 mm

Yield
Potential: 1.1 t/ha (W)
Actual: 0.6 t/ha

Paddock History
2007: Wyalkatchem
2006: Pasture
2005: Barque barley

Soil Type
Deep siliceous sand

Plot size
24 m x 1.5 m x 4 reps

Yield Limiting Factors
Rainfall

Key messages

- **Incorporating seed behind press wheels was very successful in 2008.**
- **Low disturbance systems suffered reduced germination and yield in 2008.**

Why do the trial?

Growing crops on water repellent siliceous sands have been a challenge ever since the country was first cleared. This challenge is greatly increased where the water repellence is severe. Wharminda is a district "blessed" with a large area of this challenging soil type. These sands "wet up" slowly and unevenly at the start of the season, so getting an even, rapid and satisfactory germination and subsequent establishment before winds hit is important.

This is the third season of sowing systems research at Wharminda investigating methods for successfully establishing crops in a single pass to reduce erosion potential and improve productivity. Previous results can be found in EPFS Summary 2006, p 176 and EPFS Summary 2007, p 177.

How was it done?

The trial was sown on 11-12 June with Wyalkatchem wheat @ 50 kg/ha and 50 kg/ha of 18:20 banded with the seed. Trifluralin @ 800 mL/ha was sprayed on the site pre-sowing. The site was monitored for crop emergence three times post sowing. Grain was harvested using a small plot header with samples kept for grain quality assessment.

What happened?

The trial site was a test of very tough conditions for crop emergence and growth on water repellent sands. The sporadic rainfall pre and post sowing led to uneven and patchy crop establishment.

The site suffered severely from post sowing erosion due to a combination of high winds and low stubble loads from the 2007 season. Initially poor emergence of crops exacerbated the problem, which resulted in the crop and trial area being sand blasted several times before the crop established enough to stabilise the site.

The crop emerged from a much greater depth than originally targeted. The post sowing erosion increased the target seed depth of 30-40 mm to 90-110 mm in the treatments incorporating press wheels (Table 1).

The standout treatments visually for most of the season were those treatments where seed was incorporated behind press wheels, and the Anderson-Concord system. The less impressive treatments were the knife point and press wheel systems, which struggled with poor emergence and this followed through to final grain yield.

One advantage of the Anderson system in the sand was the very wide press wheels, which prevented much of the furrow infill that occurred with the other narrower press wheel systems. The Anderson system emerged 20 mm shallower than the treatments sown with narrower press wheels, which had to emerge from below the length of their coleoptiles. The Anderson is an aggressive knife point system which spreads seed 165 mm wide, and so requires car tyres for press wheels on the commercial unit to press seed the full width of the seed spread.

There were no major differences in the first emergence count, due to the site recovering from severe sandblasting.

At the second emergence count, the site had just been freshly sand blasted making emergence counts a quick job, as there was very little remaining crop. At this stage the best treatment was systems with the seed incorporated behind the press wheels (seed tubes attached to the back of press wheels, followed by Agmaster star harrows). Sweeps + Harrows performed well, followed by knife points + harrows. Using the Anderson rolling shields/ disc levellers combined with a standard knife point + press wheel system resulted in poor emergence, as did the addition of snake chains and the Atom-Jet mallee point.

The plant count in September revealed other treatments which were performing relatively well by that stage. Establishment with the seed incorporated system was greater than with sowing with sweeps and harrows, knife points and harrows and the Anderson system. The lower disturbance systems resulted in lower crop establishment.

Treatments that resulted in greater emergence generally followed through to better grain yield and quality. Incorporating seed behind the press wheels yielded more than any other treatment. The Anderson system yielded as well as the knife points and rotary harrows and sweeps with rotary harrows treatments.

Incorporating seed behind press wheels, sweeps and rotary harrows and the Anderson system were the only treatments to reach APW quality specifications with the rest of the trial rated for General Purpose quality only.

Table 1 Seeding System impact on seeding depth, crop establishment and grain yield

Opener	Treatment	Seed Depth (mm)	Plants/m^2 July	Plants/m^2 August	Plants/m^2 Sept	Grain Yield (t/ha)	Test weight (kg/hL)	Screenings (%)
KP PW + RH	Incorporation of seed behind press wheels	40	38	103	83	0.66	79.1	3.6
KP PW	Anderson System (165 mm seed spread)	79	41	43	43	0.45	78.1	5.1
KP PW + RH		98	48	49	49	0.42	78.1	5.6
Sweeps + RH		71	33	55	55	0.37	78.2	4.9
KP PW	16 mm point - 4" working depth	104	35	30	30	0.28	75.1	7.1
KP PW	16 mm winged point	102	31	32	32	0.28	74.5	7.2
KP PW	16 mm point - Shallow	86	26	31	31	0.27	74.4	7.4
KP PW	12 mm point	90	33	30	30	0.25	75.4	6.7
KP PW	16 mm point	95	29	38	38	0.25	74.3	7.8
KP + RH		97	31	34	34	0.25	76.4	6.6
KP PW	16 mm point - Deep	112	55	40	29	0.25	74.3	6.7
KP PW	16 mm + Chain	98	25	46	32	0.25	74.4	7.4
KP PW	16 mm + Snake Chains	102	31	26	26	0.21	74.1	7.8
K-Hart disc		84	24	29	29	0.21	76.3	7.0
KP PW	Use aggressive snake chains	95	32	25	25	0.18	72.5	8.6
Atom Jet		106	36	36	36	0.17	75.1	7.5
Atom Jet	Rhizo Point	105	30	26	26	0.17	72.4	8.9
KP PW	Use with Anderson rolling shields / disc levellers	103	25	25	25	0.17	74.7	7.4
LSD (P = 0.05)			***ns***	***28***	***22***	***0.14***	***2.9***	***1.6***

**KP = Knife Point, PW= Press wheel, RH = Agmaster star harrows, K-Hart = Wavy coulter opener + V-paired discs + press wheel.*

Table 2 Summary of Seeding System impact on crop establishment and grain yield 2006-2008

Treatment	2006	2007		2008	
	Yield (t/ha)	Plants/m^2	Grain Yield (t/ha)	Plants/m^2	Yield (t/ha)
16 mm Knife Point + Press Wheel	0.69	99	0.56	38	0.25
16 mm Knife Point + Press Wheel (work shallow)	0.11	97	0.40	30	0.28
Incorporation of seed behind press wheels	0.12	84	0.48	83	0.66
Anderson system	N/A	157	0.37	43	0.45
16 mm Knife Point + Press Wheel + Snake Chains	0.31	102	0.61	25	0.21
Sweeps + Harrows	0.28	101	0.37	55	0.37
16 mm Knife Point + Rotary Harrows	0.18	136	0.46	34	0.25

What does this mean?

Traditional knife point and press wheel systems performed poorly in 2008 compared to higher disturbance systems. This is most likely due to the knife point displacing the small amount of wet soil and allowing dry soil to fall in to the seed furrow. Growers in the Wharminda district are well aware of the need to allow the soil to wet up sufficiently before sowing, however this is balanced against the optimum sowing window, which was rapidly closing in 2008.

Treatments emerging from the optimum depth of 40 mm in 2007 and 2008 were the best yielding treatments sown (Table 2). It is extremely easy to sow too deep in sandy conditions.

The results for each season have been extremely contrasted with different optimum seeding systems each season. The knife point press wheel system performed well in 2006 and 2007, where seeding was achieved with adequate moisture. In 2006 the poorer treatments included the higher disturbance systems, compared to 2008 where these systems yielded well. Sowing seed behind press wheels in 2006 was unsuccessful, yet in 2007 resulted in reasonable yield and was the best performing treatment in 2008. The Anderson system was not included in 2006, however performed well in 2008.

In 2008 a clear advantage was shown for the higher disturbance systems, where as in 2006 and 2007 these systems generally had an establishment and yield penalty. In 2006 and 2007, the trials were sown into good moisture conditions, with 2007 receiving good rainfall post sowing. 2008 was not a wet start, with small showers only partially wetting the sand up.

The results indicate the sporadic nature of the last three seasons and also the frustrations of sowing into water repellent sands. A system that works well one season is not guaranteed success the following season. If growers are faced with a similar situation again as in 2008 where the soil has only partially wetted up, using a broadcast, or sowing behind press wheels system may prove useful. The challenging aspect is balancing the post sowing erosion risk, because if the crop emerges poorly, then it will be exposed to erosion by default.

Funding has been approved for further work on the water repellent sands, which should include options for growers keen to utilise knife points, but also achieve greater mixing of the wetting and non-wetting sands.

Acknowledgements

Tim Ottens for the use of his land for the purposes of the trial. SANTFA, National Landcare Program and SARDI for funding the work. Craig Brands, Jon Hancock, Jess Brands, Leigh Davis and Brenton Spriggs for technical assistance. Thanks to SANTFA sponsors, CASE IH, Flexi-Coil, Agmaster, K-Hart and Atom-Jet for trial equipment. Thanks to Jack Desbiolles from Uni SA for trial equipment assistance.

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No-Till Learning Curve

Michael Bennet

SARDI and SA No-Till Farmers Association, Minnipa Agricultural Centre

Research

Try this yourself now

Tillage system definitions:

Minimum Tillage

One tillage pass prior to sowing.

Direct Drill

One pass seeding with a full cut.

No-Till

One pass seeding with narrow point.

Zero-Till

One pass disc seeding.

Key messages

- **Start with small areas of no-till first to gain experience before sowing the whole farm with no-till.**
- **Regardless of seeding system, sow the seed where the moisture is.**
- **Older machinery can be adapted to no-till without large expense.**
- **Don't work points too deep in stony soils.**
- **Erosion risk should be lower with no-till seeding than full cut seeding.**

Why do the case studies?

No-till sowing methods have been used for over a decade on Eyre Peninsula with varying degrees of success. There are many different reasons why farmers adopt no-till seeding. These include reducing erosion, increasing machinery efficiency, speeding up seeding program, earlier seeding, leaving weed seeds on the soil surface and improving stubble handling. The transition road to no-till can be a bit bumpy and growers can have a steep learning curve with the new management system. The no-till system can take a while to get used to, but it is certainly worth the effort. This article will compare the experiences of three farming businesses who have adopted no-till seeding methods within the last four years.

Sam and Bill Shipard – Penong

Sam and Bill Shipard farm at Penong, running a mixed farming operation. Sam was first interested in no-till because of frustrations with poor seeding depth control achieved by their full cut seeder. The issue of full cut seeding burying weed seeds, particularly brome grass was a critical factor too.

The first foray into no-till was in 2005, when the majority of the program was sown in one pass with points and press wheels. Prior to this, they were sowing the majority of their country direct drill with full cut and prickle chain. Sam found he had greater control over seeding depth across the machine as well as cleaner crops. Their Walker airseeder bar that was used for full cut seeding was fitted with Agmaster points and Agmor boots with press wheels. Sam has found the Agmor boots easy to sow shallow with, but they need adjusting to chase moisture deeper.

During the first four seasons of no-till sowing, a few paddocks have had poor germination due to sowing too shallow and the surface drying out after seeding. After a few days of seeding the boots were adjusted to sow deeper and the germination improved. Sam considers seeding at 1 cm depth to be too shallow in his environment, as it dries out very quickly at seeding time. Typical seeding depth ranges between 3 and 5 cm, depending on where the moisture is.

Grassy weeds such as brome grass, ryegrass and barley grass have been less of a problem than in the past, but Sam is unsure whether that is due to the dry run of seasons, or the change in tillage system. Spear grass, however is one weed which is tougher to kill with knockdown herbicides and no-till than when they had a full cut at seeding.

Perennial weeds were a major concern when first starting out in no-till. Sam still has the option to cultivate patches of hard to kill weeds, however at this stage he has opted to spray them rather than cultivate. Sam has had good success in spraying Lincoln weed and onion weed and some success in controlling Bindii. Saltbush, however remains a tough one to kill.

Sam has found Lincoln weed residue easier to sow through with points than sweeps, as they are easier to get off the tines by lifting out and don't tend to drag as much. Lincoln weed is still sprayed, especially after the 80 mm of rainfall their farm received in December 2008.

Sam has not found the crop germination in hard flats any better or worse under no-till than a full cut seeding system, neither has produced a satisfactory result, but hopefully with the December rain, a better result will be achieved in 2009.

The no-till system allows the Shipards greater flexibility in their system, as they are not as "committed" to sowing certain areas as they had been previously with the ground worked up. It does however require greater vigilance to keep on top of weeds for the coming cropping season.

Running a large cropping program of around 4,000 ha with a single 13.4 m seeder is a logistical challenge. Seeding is a round the clock operation. Despite the extent of the size of the sowing program, the seeder only runs at 8 km/h to maintain even seeding depth across the machine. Sam considers that they spend far too much time on the tractor seeding to be spending even more time working country up. Spraying is a relatively quick operation in comparison. In order to keep a lid on knockdown herbicide costs, they aim to spray as much country as they can while the weeds are small and need less herbicide to provide adequate control. This early spraying is also beneficial to the knockdowns because it gets them out before dust becomes a limiting factor for spraying.

Darren and Brendan Crettenden, Mangalo and Heggaton

Darren and Brendan adopted no-till in 2005. The main motivation was to reduce the wind erosion risk which was plaguing their fragile sands. The Crettendens had been successfully sowing their barley direct drill for 20 years. The operation is run as a mixed farming operation with a greater focus on livestock on the white sandy grass land at Heggaton.

In 2005, a second hand Symonds airseeder was purchased to facilitate no-till on the property. The tines were fitted with heavier springs than the original ones and fitted with primary sales points set on 280 mm row spacing using ARP press wheels. Despite the heavier springs, the tines still struggled to dig deep enough, particularly on heavy ground and when the soil was drying.

In the first season, the crop ended up sown much deeper than originally intended. This resulted in a staggered germination and slow crop growth. In 2006, primary sales flexi-boots were fitted which allowed greater control of seed depth than the original boots offered.

No-till has worked well for sowing cereals, although they are struggling to get a good emergence with lupins. Whether it is the dry seasons recently, or the sowing system, lupins are not germinating as well on water repellent sands as in the past.

One problem with no-till is that the lack of full cut and mixing of soil means that paddocks that are rough from erosion, don't improve over time. These paddocks can be quite a challenge to spray. Although a full cut seeding operation would leave the paddocks more exposed to erosion, it would help flatten out some of the small drift mounds which don't disappear under a knife point sowing regime.

Water repellent sands are a major issue for the Crettendens. Poor germination on deep sands is a major problem, especially when there are significant wind events post-sowing.

They have found great success with clay delving. Results of delving in 2008 saw an increase in yield from 0.6 t/ha where it was un-delved, up to 1.7 t/ha where the delver had been through. Delving is planned for all areas of water repellent soils, but will be undertaken over many years to spread out the financial expense and erosion risk.

In order to save enough sheep feed, some compromises on spray topping were made in 2007. This led to greater levels of grass in the 2008 crop than desirable. In the future a greater emphasis on grass seed set control will be followed through on even if it requires hay to be purchased or cut on farm.

Darren and Brendan will cultivate some pasture paddocks to be sown in 2009 to stimulate a grass weed germination. No-till sowing across the majority of the farm is a great advantage though, as paddocks are not committed for seeding until the sprayer and seeder hit the paddock, so it offers greater flexibility in terms of the amount of land sown each season.

Chris and Bradley Lynch, Mount Cooper

Chris and Bradley have been practicing no-till since 2004, concentrating on their Mt Cooper block but also trialling it elsewhere across soils ranging from red loams, to grey calcareous sandy loams, and sand, with rocky limestone reefs common. The following aims to explain their reasons to go no-till; the advantages it has given them; the challenges they've had with it and how they've tried to best overcome them; where they are currently at with it and what they have settled on. They run a 60/40 crop/pasture ratio.

The move to no-till was made because they wanted to be able to:

1. Increase cropping frequency – or at least have the flexibility to do so.
2. Minimise erosion risk.
3. Retain stubble – for all its proclaimed benefits. Therefore they needed good stubble flow so they used wider row spacings with no finger tine harrows.
4. Tilth below seed for quicker root growth – they suspected a hard pan and hoped to reduce root disease, so they needed higher tine breakout and used knife points.

No till

5. Avoid stimulation of grass seeds, so they wanted to sow in one pass with no harrows.
6. Double shoot as they realised more N would have to come from the bag. They didn't want to pre-drill as that would increase the chance of giving weed seeds a seed bed.
7. Good accurate seed placement in furrows not crests! Better harvesting of water so press wheels were used.

Concerns about moving to a no-till system were:

- Stones causing breakages. They opted for hydraulic tines which are claimed to have softer recoil and can vary the tension infinitely on the go.
- Weeds – no cultivation meant relying on chemicals. They were cautiously confident about this through having seen numerous successful no-till farmer case studies.
- Wider rows and lower SBU (seed bed utilisation). They hoped that any yield penalty associated with going to wider rows might be offset from the advantages which included allowing them to retain more stubble, sow more crop, and be able to use higher rates of pre-emergent herbicides safely (less soil throw). But to improve SBU (for better water use efficiency, lower fertiliser toxicity risk, and better weed competition) they decided to get splitter boots and 100 mm wide 'U' shape press wheels to make the row spacing more like 250 mm instead of 300 mm – thus hoping to get the best of both worlds.

Good things found with no-till compared to their conventional system:

1. Minimal paddock preparation – much less time and thought spent on 'preparing the paddock'; no stubble management or working up. Originally they thought it would be best to cut stubble short, but now believe it is better to keep it as high as possible. This avoids excessive stubble matted in header rows for better herbicide efficacy and crop establishment.
2. Good grass control - can use herbicides effectively and safely. Paddocks have less barley grass in them now, possibly because of the 'take no prisoner' rates of glyphosate used compared to cut rates with the conventional sowing system which may have allowed some plants to survive.
3. Crops seemed to hang on and finish better with lower screenings of no-till crops. They attribute this to wider row spacing leaving more water to finish grain fill, although this may be a trade-off with maximum yield potential.
4. Zero erosion. Soil is not pulverised as much, is not exposed for as long and it is protected by stubble. They have not suffered water erosion even in old gullies.
5. More flexibility – can tighten rotation with minimal paddock preparation and can also make sowing decisions later when the risk of the season is better known.
6. Longer sowing window. They can sow earlier with better tine breakout for hard ground and ability to use more pre-emergent chemical for extra insurance against weeds. Can sow longer when moisture would not be sufficient to germinate a crop with a conventional method.
7. Less dust when spraying knockdown herbicide.
8. Better traffic ability – can get on paddocks quicker after a rain.

Challenges they have found with the no-till system:

1. Slower seeding speed. Despite a wider sowing window, there is more downtime and cannot travel as fast due to draft requirements.
2. Breakages – when working in stone, cast points tended to break and come loose and the flexi sowing boots suffered as well. Their recipe to reduce downtime involves using: pressed steel (DBS) points with rigid (Agmaster) split sowing boots. Over extreme rock they slow down to 5 km/h, reduce tension on tines, and lift them up slightly. If there is a significant part of a paddock that has tight stone they won't hesitate to sow it with their conventional sowing machine.
3. Reliance on chemicals. Significantly higher chemical cost, particularly if extrapolated over the whole farm. Risk of a weed blowout if knockdown chemical doesn't work as well as it should, e.g. if you receive an untimely shower of rain on a freshly sprayed knockdown herbicide. Herbicide resistance is often associated with no-till systems, but of primary concern is weed numbers. They believe that if they aim to keep weed numbers low by using a range of strategies, then there is less chance of a resistance problem. A trial on a bad patch of ryegrass on the property found Trifluralin to still be as useful as alternative chemicals and mixtures (EPFS Summary 2006, p 185).
4. Sowing too shallow. This was a new problem to them, as for years under their conventional system the only problem was sowing too deep. In theory, the flexi boots would be a way of getting seed sown somewhat independent to the tine depth and movement. In practice however, they found the flexi boots flexed too much, especially when fitted with splitter tails. They have now replaced these with rigid, but adjustable boots that give them the flexibility to sow deep or shallow according to where the moisture lies.
5. More stone – digging deeper with knife points results in pulling up more stone which can be frustrating, particularly if the paddock was once stone picked clean.
6. Poor crops on grey soil with no-till. They have had good crops using the no-till system on their red and sand soil types, but have had some disasters on the grey calcareous soils. Grey soils are unforgiving and there is little margin for error with

no-till. They do not understand the exact reasons for the poor performances, but the vigour of crops on grey soils is poor at the best of times (even under the conventional system), which possibly stems from poor phosphorus uptake, slow growing roots and therefore greater root disease. A working prior to sowing with knife points has given less crop disasters. This is possibly due to better sideways tilth, nutrient mineralisation, some level of root disease control, all of which lead to faster growing roots and hence better ability to assimilate moisture and nutrients and grow away from organisms causing root disease. Whatever the reason, they have found it too risky to no-till grey soils coming out of pasture. They also believe that the yield penalty from going to wider rows is amplified on grey soils since the lack of early crop vigour leads to poor water utilisation. Liquid fertilisers may improve crop vigour on grey soils and possibly allow better success with no-till and/or wider row spacings.

Where are Chris and Bradley at now?

Chris and Bradley are confident with using no-till on their red soils and sand soils as well as possibly on some grey soil stubbles. However, a larger part of their cropping program consists of grey soil coming out of pasture and this will be worked once and then sown either conventionally or with knife points. At the moment they see no-till being part of their farming system, but it is not their only farming system. They are comfortable having a 'horses for courses' approach, as it still gives them enough flexibility, reduces their upfront costs on herbicides, and minimises risk of crop failures. No-till is well suited to a continuous cropping system, and currently there are no reliable break crops for our low rainfall grey soils to sustain continuous cropping. Even on the more reliable red soil which has been continuously cropped they have pulled a paddock or two of cropping out to pasture-sheep recently in the advent of sky-rocketing fertiliser costs.

Chris and Bradley acknowledge that a hard plough pan exists and that extra tilth below the seed should allow better root growth, however, their experience has been that working deeper may come at a greater cost via higher diesel use, slower sowing, more inconsistent seed placement, more rock and more breakages which leads to even slower seeding. They have seen some great conventional crops even though they have an apparent plough pan. This leads them to think that of primary importance (at least in their hostile subsoils) is for roots to be able to grow sideways and out into the inter-row to fully utilise moisture and nutrients throughout the top 10 cm.

What does this mean?

All three growers identified seed placement as the key issue governing their initial success. Sowing too shallow was an issue for the Lynch family and an on a smaller scale for the Shipard family. The Crettendens had the opposite issue, with their initial seed boots placing the seed far too deep. Both issues have been overcome with alternative seed boots or adjustments made.

All three growers made a "jump" into no-till, sowing large proportions of their property with no-till in the first season. This can lead to a steep learning curve, however the advantage is that the machine doesn't need to be modified to no-till, or back to full cut during seeding. Starting with small areas for the first few seasons however will help farmers gain confidence to sow greater areas in the following seasons.

Many growers found the 2006 season that was extremely costly for sowing too shallow. The soil dried out quickly after sowing which led to staggered germination. The problems in 2006 were exacerbated by cold weather and frosts which slowed crop growth, combined with hungry mice which eagerly chewed off new seedlings and dug up emerging grain. Mice are an issue that usually rears its head after a good season's grain yields, but certainly a greater challenge in no-till where there is no burial of residual grain or significant disturbance of mouse burrows.

In the first season of no-till it may be useful to try dry sowing some grain when the pressure of seeding time is not as great. This should be contrasted with wet sowing after the break of the season. This may allow some experience to be gained in seed placement and to also monitor soil throw through the seeder and make sure that certain rows of the machine aren't buried too deep nor have excessive herbicide concentrated on the rows. It is difficult to spend time getting setup exactly right at seeding when the optimum seeding window is closing, but if seed placement is not optimised then it can be more costly than delaying the finish of seeding by a day or two.

There is a wealth of farmer experience on Eyre Peninsula for sowing crops using no-till methods. Many growers are more than willing to share their knowledge and skill with others, and often it's only a matter of asking and having a look over the fence.

Acknowledgements

Thanks to the Shipard, Lynch and Crettenden families for their involvement in the no-till case studies. Thanks to the National Landcare Program, SANTFA and SARDI for funding the work.

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Gaining Ground: No-till Adoption on Eyre Peninsula

Rick Llewellyn[1] and Frank D'Emden[2]

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Survey

Key messages

- **Upper and Lower EP now have a level of no-till adoption among the highest in southern Australia with around 85% of growers now using no-till cropping.**
- **Adoption on Western EP is lower and is expected to remain much lower than other regions for the next five years.**
- **Once no-till has been adopted it is usually used on the vast majority of the crop area and it is uncommon for growers to later stop using no-till.**

Why do the study?

The main objectives were to identify no-till adoption trends across southern cropping regions and identify opportunities for RD&E to develop widespread and sustainable use of conservation cropping practices. In this preliminary report only summary statistics and trends relating to Eyre Peninsula are presented.

How was it done?

This study expands on a study of no-till adoption conducted in 2003. This 2008 study was expanded by GRDC, DAFF and SANTFA to include selected cropping regions across WA, SA, Victoria, NSW and Southern Queensland. Using the extensive agricultural database of Solutions Research (a national surveying company), primary cropping decision makers on grain growing farms from across selected grain growing regions were contacted (Eyre Peninsula regions are shown in Table 1). The interviews began in April with call backs completed by early July 2008 resulting in a total of 1172 respondents. Of all potential respondents contacted nationally, 14% refused to complete the survey. A relatively broad definition of no-till seeding was used in the study based around seeding with low soil disturbance (points or discs) and no prior cultivation.

What happened?

The proportion of EP growers who have used no till has increased substantially over the past five years (Table 2 and Figure 1). Around 85% of growers on Lower and Upper EP are now using at least some no-till. Adoption on Western EP remains relatively low and is not expected to increase rapidly based on the relatively high proportion of growers stating that they do not expect to be using no-till in five years' time (Table 2).

Common reasons given for adoption of no-till are shown in Table 3. Soil conservation is a more commonly stated reason for adoption on Upper EP than for the other EP regions.

It is uncommon for growers who adopt no-till to later stop using no-till. Of the Eyre Peninsula regions, less than 5% of growers who have used some no-till have ceased using no-till (data not shown). Disadoption also does not appear likely to be common in the near future, with no current no-till users on EP stating that they will not be using no-till in five years' time.

Extent of use

No-till users tend to use no-till on a very high proportion of their cropping land (Table 4). No-till users on Lower EP are much more likely to use no-till on all of their cropping area than those on Western EP and this difference is expected to increase over the next five years.

Table 1 Regions, respondent numbers and Statistical Local Areas used to define regions

Regions	Respondents	Statistical Local Areas
Lower EP	50	Lower Eyre Peninsula DC; Tumby Bay DC
Upper EP	56	Kimba DC; Cleve DC; Wudinna DC
Western EP	40	Elliston DC; Streaky Bay DC; Ceduna DC
SA Mallee*	90	Loxton-Waikerie; Karoonda East-Murray, Southern Mallee, Coorong

**SA Mallee has been included for comparison with Eyre Peninsula regions*

Table 2 No-till adoption and expected future adoption for EP regions (% of respondents)

Region	Used no-till prior to 2004	Using no-till in 2008	Have used no-till	Do not expect to be using no-till in 5-years' time**
Lower EP	70	84	86	8
Upper EP	71	84	86	9
Western EP	48	55	63	23
Mallee *	50	70	74	12

**SA Mallee has been included for comparison.*
***Percent of growers stating that they would be using no-till in 5 years' time on Lower, Upper, Western and Mallee was 84% ,88%, 60% and 74% respectively; balance was 'don't know'.*

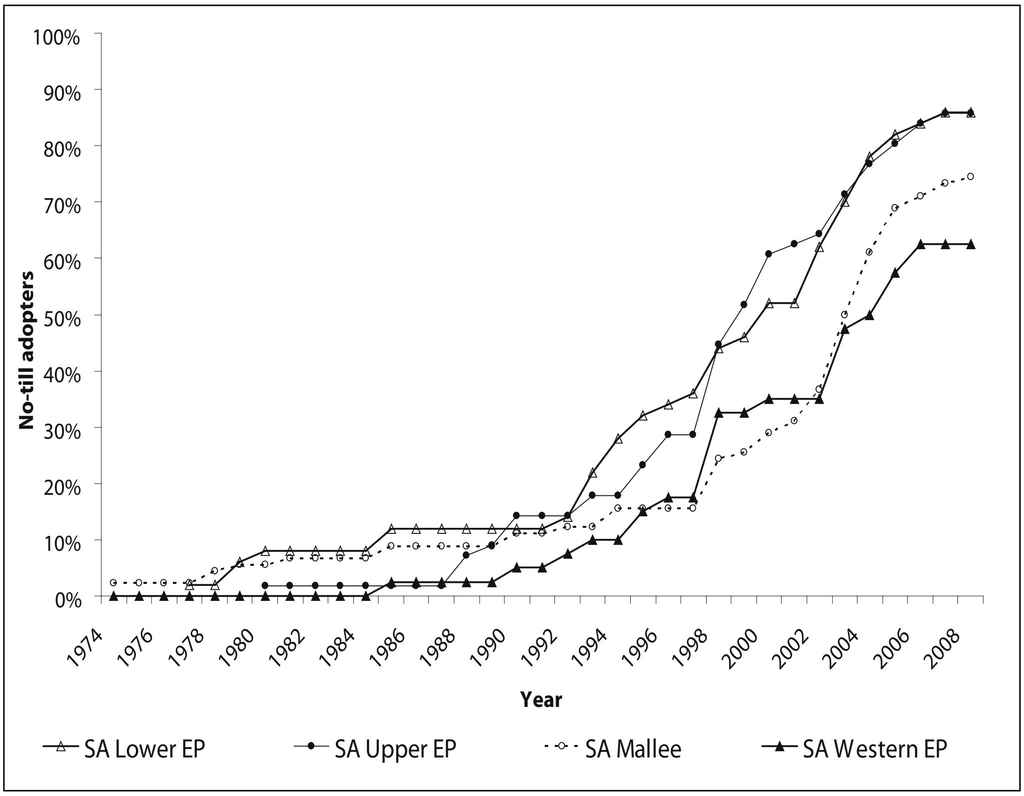

Figure 1 Cumulative proportion of growers who have used no-till by region

No till

Table 3 Common reasons for adopting no-till (% of no-till users citing reason)

	Lower EP	Upper EP	Western EP	Mallee
Decreased fuel and labour costs	32	30	35	32
Improved soil conservation	28	38	24	39
Better soil moisture management	12	11	17	10
Improved soil structure	7	4	12	4

Table 4 Extent of no-till use by no-till adopters in EP regions

Region	Average proportion (%) of crop sown no-till in 2008 (by no-till users)	% of no-till users who have reduced their proportion of crop sown no-till	% of no-till users sowing entire crop no-till 2008	% of no-till users expecting to sow entire crop no-till in 5 years' time
Lower EP	93	7	76	83
Upper EP	88	10	66	65
Western EP	82	8	55	42
SA Mallee*	70	13	40	48

**SA Mallee has been included for comparison.*

No-till adopters on EP have not generally reduced their proportion of crop sown no-till (Table 4). The proportion of no-till users stating that they have generally reduced their proportion of crop sown using no-till (for reasons other than seasonal variation) did not exceed 10%.

The proportion of growers on Lower, Upper, Western and Mallee stating soil conservation as a main reason for increasing the area under no-till was 9%; 40%, 7% and 30% respectively. The most common reasons given for increasing extent of use related to lower fuel and time-labour costs, especially on Western EP.

Growers were also asked if the major rise in glyphosate prices had affected their use of tillage. Over the entire national study of 1172 grain growers, 21% of no-till users reported increased use of tillage as a result of increased glyphosate prices (72% reporting no change and 7% reporting less tillage), compared to 32% of non-users reporting increased use of tillage as a result of increased glyphosate prices (61% reporting no change and 7% reporting less tillage).

Of the EP regions, only Western EP suggested a net shift to increased tillage as a result of glyphosate price increases (18% of growers stating increased tillage; 8% stating reduced tillage). In the SA Mallee, the response was greater with 29% stating increased tillage (7% less tillage).

What does this mean?

- Rapid gains in adoption over the last 10 years have resulted in the Upper and Lower EP regions now having no-till adoption rates well above the national average.
- No-till adoption on Upper and Lower EP is on a path to plateau at levels around 90%.
- Once no-till is adopted it is generally used on a very high proportion of the crop area and very few growers stop using no-till after they first adopt.
- Based on current trends Western EP appears to be following not only a slower, but lower, adoption trajectory than most other cropping regions in this national study.
- The substantial glyphosate price increase was likely to have influenced decisions to increase tillage use on Western EP but does not appear to have had a net effect on Upper and Lower EP where extensive no-till adoption is more established.
- In addition to the preliminary results presented here, further analyses on the full set of results are being conducted.

Acknowledgements

Funding for the SA No-till Farmers Association/Conservation Agriculture Alliance of Australia and New Zealand initiative that has supported this study has come from the Grains Research and Development Corporation, Department Agriculture, Fisheries and Forestry, SA No-till Farmers Association, WA No-till Farmers Association and CSIRO. Gratefully acknowledged is the input from Greg Butler & Michael Bennet (SANTFA), Patricia Hill & David Gobbett (CSIRO Sustainable Ecosystems) and the time offered by the farmer participants. SANTFA through the National Landcare Program provided funds for additional surveying on Eyre Peninsula.

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Farming Systems

Research

Responsive Farming Using Variable Rate Sowing

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Key messages

- **The profitability of VRT, excluding capital outlay, was similar to or better than standard practice over the last two dry seasons at Minnipa.**
- **The long term impacts of reducing inputs and the extent of any yield reductions in above average seasons is yet to be determined.**

Why do the trial?

Now more than ever it is important that our low rainfall farming systems are low risk and flexible or responsive - paddock inputs need to balance the best agronomic and economic advice with the need to ensure reliable outcomes at low cost. In this way, risk can be managed over variable soil types and with unpredictable finishes to seasons.

Variable rate technology (VRT) offers farmers the ability to adjust sowing and fertiliser rates 'on the go' during the seeding process, allowing the opportunity to change inputs according to the production capability of different paddock zones or soil types. Previous research investigating how crop canopy size affects crop growth and yield on different soil types has shown that in a good season (2005) reduced canopy size reduced yield on all soil types (EPFS Summary 2005, pp 25-26), while in a poor season (2006) grain yield increased with smaller canopies on heavy/shallow soil types (EPFS Summary 2006, pp 91-92). In 2007, another poor season, VRT was as profitable as standard practice.

To further evaluate variable rate sowing as a tool to improve paddock profitability in low rainfall upper EP farming systems, a broadacre trial was resown, and a new trial was established in 2008.

How was it done?

A paddock, N2, at Minnipa Agricultural Centre was zoned in 2007 using a combination of yield, EM38 and elevation maps to produce three distinct production zones. Seed and fertiliser inputs were tailored for two zones (low input for poor zone and high input for the good zone) and compared against standard practice inputs (suitable for the medium zone) (Table 2). The paddock was sown to alternating strips of the three input regimes across the whole paddock which allowed comparison of all treatments in each paddock zone. The paddock was sown with

Almost ready

Location
Minnipa
Minnipa Agricultural Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2008 Total: 251 mm
2008 GSR: 139 mm

Yield
Potential: 1.21 t/ha (W)
Actual: 0.04 – 0.65 t/ha

Paddock History
N1
2007: Wheat
2006: Wheat
2005: Pasture
N2
2007: Wheat
2006: Pasture
2005: Barley

Soil Type
Sandy loam to sandy clay loam

Continues

Soil test
Outlined in article

Diseases
Rhizoctonia

Plot size
Paddock trial

Yield Limiting Factors
Very dry start and finish to season

Environmental Impacts
Soil Health
Soil Nutrients: needs to be monitored

Resource Efficiency
Energy/fuel use: standard
Greenhouse gas emissions (CO_2, NO_2, methane): standard

Social/Practice
Time (hrs): standard
Clash with other farming operations: nil
Labour requirements: standard

Economic
Infrastructure/operating inputs: VRT technology
Cost of adoption risk: low if improving returns

Correll wheat in 2007. In 2008, the paddock was resown to the same treatments across the paddock, this time with Wyalkatchem wheat, sown on 21 May.

Another paddock, N1, was segregated into three zones in 2008 using the same method. This time seed and fertiliser inputs were lowered to reflect farmer input rates across upper EP which have tended to decrease in response to the tough economic situation and the poorer seasons being experienced at present. Nil fertiliser, half rate of fertiliser and standard practice treatments were sown across the paddock, again in alternating strips across all the paddock zones (Table 3). The paddock was also sown with Wyalkatchem wheat on 21 May.

Both paddocks received standard weed management across all zones.

For each paddock, early crop growth, Rhizoctonia infection, maturity dry matter, harvest indices and soil water measurements were taken. The paddocks were harvested using the MAC header (Case IH 2366) with yield data recorded by the yield monitor. Grain samples were collected and analysed for quality. Gross margin analyses of treatments within each zone were used to compare different system approaches.

Table 1 Soil characterisation of sieved soils for zones in paddocks N2 and N1, Minnipa 2008

Paddock	N2			N1		
	Good	Medium	Poor	Good	Medium	Poor
Colwell P 0-10 cm (mg/kg)	22	29	46	28	36	48
Mineral N 0-60 cm (kg/ha)	121	128	152	226	275	242
Depth to soil $CaCO_3$ > 25% (cm)	20	40	20	60	40	20
Depth to B > 15 mg/kg (cm)	80	80	20	100	60	80
Depth to Cl > 1000 mg/kg (cm)	>120	>80	40	80	60	40

What happened?

Soil in the poor zones of both paddocks are characterised by very high reserves of N and P in the surface layer that have accumulated from years of fertiliser application exceeding plant requirements, but with very hostile levels of boron and salt not far below (Table 1). These subsoil constraints will always restrict productivity except in those few wet years when frequent rainfall events will leach some of the hostile elements deeper and the crop will be able to perform well on the moist upper layers anyhow. The good zones had lower reserves of N and P but the root zone is much deeper (no hostile B or salt until 80 cm or more below the surface).

In N2, grain yields were very low across all treatments and zones, with the crop failing on the poor soil type (Table 2). Grain yield was not influenced by changing from standard to low inputs in any zone, but appears to have been penalised slightly by increasing the nitrogen inputs (high input).

Overall grain quality was poor with high screenings and poor or borderline test weight for all treatments, segregating grain from good and medium soil treatments into AGP1, and from poor soil into AUW1. Protein was high for all treatments.

The good zone generated the highest gross income per hectare (or incurred the least loss) followed by the medium zone, while the poor zone suffered income losses for all treatments. As 2008 was not a season to be able to capitalise on extra nitrogen inputs, the combined loss of grain yield and higher input costs penalised the gross income of high input treatments in all zones. Low input treatments had the lowest input costs, hence were able to achieve a better gross income than the standard inputs on the good and medium soil types.

In N1, grain yields were higher than those of N2 (Table 3). Grain yields were highest for the good zone, while the medium and poor zone achieved similar, lower yields. There was little response to phosphorus or nitrogen in the dry year, as grain yield did not change markedly when fertiliser was halved or reduced to nil.

Grain quality was generally good for all treatments with high protein, screenings under 5% and adequate test weight (>74 kg/hL) and achieved APW1. The exception was the medium soil, nil and standard input treatments which had higher screenings segregating the grain to AGP1.

Table 2 Sowing inputs, grain yield and quality and gross income for VRT treatments in N2 at Minnipa, 2008

Paddock Zone	Paddock Area (%)	Treatment	Seed Rate (kg/ha)	DAP (kg/ha)	Urea (kg/ha)	Grain Yield (t/ha)	Protein (%)	Screenings (%)	Gross Income[1] ($/ha)
Good	32	High input	50	60	50	0.36	14.9	8.9	-12
		Standard	50	60		0.42	14.5	9.0	35
		Low input	35	40		0.40	14.5	8.8	52
Medium	42	High input	50	60	50	0.25	15.2	6.8	-38
		Standard	50	60		0.28	14.9	6.1	3
		Low input	35	40		0.29	15.2	6.6	26
Poor	26	High input	50	60	50	0.04	14.9	10.8	-90
		Standard	50	60		0.05	14.8	11.4	-56
		Low input	35	40		0.05	14.8	12.5	-34

[1]Gross income is yield x price less seed and fertiliser costs delivered cash at Wudinna, December 2008.

Table 3 Sowing inputs, grain yield and quality and gross income for VRT treatments in N1 at Minnipa, 2008

Paddock Zone	Paddock Area (%)	Treatment	Seed Rate (kg/ha)	DAP (kg/ha)	Grain Yield (t/ha)	Protein (%)	Screenings (%)	Gross Income[1] ($/ha)
Good	32	Standard	50	60	0.65	14.7	2.9	103
		Low input	50	30	0.64	14.7	2.8	132
		Nil input	35	nil	0.59	14.2	3.3	142
Medium	42	Standard	50	60	0.40	15.7	5.5	31
		Low input	50	30	0.38	15.1	3.6	64
		Nil input	35	nil	0.38	15.5	6.3	79
Poor	26	Standard	50	60	0.39	15.0	3.1	37
		Low input	50	30	0.40	14.6	2.9	68
		Nil input	35	nil	0.36	14.6	3.8	82

[1]Gross income is yield x price less seed and fertiliser costs delivered cash at Wudinna, December 2008.

Reflecting grain yield, gross income was highest for the good soil type treatments, while the medium and poor zones achieved similar gross incomes for each treatment. Reducing inputs increased gross income across all zones as input costs were reduced.

Table 5 presents a comparison of the gross incomes if the different sowing treatments were applied across the whole paddock with the two VRT combinations. The prescription rates prescribed for N2 cannot be compared with N1 as they have different aims. The VRT – 'Go for gold!' aim for N2 is to re-distribute inputs to maximise potential of the different soil zones while maintaining a similar input cost to a standard fertiliser rate across the whole paddock. In N1, the VRT – 'Go for gold!' aim is to increase overall profitability by reducing inputs on areas with poorer yield potential. The VRT – 'Hold the gold!' treatment for both paddocks reduces inputs on all zones, an approach to minimise risk.

For N2, the profitability of VRT – 'Go for gold!' approach was slightly less than the standard blanket approach in 2008. The VRT – 'Hold the gold!' approach however was much more profitable achieving $16/ha more gross income. The most profitable option would have been to use low inputs across the whole paddock (Table 5).

In N1 both VRT treatments were more profitable than applying standard inputs across the paddock in 2008. However, if fertiliser inputs were lowered or even reduced to nil, gross income would have been maximised. The season was so dry that the crop had low nutritional requirements and would have accessed some residual nutrition left by crops in previous years.

If the poor zone of each paddock was easily partitioned and had

Table 4 Treatments applied to VRT gross income analysis for N2 and N1, Minnipa 2008

Paddock zone	N2		N1	
	VRT – Go for gold!	VRT – Hold the gold!	VRT – Go for gold!	VRT – Hold the gold!
Good	high	standard	standard	low
Medium	standard	low	low	nil
Poor	low	low	nil	nil

Table 5 Comparison of the gross income of different sowing regimes vs prescription rates across whole paddocks at Minnipa, 2008

N2		N1	
Treatment	Gross Income[1] ($/ha)	Treatment	Gross Income[1] ($/ha)
High input	-43	Standard	72
Standard	-2	Low input	102
Low input	19	Nil input	114
VRT – Go for gold!	-11	VRT – Go for gold!	90
VRT – Hold the gold!	14	VRT – Hold the gold!	109

[1]Gross income is a cumulative sum of yield x price (with quality adjustments) less seed and fertiliser costs delivered to cash pool at Wudinna, 2008, for treatment performance in each zone.

not been cropped in 2008, N2 would have made $22/ha across the paddock and N1 would have made $88/ha. This would have been a good outcome for N2 which suffered losses on the poor ground with all cropping treatments. However, in N1, where the poor and medium zones performed similarly and had positive gross incomes, this approach would have incurred income loss compared with sowing the paddock with nil or low inputs, or the 'VRT-Hold the gold!' treatment.

What does this mean?

VRT has been as good, or better than a standard input, blanket approach to sowing a wheat crop at Minnipa over the past two very dry seasons.

In such dry seasons though, the most profitable approach was to reduce inputs across the whole of both paddocks as this reduced cost with very little impact on grain yield. Limiting fertiliser inputs, particularly on the higher yielding areas of the paddock, may however limit grain yield and profitability in better seasons and is not sustainable in the long term.

The practical VRT approach – 'Hold the gold!' offers farmers the opportunity to reduce inputs on poorer performing areas of paddocks where nutrition is generally higher because of years of fertiliser application exceeding plant requirements, but still applies some inputs on the better areas of paddocks to ensure that grain yield is maintained. This approach aims to sustain overall grain yield across whole paddocks with a reduced level of risk.

Determining inputs for different soil zones is dependent on knowing where these zones are, knowing what the production potential is for different zones of paddocks (e.g. soil type, presence of subsoil constraints, nutrient availability) and then balancing this with the business financial position, perception of the season and personal approach to risk.

If a paddock zone has consistently poor crop production and thereby carries higher risk, it may be beneficial to separate it from the cropping rotation of the paddock and either not crop it at all, or if the business has livestock, sow with something that will improve it's feedbase value such as a permanent pasture species or a low cost cereal. The decision will depend on the shape and orientation of the zone with respect to sowing direction and location within the paddock, and ability to manage weeds on that area.

Additional research is required to determine the extent of any yield penalty when seed and fertiliser rates are reduced in average to above average seasons. It is intended that these treatments are applied to these paddocks for the next few years to track the long term impact of changing inputs, how the different zones respond to different treatments in different seasons, and how the overall economics stack up.

Acknowledgements

Special thanks to Brenton Spriggs and Trent Brace for their assistance sowing, managing and harvesting the trials, and to Kaye Brace and Amanda Cook for their help towards monitoring the trials. Thanks also to Brendan Frischke of gps-Ag for yield map data analysis.

GRDC Grains Research & Development Corporation

Wide Row Sowing on EP in 2008

Alison Frischke
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Research

Searching for answers

Location
Minnipa
Minnipa Agricultural Centre

Rainfall
Av Annual: 325mm
Av GSR: 242mm
2008 Total: 251mm
2008 GSR: 139mm

Yield
Potential: 1.61 t/ha (W)
Actual: 0.38 t/ha (W)

Paddock History
2007: Wheat
2006: Medic pasture

Soil Type
Red sandy loam

Soil test
Nitrate nitrogen: 146 kg N/ha
Phosphorus: 46 mg/kg

Plot size
Broadacre: sowing pass, 250 m long

Yield Limiting Factors
Very dry season

Location
Koongawa
Dean Willmott

Rainfall
Av Annual: 300 mm
Av GSR: 225 mm
2008 Total: 211 mm
2008 GSR: 133 mm

Yield
Potential: 1.20 t/ha (W)
Actual: 0.2-1.2 t/ha

Continues

Key messages

- **After three seasons of trialling wide row sowing in cereals on Eyre Peninsula, there has generally not been a yield penalty when sowing rates have been lowered in conjunction with increasing sowing width.**
- **Unfortunately, finishes to the seasons have been extremely poor. A different pattern of rainfall is (still!) needed to make sound conclusions about wide row or skip row sowing in EP farming systems across a wide range of season types.**
- **Lowering sowing rate alone may be a lower risk option, with benefits to weed management from the narrow rows.**

Why do the trial?

Wide row sowing coupled with lower seeding rates is a potential tool to manage soil water use in paddocks that run the risk of haying off. This is particularly relevant for cereal crops on central and eastern Eyre Peninsula following medic or a grain legume. These paddocks have high soil nitrogen levels, which encourages vigorous early cereal growth and thus increases the risk of haying off with a poor finish to the season.

The logic is that if adequate moisture falls early in the season and is stored in the soil profile, root growth under wide row sowing will initially move downwards leaving a zone of relatively wetter soil conserved in the inter-row soil (below the zone of evaporation) that can be accessed by roots later in the season when roots grow out laterally. This is particularly beneficial in a season where late winter and/or spring rain fails to deliver (EPFS Summary 2007, p 163).

Wide row sowing has been trialled on EP for two seasons with varying results. Both seasons received very good opening rains, suitable for wide row sowing, however despite promising visual signs at flowering (wide row crops were fresher) the season finishes were so harsh that the benefit of slowed maturity by wide row sowing were negated and yield differences were limited (EPFS Summary 2007, p 166).

Further trials were sown at MAC and by several farmers in 2008 to see what a different season could make to evaluating wide row sowing on Eyre Peninsula.

How was it done?

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Paddock S6w was resown to wide row sowing in 2008. In 2007 the paddock had soil nitrate levels of 146 kg N/ha and a Colwell P level of 46 ppm. Given that yields that season were only 0.7 t/ha it was considered that the paddock would still have potential to hay off given dry spring conditions.

The trial was resown with the same five treatments; two row spacings – 30 cm (normal spacing) and 60 cm (double spacing), at either 30 kg/ha or 60 kg/ha seeding rates. For the 60 cm spacing, all tines were working but only every second seeding. A fifth treatment used the 60 cm spacing with 30 kg/ha of seed but every second tine was removed, i.e. sowing was at 60 cm row spacing with no inter-row working. The crop was sown to Maritime barley, with 50 kg/ha of 18:20 applied with the seed for all treatments, on 28 May.

As in 2007, the bar used was a 30 – tine Horwood Bagshaw PSS seeder

Paddock History
2006: Grass free medic pasture
2005: Wheat
2004: Wheat

Soil Type
Loamy sand to red sandy clay loam

Diseases
Low levels crown rot

Plot size
Paddock length sown (2 km) but small plots reapt (20 m) x 3 reps

Yield Limiting Factors
Moderate start with very hard finish

Location
Butler
Mark Fitzgerald
Butler Ag Bureau

Rainfall
Av Annual: 325 mm
Av GSR: 220 mm
2008 Total: 265 mm
2008 GSR: 197 mm

Yield
Potential: 1.8 t/ha (W)
Actual: 1.35 t/ha

Paddock History
2007: Wheat
2006: Peas
2005: Barley

Soil Type
Sandy loam over clay

Diseases
Low levels crown rot

Plot size
Broadacre strips 350 m long

Yield Limiting Factors
Limited starting moisture with very dry finish

Resource Efficiency
Energy/fuel use: wide rows likely to be lower – less tines to pull

Social/Practice
Time (hrs): same
Clash with other farming operations: same
Labour requirements: 1.5 hours extra to modify machine

Economic
Infrastructure/operating inputs: nil
Cost of adoption risk: could be a risk if it's a bumper season
Market stability risk: not applicable

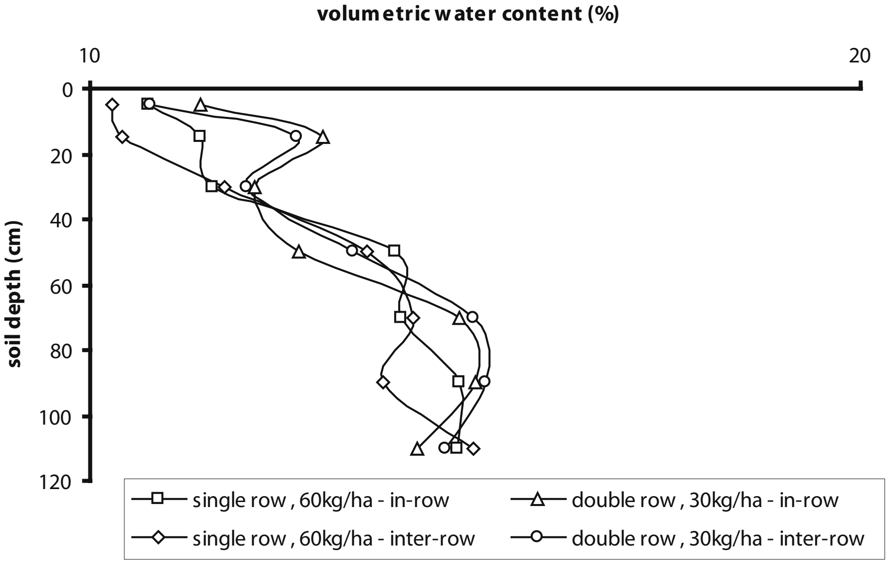

Figure 1 Soil moisture in-row and inter-row of single row @ 60 kg/ha and double row @ 30 kg/ha treatments at sowing at Minnipa 2008

with 30 cm row spacing. Treatments were sown as replicated broadacre strips 250 m long. Treatments were monitored for soil moisture at sowing to measure any differences in residual moisture between treatments from the 2007 season. Grain was harvested by the farm header in strips 200 m long, and yield calculated by a yield monitor. Grain samples were taken for quality tests.

Koongawa – Dean Willmott

After some success with skip row sowing in 2007 at Koongawa, Dean chose another paddock which grew a medic pasture in 2007 following two cereal crops to trial skip row sowing in 2008. The paddock was variable in soil type; ranging from a loamy sand (light) on the rises to a heavier red sandy clay loam (loam) tending towards the flats.

Dean's seeder was a DBS bar on 30 cm spacing. To change tine configuration to skip row, Dean and Richard (Dean's workman) only had to release the oil pressure to the tines, lift appropriate units up and secure with a hand-made stopper. They lifted just the back row of tines which was both easy and gave them the configuration they wanted; every third tyne lifted to give two rows 30 cm apart with 60 cm to the next pair. The change took about 45 minutes for two men.

Single runs the length of the paddock were sown on 6 May with Clearfield Stilleto wheat in combinations of either 30 or 60 kg/ha with 10:22 @ 25 kg/ha. Sowing configurations of either standard sowing (30 cm spacing) or skip row were replicated four times. A Clearfield variety was chosen to ensure weed control could be achieved easily in all row treatments.

A small plot harvester was used to reap 40 m lengths from each treatment for the two soil types, light and loam as defined above. Grain samples were collected for quality analysis.

Butler – Mark Fitzgerald

At Butler, Mark decided to try wider rows because he was getting fed up with the run of dry seasons, and wanted to experiment with growing crops that may finish better in a short growing season, as well as have a bureau activity that had something positive to focus on. After discussing the trial with Ed Hunt, they felt that dropping the sowing rate would achieve most of the advantage they were looking for, so different sowing rates were also incorporated into the trial. Mark approached the Cleve Ag School, and all the calibrating, row spacing alteration, and sowing of most of the plots were done by year 11 students, and incorporated into their studies. Mark said it was great to have the school involved, as the Ag Bureau members got to interact directly with the next generation of farmers.

As the trial progressed Mark started to wonder if the results could shed a little light on some other areas such as the economics of cropping, i.e. if there are half as many tines in the ground under wide rows, there should be savings in fuel, plus half as many tines/points/boots/press wheels to purchase and maintain. Also, a given horsepower could pull a much larger machine, or a smaller tractor could pull an existing seeder, reducing the capital cost per hectare or per tonne of grain. If such savings are possible, a slight yield reduction by adopting wider rows could be offset and the net result could be more profitable.

Another aspect of the trial was to have a 'play' with inter row spraying with a single shielded sprayer manually steered, which proved to be easier than first thought. The effectiveness of the shielded sprayer was terrific, but the real issue is accurate, reliable steering, whether by GPS, Robocrop, mechanical, or 'live' (the human factor!).

The paddock was sown on 1–3 April to combinations of 25, 50 and 75 cm row spacing, with seeding rates of 30, 45 and 60 kg of Wyalkatchem wheat. All treatments were sown with 32:10 @ 20 kg/ha, and replicated four times.

Dry matter production for all treatments and replicates, and soil moistures for selected treatments from two replicates were measured late August. The trial was harvested using Mark's header and grain weighed in a weigh trailer. Grain samples were collected for quality analysis.

What happened?

For all wide row trial sites, seasonal rainfall was well below average. Koongawa was the only site receiving some useful early rains, but like all the other sites, Koongawa suffered from very dry conditions after mid August.

Table 1 Maritime barley grown with different sowing rates and spacings in S6W MAC, 2008

Sowing Treatment	Grain Yield (t/ha)	Screenings (%)	Test Weight (kg/hL)	Gross Income ($/ha)[1]
Single row, 60 kg/ha	0.38	17.4 c	69	32 b
Single row, 30 kg/ha	0.38	19.5 bc	69	37 a
Double row, 60 kg/ha, worked between rows	0.36	28.0 a	68	27 c
Double row, 30 kg/ha, worked between rows	0.40	21.5 b	69	39 a
Double row, 30 kg/ha	0.37	18.5 c	69	38 a
LSD (P=0.05)	*ns*	*2.8*	*ns*	*3*

[1]Gross income is yield x price (with quality adjustments) less seed costs delivered to cash pool on 1 December 2008, Wudinna. Plots with screenings above 15% and 25% were downgraded to Feed 2 and Feed 3 respectively. $300/t used for seed value.

Table 2 Performance of Clearfield Stilleto wheat grown on light soil with different sowing rates and spacings at Koongawa, 2008

Sowing Rate (kg/ha)	Grain Yield (t/ha)		Protein (%)		Screenings (%)	
	Single row	Skip row	Single row	Skip row	Single row	Skip row
30	1.20 a	0.91 b	14.0	15.0	3.7	4.0
60	0.93 b	0.86 b	14.8	15.1	3.8	3.8
LSD (P=0.05)	*0.15*		*ns*		*ns*	

Table 3 Gross income of Clearfield Stilleto grown on light soil with different sowing rates and spacings at Koongawa, 2008

Sowing Rate (kg/ha)	Gross income ($/ha)[1]		*Average*
	Single row	Skip row	
30	308	227	*267*
60	236	204	*220*
Average	*272*	*216*	*LSD (P=0.05) 30*

[1]Gross income is yield x price (with quality adjustments) less seed costs delivered to cash pool on 1 December Kimba, 2008. No protein adjustments (all above standards), plots with screenings above 5% were downgraded to AGP1. $350/t used for seed value.

Table 4 Performance of Clearfield Stilleto wheat grown on loam soil with different sowing rates and spacings at Koongawa, 2008

Sowing Rate (kg/ha)	Grain Yield (t/ha)		Protein (%)		Screenings (%)	
	Single row	Skip row	Single row	Skip row	Single row	Skip row
30	0.19	0.30	16.2 b	16.6 a	1.9 b	2.7 a
60	0.22	0.24	16.6 a	16.4 ab	1.5 b	1.7 b
LSD (P=0.05)	*ns*		*0.3*		*0.7*	

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At sowing, on average there was 73 mm of plant available water in the profile (Figure 1). Soil moisture in double row spacings was slightly higher in-row (extra 2 mm) and inter-row (extra 6 mm) than single row spacing.

Given that there was little rainfall pre-seeding and winter and spring rainfall was quite low, soil moistures were not taken at anthesis or maturity.

Although the potential yield was 1.61 t/ha, the paddock only averaged 0.38 t/ha. Despite the small amount of extra moisture at sowing in the double row 30 kg/ha treatment, all treatments yielded the same. Screenings were generally high, pushing all treatments to Feed 2, but were lower for both single row and the double row 30 kg/ha treatments. Test weight was adequate for all treatments.

Grain income was very low due to the poor grain yields, and similar for all treatments. However, gross income was highest and the same for all three treatments with 30 kg/ha sowing rate; the income advantage coming from half the seed input cost ($9 for 30 kg/ha vs $18 for 60 kg/ha).

Koongawa – Dean Willmott

On the light soil, the single row spacing out-yielded skip row treatments, and 30 kg/ha sowing rate out-yielded 60 kg/ha; the combination of single row sowing with 30 kg/ha seed out-yielded all other treatments. There were no quality advantages between sowing regimes, with high protein for all treatments and no difference in screenings (Table 2). Test weights were all above 74 kg/hL.

Gross income in turn was highest for single row treatments and 30 kg/ha sowing rate treatments, with the single row, 30 kg/ha combination earning the greatest income (Table 3).

On the loam there was a difference between sowing widths with single row averaging 0.21 t/ha and skip row averaging 0.27 t/ha (Table 4). Protein levels were high and screenings low for all sowing regimes. Test weights were all above 74 kg/hL.

Gross income was higher on average for the skip row and 30 kg/ha treatments (Table 5).

Table 5 Gross income of Clearfield Stilleto wheat grown on loam soil with different sowing rates and spacings at Koongawa, 2008

Sowing Rate (kg/ha)	Gross income ($/ha)[1]		*Average*
	Single row	Skip row	
30	39	67	*53*
60	37	42	*40*
Average	*38*	*54*	*LSD (P=0.05) 13*

[1]Gross income is yield x price (with quality adjustments) less seed costs delivered to cash pool on 1 December Kimba, 2008. No protein adjustments (all above standards). $350/t used for seed value.

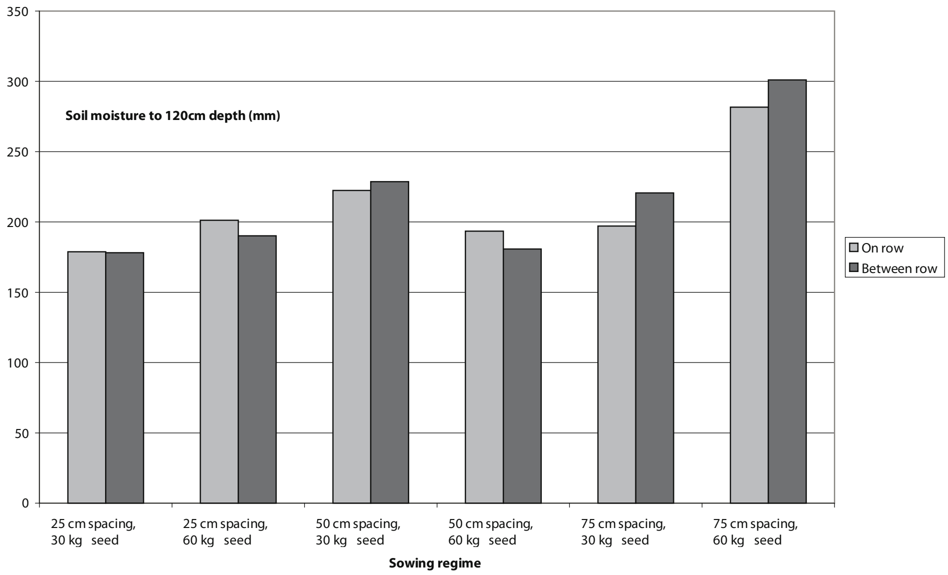

Figure 2 Soil moisture in-row and inter-row of 25 cm vs 75 cm treatments with 30 vs 60 kg/ha seed at Butler, late August 2008

Butler – Mark Fitzgerald

The crop emerged in the third week of April. Given the moisture stress the crop was experiencing, the crop pushed through to maturity quickly with stem elongation occurring in mid June, and the 75 cm sowing with 60 kg/ha seed pushed a head out first; the treatment with the greatest plant density competition in the row.

Greater weed densities were present between the wide rows. There was good stubble cover across the paddock, even between the 75 cm rows. More incorporation occurred between 25 cm spacings but there was still adequate cover.

Dry matter production was highest for the 25 cm spacing treatments. There was no effect of sowing rate on dry matter production.

Only the 75 cm spacing with 60 kg/ha of seed appeared to have more moisture in the row and inter-row, followed by 50 cm spacing with 30 kg/ha seed. Unfortunately, due to limited resources, we chose not to sample the 50 cm spacing with 45kg/ha seed – the highest yielding treatment! (Table 6).

Grain yield was highest for the combination of 45 kg/ha sowing rate with 50 cm row spacing. The season was such that the standard row spacing or doubling of row spacing, and a moderate cut in sowing rate favoured grain yield

Table 6 Grain yield and screenings % of Wyalkatchem wheat grown with different sowing rates and row spacings at Butler, 2008

Row spacing (cm)	Grain Yield (t/ha)			Average	Screenings (%)	Dry Matter (t/ha)
	Sowing rate (kg/ha)					
	30	*45*	*60*			
25	1.35 bc	1.39 b	1.34 bcd	*1.36 a*	1.9	2.26
50	1.30 bcd	1.55 a	1.23 cd	*1.36 a*	2.8	1.69
75	1.21 d	1.31 bcd	1.24 cd	*1.25 b*	3.4	1.34
Average	*1.29 b*	*1.42 a*	*1.27 b*			
LSD (P=0.05)	*0.13*			*0.08*	*0.4*	*0.13*

Table 7 Gross income % of Wyalkatchem wheat grown with different sowing rates and row spacings at Butler, 2008

Row spacing (cm)	Gross income[1] ($/ha)		
	Sowing rate (kg/ha)		
	30	45	60
10	357	363	344
20	342	385	312
30	320	361	315
LSD (P=0.05)	*ns*		

[1]Gross income is yield x price (with quality adjustments) less seed costs delivered to cash pool on 1 December Pt Neill, 2008. No protein or screenings adjustments (all above or within standards). $350/t used for seed value.

and screenings. A drop to 30 kg/ha sowing rate penalised grain yield.

There was no difference in grain protein between treatments, all averaging 11.5%. Screenings increased as row spacing increased reflecting the increased competition for moisture between plants in the row.

A sowing rate of 45 kg/ha gave the highest gross income for each row spacing.

What does this mean?

The likelihood of wide rows giving a yield advantage in cereals over conventional spacing appears to be very dependent on the ability of soil to capture early season rainfall, and for plants to be able to capitalise on that stored moisture later in the season in a year when rainfall is limited.

The 2006 and 2007 seasons both began with good opening rains giving the opportunity to store soil moisture in the inter-row, however conditions later in the season were so harsh that the fresher, less mature wide row crops were unable to capitalise on their position to finish better than conventionally sown crops.

Unfortunately 2008 did not give us an opportunity to store moisture at the beginning of the season, and also lacked good winter rains that may have been a second opportunity for storage. Skip rows at Koongawa on the loam at 30 kg/ha of seed and Butler at 50 cm with 45 kg/ha of seed had benefits over single rows at the same sowing rates, while at Minnipa and Koongawa sand, simply dropping the sowing rate had the same or greater benefit to crop performance compared with the wider row option. Again, in general it can be noted, that by doubling the row spacing and dropping the sowing rate, that grain yields have been the same, if not better, than conventional sowing spacings and sowing rates, depending on soil type.

Early results from research (using rain-out shelters and irrigation to avoid drought conditions!) conducted in Western Australia in 2008 by PhD student Hayden Sprigg are indicating that narrow rows out performed the wide rows under both rainfall regimes (including the high summer rain/ droughted winter treatment). One of Paul Blackwell's (Dept of Ag, WA) findings is that the crop has to be sown early to make use of all the inter-row moisture, but Hayden's trial was sown late, again supporting evidence that wide rows only out-

Farming Systems

yield narrow rows when a critical set of conditions are satisfied.

Wider rows coupled with lower sowing rates are generally holding their own in seasons that have been really harsh, and have not satisfied wide row sowing success (as defined by Paul Blackwell's work). To make a conclusion about their place in EP farming systems would still be premature after the poor 2008 season – the run of seasons we have had is unusual and evaluation is still needed with a different pattern of rainfall. So bring on a better year! However, it would be fair to say that the criteria for success seem to be quite tight, so whether they occur often enough to make the approach viable in the long term is becoming doubtful. However, as Dean agrees, in the meantime a lower seeding rate on normal row spacing may be as effective, and create less of a weed problem.

Acknowledgements

Special thanks to Mark Klante, Dean Willmott, Mark Fitzgerald, for their enthusiasm in organising and managing the trials. Mark thanks the Butler Ag Bureau for their support, as well as EP Farming Systems and LEADA for their help and enthusiasm.

Thanks also to Brenton Spriggs, Trent Brace, Kempy, Cleve Area School year 11 agriculture students, Wade Shepperd, Michael Bennet, Cathy Paterson, Kieran Wauchope and Neil Cordon for their help towards sowing, managing and harvesting the trials.

Funding from GRDC and the SA Government Drought Response team for resources to collect the data is much appreciated.

Row Direction, Row Spacing and Stubble Cover Effects

Jon Hancock and Alison Frischke
SARDI, Minnipa Agricultural Centre

Research

Key messages

- **Mean grain yield has been 8.4% higher with north-south over east-west sowing over the last four seasons.**
- **Grain yield has been higher with narrower row spacings when stubble has been retained.**

Why do the trial?

Since 2005, a trial has been running at Minnipa to investigate the effects of row direction, row spacing and stubble cover on grain yield and quality. North-south sowing has improved grain yields in the past and the trial was sown to wheat in 2008 to determine whether a yield response to north-south sowing could be maintained for yet another season.

How was it done?

A trial at Minnipa Agricultural Centre has been sown with identical treatments from 2005 to 2008. The trial has three treatments, sowing direction (north-south vs east-west), row spacing (18, 23 and 30 cm) and stubble cover (retained vs burnt). Crop type has changed over the time of the trial with Yitpi wheat sown in 2005, Wyalkatchem wheat sown in 2006 and Maritime barley sown in 2007. In 2008, the trial was sown to 60 kg/ha of Clearfield Janz with 60 kg/ha of 18:20 on 23 May. The trial was sprayed with 900 mL/ha of Midas on 22 July.

Plots were harvested at maturity and grain samples were retained for quality analysis.

What happened?

To improve the robustness of data analysis, grain and grain quality data were analysed across all years to determine the effects of row direction, row spacing and stubble over the long term. In each year of the trial, there was a positive grain yield response to north-south sowing which culminated in an overall increase in grain yield of 8.3% over east-west sowing (Table 1). Grain yield increased with the narrower row spacings (18 and 23 cm) only when stubble was retained (Table 2).

Grain protein declined from 11.2% with E-W sowing to 10.8% with N-S sowing. There was also an interaction between row spacing and stubble retention which reflect differences in grain yield with a protein penalty for higher yields.

Grain screenings were not affected by any treatment and averaged 1.9% over the time of the trial.

Try this yourself now

Location
Minnipa
Minnipa Agricultural Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2008 Total: 251 mm
2008 GSR: 139 mm

Yield
Potential: 1.21 t/ha (W)
Actual: up to 0.91 t/ha

Paddock History
2007: Barley
2006: Wheat
2005: Wheat

Soil
Red sandy loam

Table 1 Effect of row direction on grain yield (t/ha) at Minnipa, 2005-2008

Year	Row Direction		Yield Advantage of Sowing N-S	
	N-S	E-W	(kg/ha)	(%)
2005	1.50	1.43	71	5.0
2006	0.31	0.25	64	25.7
2007	1.26	1.16	99	8.6
2008	0.91	0.84	71	8.5
2005 - 2008	0.99 a	0.92 b	76	8.3
LSD (P=0.05) (2005-2008)	0.06			

Table 2 Effect of row spacing and stubble on mean grain yield (t/ha) at Minnipa, 2005-2008

Row Spacing (cm)	Stubble Retained	Stubble Burnt
18	1.03 a	0.95 b
23	1.00 a	0.92 b
30	0.91 b	0.93 b
LSD (P=0.05)	*0.05*	

Table 3 Effect of row spacing and stubble on mean grain protein (%) at Minnipa, 2005-2008

Row Spacing (cm)	Stubble Retained	Stubble Burnt
18	10.8 bc	11.3 a
23	10.7 c	11.1 ab
30	10.9 bc	10.9 bc
LSD (P=0.05)	*0.3*	

What does this mean?

Data from all years of the trial has shown a positive yield advantage from sowing in a north-south direction. The mean grain yield increase of 8.3% with north-south sowing over east-west sowing, or 4.2% over a 50/50 mix of north-south and east-west sowing (i.e. round and round) makes north-south sowing the preferred sowing direction. Growers need to assess how this fits in with other factors such as paddock orientation and the orientation of sand hills when making the decision of which direction to sow.

The benefit of stubble retention to grain yield has also been demonstrated in this trial and is encouraging for growers in stubble retained, no-till systems. The benefits of stubble in reducing soil evaporation, increasing organic matter and promoting disease suppression are well documented. The decline in yield with 30 cm row spacing in the stubble retained system shows that wider row spacings must be used for other reasons than just grain yield, for example increased herbicide safety, better trash flow and reduced power requirements.

Acknowledgements

We would like to thank Wade Shepperd for technical assistance and Chris Dyson for assistance with statistical data analysis. CLEARFIELD and Midas are registered trademarks of BASF used under licence by Nufarm Australia Limited.

GRDC Grains Research & Development Corporation

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Responsive Farming Using Wheat Agronomy

Alison Frischke[1], Haydn Kuchel[2] and Wade Shepperd[1]
[1]SARDI, Minnipa Agricultural Centre, [2]Australian Grain Technologies, Adelaide

Research

Key messages

- **The early maturing, and locally adapted variety Axe, showed the greatest average gross return due to its high yield, large grain and AH quality.**
- **Matching wheat variety selection with sowing date and soil type can help to maximise returns.**
- **The mid growing season variety Wyalkatchem performed well if sown early, while Axe performed well against the other varieties if sown later, facing a shorter growing season. Although Gladius was not the highest yielding variety, it did show the most stable yield over the different soil type and sowing date treatments.**
- **Screenings were affected by the harsh spring for earlier sown varieties as more yield potential had been set, however the extra grain yield achieved meant that gross income remained higher. Correll suffered from poor test weight, compromising gross income.**

Why do the trial?

It is critical in a region of low and variable rainfall, and a time of high input costs and fluctuating commodity prices, that WUE is maximised to get the best possible yield and economic outcome for a crop. Early maturing wheat lines perform well under low rainfall situations in field trials. Trials were established to see how two of these varieties compare with later maturing lines, and how they respond to soil type, sowing time and sowing rate, i.e. to evaluate how they can best fit into the farming system.

How was it done?

Paddock N1 at Minnipa Agricultural Centre was zoned using yield and EM maps to produce three distinct production zones which were called poor, medium and good. The medium (sandy clay loam) and good (loamy sand) soil types were chosen for soil type comparisons.

Small plot trials were established on three sowing dates (mid May, end May, mid June) to compare two very early maturing wheat lines, Axe (well adapted to SA) and Young (less adapted to SA), against the widely grown and early to mid season variety Wyalkatchem and two newer varieties Correll (mid to late season) and Gladius (mid season). All varieties were sown at two plant densities (30 and 60 kg/ha). Plots received typical weed management.

The soils at each site were characterised, soil moisture was taken at sowing and maturity, and grain samples collected for yield and quality (good soil only). Unfortunately a flock of galahs took a liking to the earliest maturing heads on the medium soil trial, so plots had to be scored for head damage at harvest.

What happened?

The first rain for the season was 28 April with 12 mm rain. The first time of sowing treatment (TOS1) wasn't sown until 14 May so the surface had dried out a little, but was followed by 16 mm over 16–18 May. Unfortunately TOS1 plots on the good soil failed due to machinery error. Time of sowing two (TOS2) was sown ahead of forecasted rain two weeks later on 27 May – however, that rain never eventuated – the story of 2008! The

Almost ready

Location
Minnipa
Minnipa Agricultural Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2008 Total: 251 mm
2008 GSR: 139 mm

Yield
Potential: 1.21 t/ha (W)
Actual: 0.1-1.0 t/ha

Paddock History
2007: Wheat
2006: Wheat

Soil Type
Sandy loam to sandy clay loam

Soil test
Presented

Diseases
Moderate Rhizoctonia

Plot size
5 m x 1.48 m

Yield Limiting Factors
Very dry season

Water Use
Water use efficiency: early sowing better
Runoff potential: nil

Resource Efficiency
Energy/fuel use: standard
Greenhouse gas emissions (CO_2, NO_2, methane): standard

Social/Practice
Time (hrs): standard
Clash with other farming operations: nil
Labour requirements: standard

Economic
Infrastructure/operating inputs: standard
Cost of adoption risk: standard
Market stability risk: standard

third time of sowing (TOS3) was another two weeks later on 12 June after 5 mm rain over 9-11 June. Very little rain was received until the end of June which brought 6 mm. July brought 41 mm, but was made up of largely light showers from 20 out of 31 days, and likewise August had 34 mm, again from showers from 14 of 31 days – the greatest rainfall event for the two months being 9 mm. Over July and August there were six frosts and lots of wind meaning there would have been a lot of evaporative losses. And then it didn't bother to rain much at all after that until harvest time!

Throughout the moisture stressed season the trial on the lighter, good soil type grew faster and looked fresher, e.g. at the start of July, the last time of sowing, TOS3, on the medium soil was barely up whereas there had been pretty good establishment on the good soil.

By the start of August, on the medium soil type there was a lot of medic in the mid May sown plots, whereas other plots were cleaner as there had been more time for medic germination before plots were sown allowing an opportunity for control before sowing. Medic was not an issue on the good soil.

Visually, there was a distinct time of sowing effect on the medium soil with mid May sowing looking the best, followed by end May then mid June sown plots. Axe had its flag leaf out on mid May sown plots. At the same time on the good soil, there were no flag leaves out. Axe appeared the tallest, followed by Correll then Gladius. Wyalkatchem looked yellow and behind in development. Again the time of sowing effect was evident.

Sowing time and variety had the greatest impact on development on both soil types. Visual scores of medium TOS1 were more advanced, progressing to less advanced on TOS3, and Axe was better than all other varieties which were about the same stage. On the good soil, TOS2 was better than TOS3, and again Axe was more advanced than other varieties, with Correll the least advanced.

Grain yield for the medium soil type trial is presented on Tables 1 and 2.

Medium soil

Grain yield data was adjusted to account for galah damage to give the results presented below (Table 1).

Table 1 Effect of sowing time and varieties on grain yield, medium soil, N1 MAC, 2008

Sowing time	Grain yield of wheat varieties (t/ha)				
	Axe	Correll	Gladius	Wyalkatchem	Young
TOS1	0.35 cd	0.56 a	0.45 b	0.53 a	0.41 bc
TOS2	0.54 a	0.36 cd	0.34 cd	0.34 cd	0.35 cd
TOS3	0.30 d	0.14 ef	0.20 ef	0.13 f	0.21 e
Average	*0.40*	*0.35*	*0.34*	*0.34*	*0.32*
LSD (P=0.05)	*0.08*				

Table 2 Effect of sowing time and sowing rate on grain yield, medium soil, N1 MAC, 2008

Sowing time	Sowing rate (kg/ha)		*Average*
	30	60	
TOS1	0.41 b	0.51 a	*0.46*
TOS2	0.37 b	0.40 b	*0.39*
TOS3	0.21 c	0.18 c	*0.20*
Average	*0.33*	*0.36*	
LSD (P=0.05)	*0.08*		

Table 3 Interaction of sowing time x varieties effects on grain yield, good soil, N1 MAC, 2008

Sowing time	Grain yield of wheat varieties (t/ha)				
	Axe	Correll	Gladius	Wyalkatchem	Young
TOS2	0.90 ab	0.78 c	0.81 bc	0.93 a	0.74 cd
TOS3	0.66 d	0.49 ef	0.57 e	0.47 f	0.48 f
Average	*0.78*	*0.64*	*0.69*	*0.70*	*0.61*
LSD (P=0.05)	*0.085*				

Table 4 Sowing time x sowing rate effects on grain yield, good soil, N1 MAC, 2008

Sowing time	Sowing rate (kg/ha)		*Average*
	30	60	
TOS2	0.82	0.85	*0.83*
TOS3	0.52	0.55	*0.53*
Average	*0.67*	*0.70*	
LSD (P=0.05)	*ns*		

Table 5 Quality, yield and gross income data for wheat varieties sown with different sowing times and sowing rates, good soil, N1 MAC, 2008

Variety	Seeding Rate (kg/ha)										
		30					60				
	TOS	Yield (t/ha)	Screenings (%)	Test Weight (kg/hL)	Grade	Gross Income[1] ($/ha)	Yield (t/ha)	Screenings (%)	Test Weight (kg/hL)	Grade	Gross Income[1] ($/ha)
Axe	2	0.89	4.6	74.8	H1	231	0.90	4.1	74.8	H1	223
Correll		0.82	6.7	69.3	AGP1	187	0.74	10.0	68.4	AGP1	157
Gladius		0.80	4.6	74.9	H1	206	0.83	5.1	72.5	AGP1	179
Wyalkatchem		0.90	4.2	73.8	AGP1	206	0.96	3.5	74.8	APW1	230
Young		0.68	9.4	75.1	AGP1	153	0.80	10.8	74.7	AUW1	140
Axe	3	0.62	3.3	76.2	H1	158	0.70	3.7	77.0	H1	169
Correll		0.48	0.1	71.4	AGP1	105	0.54	2.1	72.5	AGP1	109
Gladius		0.58	1.2	77.0	H1	147	0.56	2.0	75.6	H1	131
Wyalkatchem		0.46	3.3	74.5	APW1	110	0.47	0	77.0	APW1	102
Young		0.48	3.1	81.0	H1	120	0.48	8.0	78.6	AGP1	95

[1]Gross income is yield x price (with quality adjustments) less seed costs delivered to cash pool on 1 December 2008, Wudinna. Grades were adjusted for each variety according to screenings and test weight. $350/t used for seed value.

If we break it down, for the earliest sown varieties, the longer growing season varieties Correll and Wyalkatchem were highest yielding. As the sowing time got later with TOS2 and TOS3 (and invariably drier), Axe out-yielded other varieties.

The greatest yield advantage across varieties was the combination of early sowing (TOS1) with 60 kg/ha seed. There was no benefit by dropping sowing rate as the season got later.

Good soil

Similar results were achieved on the good soil, whereby sowing time and variety affected yield, however sowing rate had no effect on this soil type (averages shown in Tables 3 and 4).

Axe and Wyalkatchem were the highest yielding varieties at TOS2 followed by Gladius. For TOS3, Axe was again the highest yielding variety followed by Gladius, but this time Wyalkatchem did not yield as well.

All varieties achieved protein contents above 15%. Screenings were highest for the earlier sown TOS2 crops compared with TOS3 (Table 5), a reflection of plants setting more yield potential early before severe moisture stress during grain fill. Test weights were adequate for all varieties except Correll, which fell below 74 kg/hL, which was also experienced by many growers in the district.

At TOS2, end of May, gross income was highest for Axe at 30 kg/ha sowing rate, and Axe and Wyalkatchem at 60 kg/ha sowing rate. Delaying sowing by two weeks until mid June meant that Axe became the highest gross income earner at both sowing rates, followed by Gladius; the two shorter growing season varieties.

What does this mean?

These trials clearly demonstrate the importance of early sowing, particularly in a season which received little rainfall pre-sowing. On the loam soil, longer growing season varieties were best in the early sowing treatment, while a shorter season variety was best at later sowing dates. Unfortunately the early sowing time was lost on the lighter soil, but similar trends were expected.

The mid growing season variety Wyalkatchem performed well if sown early, while Axe performed well against the other varieties if sown later, facing a shorter growing season. Although Gladius was not the highest yielding variety, it did show the most stable yield over the different soil type and sowing date treatments.

Grain yields reflected the plant available water on the two soil types, with the light soil achieving yields at least double that of the loam. On a heavier loam capillary action continues to draw moisture to the top layers of soil where it is subject to evaporation, whereas on sandier soils there is little capillary action, and the sandy surface effectively acts as a layer of mulch.

Screenings were affected by the harsh spring for earlier sown varieties as more yield potential had been set, however the extra grain yield achieved meant that gross income remained higher. Correll suffered from poor test weight, compromising gross income.

These preliminary results show that matching variety selection with sowing date and soil type can help to maximise profits.

Acknowledgements

We thank GRDC for funding this work, Leigh Davis and Cathy Paterson for help harvesting the trials, and Amanda Cook for assistance with the article.

GRDC Grains Research & Development Corporation

Farming Systems

Responsive Farming Using Early Maturing Barley

Alison Frischke[1], Jason Eglinton[2], Stewart Coventry[2] and Wade Shepperd[1]

[1]SARDI, Minnipa Agricultural Centre, [2]University of Adelaide, Waite

Key messages

- **WI3806/1 was the best yielding variety compared with lines selected for short growing season and also with released varieties in 2008, a drought year.**
- **WI3806/1 is a sister line to Fleet, but Fleet was selected for release due to slightly better net blotch resistance and higher yield potential under more favourable conditions. WI3806/1 has exhibited better yield under low rainfall conditions and also very stable grain size.**
- **Varieties with the characteristics of WI3806/1 may not maximise profit in good seasons, but they are likely to maintain cash flow (and perhaps some profitability) even under extreme moisture stress. Growing interest in using specialised varieties as part of a risk management program for cropping enterprises may support the release of such varieties in the future.**

Why do the trial?

In environments where drought occurs with high frequency, early maturing varieties are an important management option and offer more flexibility for the farming system. Early maturing varieties also offer an option for more diverse weed management by late sowing in selected paddocks. A risk-minimisation approach which breeds for reliable performance in 'bad conditions' runs counter to the current approach of breeding for high yield potential in good conditions, with the aim of growing enough in the good seasons to 'sit out' the bad ones. In environments of the upper EP where yield is rarely above 3 t/ha, having such a variety to capitalise on early moisture and provide a 'bankable' base yield even in extremely tough growing conditions is important. This option may also be more advantageous than growing feed quality crops with such low returns for delivering feed on the EP. The disadvantages of early maturing varieties are the increased risk of reproductive frost damage, however with recent advances in frost tolerance in barley this could be reduced in the future. Currently there are a number of early maturing lines with putative frost tolerance in the pipeline. A barley variety specifically adapted to low rainfall environments will provide farmers more choice in their farming systems.

A trial was sown to compare early maturing barley lines selected from field trials to compare with other adapted and current varieties. The lines ranged in maturity from equivalent to Schooner through to significantly earlier than Keel. This was the only trial of its type in the state.

How was it done?

A medium (sandy clay loam) soil zone in paddock N1, Minnipa Agricultural Centre, was chosen to represent a typical district soil type.

A small plot trial was sown on 27 May to compare the early maturing barley lines with other released varieties. Lines were sown at 50 kg/ha with 50 kg/ha of 18:20. Plots were replicated three times.

The soil was characterised, soil moisture was taken at sowing and maturity (data not shown), maturity scored on 21 August and 5 September, and grain samples collected for yield and quality. Unfortunately a flock of galahs took a liking to the earliest maturing barley heads, so plots had to be scored for head damage at harvest.

Almost ready

Location
Minnipa
Minnipa Agricultural Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2008 Total: 251 mm
2008 GSR: 139 mm

Yield
Potential: 1.6 t/ha (B)
Actual: under 0.5 t/ha

Paddock History
2007: Wheat
2006: Wheat

Soil Type
Sandy clay loam

Plot size
5 m x 1.48 m

Yield Limiting Factors
Very dry season

Water Use
Water use efficiency: improved by some breeding lines selected for early maturity

What happened?

The trial was sown ahead of rain forecasted on 27 May with very little subsoil moisture – however, that rain never eventuated – the story of 2008! The next rain was not until two weeks later on 10 June which only brought 5 mm, resulting in patchy emergence. Very little rain was received until the end of June which brought six mm. July brought 41 mm, but was made of largely light showers from

Table 1 Development and grain yield of early maturing barley lines cf. released varieties, MAC 2008

Variety	Development 21 August*	Development 5 September*	Grain Yield** (t/ha)	Significance***
WI3806/1	E	F	0.50	I.........
Yagan	F	H	0.34	.I........
WI4215	E	F	0.32	.I........
WI4438	E	F	0.29	.II.......
WI4506	E	H	0.28	.III......
Keel	F	F	0.26	.IIII.....
VB0704	E	F	0.22	..IIII....
BX04S; 092MM1_2-004	E	F	0.20	..IIIII...
Hindmarsh	E	F	0.20	..IIIII...
WI4025	F	H	0.17	....III...
Fleet	E	F	0.16	.....III..
WI4501	H	H	0.14	.....IIII.
Schooner	E	F	0.12	IIII
Unicorn	F	H	0.12	IIII
WI4468	H	H	0.11	IIII
BX03S; 198DMS-263	H	H	0.08	III
WI4495	H	H	0.06	II
WI4496	H	H	0.05	I
WI4441	H	H	0.04	I
LSD (P = 0.05)			*0.09*	

**Maturity score: E=early, before flag leaf emergence, F = flag leaf emerged, H = head emerged*
***Grain yields adjusted using a galah damage score as a covariate*
**** Treatments with the same line are not significantly different.*

Farming Systems

20 out of 31 days, and likewise August had 34 mm, again from showers from 14 of 31 days – the greatest rainfall event for the two months being 9 mm. Over July and August there were six frosts and lots of wind meaning evaporative losses would have been high. And then it didn't bother to rain much at all after that until harvest time!

The season was incredibly harsh and subsequently grain yield of the varieties was very low, with some plots essentially failing. A nearby farm paddock sown with Fleet and Hindmarsh the same day suffered the same fate; Fleet failed, while some seed only was recovered from Hindmarsh.

In the trial, WI3806/1 was the outstanding variety yielding 0.5 t/ha (Table 1). Yagan was the second top yielding variety, equal with WI4215, WI4438 and WI4506, and followed closely by Keel. WI4438 is a malting quality line derived from Commander that has also performed well in breeder's trials in 2008. The test line WI4025 performed exceptionally well in breeder's trials in 2004 and 2006 and it attracted significant attention at the MAC field day, however it did not withstand the extreme conditions of 2008.

The relative maturity of the lines is shown in Table 1 and it is notable that the 'ultra-early' maturing lines performed well below expectations. It is likely that the frost events in August caused significant damage to these lines during the sensitive flowering period. This highlights the risk of very early varieties avoiding dry conditions in late spring but having greater exposure to frost events. It may be that the maturity of WI3806/1 represents an appropriate balance of these risks for upper Eyre Peninsula.

What does this mean?

2008 was the worst year on record for Minnipa. The fact that grain was produced at all in the top yielding varieties highlights their adaptation to dry seasons and ability to tolerate moisture stress. The trial will be sown again in 2009 to evaluate the performance of the varieties in another season.

WI3806/1 is a sister line to Fleet (pedigree = Mundah/Keel/Barque) and was subject to extensive field evaluation leading to the final commercial release. Fleet was selected due to slightly better net blotch resistance and higher yield potential under more favourable conditions. WI3806/1 is slightly earlier in maturity (although not as early as Keel) and exhibited significantly better yield under low rainfall conditions and very stable grain size. Varieties with the characteristics of WI3806/1 will not maximise profit in good seasons because other varieties will outperform them, but they are likely to maintain cash flow (and perhaps some profitability) even under extreme moisture stress. In the 2008 season WI3806/1 would have doubled the gross income of current varieties grown. Growing interest in using varieties as part of a risk management program for cropping enterprises may support the release of such varieties in the future.

Acknowledgements

We thank GRDC for funding this work.

GRDC Grains Research & Development Corporation

How Much Soil Moisture is Conserved During a Summer Fallow?

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Research

Almost ready

Location
Minnipa
Minnipa Agricultural Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2008 Total: 251 mm
2008 GSR: 139 mm
2007 Total: 286 mm
2007 GSR: 141 mm

Yield
Potential 2008: 1.2 t/ha (W)
Potential 2007: 1.4 t/ha

Soil Type
Constrained red sandy clay loam termed 'MAC heavy'
Less-constrained red light sandy clay loam termed 'MAC loam'

Key messages

- **Stored soil moisture at sowing can play an important role in reducing the risk of winter crop failure. Soils with a large plant available water capacity or 'bucket' have the greatest potential to store moisture.**
- **Much of the rain that falls during summer is lost through soil evaporation. Any large pre-Christmas rainfall events are inevitably lost on shallow soils where there is little follow-up rainfall.**
- **Rainfall events closest to sowing time are most likely to benefit the winter crop.**
- **Using APSIM to model the water balance from 1950-2008 for a typical summer-fallow/winter cereal system at Minnipa Agricultural Centre showed that fallow efficiency (the efficiency of capturing and storing rainfall) averaged 15–17% for heavy and loam soils respectively.**
- **Investment in weed control applications should take account of the potential for soil moisture capture as influenced by the timing of rainfall and the plant available water capacity or yield potential of the soil.**

Why do the trial?

There are perennial questions from farmers about the value of summer rainfall events, the potential for storing this moisture for the following crop and under what conditions should weed control be considered. Given the current price of inputs and the run of seasons with dry finishes, knowing the potential for summer rainfall to be turned into grain will help make better decisions about spending money on weed control. Where soil moisture is unlikely to be stored for later use by a crop, weed control costs may be reduced or avoided provided that the uncontrolled weeds do not cause trouble with later sowing operations, crop emergence or seed bank build-ups.

Knowing the size of the soil "bucket", or the amount of plant available water a soil can store is a critical piece of information that can help determine yield potential. Where this information is available spatially, soils that have higher potential can be managed differently from poorer performing areas with different management applications that may include fertiliser and sowing rates as well as summer-autumn fallow weed control.

How was it done?

Soil characterisation

Jon Hancock and colleagues have recently characterised more than 40 soils from on-farm sites and trial locations across the upper Eyre Peninsula. This information can be used to calculate plant available water capacity (PAWC), and yield potential through crop-soil modelling studies. This information is available through the Australian Soils Resource Information System (ASRIS) national soils database (http://www.asris.csiro.au) and via the APSOIL database (www.apsru.gov.au).

In brief, soil characterisation defines the plant available water capacity (PAWC) by determining the drained upper limit (DUL) (or field capacity) using the pond technique described by Dalgliesh and Foale (1998) and the crop lower limit (CLL) using the soil moisture measured at the harvest of various crops. The lowest soil moisture value as measured over a range of crops and seasons is the most reliable indicator of CLL. Rooting depth is also an important parameter and is determined by the observation of roots down the soil profile as well as the presence of chemical constraints such as boron (B), chloride (Cl) or electrical conductivity (EC1:5). In soil layers where the concentration of B exceeds 15 mg/kg (Cartwright et al. 1986), Cl exceeds 1000 mg/kg and/or EC exceeds 1 dS/m (regarded as very high to extreme soil salinity rating for clay contents 10–40 % by Shaw 1999, Table 8.5, p 136) root proliferation and plant water uptake is restricted. In addition to these chemical constraints, many Eyre Peninsula soils may have shallow rock layers further reducing rooting depth.

In this paper, two soil profiles representative of 'heavy' (shallow and constrained) and 'loam' (deeper and less-constrained) soils from the Minnipa Agricultural Centre were made the focus of this study.

Modelling the water balance

APSIM is a crop-soil model that simulates the major processes that occur while growing crops and pastures. These include the nitrogen and carbon dynamics in soil, soil water balance (including evaporation, drainage, leaching and runoff), crop growth and interactions with daily temperature, radiation and rainfall. APSIM requires accurate information about soil type (water holding capacity, rooting depth, chemical or physical constraints, carbon and nitrogen content), information about crop variety, planting time, fertiliser application and daily climate. Recent work done by the authors has shown that APSIM can be a reliable and accurate model for simulating crop x soil type interactions provided it is parameterised correctly (EPFS Summary 2007, pp 95-99).

Using APSIM (V6.1) and the long term weather records for a heavy and loam soil at the Minnipa Agricultural Centre, simulations of the period 1950 to 2008 were undertaken to model the water balance and crop growth of a typical winter-spring grown wheat system with a weed free summer-autumn fallow. In the simulations, soil N and organic matter at sowing were reset to the same amount each year so that there was no effect of residue build up or SOM decline over time. Soil mineral N at sowing was assumed to be 186 kg N/ha to 60 cm on the heavy soil and 170 kg N/ha to 120 cm on the loam soil representing a very high soil N situation. High available N contents in the profiles of the 'constrained' heavy soils or following phases of volunteer medic pastures is not uncommon and means that the simulated wheat crops are generally unconstrained by N limitation. Wheat (cv. Wyalkatchem) was sown between 20 April and 30 June and sowing within this period was triggered by 10 mm rain over three days. Harvesting took place when the wheat was ripe (generally November) and the fallow period was defined as the time between harvest one year and sowing the following year. The effects of rainfall, evaporation, drainage (insignificant) and water extraction by the crops were all calculated by the model. The efficiency of capturing rainfall into stored soil moisture during a fallow is termed 'fallow efficiency' and was calculated by: Fallow efficiency (%) = [(soil water at sowing- soil water at previous harvest)/rainfall *100]

What happened?

Soil profile characterisations

Two soil profiles from the Minnipa Agricultural Centre were characterised, namely a constrained red sandy clay loam, referred to as MAC heavy (Figure 1a) with a PAWC 46 mm (for cereal) and a less-constrained red light sandy clay loam, referred to as MAC loam (Figure 1b) with a PAWC of 93 mm. At depths below 40 cm, the MAC heavy soil contains chloride concentrations > 1000 ppm, electrical conductivity > 8.7 mS/cm and 46% rock material by volume. It is therefore a hostile environment for root growth and restricts the rooting depth and ability of crops and pastures to extract soil moisture. Typically for these 'heavy' soil types organic carbon is relatively high (1.4%) and the soil profile can contain large amounts of mineral nitrogen that crops have been unable to access. The higher organic carbon content is due to the higher clay content providing some protection of the organic matter. The rooting depth of the MAC loam is approximately 60 cm with similar toxic concentrations of salt below this depth as displayed in the MAC heavy soils.

Water storage efficiency of summer-autumn fallows

The time between harvest and the following crop is termed the summer-autumn fallow period where there is an opportunity to maximise the capture of any rainfall. At Minnipa, there is on average 126 mm of rainfall received between harvest and sowing, which represents about 38% of the average annual rainfall (Table 1). In each year of the simulation, the fallow period is determined by the date of harvest and the date of sowing the following year. Using APSIM to simulate a weed free fallow during summer-autumn from 1950 to 2008, there was on average an increase of 14 or 16 mm of water stored in the profile for a MAC heavy or MAC loam soil type, respectively. Over the 58 years, fallow efficiency was calculated from the simulated data to average between 15 and 17% with little difference found between the two soil types.

Looking at the two most recent summer-autumn fallow periods 2006/07 and 2007/08, rainfall exceeded the long term average (Table 1). Fallow efficiency was substantially higher during 2006/07 compared with both the long term average. This was due to much of the rain falling close to the winter cropping period as demonstrated in Figure 2a (2006/07) and Figure 2b (2007/08) for the MAC heavy soil. Except in the case of substantial rainfall near harvest, soil moisture is generally near or below (due to air-drying in the topsoil) CLL at harvest. As summer rainfall events

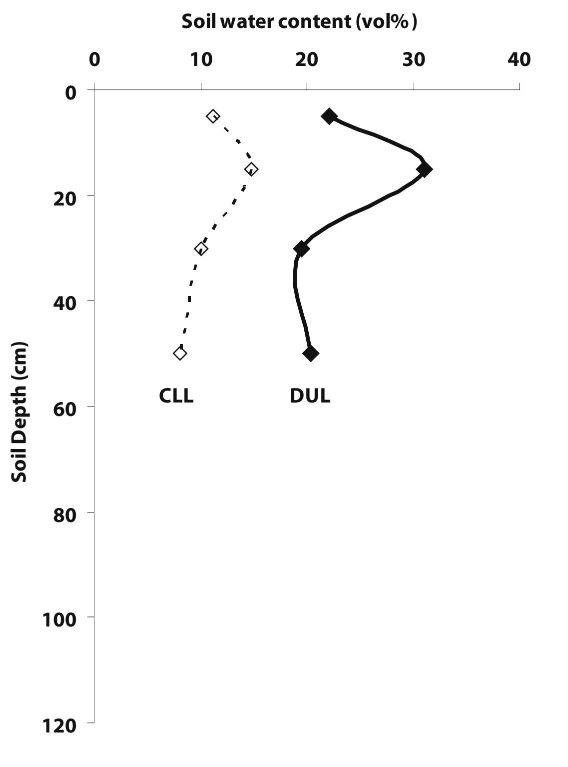

Figure 1a PAWC (wheat) = 46 mm (0-40 cm rooting depth)

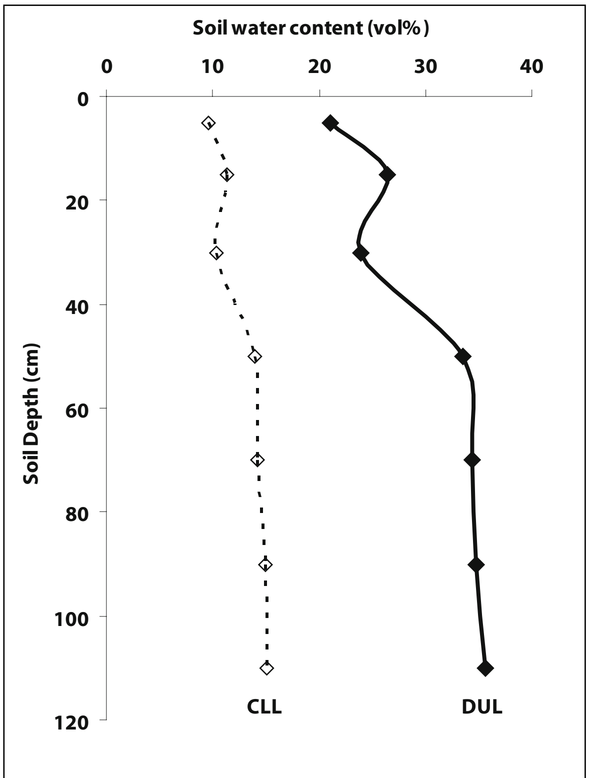

Figure 1b PAWC (wheat) = 93 mm (0-60 cm rooting depth)

Figure 1 The plant available water capacity (PAWC) obtained by characterising the crop lower limit (CLL) for several crop types and drained upper limit (DUL) of a constrained red sandy clay loam termed 'MAC heavy' (Figure 1a) and a less-constrained red light sandy clay loam termed 'MAC loam' (Figure 1b) at the Minnipa Agricultural Centre

are intermittent, soil moisture generally returns to CLL or below unless there is follow-up rainfall.

The impact of soil bucket size and sowing moisture on long term yield

While there is no doubt about the over-riding influence that in-crop rainfall has on crop performance, soil moisture at sowing does influence the risk profile, or the spread of yields that may be achieved. Compared with a dry soil profile at sowing, a 50% or 100% full profile on either soil type increased average yield and reduced the spread of yields around the average. On the dry EP environment, it is rare that a full or even half full profile could occur at sowing on a MAC loam, so the most realistic scenario to examine is the weed-free fallow treatment which does outperform the 0% sowing moisture scenario in most seasons. Compared to a dry profile at sowing, grain yield was on average 615 kg/ha higher with a fallow phase on a MAC heavy (Figure 3a) and 660 kg/ha higher on a MAC loam (Figure 3b).

Table 1 Rainfall (mm), change in soil water between harvest and sowing and calculated fallow efficiency for summer-autumn fallows simulated between 1950 and 2008 at the Minnipa Agricultural Centre

	Average	2006/07	2007/08
Rainfall	126	152	141
Δ SW MAC Heavy	17	50	21
Δ SW MAC Loam	21	57	23
Fallow Efficiency % Heavy	15	33	15
Fallow Efficiency % Loam	17	37	16

Δ = *change*

What does this mean?

- Controlling weeds over summer is a big cost which may be reduced in circumstances where weed growth will not affect sowing operations or result in increasing populations of problem weeds. Stored soil moisture from large pre-Christmas rainfall events with no follow-up rain is lost to evaporation within 4 to 6 weeks. Rainfall events post February may be conserved if weeds are controlled and more likely to provide a return on herbicide costs.
- Whilst the PAWC or bucket size has a limited influence on the storage of soil moisture pre-sowing (because summer rainfall is often low and intermittent) PAWC does strongly impact the performance of crops in the season, particularly in years with dry springs.

Acknowledgements

We would like to thank Wade Shepperd, Kaye Brace and Trent Brace for technical support.

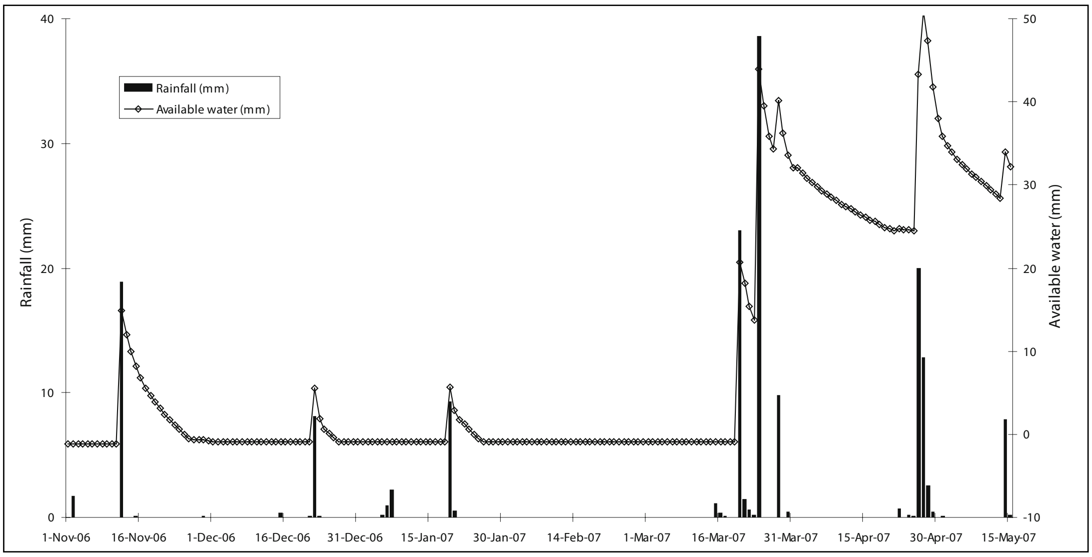

Figure 2a Rainfall (left, y1 axis) and simulated available soil moisture (right, y2 axis) in the summer-autumn fallow period (2006/07) for a MAC heavy soil and weather data from Minnipa Agricultural Centre

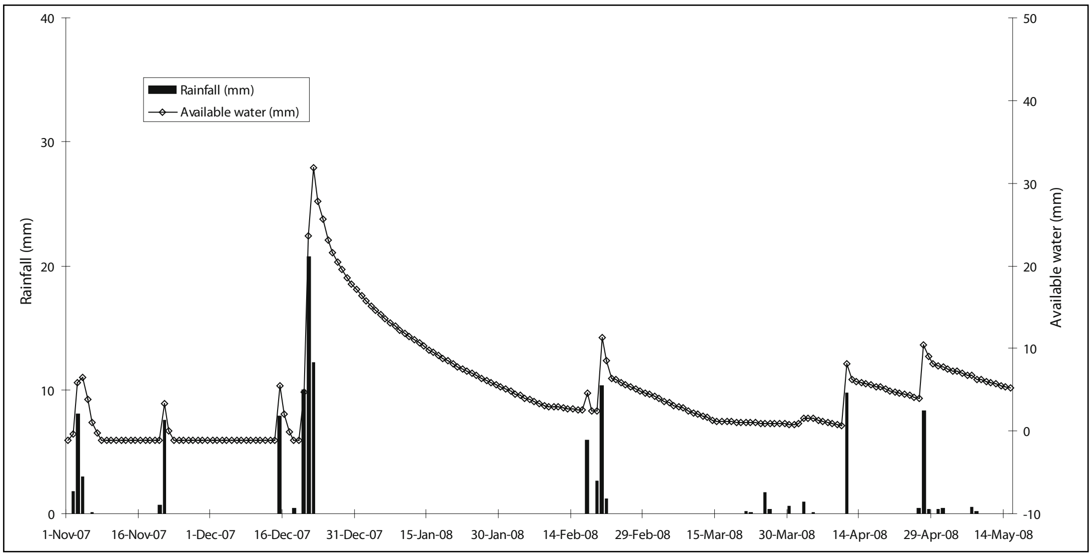

Figure 2b Rainfall (left, y1 axis) and simulated available soil moisture (right, y2 axis) in the summer-autumn fallow period (2007/08) for a MAC heavy soil and weather data from Minnipa Agricultural Centre

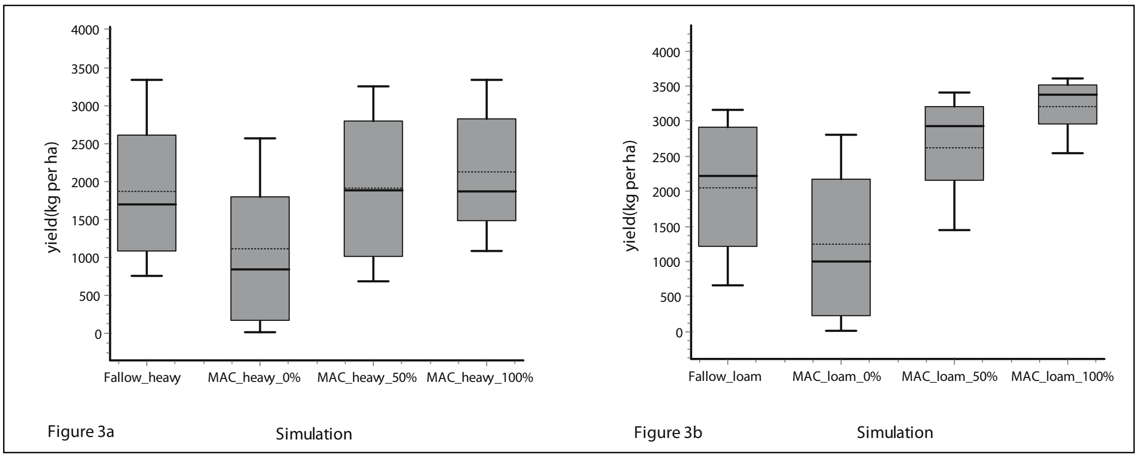

Figure 3 Box and whisker plots of average wheat grain yield (kg/ha) (1950–2008) for sowing moisture of 0, 50 or 100% of PAWC for MAC heavy (38 mm) and MAC loam (108 mm) compared with the yield following a weed free summer-autumn fallow at both sites. (Box and whisker plots display the average yield as the centre dashed line, the 25th and 75th percentiles bottom and top of the box and the 10th and 90th percentiles bottom and top of the whiskers).

The Impact of Livestock on Paddock Health and Economics

Research

Alison Frischke, Nigel Wilhelm, Mark Klante and Amanda Cook

SARDI, Minnipa Agricultural Centre

Searching for answers

Location
Minnipa
Minnipa Agricultural Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2008 Total: 251 mm
2008 GSR: 139 mm

Yield
Potential: 1.21 t/ha (W)
Actual: 0.28 t/ha (W)

Paddock History
2007: Wheat
2006: Wheat

Soil Type
Red sandy loam

Soil test
Organic C: 1.18 %
Phosphorus: 28 mg/kg
Boron: often >12 ppm between 40-60 cm

Diseases
Low levels Rhizoctonia

Plot size
8 sowing widths across paddock

Yield Limiting Factors
Poor season

Livestock
Enterprise type: Self replacing merinos
Stocking rate: District practice

Environmental Impacts
Soil Health
Soil structure: Stable
Disease levels: Med-High Rhizo, Low Crown Rot
Tillage type: No-till
Compaction risk: Low
Ground cover or plants/m^2:
Grazed to 1 t/ha straw residue
Perennial or annual plants: Annual
Grazing Pressure: Low

Continues

Key message

- **A long term trial was established at Minnipa Agricultural Centre in 2008 to test whether soil health and fertility can be increased under a higher carbon input system with well managed grazing. Baseline data was collected in 2008.**

Why do the trial?

A well run mixed farming enterprise of cropping and livestock can be as profitable as a continuous cropping business for most districts across Eyre Peninsula, but carries less risk, as shown by a profitability analysis in the Eyre Peninsula Grain & Graze and Farming Systems projects. However, as livestock graze they remove large amounts of plant biomass which would have otherwise have been ground cover then decomposed into the soil and contributed to the carbon pool.

In high rainfall areas the benefits of retaining stubble have been shown to improve soil carbon levels and microbial health. In low rainfall areas there's no doubt that stubble retention helps reduce erosion and can help plant establishment in poor moisture conditions at sowing, but in an environment where biomass production, soil moisture and microbial activity levels are lower, a clear relationship with soil health is still to be established. Value adding to stubbles by grazing is usually regarded to be of greater economic value.

A broadacre trial was established on Minnipa Agricultural Centre to test whether soil health and fertility can be increased under a higher carbon input system with well managed grazing (pastures will be sown if necessary to produce high biomass). This system is being compared against a more traditional ley (low input grazed) system, as well as un-grazed high carbon input and low carbon input systems.

How was it done?

Paddock South 7 on Minnipa Agricultural Centre was divided into four sections prior to seeding in 2008 (each eight seeding runs wide) (Figure 1) and soil sampled at four points in each section; 0–60 cm for soil nutrients, constraints and water holding capacity, 0–10 cm for RDTS analysis, and 0–30 cm for carbon fractions (see Table 1 for treatments).

All treatments were sown using direct drill on 17 May 2008, with Wyalkatchem wheat. All sections received standard weed management. The original intention at the start of the year was that treatments A and D would be grazed to minimum soil cover whenever possible. However, productivity was so low that livestock were not introduced at any stage. The volunteer population of medic is so low in this paddock that it was thought necessary to seed the traditional ley system (low carbon input) with wheat (with the intention of grazing it off).

During the season quadrat cuts were taken at each sample point to assess early and maturity dry matter production, harvest index, tillers and viable heads. Plants were also scored for Rhizoctonia root infection at mid tillering.

The trial was harvested on 11 November using the farm header. Yields for each section were determined using yield map data, and grain samples were retained for quality analysis.

What happened?

The paddock had an average Colwell P of 28 mg/kg in 0–10 cm, total N of 104 kg/ha to 60 cm deep, calcium carbonate levels above 20% below 20 cm, and boron levels above 10 mg/kg below 40 cm.

2008 was the establishment year of the trial and is yet to be grazed

Water Use
Runoff potential: Low
Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, NO_2, methane): Cropping and livestock

Social/Practice
Time (hrs): No extra
Clash with other farming operations: Standard practice
Labour requirements: Livestock will require supplementary feeding and regular checking

Economic
Infrastructure/operating inputs: High input system has higher input costs
Cost of adoption risk: Low

so there are no treatment results to report at this stage. Tables 2 and 3 show average crop performance in the 2008 season.

What does this mean?

Because of the very poor year, 2008 was only used for benchmarking. The crop suffered from moisture stress throughout the season, starting with very low sowing soil moisture levels, then only receiving small rainfall events followed by drying winds during growth. The crop also suffered from moderate Rhizoctonia, and lower than desired head density and harvest index. Subsequently grain yield and WUE was low, protein high, and screenings high. Test weight of all sections was adequate.

Over the next few seasons appropriate analysis will be carried out to measure any changes to the soil or crop performance in the farming systems, followed by financial assessment to evaluate the merits of each system.

Acknowledgements

We gratefully acknowledge the help of Wade Shepperd, Kaye Brace, Trent Brace, Brenton Spriggs, Leigh Davis, Emma McInerney and Naomi Scholz for their technical assistance and management of the paddock. Thanks also to Brendan Frischke of gps-Ag for yield map data analysis.

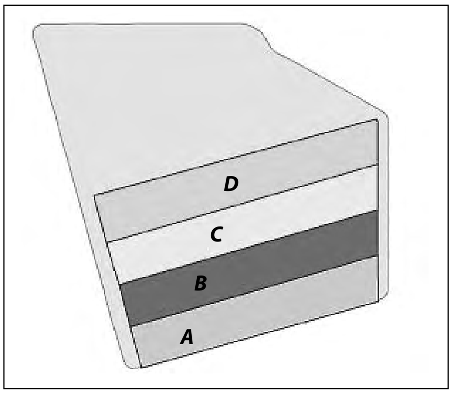

***Figure 1** Paddock plan of carbon management trial, S7 MAC, 2008*

***Table 1** Treatments applied to South 7 Carbon Management Trial, MAC 2008*

System	Wheat Sowing Rate (kg/ha)	Nutrients Applied in 2008 (kg/ha)
Traditional ley system – grazed (A)	50	7 N, 8 P
Traditional ley system – ungrazed (B)	50	7 N, 8 P
High carbon input system – ungrazed (C)	70	25 N, 12 P
High carbon input system – grazed (D)	70	25 N, 12 P

***Table 2** Crop Performance in Carbon Management Trial, 2008*

System	Early DM (t/ha)	Rhizo score (0-5)	Fertile heads/m^2	Harvest Index (%)
Traditional ley system – grazed (A)	0.81	1.9	139	33
Traditional ley system – ungrazed (B)	0.62	2.0	121	35
High carbon input system – ungrazed (C)	0.72	1.6	149	37
High carbon input system – grazed (D)	0.88	1.7	126	35

***Table 3** Crop Yield Performance of Sections in Carbon Management Trial, 2008*

System	Grain Yield (t/ha)	WUE (% of potential yield)	Protein (%)	Screenings (%)	Test Weight (kg/hL)
Traditional ley system – grazed (A)	0.25	21	14.4	9.6	74
Traditional ley system – ungrazed (B)	0.24	20	14.2	10.3	75
High carbon input system – ungrazed (C)	0.30	25	14.4	7.3	74
High carbon input system – grazed (D)	0.35	29	14.4	8.5	75

Grains Research & Development Corporation

Government of South Australia
Eyre Peninsula Natural Resources Management Board

CARING FOR OUR COUNTRY

Grain & Graze
Profit through knowledge
EYRE PENINSULA

Minnipa Farming Systems Competition

Michael Bennet[1], Andy Bates[2] and Bruce Heddle[3]

[1]SARDI, Minnipa Agricultural Centre, [2]Consultant, Streaky Bay, [3]Farmer, Minnipa

Demo

Best practice

Location
Minnipa
Minnipa Agricultural Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2008 Total: 286 mm
2008 GSR: 140 mm

Yield
Potential: 1.44 t/ha (W)
Actual: 0.46 t/ha

Soil Type
Red clay loam

Plot size
2.5 ha

Yield Limiting Factors
Late sowing, poor agronomy, rainfall

Key messages

- **Barley grass wrapped up in little rectangles tied with string can be very profitable.**
- **Early sowing was the key for grain and hay production.**

Why do the trial?

The Farming Systems Competition, sponsored by AWB, was inaugurated in 2000 to compare the impact of four different management strategies on production, profitability and sustainability at the Minnipa Agricultural Centre.

How was it done?

The competition is divided in to four separate teams, each allocated a 2.5 ha paddock to provide their input for management decisions. The teams are: local farmers, local consultants, district practice and hiding somewhere are the local Minnipa researchers.

What happened?

What happened indeed? This is the third season we've been asking that question, as have many disgruntled growers across the nation! Low risk strategies was the name of the game in 2008. The Farmers and Consultants went away from the norm with a foray into an opportunity crop, barley for the Farmers, and the Consultants an almost input free oat enterprise.

District Practice has moved away from just that, and was sown to canola which was intended for hay as a comparison for feed production between the oats sown in the Consultants paddock. This comparison turned out to be invalid due to the late sowing date of the Consultant's oats. The Consultants were concerned about bringing stem nematode through oat seed, so chose to source their seed from a confirmed stem nematode free source. This seed however did not arrive until mid-late May.

The Researchers however didn't break from tradition and proceeded to sow an expensive crop (more certified seed), with a similar result as the last two years - little financial return!

The Farmers and District Practice capitalised on the early break to the season and sowed on 29 April. While the neighbour's crops were emerging the Consultants blood pressure was rising until the 20 May when their Winteroo oats were sown. They only wanted their paddock sown a month earlier! The Researchers were cooling their heels, patiently waiting for a germination of weeds and sowed on 26 May. Not a smart move in another short growing season.

The 2008 season also saw a departure of grain production from all but the Research team. District Practice and the Farmer's paddock were cut down for small squares, while the Consultants put the sheep in on their paddock.

TEAM 1

The Farmers (Not Too Cocky Cockies)

Team Motto: To farm profitably today while giving our kids the chance to do the same tomorrow.

What did we learn last year?

2008 will surely be an unforgettable year for all of the wrong reasons. After a less than brilliant outcome in 2007, we decided to try and claw back some profit with an early sown barley crop, set up to give us as

Table1 Farming Systems Competition Summary 2001-2008

Year	Date	Farmers	Consultants	Researchers	District Practice
2001		Yitpi wheat Yield: 2.75 t/ha GM = $600/ha	Yitpi wheat Yield: 2.77 t/ha GM = $572/ha	Frame wheat Cut for hay GM = $207/ha	Yitpi wheat Yield: 2.79 t/ha GM = $575/ha
2002		Krichauff wheat Yield: 1.48 t/ha GM = $316/ha	Krichauff wheat Yield: 1.25 t/ha GM = $231/ha	Barque barley Yield: 1.36 t/ha GM = $195/ha	Grazed pasture GM = -$4/ha
2003		Krichauff wheat Yield: 1.21 t/ha GM = $163/ha	Krichauff wheat Yield: 0.99 t/ha GM = $118/ha	Rivette canola Yield: 0.50 t/ha GM = $90/ha	Yitpi wheat Yield: 0.85 t/ha GM = $117/ha
2004		Wyalkatchem wheat Yield: 1.01 t/ha GM = $84/ha	Keel barley Yield: 1.35 t/ha GM = $67/ha	Yitpi wheat Yield: 1.25 t/ha GM = $132/ha	Krichauff wheat Yield: 0.82 t/ha GM = $41/ha
2005		Toreador medic 793 grazing days GM = $11/ha	Kaspa peas Yield: 1.57t/ha GM = $83/ha	Wyalkatchem wheat Yield: 1.98 t/ha GM = $108/ha	Regenerated pasture 764 grazing days GM = $53/ha
2006		Wyalkatchem wheat Yield: 0.71 t/ha GM = $26/ha	Wyalkatchem wheat Yield: 0.81 t/ha GM = $22/ha	Angel medic GM = -$166/ha	Wyalkatchem wheat Yield: 0.60 t/ha GM = $1/ha
2007		Wyalkatchem wheat Yield: 0.86 t/ha GM = $215/ha	Wyalkatchem wheat Yield: 1.22 t/ha GM = $345/ha	Angel medic GM = $0/ha	Wyalkatchem wheat Yield: 0.52 t/ha GM = $78/ha
Running gross margin after 2007		**$1358**	**$1416**	**$553**	**$851**
	1 May	Sloop SA @ 45 kg/ha 18:20 @ 25 kg/ha	Roundup Powermax @ 1 L/ha		Tarcoola Canola @ 6 kg/ha
	20 May		Winteroo Oats @ 80 kg/ha	Roundup Powermax @ 1 L/ha + Goal @ 100 ml/ha+ Trifluralin @ 800 ml/ha	
	20 May			Gladius Wheat @ 55 kg/ha +18:20 @ 40 kg/ha	
	15 Aug			MCPA LVE @ 700 ml/ha	
	1 Oct	Baled for Hay			Baled for Hay
		180 grazing days 81 small squares of barley hay GM = $119/ha	180 grazing days GM = -$52/ha	0.46 t/ha Gladius Seed GM = $20/ha	180 grazing days 49 small squares of canola hay GM = $70/ha
Running gross margin after 2008		**$1477**	**$1364**	**$573**	**$921**

much flexibility as possible if the season turned 'pear shaped' again, and it did!

We used Sloop SA barley sown early @ 55kg per ha with 25 kg/ha of 18:20, with a goal of getting malting barley if the season went well, but relying on its reasonable plant vigour to give us some weed competitiveness and a hay option if needed. The medic was deliberately left uncontrolled to increase the options, and the bulk if hay did become reality. Grazing was the final 'fall back' position.

The crop established well, but with little weed control of any kind and the extremely dry late May and June, the background population of Barley grass, (which we have never really got on top of), made its presence felt.

By mid September, it had become pretty obvious that we were unlikely to get a crop, let alone make malting for our grain. So the decision was made to take the opportunity to clean up the weed problem and perhaps salvage at least some profit. For small tonnages, small square bales seem to often capture a significant price premium over the big bale options. The slasher windrows were baled direct (rather than raked) to minimise expense and hay losses. At the time, people were still keen to secure hay, and a price was set that saw us return a tidy profit.

2009 plans:

It would be nice to get sufficient margin at some stage to really take a break and deal with the pretty well entrenched weed issues we face.

However, the reality is that like most farmers, we need to continue with options that give the maximum chance of making a dollar, while keeping our options open and our risk under control. We hope that we demonstrated that even under the most trying seasonal conditions, being flexible can achieve profitability, while still making a useful attempt at dealing with agronomic challenges, and hopefully keep open the option of capitalising on the really bumper season that will inevitably come along.

On good deep ground with sound fertiliser history and really not much production from the past several crops – well, it looks like another wheat crop coming up. Who knows, next year might finally be the big one we all need!

TEAM 2

The Consultants (De$parately $eeking $olutions)

Team Motto: If we get trounced, please blame Ed Hunt.

What did we learn last year?

The aim in 2008 was to obtain a year with excellent grass weed control, specifically barley grass. Hay was the chosen pathway to obtain grass seed set control and oats were supposed to be dry sown in late April or early May. The actual sowing date was later than desirable and vegetative growth suffered as a result.

The farm staff considered the crop biomass and height unsuitable for cutting hay, so a late paraquat "spray top" followed by light grazing was suggested. The farm staff considered conditions unsuitable for the herbicide application, so no grass seed set control was achieved for 2008!

2009 plans:

We aim to do what we set out to in 2008 – barley grass control through hay or self regenerating pasture. Seasonal conditions in autumn will dictate the final paddock use, but it is likely that hay or pasture will be utilised to obtain a reduction in barley grass population. However, excellent early rainfall may result in the paddock being sown to wheat.

TEAM 3

The Researchers (Starship Enterprise)

Team Motto: Boldly going where no man has gone before.

What did we learn last year?

2008 saw the Research team planning to head back in to a profitable phase in the rotation. Since we didn't have any success in growing certified Angel medic seed, we thought we'd have a crack at growing certified Gladius seed instead. We sowed at 55 kg/ha and got 8 kg back for every kilo we planted. If the seed to harvest ratio was a constant (which it isn't unfortunately), then we should have sown at 150 kg/ha, then we would have reapt 1.2 t/ha!

We were charging into the season with profitability as the main focus, although we didn't want to drop the ball agronomically. We applied an adequate rate of fertiliser and took care of the weeds which we knew were still in our paddock. Rather than the lack lustre approach of our neighbours, we were aiming to farm for the long term and not forget the agronomic lessons we've learnt over the last few years.

We were in a similar boat as the Consultants, we didn't have our seed early enough for our target sowing date. We were not aiming for an Anzac day sowing, however we wanted to wait for weeds to emerge. Hindsight is a wonderful thing – we should have gone for the Anzac day seeding.

Our Gladius struggled all season, but managed to put together a useful crop for pure seed build-up on the farm. The crop highlighted the differences in soil type at both ends of the paddock, with the sandy end performing better.

After the 55 mm rainfall event in December, the courageous researchers considered planting forage sorghum to capitalise on our ballsy risk management strategy, however after considering our sulfonylurea history (and terrible economic performance) we decided that sorghum would not be the best option and will conserve this moisture for the 2009 crop.

2009 plans:

2009 is the season for the researchers to make up some lost ground (I think we've said that once or twice before?) and catch up the lead of the Farmers and Consultants. Actually we'd just be happy to overtake district practice at this stage.

We're going to sow our paddock back to Gladius for a second crop of pure seed to take try and make up for the two economically unproductive seasons we had growing medic.

Acknowledgements

AWB is appreciated for its continued long term support of the MAC Farming Systems Competition. The competition would not be possible without the support of the MAC broadacre team, Mark Klante, Brenton Spriggs and Trent Brace.

SARDI

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AWB

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Risk Management

Information

2009 Planning Guide for Farmers with Limited Finances

Geoff Thomas[1] and Nigel Wilhelm[2]
[1]Low Rainfall Collaboration Project, [2]SARDI, Minnipa Agricultural Centre

In early 2008, the 'GRDC 2008 Planning Guide for Low-Risk Farming' was distributed throughout south eastern Australia to help farmers work their way through a decision-making process that was intended to lead to the best possible outcomes for the 2008 cropping season.

However, since that booklet was released, another major drought has hit many of the cropping districts of southern Australia. This has meant that the financial and emotional fabric of many farms has been further eroded, in many cases to the point where survival is now the issue. These guidelines have been developed from the 2008 version but have been tailored specifically for those businesses which have very limited finances to fund a program for 2009. It will also have some relevance to those businesses with better finances but who are also looking to reduce their risk in some parts of their enterprise in 2009. For those businesses with sufficient resources to carry on in 2009 with relative freedom to operate, the 2008 guidelines and options are still relevant, providing any financial data is updated to current levels.

These guidelines have been developed to help farm businesses plan a low-cost/low risk-strategy designed to return a modest profit while maximising the chances of the business continuing. The aim is to minimise costs and risks, not maximise profit, by carefully considering how much the business can afford to lose, rather than what it can potentially make. This approach will probably mean reduced profit potential, should 2009 prove to be a 'bumper' season, but financially constrained businesses simply can't afford the costs and risks of a full program.

Before you plan

It is important to realise before planning for next year commences, that it is very difficult to think logically and make rational choices when under extreme pressure.

Most people, farm managers included, struggle to make sound decisions if they are extremely stressed – it's only natural. Counselling services are a valuable resource during these difficult times. As the manager you are the most important asset of a farm business and need to be healthy for your business and for your family. External support for planning (such as counsellors, accountants, farm consultants, financial advisers) has never been more important.

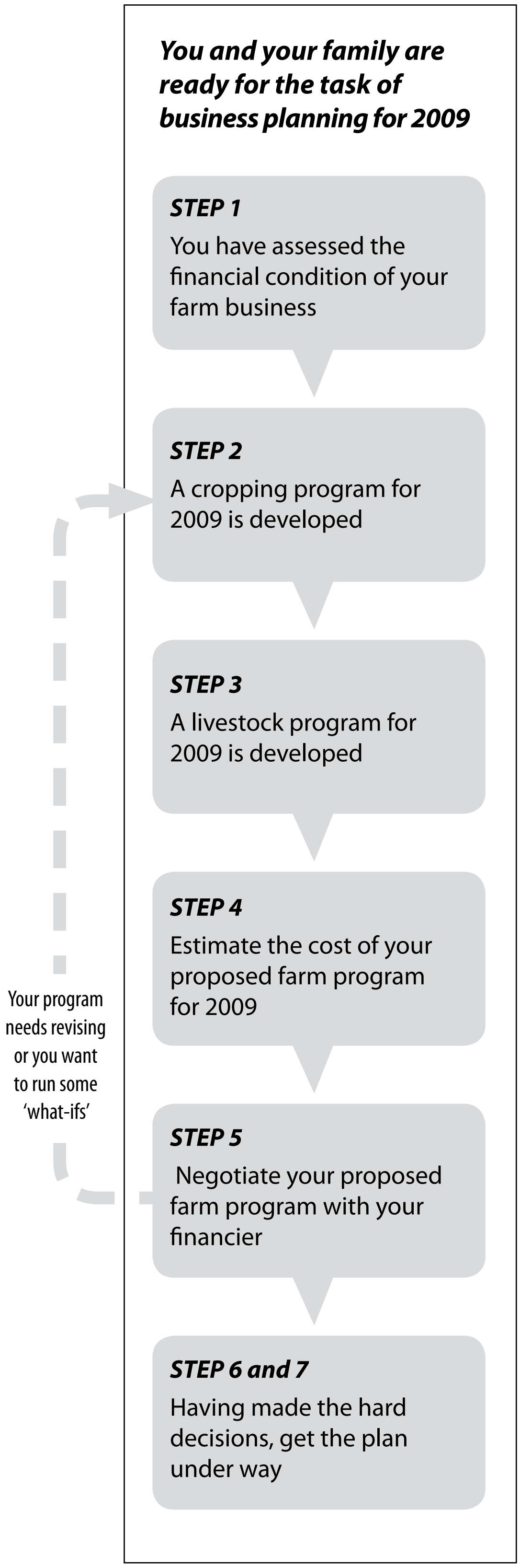
Are you confident that you and your family are ready to face up to the task of business planning for 2009? If not, seek support from relatives, friends, your social network and/or professional counselling services.

If you do not want to keep farming, make an appointment with your accountant and/or financial adviser to consider the options and work through them with your family. How do the various options fit your succession plan? There is assistance available if you think it is time to leave farming.

If you just want a break from farming, is share farming or leasing out some of the farm an option? Do you take stock on agistment? Should you consider an arrangement such as those offered by Glencore and AACL?

If you want to continue but your banker suggests you have a doubtful future, seek a second opinion.

Figure 1 Decision cycle for 2009



If you and your family are ready to plan your farm business for 2009, the following decision cycle and supporting notes will help you in that process.

The decision cycle

Business planning is cyclical and it is good practice to revisit your plan on a regular basis to see whether it needs adjusting for new conditions. It is unusual for any manager to get the program exactly right the first time around, especially in this era of rapidly-changing seasonal and financial conditions.

This guide to decision making concentrates on low cost/low risk options for farm businesses with little financial freedom to operate into 2009. It is about having a look at a range of options and considering their potential outcomes. Each key decision should be assessed for the likely benefits and costs of implementation, which will focus attention on those decisions that are critical for survival.

Don't overlook the importance of the personal perspective as well as the financial.

Step by step

Each section below relates to a step in the decision cycle.

STEP 1

Work out the financial condition of your business and discuss it with your financier. Do it early.

- **Work with your accountant and/or financial adviser to establish the financial health of your business, including off-farm investments.**
  - Some of these financial services will be available for no cost, or at reduced rates, in EC-declared areas.
  - Clearly identify your fixed costs (rates, taxes, interest on loans, school fees, living expenses, etc) and input costs (fertilisers, fuel etc) separately and consider how they can be met.
  - Most businesses will have commitments to repay borrowings. These should be clearly defined and all finance and repayment options discussed with the financier.
  - This is the first step in your plan and will give you and your financier a clear position of the real state of the business and possible options.
  - Remember, your financial issues are also your financier's. Communication is the key: act early and talk with your financier to see how potential problems can be managed or avoided.
- **Next work out the gross margins (income minus input costs) for each of your crops and livestock enterprises in 2008. This will give you a good indication of what did best in a poor season. Then do the same for average yields at current costs and prices, which will give an indication of what crops and paddocks will fit a low-risk strategy.**

STEP 2

Plan the detail of your cropping program

- **The most important consideration is time of sowing because it is likely to be the main determinant of yield and profit. Plan your program so you get all the crop in as soon as rains allow. Late-sown crops are usually high-risk crops and there is no place for them in this strategy.**
- **A second essential is to check the germination of seed grain. With light seed weights from the 2008 harvest, germination might be low or variable.**
- **Group your cropping paddocks into three categories: *definitely will seed, will seed with a good start, will not seed.***

1. *Definitely will seed*
   (best cropping paddocks; low risk/high return)

   These paddocks:

   - will have low weed and disease levels and good levels of carry-over nutrition.

- will usually be the ones that have performed well in the past. Your paddock records will reveal these.
- are dominated by soil types that reliably finish crops.
- have been set up to easily and quickly seed in 2009.
- should be the first seeded. Dry seeding some is a real option but avoid situations with variable moisture (re-seeding after poor establishment is expensive and untimely).
- should be seeded with high-value cereals (e.g. hard wheat, malting barley).
- should be monitored closely to avoid major yield-limiting constraints such as severe leaf diseases or nutrient deficiencies (N or trace elements most likely). Early interventions are usually the most effective and the cheapest.

2. *Will seed with a good start to 2009*
   (average cropping paddocks; medium risk/medium cost)
   - These paddocks have one or two factors that will either increase the cost of production (e.g. low fertility, high weed or disease burden) or increase the risk of a good outcome (e.g. major areas of a soil type that requires a good season to produce well or high weed numbers that require delayed seeding).
   - Plan not to seed all of these, even with a good start. More cropped area means more risk and requires higher cash flow, both of which can reduce viability. The finances saved by reducing cropping area can be used to build the potential in the cropped paddocks as the season progresses (e.g. extra N). This keeps up-front costs low and reduces overall risk. The old adage that 'it doesn't cost much to put a crop in' is simply not true any more.
   - A smaller cropping area will mean the entire seeding program will be more timely.
   - Seed this category after the 'definite' paddocks to allow low-cost weed control options prior to seeding.
   - Seed these paddocks with cereals and manage them so they can be used for grazing or hay if necessary.
3. *Will not seed*
   (difficult, high-risk cropping paddocks)
   - These paddocks should be used to support the livestock enterprise.

- **Control summer weeds only in paddocks to be cropped (i.e. do not spray paddocks that will not be cropped.)**
  - Do not spray early summer weeds in paddocks to be cropped unless trash flow is a critical issue. Summer weed control should be a higher priority on lighter soils than on heavy.
  - In late summer/autumn, spray early after a major rainfall event with the lowest-cost effective chemical option under suitable delta-T conditions. This will minimise costs and kill the weeds before they suck out the soil moisture.
  - If spraying conditions deteriorate, adjust the operation to compensate (e.g. increase water rates, increase herbicide rate, switch to night spraying). Timely control is more important than perfect spraying conditions.
  - Use sheep to reduce bulky weeds for easy seeding.
  - Maintain high levels of crop residue to maximise infiltration of rainfall, slow evaporation and protect the soil.
- **Grass control**
  - Due to the severe impact of high grass numbers on cropping profitability, the difficulty of keeping grasses under control and the long-term nature of seed bank management, grassy weed control should not be compromised. This includes pre-seeding weed control for crops.
- **Control fertiliser costs**
  - Substantial savings are possible on most farms by reducing P fertiliser rates or in some cases leaving it off altogether.
  - One approach is to use no P unless reserves are known to be low as shown by the fertiliser and cropping history, or low levels indicated by a soil test. You will not fall off a production cliff without P provided soil reserves are adequate. If there is any doubt about the available soil P reserves in a paddock or zone, soil test.
  - If you need to use P, apply it with the seed and use only enough for the 2009 crop.
  - With nitrogen, use only 0–10 kg N/ha at seeding. More can be applied mid-season if necessary when you have a better idea of the crop potential.
  - Do not apply other nutrients (e.g. K or S) unless you are confident they are deficient. Soil testing is the most reliable method of predicting these deficiencies.
  - Manage trace element deficiencies by using seed from a very fertile paddock, applying a seed dressing or foliar sprays.
- **Long fallows**
  - Critically review the value of long fallows in 2009. Not fallowing next year may increase the risks of cropping in 2010 but will eliminate a cost that will return no income in 2009. Paddocks that were to be long-fallowed in 2009 may generate income in the form of extra grazing or a hay cut.

STEP 3

Low cost livestock management

- **Concentrate on livestock management to increase weaning percentage and growth rates, which can often be achieved with little cash outlay.**
- **Increasing livestock turnover is the key. Higher profitability and lower risk can sometimes be achieved by selling growing stock at lower weight ranges.**
- **There is likely to be plenty of low-cost feed grain available in 2009 but it should be tested for nutritional value, particularly energy levels.**
- **Do a forward feed budget and ensure you have enough feed for existing stock until, say, one month after the average break of season when there is likely to be sufficient grazing available (this step is critical for all livestock enterprises). If you do not have enough feed options include:**
  - reducing stock numbers
  - securing more feed. Consider saving feed grain for this purpose and cost the options of selling it now or value-adding through sheep. In any case, store on-farm and keep options open
  - using existing stored fodder and paddock feed more efficiently.
- **If you have enough feed to carry stock past the average break, will your current cropping plans ensure enough feed for your stock throughout 2009? If not:**
  - nominate a paddock or two of cereal for grazing or hay.
  - secure more feed reserves early, preferably save your own.
  - improve infrastructure (fencing, watering) to allow more efficient grazing.
  - refine grazing management, including setting up for containment feeding.
- **Know the real costs of feeding (grain, hay, machinery and labour).**
- **Containment feeding will improve efficiency.**
- **Grain feeding is still economic for breeding stock.**
- **Better grazing management (e.g. using larger mobs of stock moved frequently) will improve feed use without damaging paddocks. With less cropped area there should be more time to manage livestock better. One of the greatest errors in sheep management is to leave them in the same paddock for too long.**
- **If feed is short, consider weaning lambs early, giving them the best paddock feed and locking up ewes on a drought ration.**
- **Finishing lambs with cheap grain may be an option. However, if many people do it the profit margin will shrink. If you can, lock in the selling price for a proportion of your lambs. Screenings are valuable for finishing – if used correctly.**
- **Do not fertilise pastures in 2009.**

STEP 4

Cost your proposed program

- **Once you have established your work plan and stock needs you can cost various 'what-if' scenarios and develop options to use depending on how the season unfolds, your available finance, and how much risk you are prepared to take.**
- **For businesses with limited funds available the emphasis should be on low-cost/low-risk options, even if some potential profit is foregone.**
- **Look at the gross margins and cash flows for the various options; not only the costs. If you don't know how to do this, seek help fast.**

STEP 5

Negotiate with your financier (e.g. bank) for funds to undertake your work plan.

- **This is your major negotiation.**
  - Do it early and be confident.
  - Go prepared with a commitment to make it all happen and information about:
    - the current financial status of your business.
    - a costed work plan for 2009.
    - some 'what-if' scenarios to demonstrate how the financier's investment will be protected if conditions change.

STEP 6

Monitor all crops and pastures closely for weeds and diseases

- **Early intervention is vital for cheap and effective control.**
- **Correct identification of pests and diseases is vital for effective control.**
- **Correct timing is often more important than the product used.**

STEP 7

Review your marketing options as the season progresses

- **Make sure the marketing tools you use are the most appropriate. The goal is minimum risk, not maximum profit.**
- **Forward marketing transfers your price risk to the market but does not reduce your production risk.**
- **Committing more than 25% of your average crop tonnage before harvest can increase risk.**
- **Forward selling has little long-term benefit where yields are highly variable.**
- **Depending on the season, grain prices and your need for cash flow, on-farm storage may be an option. Buyers may pay more if you can store grain for a period. Storage can be done cheaply using facilities such as bunkers but care must be taken to ensure grain is kept free of insect pests.**

GRDC Grains Research & Development Corporation

Climate Change on EP – Can Our Farming Systems Cope?

Samantha Doudle and Naomi Scholz
SARDI, Minnipa Agricultural Centre

Survey

Key messages

- **An Eyre Peninsula based report has been written "Exploring adaptive responses in dryland cropping systems to increase robustness to climate change." as a result of a climate change project carried out through Minnipa Agricultural Centre.**
- **The worst case climate change projections to 2030 are going to be less severe than the weather we have experienced in the past five years.**
- **There is less certainty and potentially more dramatic climate change projections for 2070.**
- **Farming businesses in strong positions after the past years of drought are good indicators of how businesses can cope in the face of climate change for the next 20 years.**
- **There are a range of principles or characteristics common to successful farm businesses on EP.**

Why do the research?

There has long been a debate about the viability of grain farming on the upper Eyre Peninsula (EP), indeed this discussion can be traced back to Goyder who in the late 1860's delineated a line of reliable cropping that runs through the low rainfall regions in South Australia and traces across the upper EP. The climate change projections of a warming and drying trend reinvigorates this debate.

How was it done?

The Eyre Peninsula Agricultural Research Foundation (EPARF) and SARDI's Minnipa Agricultural Centre and Climate Applications Unit collaborated with a small group of farming systems consultants on a Department of Climate Change funded project, to assess how the challenging conditions of the past five years compare to the various climate change scenarios for the lower rainfall areas of Eyre Peninsula and the upper North of SA. Case studies were then conducted by the consultants on eleven robust farming businesses which have maintained their strength despite the recent run of poor seasons.

The basic premise of this project was that many features of resilience to climate change in coming decades (up to 2030) could be understood from current resilience. However, it is accepted that the projected changes for 2070 include a future that may present challenges not previously met and that there may be more dramatic shifts in climate in the coming decades than what is suggested by the global climate models.

Climate change projections from Suppiah (2006), Bureau of Meteorology and CSIRO (2007), indicate with high confidence that Eyre Peninsula will be 0.6 to 1.5 degrees warmer by 2030 and that while there is less confidence in rainfall projections, the most likely annual rainfall decline by 2030 is about 5%, with a 1 in 10 chance that it will be 10% drier. For most locations assessed in this project the mean of the last five years is about 20% below the mean of the 1980 to 1999 period. Although five years is a short period it was considered a guide for evaluating farming systems.

The project identified the characteristics of these eleven robust businesses, the strengths and vulnerabilities and the most important requirements for the future to build on the strengths and minimize the vulnerabilities.

What have we learnt?

The range of businesses assessed in this study were diverse in terms of location (from Ceduna in the north-west to Tumby Bay in the south-east of Eyre Peninsula and Port Germein in the upper North of SA), land zone (calcareous sands and red soils, siliceous sands and deep soils over clay), annual rainfall (300–375 mm), agronomic practice (60–100% cropping), property size (1,500 – 4,570 ha) and many other factors. Not all businesses have come from a strong background, but all have managed to maintain their business strength over the past five very challenging seasons.

From this study, there is no one recipe to achieve or maintain strength in terms of agricultural practices across these diverse circumstances; however there were some common business management features and personal characteristics:

- They aim to improve their business but in a measured and conservative way. An important business goal is to achieve high equity and to recover that high equity after major expansions or investments.
- They are often not the earliest adopters of new technology. When they do adopt they do it well and consolidate before moving on to the next thing.
- They are keen to learn (often not formally educated), are organised and allocate time to planning and reviewing.

- They recognise they are not experts in every aspect of their business and consult with others for these skills.

These characteristics are not rocket science and should be achievable for many businesses.

This project team believes that the research, development and extension (RDE) requirements for robust and sustainable businesses in the future under potential climate change impacts should build on what we know is required for low rainfall businesses to better manage short term variability:

- An improved ability to identify and analyse potential enterprise costs, benefits and risks.
- The flexibility to change the system in response to market and season to develop lower risk, responsive farming systems - including a range of crop types, enterprise mixes, input types and levels.
- The need to maintain networks and relevant information flow to provide short term support, community confidence and balance to sensational climate change headlines.

Given the similarity between short and longer term RDE requirements, increased investment in low rainfall agricultural RDE now is also a solid investment for the future under climate change.

Acknowledgements

Project funded by the Department of Climate Change.

Exploring adaptive responses in dryland cropping systems to increase robustness to climate change.

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The full report is available to download from the SARDI website www.sardi.sa.gov.au, or ring Minnipa Agricultural Centre (08) 8680 5104 for a CD copy.

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Agricultural Research Foundation Inc.

Australian Government
Department of Climate Change

Types of work in this publication

The following table shows the major characteristics of the different types of work in this publication. The Editors would like to emphasise that because of their often un-replicated and broad scale nature, care should be taken when interpreting results from demonstrations.

Type of work	Replication	Size	Work conducted by	How analysed
Demo	**No**	**Normally large plots or paddock size**	**Farmers and agronomists**	**Not statistical, trend comparisons**
Research	**Yes, usually 4**	**Generally small plot**	**Researchers**	**Statistics**
Survey	**Yes**	**Various**	**Various**	**Statistics or trend comparisons**
Extension	**N/A**	**N/A**	**Agronomists and researchers**	**Usually summary of research results**
Information	**N/A**	**N/A**	**N/A**	**N/A**

How Does the Recent Run of Poor Seasons on the Upper Eyre Peninsula Compare with the Long Term Record?

Bronya Alexander and Peter Hayman
SARDI, Waite

Survey

Key messages

- **The recent run of dry seasons is at the extreme end of historical records on the upper Eyre Peninsula. For Minnipa, the last five years are dryer than any other five year period on record. Although the average of the last 10 year and 20 year periods have been below the long term average, there have been drier periods in the past for Minnipa.**
- **The last five years and the last decade are drier than most of the climate projections for 2030.**

Why do the research?

Farmers in low rainfall regions such as the upper Eyre Peninsula have suffered a run of poor seasons. This raises three questions:

1. How unusual is the recent run of seasons compared to the long term?
2. How does the run of recent seasons compare to projections for 2030?
3. Is the recent run of seasons due to climate change?

How was it done?

To answer these questions we take the historical growing season rainfall (GSR) from April to October every year from the Bureau of Meteorology's records for a particular location on the Eyre Peninsula. To compare or rank different years we simply order all the years from the driest to the wettest, and the driest year is considered a rank of 1, the second driest year is ranked 2, and so on up until the full length of the historical rainfall record. We would use the same process if we were to rank the height of children in a classroom by making them stand from shortest to tallest, with the shortest child ranked as 1.

What happened?

Historical April to October or GSR for Minnipa is shown in Figure 1, where the long term average is 240 mm (Bureau of Meteorology station number 18052). The GSR in 2008 was 127 mm which is 47% below the long term average and the GSR for 2006 was 102 mm which is 57% below the long term average. The average of the last five years is 166 mm which is 31% below the long term average.

The first question is how unusual is it for a single year to be 47% below the long term average, or for a five-year period to be 31% below the long term average? Figure 1 shows that 2006 was the second driest year on record (behind 1959 at 88 mm GSR), and 2007 and 2008 were equal fifth driest on record. Each of these years individually is quite unusual in terms of the historical record, but what's more worrying is that they have occurred in three successive years.

Figure 2a takes the 5-year running mean plotted in Figure 1 and displays it in terms of the percent departure from the long-term average (240 mm). The last bar on the right shows that the average of the five years from 2004-2008 was 31% below the long-term average, and this is the lowest that any 5-year period has been since records at Minnipa began in 1915. Figure 2b gives the 10-year running mean from Figure 1 and shows that the last 10 years from 1999-2008 were 16% below the long-term average. This was ranked the 5th lowest 10-year period due to the drier run of 10-year periods back in the 1940s at Minnipa. The last 20 years at Minnipa have been 5% below the long-term average and are ranked the 20th driest 20-year period out of 75 20-year periods. Therefore we would expect a similar 20-year period to occur one year in four (25% of the time). So the last 5 and last 10 years have been significantly drier than usual at Minnipa, but the last 20 years were not as unusual.

The second question relates to how we should interpret a 5 or 10% reduction in GSR from a climate change projection. Obviously we can't say that because we have survived one year that was 47% below the long term average we can handle a future climate that is 10% below the long term average. This would be a case of confusing extreme results from a single year with the average of 20 years.

Climate change projections, such as those found in the *Climate Change in Australia* report (www.climatechangeinaustralia.com.au) suggest an average drying of 5% by 2030 for the Eyre Peninsula, with the extreme end of projections pointing to a possible 10% decline. Historically, a 10% reduction in rainfall for a single year is expected four years in 10 (40% of the time), but of all the 20-year consecutive periods since 1915 only 12% have been drier than 10% of the long-term average. The last 20-year period, as mentioned earlier, was about 5% below the long-term average, so a projection of 5% would be similar to the average of the last 20 years. However a 10% drying would be worse than the last 20 years, but not as dry as some other 20-year periods in the past for Minnipa.

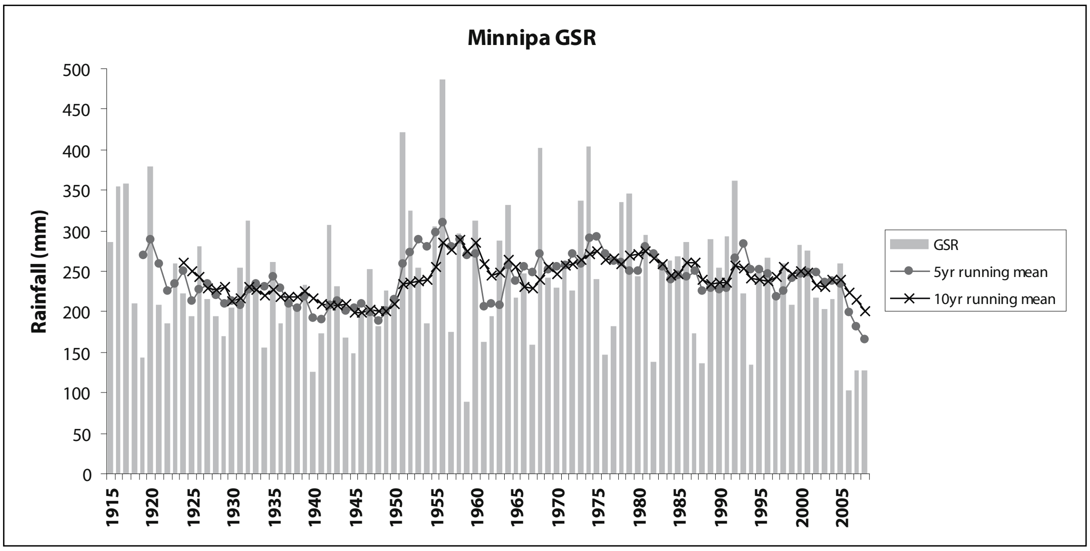
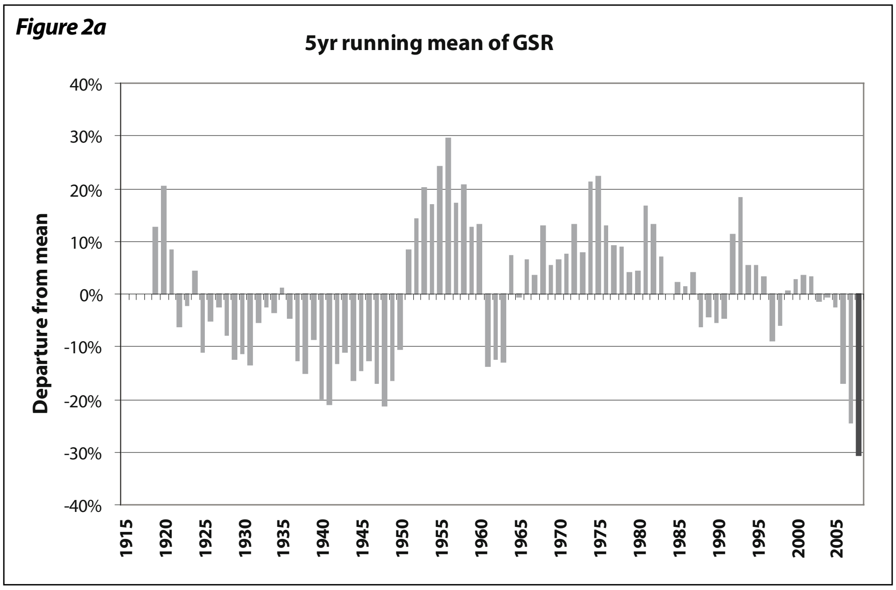


Figure 1 ***Annual growing season rainfall (GSR) at Minnipa and the 5-year running mean. The average is 240 mm***



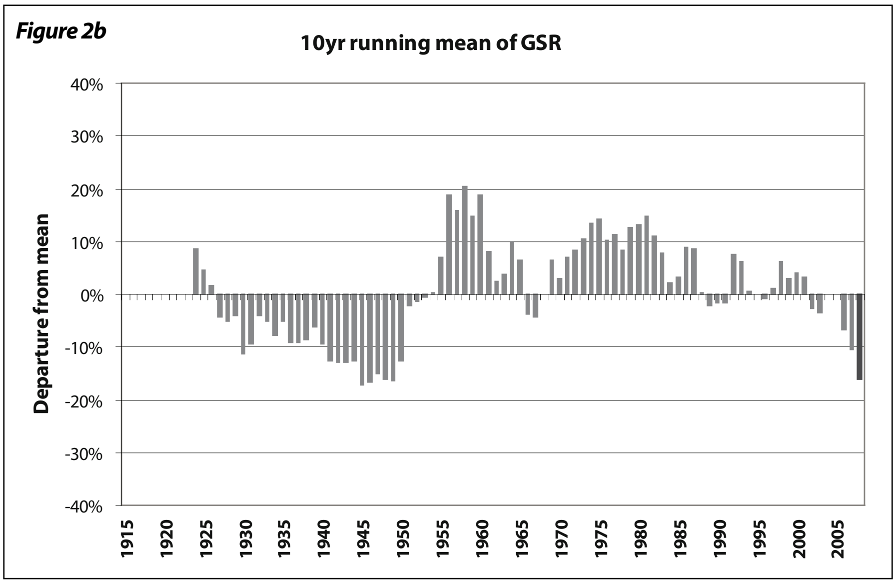


Figure 2 ***The 5-year (Figure 2a) and 10-year (Figure 2b) running mean of the growing season rainfall (GSR) at Minnipa in terms of the percent difference from the long-term average GSR of 240 mm. The last bar to the right in Figure 2a represents the average GSR from 2004–2008 and shows that it is 30% below the long-term average, whereas the last 10 years (Figure 2b) have been 16% below the long-term average***

Recent climate change projections use the base period of 1980-1999. This means that a projection of, for example, 10% decline in rainfall for 2030 would suggest that the average rainfall centred on 2030 will be 10% lower than the average during 1980–99. Therefore, to properly compare the recent years with the projections, we need to use the average GSR between 1980–99, instead of the full historical record. However, because the average GSR from 1980-99 (240.6 mm) is almost the same as the average across the full record (240mm), this doesn't change the results for Minnipa.

The 1980–1999 average GSR at Ceduna is 202 mm (Bureau of Meteorology station number 18012), and the average for Lock is 274 mm (station number 18046). The last five years at Ceduna were 19% below the 1980–1999 average and was ranked the 2nd lowest 5-year period on record. The last 20 years at Ceduna were 3% below the 1980-1999 average and ranked the 7th lowest. For Lock, the last five years were 21% below the 1980-1999 average (ranked the lowest) and the last 20 years were 11% below the 1980-1999 average (ranked the 2nd lowest).

What does this mean?

1. How unusual have the recent run of years been? The recent 5 to 10-year run of seasons on the upper Eyre Peninsula have been unusually dry compared to the long term record. The last five years of GSR have been the driest five-year period on record at Minnipa and Lock, and the second driest at Ceduna. The last 10 years have been the 5th driest on record for Minnipa due to a drier period in the 1940s. However, historically there have been many drier 20-year periods at Minnipa. As can be seen in Figure 1, prior to the last decade, there were quite a few wet years.
2. How do the recent years compare with the climate change projections? The average of the last 20 seasons at Minnipa is similar to the average rainfall projections for 2030, at around 5% decline in rainfall. However the early part of the last 20 years was wetter than the later years, so if we consider just the last 10 years at Minnipa which were 16% below the 1980–1999 average, this is significantly drier than even the more extreme projections of a 10% decline in rainfall. The last 20 years at Lock were 11% below the average, so the current projections give a one in ten chance that the average 2030 climate will be as dry as the average of the last 20 years for Lock.
3. Is the recent run of dry seasons due to climate change? In one sense, without being a time traveller, it is difficult to answer this question. Climate science has a high degree of confidence that global temperatures are rising and that most (but not all) of the recent rise in temperature has been caused by greenhouse gasses. The media often talks about climate change being associated with a hotter and drier future for Australia. For the planet as a whole, a warmer world would be expected to be a wetter world, but most global climate models show a drier future for southern Australia along with mid latitude regions in other parts of the world. There is no doubt that warmer temperatures alone will have an impact on the moisture budget, but this impact is relatively small compared to the change in rainfall.

Farmers and scientists in 2050 will look back at this period in the early 2000s as

(A) a shift in rainfall to a new drier regime

(B) a run of bad seasons, much as we look back on the 1930s or

(C) a window on what a drier future looks like with climate change.

It is unlikely that the recent *extreme* dry years will be the new *average* climate in the coming decades and there is no reason to suspect that we will not get any wet years. One interpretation is that there will be an increased ratio of poor years to good years and we need to keep working on farming systems that can cope with poor seasons and still make the most of good seasons.

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Alternative Management for High Risk Cropping Land

Brett Masters and David Davenport
Rural Solutions SA, Port Lincoln

Information

Searching for answers

Location
Eastern EP
Buckleboo Farm Improvement Group
Franklin Harbour Ag Bureau
Tumby Bay Ag Bureau

Key messages

- **High input costs and variable seasons have increased the risk of cropping on many soil types.**
- **The 'Farming to Manage Risk' model enables growers to simulate management changes on their property and evaluate them against the current system.**
- **Livestock can play a key role in risk management where a property has low debt.**
- **Low input opportunity cropping on high risk soils can provide flexibility for management options.**
- **Where growers are carrying a high level of debt they are often 'locked' into cropping a high proportion of the property to service these commitments.**

Project background

An initiative of the Advisory Board of Agriculture, this pilot program was funded by the National Landcare Program with the aim to;

- Identify, trial and assess newly developed tools and protocols to support risk management.
- Incorporate risk management tools in farm planning based on land capability.

The program involved two group workshops and individual property visits. The 'Farming to Manage Risk' simulation model was used to evaluate the current farming system against key benchmarks and changed systems. Growers then identify changes that they would like to make to their system and the model was used to simulate the profitability of the changed system in varying rainfall years. The key focus was for the farm business to reduce risk exposure whilst increasing sustainability and profitability (EPFS 2007 Summary, pp 121-122).

The program was delivered to 45 farm businesses in the Eyre Peninsula and Northern and Yorke Natural Resource Management regions including growers in the cropping areas of Buckleboo, Cowell and Tumby Bay.

Project outcomes

Workshop participants identified the biggest risk factors to the profitability of their enterprise as: environmental conditions, increasing input costs, increased complexity in grain marketing, uncertain commodity prices and difficulties in sourcing labour.

A common goal for participants was to identify the best enterprise mix for different production zones on their property. This was in order to use the livestock enterprise to reduce risk in poor seasons whilst still having enough cropping in the system to take advantage of better seasons.

All strategies evaluated aimed to reduce risk by increasing the flexibility of the farming system.

Key changes evaluated included;

- Changing the enterprise mix (crop:livestock).
- Changing cropping intensity and level of inputs on different production zones.
- On farm storage to capitalise on grain markets.
- Sowing cereals for grazing.

There was significant variation between properties with regard to equity levels, livestock percentage, return on capital and cost of production.

A key indicator of cropping risk is the break-even price for grain. In cases where the model identified that the cost of grain production in a particular zone outweighed potential productivity, growers needed to look at alternative production options for that zone.

Summary and recommendations

- Cropping has the highest potential return but also has the highest risk exposure.
- Low debt levels allow the most flexibility in risk management options.
- Livestock are a good risk management tool as they have lower input costs than cropping.
- Where a property has high debt levels the returns from livestock are not high enough to reduce the debt, thus 'locking' growers into cropping.
- Sowing low input cereals is a highly effective management strategy for high-risk land. By not committing high inputs at the beginning of the season the grower has the flexibility to graze the paddock in a poor season where feed is short, or increase inputs to finish the crop if the season is good.

Further information

For more information on this project contact Brett Masters, Rural Solutions SA, Port Lincoln.

Acknowledgements

Thanks to the Advisory Board of Agriculture steering committee and Ed Hunt for feedback and support in developing the program. Members of the Buckleboo Farm Improvement Group, Tumby Bay and Franklin Harbour Ag. Bureaus for participation and feedback on the program.

Government of South Australia
Eyre Peninsula Natural Resources Management Board

Australian Government
Department of Agriculture, Fisheries and Forestry
National Landcare Program

ADVISORY BOARD OF AGRICULTURE
Governing body of The Agricultural Bureau

Government of South Australia
Northern and Yorke Natural Resources Management Board

Sometimes, despite the best made plans, things are out of your control!

Improving Farm Decisions

Geoff Thomas
Low Rainfall Collaboration Project

Information

Key messages

- **Farmers often face a large array of options for the enterprises and practices they can use on their farms. The decisions of which to use and how best to use them are usually complex in terms of 'putting it all together' into a system which suits the farm, the business and lifestyle.**
- **Many decision support tools have been developed to help in the process but these are poorly used by farmers or their advisers. Finding out why is the challenge facing Bill Long, farmer and consultant from Ardrossan, under a GRDC supported project with Charles Sturt University.**

Grains Research & Development Corporation

Farmers often face a large array of options for the enterprises and practices they can use on their farms. The decisions of which to use and how best to use them are usually complex in terms of 'putting it all together' into a system which suits the farm, the business and lifestyle. Yet getting these decisions right is more important than ever in the tough environment of current farming where production is often not as important as profit and managing risk. It is not only farmers who face these challenges – so do all those who advise farmers and do research.

Computer based decision support tools can play an important part in helping the farmer understand the options, the relationships between them, and the impact of adoption on profit and risk. There are a number of tools such as Plan2Profit, Mallee Calculator, MIDAS, Yield Prophet, Cropmate and many others that have been developed and are readily available for farmers and advisors to access and use to support farm decision making processes.

Each model has strengths and weaknesses in providing solutions to farmers and advisors. Some are simple and straight-forward and can provide quick and easy answers to a simple problem whilst others require more input to conduct more complex whole farm analysis. Some of these tools allow farmers and advisers to evaluate options within the whole farm context and ask 'what if' questions to assess the impact of a decision on whole farm profit, equity levels and yearly cash flow over a set period of time.

Unfortunately these tools are not widely adopted. There is a clear need for these tools to be evaluated and compared and the features and benefits of each highlighted. It is not just about grain production. Many farmers find it difficult to integrate livestock and grain production, especially under intensive cropping systems and decision tools have the potential to assist.

GRDC has provided a post graduate scholarship for consultant Bill Long, from Ardrossan in South Australia, to find out why adoption of decision support tools is slow. Bill is doing a Masters Degree with the Charles Sturt University under the supervision of Kevin Parton from the Orange Campus, John Mullen from NSW DPI, with support from Zvi Hochman (CSIRO). All three are highly regarded experts in this field.

Bill is looking at a range of commonly used decision support products on offer to identify the key features that appeal to farmers and advisors, or act as a disincentive to their use. He will not only provide an overview of the range of products available but will also research the hypothesis that some personality types are more likely to use decision support tools than others. Bill will be working with farming systems groups and farm consultants in exploring these issues.

The intention is to develop more user friendly tools to not only assist farmers but also provide the basis for farm consultants to assess technologies within the farm business context as part of serving their clients. It will also assist research people in assessing the value of their results and determining which areas of future work will have greatest impact on the farm business. It is more essential than ever that best use is made of the research dollar at a time of shrinking research investment in agriculture.

All of this is within the tough and uncertain environment we face, where poor decisions can be very damaging to the farm business.

Section editor:
Alison Frischke
SARDI
Minnipa Agricultural Centre

Disease

Survey

Research

Searching for answers

Survey of Disease Suppression for Rhizoctonia on Upper Eyre Peninsula

Amanda Cook[1], Wade Shepperd[1], Nigel Wilhelm[1] and Chris Dyson[2]

[1]SARDI, Minnipa Agricultural Centre, [2]SARDI, Waite, 'the statistician expert who helped make sense of our data'.

Key messages

- **Disease suppression tended to be weaker where cereal grain yields over ten years were at the lower and higher end of the range for upper Eyre Peninsula.**
- **Rhizoctonia disease score in-crop from fifty paddocks in 2007 showed higher P inputs, higher average cereal grain yield over ten years and low calcium carbonate content of the soil all reduced the incidence of disease in crop.**
- **The disease scores of paddocks in cereal crop in 2007 showed the current Rhizoctonia disease levels reflected the long term yield of the paddock.**
- **Leaf analysis of the surveyed paddocks in 2007 showed 70% of paddocks were below adequate levels for P and 50% were below adequate levels for Zn.**

Why do the research?

The importance of soil biology to current dryland farming systems is not well understood due to the complexity of these systems which involve not only the cycling of nutrients but also disease suppression, soil structure and water holding capacity. The soil-borne fungus *Rhizoctonia solani* is one of the most important plant pathogenic fungi to agriculture, with a wide range of plant hosts and world wide distribution (O'Brien and Zamani, 2003). *Rhizoctonia solani* AG8 is a major disease in cereal based farming systems, despite advances in the control and management of other disease pathogens through plant breeding, development of fungicides and better understanding of disease cycles.

Rhizoctonia bare patch disease was first described in the 1920s in Australia, but mechanical tillage with multiple workings reduced the effect of the disease until the 1970s when Rhizoctonia again became a major issue in all cereal growing regions of Southern Australia due to changes in farming systems with reduced tillage and the retention of crop stubbles (MacNish and Neate, 1996). On upper and eastern Eyre Peninsula alone, Rhizoctonia is estimated to reduce profitability by around $65 million per year (N Cordon, pers comm.).

Decline of *R. solani* disease symptoms and the development of biological disease suppression in a dryland cereal system were first observed in a tillage and rotation trial at Avon, SA. In 1983 the severity of Rhizoctonia resulted in poor plant growth in 46% of the crop area, but this declined to negligible levels by 1990. Avon soil is an alkaline calcareous sandy loam, pH 8.2, organic carbon of 1.6%, total N 0.15%, $CaCO_3$ 8% (Roget, 1995).

Disease suppression in Avon soil to *R. solani* was found to be biologically based (Wiseman, et al 1996). Further research on the Avon soil identified that an interaction between three diverse groups of bacteria, *Pantoea* *agglomerans*, *Exigubacterium acetylicum* and Microbacteria (PEM), was the major contributor to disease suppression of Rhizoctonia (Barnett, et al. 2006). The level of mineral nitrogen in the soil is believed to be a 'switch' which turns disease suppression on and off (Roget and Gupta, 2006) with suppressive activity being reduced when mineral N increases in the surface soil.

Many scientific and anecdotal reports exist about the impact of management on the severity of Rhizoctonia, but these reports are not always consistent. During 2006 and 2007 a survey was conducted to investigate the occurrence and extent of disease suppression in a range of soils across upper Eyre Peninsula (EP) in contrasting management systems. Potential disease suppression was estimated using a bioassay with young wheat seedlings. The assay estimates the potential of the microbiota in the soil to compete with Rhizoctonia under ideal conditions. Paddock management history for the last ten years was collected from each location.

In 2007 fifty of the survey paddocks were sown with a cereal crop. These locations were visually scored for Rhizoctonia patches early in the growing season to compare potential suppression estimated in the bioassay with actual disease expression in the field.

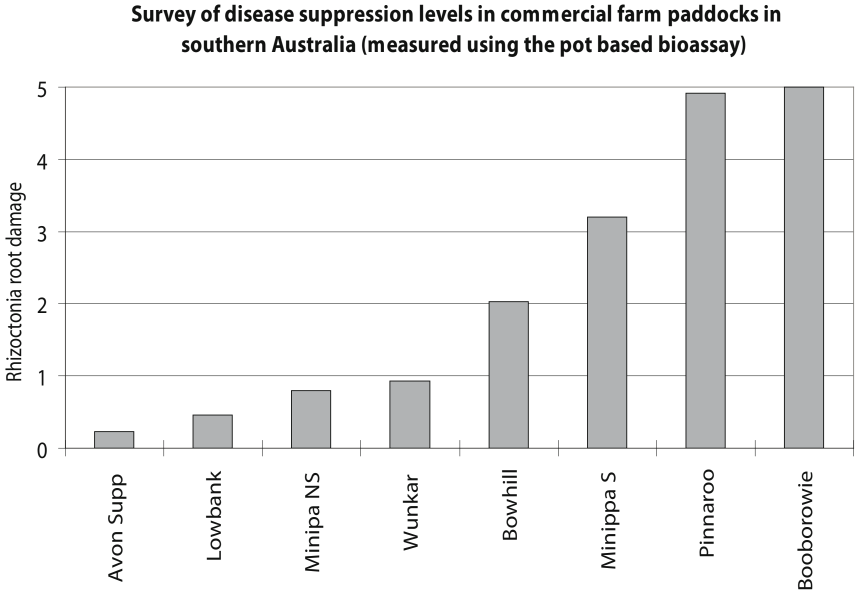

Figure 1 Survey of disease suppression levels in commercial farm paddocks in southern Australia

How was it done?

Pot Bioassay

A pot bioassay was used to measure potential disease suppression (Roget et al., 1999). A paddock on the Minnipa Agricultural Centre (MAC), N12 was included within each pot bioassay as a benchmark soil. This is a continuously cropped non-grazed paddock which has shown accumulation of soil organic carbon over twenty two years (two green manure crops in 1992 and 1997) and reduced visual symptoms of Rhizoctonia over this same time (B Holloway, pers comm.). MAC N12 (labelled as Minnipa NS) showed potential disease suppression in a soil bioassay of commercial farm paddocks in southern Australia but at a lower level than Avon (Figure 1) (Roget and Gupta, 2006).

This bioassay estimates the potential of the microbial population in the soil to compete with the Rhizoctonia pathogen. Microbial competition lowers the level of Rhizoctonia disease on the seedling roots in a potentially suppressive soil.

All soil samples from the survey were analysed for fertility, pathogen DNA levels and chemical characteristics. Farm paddock management history for the previous ten years was also collected and included rotations, cereal yields, tillage practices, fertiliser management, herbicide usage and frequency of stubble burning.

Detailed Field Survey

Fifty of the sampled paddocks were sown to a cereal crop in the 2007 season and these were surveyed for Rhizoctonia disease early in that growing season. A two hundred metre transect, following the same transect where soil was collected for the pot bioassay, was scored every two metres for visual patch symptoms of Rhizoctonia. Two plants were removed at random every ten metres along the transect, and the roots were washed, frozen and later scored for Rhizoctonia using the McDonald and Rovira method (1983).

Statistical analysis

Data were analysed using multiple regression analysis to relate the measured factors to both current Rhizoctonia levels and long term wheat yield. Soils were classified according to collection time, either over summer (Dec-April) or in crop (May-Nov), and soil type, either grey calcareous sandy loam, red sandy loam or sand.

What happened?

Crop intensity varied between soil types with the number of cereal crops over a ten year period on grey calcareous soils averaging six, but the average on red sandy loams and sands was almost seven (Table 1). Average yields achieved over the ten year period were 1.1 t/ha on the grey soils (Penong, Mudamuckla, Wirrulla, Streaky Bay, Elliston), 1.5 t/ha on the red sandy loams (Minnipa, Wudinna, Mt Cooper, Kimba, Rudall, Cleve) and 1.7 t/ha on the sands (mostly Wharminda and Lock).

Table 1 Soil properties, management history and potential disease suppression on several soil types of upper EP

Factor	Grey calcareous sandy loam			Red sandy loam			Sand		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
% $CaCO_3$	55	16	82	9	0	65	4.5	0	6
% Cereal*	60	0	100	68	10	100	67	50	90
Ave P input (kg/ha)*	12	0	20	11	0	16	11	8	13
Potential Suppression	0.8	-1.1	3.5	0.8	-0.8	3.5	1.6	-0.7	3.3
Rhizoctonia g DNA g/soil	0.6	0.1	1.8	0.6	0	1.9	0.6	0.1	2.6
Yield (t/ha)*	1.1	0.3	2.2	1.5	0.7	2.8	1.7	0.9	2.5
Total N %	0.15	0.07	0.23	0.11	0.05	0.38	0.07	0.02	0.17

*Average over a ten year period from farm management history, other measurements taken at time of survey.

Average Rhizoctonia DNA levels were 0.6 g DNA per g soil, for all soil types.

Pot Bioassay

The bioassay measures the 'potential disease suppression' of a soil given adequate carbon (food for the microbial population). The average potential suppression was higher for the sandy soils than for other soil types (Table 1). The only factors (apart from soil type) with significant influence on suppression were average grain yield over ten years and soil collection time (higher in summer).

The interaction with long term yield showed potential disease suppression was strongest with paddocks yielding up to around 1.4 t/ha (Figure 3, and ignoring the two soils with very low yields). This result may be due to a greater number of soils being sampled within this yield, or it may be related to the level of carbon or sugar which we added to the bioassay. Nitrogen is believed to be a 'switch' to activate disease suppression expression (Roget and Gupta, 2006) so if the soils have high nitrogen, the level of carbon used in the bioassay may not have been enough to 'switch' on disease suppression.

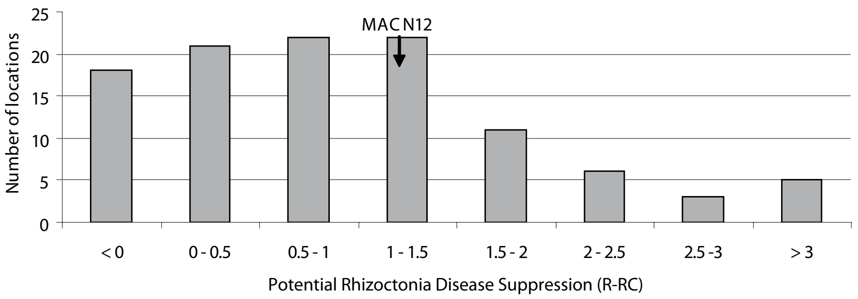

Figure 2 ***Distribution of potential disease suppression of Rhizoctonia in 108 EP soils. N12 is considered suppressive so all soils with equal or higher values would also be considered suppressive***

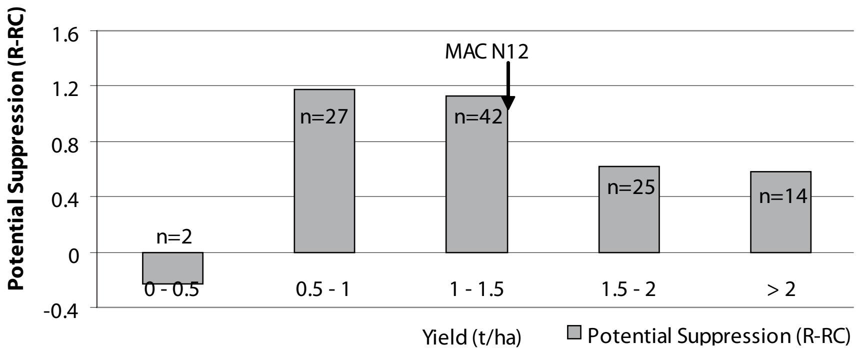

Figure 3 ***The relationship between potential disease suppression and long term wheat yield on upper EP surveyed soils***

Disease

Yield

The long term yield of the eighty-five EP paddocks increased with phosphorus (P) inputs (over ten year period), potential suppression, decreasing calcium carbonate content and soil type.

In–crop Paddock Survey

Scoring rhizoctonia disease from fifty paddocks in 2007 showed that the main factors affecting Rhizoctonia disease levels were phosphorus (P) inputs, average cereal grain yield over ten years and the calcium carbonate content of the soil. There was no relationship between rhizoctonia disease in-crop and potential disease suppression, indicating that either other factors are controlling disease expression or masking suppressive activity, the level of suppressive activity is too low, or the potential suppression bioassay needs adjusting for these soils (eg. more carbon needed).

An increase in the level of phosphorus applied (average units of P over a ten year period) reduced disease symptoms. Every extra 3 kg/ha of P reduced disease score by 0.5 of a unit and increased yield by 40 kg/ha.

Low yielding paddocks over the ten year period were more likely to have Rhizoctonia when surveyed. Increasing calcium carbonate levels in the soil increased the severity of Rhizoctonia. More research is required to determine if the effect of calcium carbonate is due nutritional effects (the tie up of phosphorus), or a direct influence on root growth.

The rhizoctonia disease level scored in cereal crops early in the 2007 season showed the lower the current disease level in crop the higher the long term yield achieved in the paddock.

Leaf tissue nutrient analysis of the surveyed paddocks showed zinc and phosphorus deficiency are still an issue on Eyre Peninsula soils with 70% of paddocks below the critical level of 4400 mg/kg P and 50% below 16 mg/kg for Zn.

Acknowledgements

Thank you to SAGIT for funding this project. Thanks to Annie McNeill, Sjaan Davey, Steve Barnett, David Roget, Gupta and Alan McKay for discussions and advice with this project. Thanks to Simon Anstis for providing the Rhizoctonia inoculum. Also a big thanks to the farmers who allowed us to collect soils and gave us their paddock records.

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Statistical analysis

Data were analysed using GENSTAT 10.1 by multiple regression analysis to relate the measured parameters or variables, and interactions, to Rhizoctonia disease levels and long term wheat yield. The MAC N12 results were limited to four samples displaying wide variation to avoid unwarranted replication. Soils were classified according to collection time, either over summer (Dec-April) or in crop (May-Nov), and soil type, either grey calcareous sandy loam, red sandy loam or sand.

A regression analysis uses all the variables measured to see what factors are influencing or most associated with the variable of interest, which was potential suppression, long term yield and in-crop Rhizoctonia disease levels. The residual (R^2) value describes how well the statistical analysis is able to fit an equation to describe the relationship. For a survey R^2 of 40% would be as high as expected. Residual standard deviation (rsd) is the unexplained variance from that relationship, e.g. rsd = 0 has no relationship, rsd = 1 is a perfect relationship.

Potential Disease Suppression

A regression analysis of potential disease suppression of eighty-five locations showed the only factors with significant influence were average grain yield over ten years ($P<0.01$, negative) and soil collection time ($P<0.01$, higher in summer) (R^2 =27%; rsd=0.82).

Yield

A regression analysis of yield over the eighty-five EP soils showed the following influenced yield (R^2 = 38%; rsd = 0.41): phosphorus (P) inputs (average units (kg/ha) over ten year period) ($P<0.01$, positive), potential suppression ($P<0.01$, negative), calcium carbonate content ($P< 0.01$, negative), the interaction between potential suppression and calcium carbonate ($P<0.05$, positive) and soil type ($P<0.1$).

In–crop Paddock Survey

Regression analysis of Rhizoctonia disease score from fifty paddocks in 2007 showed P inputs ($P<0.05$, negative), average cereal grain yield over ten years ($P<0.05$, negative) and calcium carbonate content of the soil ($P<0.01$, positive) influenced the incidence of disease in crop (R^2 = 42; rsd = 0.15). There was no interaction with potential disease suppression.

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Types of work in this publication

The following table shows the major characteristics of the different types of work in this publication. The Editors would like to emphasise that because of their often unreplicated and broad-scale nature, care should be taken when interpreting results from demonstrations.

Type of work	Replication	Size	Work conducted by	How analysed
Demo	**No**	**Normally large plots or paddock size**	**Farmers and agronomists**	**Not statistical, trend comparisons**
Research	**Yes, usually 4**	**Generally small plot**	**Researchers**	**Statistics**
Survey	**Yes**	**Various**	**Various**	**Statistics or trend comparisons**
Extension	**N/A**	**N/A**	**Agronomists and researchers**	**Usually summary of research results**
Information	**N/A**	**N/A**	**N/A**	**N/A**

Disease Suppression Trial at Streaky Bay

Amanda Cook and Wade Shepperd
SARDI, Minnipa Agricultural Centre

Research

Searching for answers

Location
Streaky Bay
K, D and K Williams
Streaky Bay Ag Bureau

Rainfall
Av. Annual: 298 mm
Av. GSR: 243 mm
2008 Total: 109 mm
2008 GSR: 179 mm

Yield
Potential: 0.6 t/ha (W)
Actual: up to 1.6 t/ha

Soil
Highly calcareous grey loamy sand

Plot size
60 m x 1.48 m

Other factors
Early moisture stress, strong winds, Polyphrades weevil

Key messages

- **The higher input systems had higher yields than the low input system in 2008.**
- **After the 2007 cereal crop, Rhizoctonia inoculum levels were high in all treatments at the beginning of 2008.**

Why do the trial?

This long term trial was established at Streaky Bay in 2004 to determine if disease suppression against rhizoctonia is achievable and if soil microbial populations can be influenced by rotation and fertiliser inputs in a grey highly calcareous soil in an upper Eyre Peninsula (EP) environment.

How was it done?

The disease suppression trial rotations are listed in Table 1. In 2007 Clearfield Stiletto was grown across all treatments to control grass weeds which were becoming an issue in the trial. In 2008 we decided to sow Clearfield varieties again into wheat plots. However, they were treated as conventional (no Midas used) due to the lack of rainfall and the possibility of residues still being in the system. Medic plots were dry sown on 12 May, and the rest of the trial sown on 28 May. Medic and canola plots had poor establishment due to strong winds and very little rain post seeding and were resown on 3 July.

The trial received 1 L/ha each of Roundup and Treflan and 80 mL/ha of Hammer pre-seeding. Insects were an issue this season with Polyphrades weevils being sprayed with Decis and Lorsban, and aphid and native budworm with Karate zeon on the canola plots. The medic plots also received 250 mL/ha of Select for grassy weed control.

What happened?

Each rotation in 2008 was in a different phase with wheat, canola or medic being used, so no direct comparisons of Rhizoctonia or dry matter production between treatments could be made. In 2009, treatments will all be wheat, and in 2010 the treatments will be all barley, so comparisons can be made.

After the 2007 wheat crop, Rhizoctonia inoculum levels were high in all treatments at the beginning of 2008 (Table 2). All other disease inoculum levels were similar at the beginning of 2008 except for a higher level of crown rot inoculum in the intensive cereal high input system.

Microbial respiration, a measure of soil biological activity, was similar in all treatments and higher than average levels for the upper EP (approximately 6.5 µg CO_2-C/g soil/day) (Table 2). Further funding is being sought to do intensive monitoring of this trial in the next few years to determine if the type and amount of carbon substrate the microbes use is different between systems.

Soil nitrate levels were slightly higher in the intensive cereal high input and district practice systems.

Both wheat and canola yields were higher in 2008 with high input systems compared to low inputs (Table 3). The protein level and screenings of the wheat was higher in the higher input system (12.7% protein, 11.7% screenings) compared to the district practice inputs (12.0% and 8.2% respectively). The test weight was lower for the high input system (379 kg/hL) compared to district practice (384 kg/hL).

The high fertiliser inputs used in this trial are used to provide a luxury level of nutrition to see if the soil and microbial population can achieve suppression by removing the possibility of a nutrient deficiency in the system. APP has been used as the liquid P fertiliser which is less economic, and this is reflected in the lower gross margins (Table 3).

What does this mean?

The Rhizoctonia inoculum level increased to high levels after a cereal crop in 2007, and significant yield increases were seen in both higher input systems this season. The microbial activity is similar between the treatments but higher than the average of the EP soils in the Rhizoctonia survey (6.5 µg CO_2-C/g soil/day). We plan to monitor carbon substrate metabolism of the microbial populations and the soil carbon pools this season to determine if the different rotation and input systems have resulted in changes over four years. Four years is a short time biologically but significant economically.

Table 1 Rotations and treatments used in the Long Term Disease Suppression trial

Rotation	Fertiliser each season	2004	2005	2006	2007	2008
District Practice	14 kg P/ha and 16 kg N/ha applied as DAP @ 60 kg/ha	Excalibur Wheat @ 55 kg/ha	Keel Barley@ 60 kg/ha	Angel Medic @ 5 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	Herald Medic @ 5 kg/ha
Intensive Cereal – District Practice Inputs	16 kg P/ha applied as MAP @ 60 kg/ha	Excalibur Wheat @ 55 kg/ha	Keel Barley@ 60 kg/ha	Ticket Triticale @ 60 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	Clearfield Janz Wheat @ 60 kg/ha
Intensive Cereal – High Inputs as fluids	20 kg P/ha applied as APP, 18 kg N/ha as UAN and TE (Zn, Mn, Cu)	Excalibur Wheat @ 55 kg/ha	Keel Barley@ 60 kg/ha	Ticket Triticale @ 60 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	Clearfield Janz Wheat @ 60 kg/ha
Brassica Break – District Practice Inputs	16 kg P/ha applied as MAP @ 60 kg/ha	Rivette Canola @ 5 kg/ha	Keel Barley@ 60 kg/ha	Stubby Canola @ 5 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	44C73 Canola @ 5 kg/ha
Brassica Break – High Inputs as fluids	20 kg P/ha applied as APP, 18 kg N/ha as UAN and TE (Zn, Mn, Cu)	Rivette Canola @ 5 kg/ha	Keel Barley@ 60 kg/ha	Stubby Canola@ 5 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	44C73 Canola @ 5 kg/ha

Table 2 RDTS rating of rotations at the start of the 2008 season

Rotation	Rhizoctonia	Take-all	Crown Rot	Prat. neglectus	Prat. thornei	Common Root Rot	CCN	Microbial Respiration (µg CO_2-C/g) soil/day	Soil nitrate µg/g dry soil
District Practice	High (103)	Low (21)	Low (56)	Low (4)	Low (2)	Low (53)	0	10.2	12
Intensive Cereal - District Practice Inputs	High (113)	BDL (7)	Low (21)	Low (5)	Low (2)	Low (62)	0	9.1	12
Intensive Cereal - High Inputs	High (125)	BDL (16)	Medium (159)	Low (6)	Low (2)	Low (115)	0	10.7	7
Brassica Break - District Practice Inputs	High (83)	BDL (8)	Low (14)	Low (7)	Low (1)	Low (39)	0	8.1	7
Brassica Break - High Inputs	High (132)	BDL (8)	Low (26)	Low (14)	Low (1)	Low (80)	0	9.4	6
LSD (P=0.05)	*ns*	*ns*	*69*	*1.4*	*ns*	*ns*	*ns*		*ns*

**ns = non-significant*
(BDL = Below Detection Level)

Table 3 Historic yields for the trial and yield, Input Costs and Fertiliser Margins of rotations in 2008

Rotation	2005 Yield (t/ha)	2006 Yield (t/ha)	2007 Yield (t/ha)	2008 Yield (t/ha)	2008 Input Costs ($/ha)	2008 GM ($/ha)	Overall GM ($/ha)
District Practice	Keel Barley 0.88	Angel medic Not harvested	Clearfield Stiletto 0.65	Herald Medic Not harvested	33	0	213
Intensive Cereal District Practice Inputs	Keel Barley 0.81	Ticket Triticale 0.23	Clearfield Stiletto 0.77	Clearfied Janz 1.39	131	342	776
Intensive Cereal High Inputs	Keel Barley 1.16	Ticket Triticale 0.42	Clearfield Stiletto 0.73	Clearfield Janz 1.61	387	396	442
Brassica Break District Practice Inputs	Keel Barley 2.08	ATR- Stubby Canola 0.03	Clearfield Stiletto 0.77	44C73 Canola 0.43	157	211	606
Brassica Break High Inputs	Keel Barley 2.43	ATR- Stubby Canola 0.05	Clearfield Stiletto 0.64	44C73 Canola 0.57	414	279	200
LSD (P=0.05)	*0.16*	*0.03*	*ns*	*0.11*			

GM calculated using prices - Wheat $140/t and Canola $302/t for 2004, Barley $126/t for Feed 1 in 2005, Triticale $220/t and Canola $480/t for 2006, AH $377/t for 2007, Wheat $276/t and Canola $520 for 2008 delivered to Port Lincoln (plus $30/t freight to Pt Lincoln). No income estimated for the pasture phases.

Acknowledgements

Thank you to SAGIT and GRDC for funding this project. Thanks to the Williams family for allowing us to have trials on their property.

GRDC Grains Research & Development Corporation

SAGIT

Disease

Brassicas and *Rhizoctonia*

Amanda Cook, Nigel Wilhelm and Wade Shepperd
SARDI, Minnipa Agricultural Centre

Research

Searching for answers

Location
Miltaburra
L, M, C & D Mudge

Rainfall
Av. Annual: 306 mm
Av. GSR: 212 mm
2008 Total: 165 mm
2008 GSR: 146 mm

Yield
Potential: 1.7 t/ha (B)
Actual: 0.9-1.5 t/ha

Paddock History
2008: Wheat
2007: Canola
2006: Wheat

Soil
Grey highly calcareous sandy loam

Plot size
12 m x 5 reps

Location
Poochera
I & J Gosling

Rainfall
Av. Annual: 324 mm
Av. GSR: 245 mm
2008 Total: 245 mm
2008 GSR: 143.5 mm

Yield
Potential: 1.4 t/ha (B)
Actual: 0.7 - 1.0 t/ha

Paddock History
2008: Wheat
2007: Oats
2006: Wheat

Soil
Grey calcareous loam

Plot size
12 m x 5 reps

Key messages

- **Early sowing and the 2008 season resulted in lower levels of Rhizoctonia than we would normally expect for these two locations.**
- **Rhizoctonia inoculum level did not decrease as much at Poochera as Miltaburra, indicating we still do not fully understand the factors which reduce and increase Rhizoctonia inoculum levels.**
- **Part of the yield response from the chemical fallow, medic and vetch treatments was due to increased stored soil moisture. However at Miltaburra there was an increase in yield after ATR-Stubby which was not explained by extra soil moisture.**

Why do the trial?

These trials were established from 2005 to 2008 to investigate the role of Brassica species on the incidence of Rhizoctonia in an environment where root diseases are a major constraint. Broad scale monitoring at Miltaburra in 2004 (EPFS Summary 2004, p 75) suggested that canola or forage brassicas in the rotation markedly reduced Rhizoctonia inoculum levels. These results were supported by trial and paddock monitoring in 2005 (EPFS Summary 2005, pp 85-87). These observations were further investigated with field trials over a number of years to test the impact of Brassica options, varieties and management on root disease levels, especially Rhizoctonia, in the following cereal crop (EPFS Summary 2006, pp 123-124, EPFS Summary 2007, pp 135-138).

How was it done?

Brassica variety and management trials were established in 2005, 2006 and 2007. Each trial has been oversown the following season with barley. Barley is very susceptible to Rhizoctonia, hence will display rhizoctonia patches readily.

Brassica Variety Trials

A large selection of Brassica varieties were chosen with treatments including high and low glucosinolate mustards, canola varieties (Stubby, Rivette and Eyre), vetch, wheat and chemical fallow.

Brassica Management Trials

The management options in canola (Triazine Resistant (ATR)-Stubby) included early and late removal of grasses; no grass control; and Terrachlor, Apron and Maxim XL seed dressings. Granular and fluid fertiliser treatments were also applied. All granular plots received 19:13 @ 70 kg/ha and urea @ 15 kg/ha. The fluid fertiliser treatments were applied at the same nutrient rates as the granular with 9.1 kg P/ha as APP, 20.2 kg N/ha as UAN (and APP) and 6.3 kg S/ha as ATS. A trace element treatment had the fluid mixed with 1 kg Zn/ha, 1.5 kg Mn/ha and 0.5 kg Cu/ha as fluid sulphates. An additional fluid fertiliser treatment, at the same cost as the granular treatment, used equivalent rates of cheaper products - phosphoric acid (81%), urea and granular sulphate forms of the trace elements.

The brassica management trials from 2007 were oversown with Barque barley @ 50 kg/ha and 18:20 @ 50kg/ha in 2008. Miltaburra was sown on 12 May and Poochera on 13 May.

Root disease inoculum in each treatment were estimated by DNA-based assay over the 07/08 summer. Rhizoctonia infection was scored mid season and plant dry matter recorded, and final yield data was collected at maturity.

Soil moisture was estimated in November 2008. Soil was collected at intervals of 0-10 cm, 10-20 cm, 20-40 cm, 40-60 cm and deeper if possible. At Miltaburra the maximum depth on average was 100 cm, and at Poochera the maximum depth was 60 cm, with calcrete present below this layer at both sites.

What happened?

Miltaburra 2008

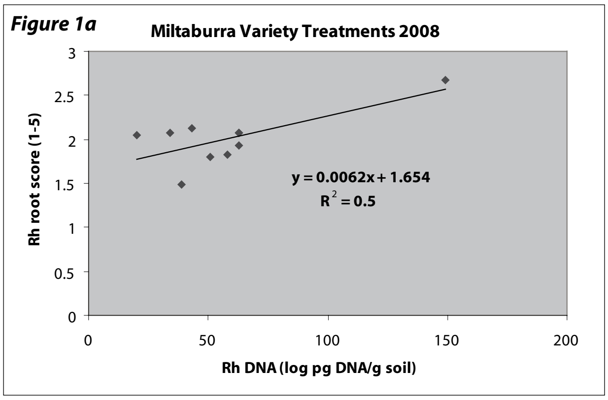
The highest level of Rhizoctonia inoculum occurred after cereal in 2007. All other treatments produced low to medium levels of inoculum (Table 1). However, disease on barley plants in 2008 were all moderate, regardless of management in 2007. Vetch in 2007 produced the best growth and yield in barley in 2008, which suggests that the vetch provided extra N which was of benefit to the barley in 2008. It appears using the best adapted varieties is important when growing canola to maximise the benefit of reducing Rhizoctonia inoculum levels. This is probably due to weed escapes in the poorly adapted varieties. This explanation is also supported by the increase in yield between ATR-Stubby in the Variety treatments (no simazine) and the Management treatments (all ATR-Stubby with simazine applied post sowing).

Barley following the grazing brassica species also had lower yields (Table 3). Obviously a penalty in this environment for growing cereal on cereal is a build up of Rhizoctonia inoculum, shown in Figure 1(a) (cereal is the highest point on graph). The penalty for this build up will depend on conditions for cereal production and Rhizoctonia development in that year.

Table 1 Results from the barley oversown at Miltaburra in 2008, from the 2007 Brassica variety and management treatments

2007 Treatment	RDTS rating for Rhizoctonia	Rhizoctonia Root Score (0=none, 5=severe)	Dry Matter (g/plant)	Yield (t/ha)
Variety				
Cereal	High (149)	2.68	0.27	0.94
Chemical Fallow	Medium(63)	1.93	0.51	1.21
ATR - Eyre	Medium (43)	2.13	0.47	1.30
ATR - Stubby	Medium (51)	1.80	0.42	1.38
Rivette	Low (20)	2.05	0.40	1.06
Juncea Canola	Low (34)	2.07	0.36	1.12
High glucosinol - ATR variety	Medium (58)	1.83	0.49	1.28
Biofumigant mustard	Medium (63)	2.08	0.33	0.92
Medic	Medium (63)	2.07	0.39	1.03
Vetch	Low (20)	1.49	0.63	1.60
LSD (P=0.05)	*39*	*ns*	*0.15*	*0.12*
Management – All ATR - Stubby				
Granular Fertiliser Control	High (104)	2.58	0.61	1.53
Chemical Fallow	Medium (60)	2.35	0.54	1.55
Cereal	High (109)	2.23	0.46	1.26
Early grass control *	High (94)	1.97	0.65	1.52
Late Grass control *	High (88)	2.32	0.60	1.51
No Grass control *	Medium (46)	2.58	0.70	1.59
Maxim XL	Medium (70)	2.13	0.63	1.47
Terrachlor	Medium (50)	2.33	0.56	1.58
Apron	Medium (58)	2.68	0.57	1.49
Fluids same cost gran	Medium (53)	2.12	0.73	1.52
Fluid same rate gran	High (81)	2.00	0.70	1.54
Fluid same rate gran + TE	Medium (73)	2.68	0.60	1.53
LSD (P=0.05)	*ns*	*ns*	*0.15*	*0.11*

*BDL = below detection level, * grass weed levels at this site were low.*



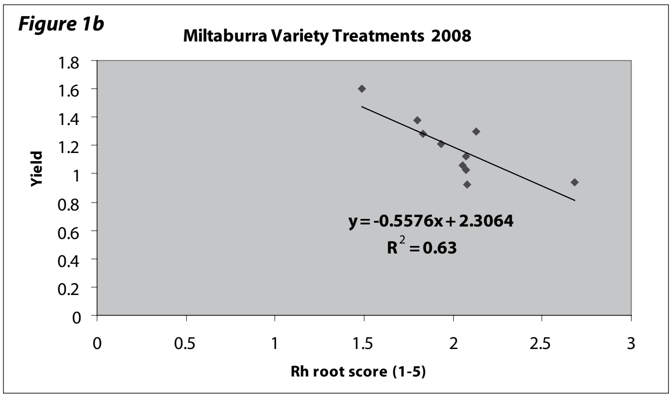


Figure 1 Miltaburra Variety treatments in 2008 season and the relationship between (a) visual root score and g DNA/g soil (b) yield and visual root score

Poochera 2008

At Poochera the level of Rhizoctonia inoculum after brassica was higher than at Miltaburra with only medic and vetch having low levels (Table 2). Although the inoculum level was higher in February, the level of disease scored on the plant roots was lower. The dry matter and final yield was also lower, due to a poorer season at this site. Barley sown after fallow, medic and vetch yielded best at Poochera.

The effect of residual soil moisture in the profile accounts for some of the yield differences between treatments, especially for the fallow and vetch plots, and medic at Poochera. However if we compared the cereal and canola treatments (ATR-Stubby), the yield response for canola is greater than just soil moisture (Table 4). Despite higher levels of soil moisture remaining under the fallow and vetch treatments, the barley crop after canola treatments yielded similar to the fallow.

The analysis of the three years of data (06–08) show cereal on cereal results in higher levels of rhizoctonia in plant root scores, lower dry matter and lower yield. The difference in yield between the barley after wheat and the barley after canola is a cumulative increase of 0.2 t/ha over three years (Table 5).

Table 2 Results from the barley oversown at Poochera in 2008, from the 2007 Brassica variety and management treatments

2007 Treatment	RDTS rating for Rhizoctonia	Rhizoctonia Root Score (0=none, 5=severe)	Dry Matter (g/plant)	Yield (t/ha)
Variety				
Cereal	High (120)	1.19	0.21	0.87
Chemical Fallow	Medium (57)	0.92	0.38	1.03
ATR - Eyre	Medium (41)	0.75	0.19	0.81
ATR - Stubby	Medium (75)	1.02	0.24	0.78
Rivette	Medium (47)	1.17	0.32	0.87
Juncea Canola	High (86)	1.35	0.27	0.86
High glucosinol - ATR variety	Medium (67)	0.78	0.19	0.74
Biofumigant mustard	Medium (42)	1.42	0.26	0.93
Medic	BDL(<19.5)	0.98	0.28	1.03
Vetch	Low (21)	0.62	0.35	1.05
LSD (P=0.05)	*44*	*NS*	*0.11*	*0.15*
Management – All ART - Stubby				
Granular Fertiliser Control	High (104)	1.86	0.20	0.69
Chemical Fallow	Medium (60)	1.58	0.34	0.91
Cereal	High (109)	1.52	0.22	0.81
Early grass control *	High (94)	1.18	0.21	0.69
Late grass control *	High (88)	1.00	0.30	0.75
No grass control *	Medium (46)	0.45	0.27	0.81
Maxim XL	Medium (70)	1.57	0.24	0.76
Terrachlor	Medium (50)	0.70	0.22	0.74
Apron	Medium (58)	1.42	0.20	0.73
Fluids same cost gran	Medium (53)	0.63	0.21	0.70
Fluid same rate gran	High (81)	1.73	0.21	0.78
Fluid same rate gran + TE	Medium (73)	1.47	0.27	0.66
LSD (P=0.05)	*ns*	*0.74*	*0.07*	*0.14*

*BDL = below detection level, * grass weed levels at this site were low.*

Figure 2a

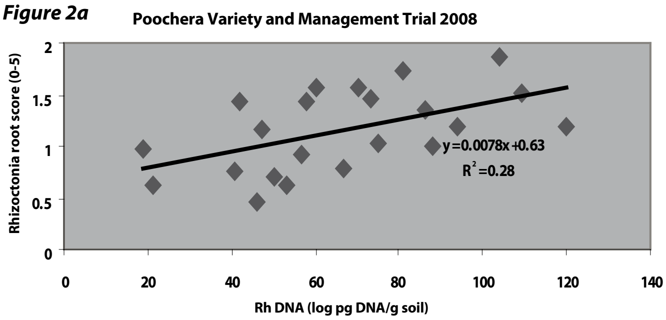


Figure 2b

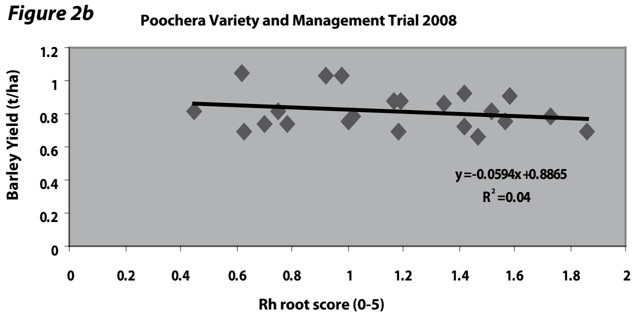


Figure 2 Poochera Variety and Management treatments in 2008 season and the relationship between (a) visual root score and g DNA/g soil (b) yield and visual root score

Table 3 Barley yield following the 2007 Grazing Brassica varieties, 2008

Variety	Miltaburra (t/ha)	Poochera (t/ha)
Bulbous Turnip	1.10	0.64
Rangi Rapeseed	1.19	0.68
Hobsons Turnip	1.11	0.57
LSD (P=0.05)	*ns*	*ns*

Table 4 Total soil moisture in profile (0 – 100 cm at Miltaburra, 0 – 60 cm at Poochera) with different crops

Variety Trial Year 1 Treatment	Soil moisture Miltaburra Nov 2007* (mm)	Extra soil moisture in profile relative to cereal (mm)	Soil moisture Miltaburra Nov 2008 (mm)	Soil moisture Poochera Nov 2007* (mm)	Extra soil moisture in profile relative to cereal (mm)	Soil moisture Poochera Nov 2008 (mm)
Cereal	82	0	39	60	0	22
Chemical Fallow	98	16	37	78	18	18
ATR -Stubby	86	4	41	55	-5	24
Medic	87	5	39	71	11	23
Vetch	95	13	40	72	12	21
LSD (P=0.05)	*7.2*		*ns*	*ns*		*ns*

**Soil moisture left in the profile after the different crops were grown.*

Organic matter may be important for rhizoctonia to survive as saprophyte (free living without a host plant) and high levels may increase disease inoculum levels. Rhizoctonia inoculum was higher at Poochera than Miltaburra and this may be due to more soil organic matter at Poochera.

What does this mean?

Three years of trials at Miltaburra show using canola in this environment reduces rhizoctonia inoculum levels, lowers the level of root infection and increases yield similar to a fallow despite increased soil moisture under the fallow treatment. DNA testing has shown the level of beneficial microbes (PEM) did not increase under the brassica treatments. Using the best adapted varieties is important when growing canola to maximise the benefit of reducing Rhizoctonia inoculum levels. Weed control is also important shown by the increase in yield between ATR-Stubby in the Variety treatments and the Management treatments, in which ATR-Stubby with Simazine was used post sowing.

The Rhizoctonia inoculum level did not decrease as much at Poochera as at Miltaburra, and this may be due to the organic C levels (Table 6), indicating we still need more research to understand the factors which reduce and increase Rhizoctonia inoculum levels.

Acknowledgements

Thank you to SAGIT and GRDC for funding this project. Thanks to the Mudge family for allowing us to have trials on their property since 2005, and thanks to the Gosling family for allowing us to have ongoing trials.

Table 5 Average results from the Brassica variety treatments over three years 2005–2008

Brassica Treatment	Rhizoctonia Root Score (0=none, 5=severe)	Dry Matter (mg/plant)	Barley Yield (t/ha)
Cereal	2.40	1.23	0.51
Chemical Fallow	1.68	1.70	0.67
ATR - Eyre	1.80	1.52	0.67
ATR - Stubby	1.71	1.44	0.71
Rivette	1.85	1.51	0.59
Juncea Canola	1.96	1.62	0.62
High glucosinol - ATR variety	1.90	1.63	0.68
Biofumigant mustard	1.93	1.37	0.51
Low glucosinol	1.79	1.42	0.59
Vetch	1.50	1.68	0.81
LSD (P=0.05)	*0.33*	*ns*	*0.08*

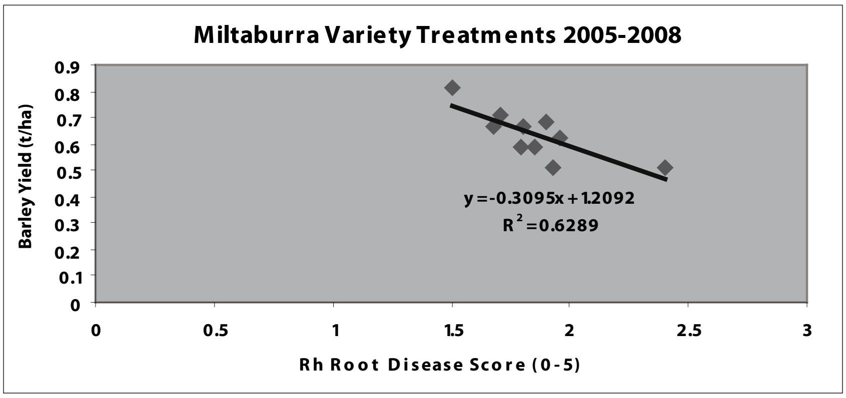


***Figure 3** Miltaburra Variety treatments in 2005-08 seasons and the relationship between yield and visual root score*

Table 6 Soil properties of trial sites

Soil	Depth (cm)	Org Carbon (%)	Nitrate N (mg/kg)	$CaCO_3$ (%)
Miltaburra*	0-10	0.5	20	54
Poochera**	0-10	1.1	29	58

**taken from SS Survey Feb 2007, **taken from Soil C project Feb 2008.*

Grains Research & Development Corporation

Understanding the Impact of Soil Carbon and Nitrogen on Disease Suppression

Research

Amanda Cook, Nigel Wilhelm and Wade Shepperd

SARDI, Minnipa Agricultural Centre

Searching for answers

Location
Poochera
I & J Gosling

Rainfall
Av. Annual: 324 mm
Av. GSR: 245 mm
2008 Total: 245 mm
2008 GSR: 143.5 mm

Yield
Potential: 1.0 t/ha (W)
Actual: 0.6 t/ha

Paddock History
2008: Wheat
2007: Oats
2006: Wheat

Soil
Grey calcareous loam

Plot size
40 m x 4 reps

Location
Minnipa
B and K Heddle

Rainfall
Av. Annual: 325 mm
Av. GSR: 236 mm
2008 Total: 234 mm
2008 GSR: 134.5 mm

Yield
Potential: 0.9 t/ha (W)
Actual: 0.1 t/ha

Paddock History
2008: Wheat
2007: Medic
2006: Wheat

Soil
Brown calcareous sandy loam

Plot size
40 m x 4 reps

Continues

Key messages

- **Trials have been established to better understand the impact of soil carbon (C) and nitrogen (N), on disease suppression of Rhizoctonia.**
- **The three trial sites established have very different mineral N levels.**
- **Carbon inputs differed with the extra cereal chaff and crop, resulting in 21 t/ha biomass being added into the system, double the cereal control.**
- **The two poor soils had contrasting biomass production in the first season.**

Why do the trial?

This research is part of a new three year project funded by SAGIT and EPARF to understand the impact of soil carbon and nitrogen cycling on disease suppression. *Rhizoctonia solani* (AG-8) continues to cause major disease problems in our cereal based farming systems. However, disease suppression offers hope for substantially reducing the impact of this disease. Disease suppression is caused by the soil microbial population and results in reduced disease on crop plants.

The development of biological disease suppression in a dryland cereal system was first observed in a rotation trial at Avon, in the lower north of SA. In 1983 Rhizoctonia caused poor plant growth in 46% of the trial area, but this declined to negligible levels by 1990. The Avon soil was an alkaline calcareous sandy loam (typical of the mallee), pH (water) 8.2, organic carbon of 1.6%, total N 0.15%, $CaCO_3$ 8% (Roget, 1995). Mineral nitrogen in the soil is believed to be a 'switch' which turns disease suppressive activity on or off (Roget and Gupta, 2006) with suppressive activity being reduced with increasing mineral N in the surface soil.

A trial is being conducted in the paddock N12 on the Minnipa Agricultural Centre (MAC) to see how robust suppression is under upper Eyre Peninsula environments. This paddock shows disease suppression and the trials are testing whether different rotation or nitrogen fertiliser options will 'switch' suppression off.

Trials have also been established on a calcareous grey and red soils to see if suppression can be induced by increasing carbon inputs into the farming system.

This work complements the current GRDC Project – 'Better prediction and management of rhizoctonia disease risk in cereals', with Gupta (CSIRO) and Roget, and the Dept of Climate Change project – 'Improving the capability of FullCAM to predict greenhouse gas emissions' (by accurately measuring carbon fractions on highly calcareous soils), with Jeff Baldock (CSIRO).

How was it done?

Increasing N Trial

A trial was established in MAC N12 to determine the relationships between soil nitrogen, microbial populations and disease suppression. The treatments aim to increase soil nitrogen in the system and monitor how this affects disease suppression. The treatments include two nitrogen fertilisers; urea and sulphate of ammonia (split applications; 30 kg N/ha at seeding and 30 kg N/ha in early Sept), peas, medic (with and without grass or mown to simulate grazing),

Location
Minnipa
Minnipa Ag Centre N12
Rainfall
Av. Annual: 325 mm
Av. GSR: 236 mm
2008 Total: 251 mm
2008 GSR: 139 mm
Yield
Potential: 1.0 t/ha (W)
Actual: 0.5 t/ha
Paddock History
2008: Barley
2007: Triticale
2006: Wheat
Soil
Red sandy loam
Plot size
40 m x 4 reps

Table 1 Soil characteristics at trial sites, MAC N12, Minnipa and Poochera, February 2008

Soil	Depth (cm)	pH ($CaCl_2$)	Boron (mg/kg)	Org C (%)	Nitrate N (mg/kg)	P (mg/kg)	$CaCO_3$ (%)
MAC N12	0-10	8.1	1.3	1.1	18	27	0.9
	10-20	8.1	1.6	0.8	28	17	1.7
	20-40	8.1	2	0.6	5	7	9.3
	40-60	8.2	2.8	0.4	3	4	14
	60-80	8.3	9	0.3	3	4	22
	80-100	8.3	16.9	0.3	4	4	28
Minnipa	0-10	8	2.7	1.3	43	24	29
	10-20	8	5.5	0.9	44	8	32
	20-40	8.1	18.8	0.7	13	5	41
	40-60	8.3	18.5	0.6	7	2	55
	60-80	8.2	19.2	1.1	5	4	57
	80-100	8.1	21.2	0.4	4	4	55
Poochera	0-10	7.9	1.4	1.2	29	25	49
	10-20	7.9	2.3	1.2	22	10	52
	20-40	8.1	2.4	0.6	40	6	48
	40-60	8.3	4.7	0.5	39	3	46
	60-80	8.8	6.9	0.4	22	3	50
	80-100	8.7	6.5	0.4	17	3	53

Table 2 Dry matter and grain yields from MAC N12 Increasing N trial, 2008

Treatment	Seeding Rate (kg/ha)	Dry Matter at Harvest (t/ha)	Grain Yield (t/ha)	Protein (%)	Screenings (%)
Wheat - Correll	60	7.5	0.44	17.0	24.5
Wheat - Sulphate of Ammonia @ 60 kg/ha (split)	60	7.5	0.46	17.4	23.7
Wheat - Urea @ 60 kg/ha (split)	60	6.7	0.41	17.5	19.8
Peas	100	3.5	0.25		
Medic	10	2.6			
Medic with grass	10	2.0			
Medic mown	10	1.4			
LSD (P=0.05)		*1.1*	*0.09*	*ns*	*ns*

Table 3 Dry matter and grain yield results from Poochera Increasing Carbon Trial, 2008

Treatment	Seeding Rate (kg/ha)	Dry Matter at Harvest (t/ha)	Grain Yield (t/ha)	Protein (%)	Screenings (%)
Barley DM*	120	15.3	1.42		
Barley and Vetch	50 +15	6.3	-		
Control wheat	60	8.7	0.61	15.2	13.6
Canola*	10	10	0.32		
Wheat DM*	120	10.7	0.71	16.6	10.7
Stubble 5 t	60	9.7	0.51	15.8	12.2
Stubble 10 t	60	10.8	0.43	15.9	10.8
LSD (P=0.05)		*2.4*	*0.09*	*0.3*	*ns*

**these treatments received double fertiliser rates* fallow (no carbon or N input into the system) or wheat (Correll @ 60 kg/ha with 50 kg/ha of 18;20). Medic plots were sown dry on 13 May and the rest of the trial was sown on 26 May. Grass selective herbicides were applied to the grass-free medic and pea treatments mid season.

Increasing C Trial

Identical trials were established on a grey and a red calcareous soil, at Poochera and Minnipa respectively, to monitor carbon input into soil with different crops. Treatments included extra cereal stubble (5 or 10 t/ha); wheat, barley or canola at high seeding rates with fluid fertiliser (to encourage high dry matter production) and wheat, Correll @ 60 kg/ha with 18:20 @ 60 kg/ha. The fluid fertiliser used was APP and UAN at the same nutrient rate as granular (12 kg P/ha and 10 kg N/ha). The barley and vetch was a brown manure treatment being sprayed out at late tillering. Zinc was drilled below the seed on all treatments except the fallow as a fluid at 1 kg Zn/ha. However, the high dry matter production treatments of wheat, barley or canola at Poochera received double fertiliser, both fluid and granular due to operator error. The Minnipa trial was sown on 26 May in dry conditions and the Poochera trial was sown on 28 May into reasonable moisture.

What happened?

The trial sites were chosen for high rhizoctonia disease levels and poor production. Initial soil tests were taken to characterise the soils at each site (Table 1). Soil pH right down the profile is similar for all three soils. The Minnipa site has high boron at a depth of 20–40 cm compared to the other sites. Organic carbon levels at all sites are typical for the upper EP; being relatively low in the surface and decreasing with depth. The Poochera site has a much higher level of nitrate-N throughout the profile (total of nearly 400 kg N/ha compared to MAC N12 at just over 100 kg N/ha and Minnipa at 180 kg N/ha). Soil P levels are good at N12 but only moderate for the highly calcareous grey soils at Minnipa and Poochera. Calcium carbonate (limestone) levels are low in N12 until deeper in the profile, while the two grey soil sites have high levels throughout the profile.

Table 4 Dry matter and grain yield results from Minnipa Increasing Carbon Trial, 2008

Treatment	Seeding Rate (kg/ha)	Dry Matter at Harvest (t/ha)	Yield (t/ha)
Barley DM	120	4.8	0.4
Barley and Vetch	50 +15	4.7	-
Control wheat	60	2.9	0.07
Canola	10	1.5	0.11
Wheat DM	120	3.9	0.11
Stubble 5 t	60	2.7	0.05
Stubble 10 t	60	2.7	0.05
LSD (P=0.05)		*1.4*	*0.05*

Increasing N Trial (N12)

The trial established well but struggled all season, especially in spring with low rainfall. All soil profiles were completely dry at the end of the season, regardless of treatment. N treatments this season had no effect on wheat growth, yield, protein or screenings. Nitrogen levels and disease inoculum will be measured at the start of the 2009 season.

Increasing C Trial

The Poochera trial was sown into reasonable moisture and yielded well given the dry season. Stubble treatments were spread with 5 and 10 t/ha of wheat chaff prior to seeding, which unfortunately also contained small grain. The grain germinated and resulted in small weak plants (as "thick as hairs on a cat's back") which competed with the crop for moisture resulting in lower yields.

The double seeding rate of barley produced the greatest dry matter and yield. The double seeding rate of wheat produced similar levels of dry matter to the stubble treatments only because of the extra small plants which germinated in the chaff of the stubble treatments. It is hard to tell the impact of double fertiliser rates in the treatments with the asterisks on dry matter production or yield.

The trial at Minnipa was sown into dry conditions and the fluid treatments germinated three weeks earlier than all the others and yielded best, but the whole trial struggled all season with low rainfall. The fluid treatments and the barley+vetch produced the greatest dry matter. The yield results from the Minnipa trial need to be treated with caution as they are extremely low.

What does this mean?

The trials have been established to better understand the impact of soil carbon (C) and nitrogen (N), on disease suppression of Rhizoctonia. We have established trials on three sites with very different mineral N levels at the start of the trial, and the two poor soils have contrasting biomass production in the first season. The carbon inputs also differed with the extra cereal chaff and crop, resulting in 21 t/ha biomass being added into the system, which is double that of the cereal control. Further monitoring of soil carbon and nitrogen, microbial populations and the changes in Rhizoctonia inoculum levels will give us a better understanding of the soil biology in our current systems in low rainfall areas, and whether it is possible to manipulate them to our advantage.

Acknowledgements

Thank you to SAGIT and EPARF for funding this project. Thanks to Goslings and Heddles for allowing us to have trials on their property.

SAGIT

EPARF
EYRE PENINSULA
Agricultural Research Foundation Inc.

Better Prediction and Management of Rhizoctonia Disease in Cereals

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Research

Searching for answers

Location
Streaky Bay
B Goosay
Streaky Bay Agricultural Bureau

Rainfall
Av. Annual: 340 mm
Av. GSR: 274 mm
2008 Total: 256 mm
2008 GSR: 164 mm

Yield
Potential: 1.3 t/ha (W)
Actual: up to 0.7 t/ha

Paddock history
2007: Barley
2006: Wheat
2005: Pasture

Soil
Highly calcareous grey loamy sand

Plot size
60 m x 1.48 m

Other factors
Early moisture stress, strong winds, Polyphrades

Key message

- **This trial and similar trials across the southern cereal growing region aim to better predict the incidence of Rhizoctonia by better understanding disease inoculum levels and soil microbial populations.**

Why do the trial?

Rhizoctonia continues to be an important but unpredictable disease in the southern agricultural region. This is a national project funded by GRDC to improve the long term control of Rhizoctonia by increasing the understanding of the interactions between disease inoculum and natural soil suppressive activity to improve the prediction and management of disease. As part of the project a three year trial was established at Streaky Bay in 2008. Disease inoculum levels will also be monitored in EP paddocks over summer.

How was it done?

Rhizoctonia disease control and inoculum levels are being compared with three different tillage systems; conventional cultivation (21 April - wide sweeps; 12 May - narrow points), strategic cultivation (12 May - narrow points), no-till and several rotations. The trial was sown on 10 June after 10 mm of rainfall with very little moisture below the seedbed. Correll wheat was sown @ 70 kg/ha with 18:20 @ 60 kg/ha and urea @ 35 kg/ha. Cobbler canola (sown @ 5 kg/ha) and Herald medic (sown @ 2.5 kg/ha) had poor establishment due to strong winds and these plots were later resown, and the canola was not harvested. Sampling included soil characterisation, soil moisture, pathogen DNA levels, root disease infection, dry matter, soil microbial populations and grain yield.

What happened?

At sowing 450 ± 112 and 371 ± 94 g of *Rhizoctonia solani* DNA per g soil were present under the no-till and cultivated treatments respectively. Root damage rating for six week old seedlings and field disease rating at anthesis (flowering) were lower as a result of conventional cultivation (Table 1).

Lack of rainfall during September and October resulted in overall poor crop performance for all the crops and no differences in grain yield between treatments this season. Wheat grain yields ranged from 0.49 to 0.65 t/ha. There were also no differences between treatments in terms of anthesis dry matter levels. The canola crop was not harvested.

The levels of *R. solani* DNA will be monitored over summer in the experimental plots and selected farmer's paddocks in order to determine the factors that influence the pathogen inoculum in soil.

What does this mean?

Conventional cultivation had a lower level of disease incidence compared to no-till or strategic cultivation, which is consistent with previous trials and farmer observations. This reduction in disease following conventional cultivation was not due to lower Rhizoctonia inoculum levels, which remained high for all treatments.

This suggests that the cultivation effect on Rhizoctonia is due to an improved soil environment for root growth through possible factors such as less compacted soil, improved nutrient regime, or a reduction of other interacting diseases. The very dry finish to the season prevented the differing levels of Rhizoctonia damage between treatments to follow through to grain yield.

This first year of the experiment was mainly to establish crop and management treatments so that we can determine their impact on pathogen inoculum levels and suppressive communities and their relationship to disease incidence. The observation of reduced disease incidence in the cultivation treatment without a change in the initial inoculum levels is contrary to our current understanding and highlights the very important role of the new technologies such as DNA assessments to help unravel this difficult disease.

Acknowledgements

Thank you to GRDC for funding this project. Thanks to the Williams and Goosay families for allowing us to have trials on their property.

Table 1 Root disease rating and field disease levels at anthesis at Streaky Bay, 2008

Rotation	Tillage	Root scoring of 6wk old seedlings		Field assessment	
		Seminal root score (0-5)	% infected rows	No. of infected rows (% infected rows)	Severity*
Continuous cereal	No-till	1.38	39	2.2 (27)	0.64
Continuous cereal	Conv. cult	1.00	26	1.2 (15)	0.33
Continuous cereal	Strategic cult	1.63	45	1.4 (18)	0.42
LSD (P = 0.05)		*0.43*	*ns*	*0.7*	*0.22*

**Increasing severity is rated on a scale of 0 to 2*

SAGIT SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE CSIRO GRDC Grains Research & Development Corporation

Cereal Variety Disease Guide 2009

Hugh Wallwork and Pamela Zwer

SARDI, Waite

Information

Summary of 2008 season and implications for 2009

Stripe rust

During 2008 three different strains (pathotypes) of stripe rust were recorded in SA. Of these the most common and widespread was the new 'Jackie' pathotype (134E16 A+ J+) which was first observed in NSW in October 2007. This pathotype was derived from the old WA pathotype and is able to severely infect some of the triticale varieties including Jackie. It is unable to overcome the Yr17 (VPM) resistance gene so varieties such as Pugsley, Gladius and Espada were mostly resistant in 2008. The original WA strain was also recorded in the Lower North and at Tumby Bay. The Yr17 attacking pathotype was recorded from only one location, Kapinnie, in SA in 2008 however it was recorded from numerous locations in NSW and Victoria so is quite likely to recur in SA in future years.

Both the Jackie and Yr17 attacking pathotypes are derived from the WA pathotype. There does not appear to be any significant variation in the level of adult plant resistance in varieties infected by these pathotypes.

A further new pathotype (134E16 A+ J+ Yr27+), which first appeared in Victoria and NSW in 2008, is capable of overcoming the Yr27 gene. This pathotype will make the variety GBA Ruby susceptible but should not change the resistance rating of any other varieties currently grown in SA.

In this year's Disease Guide we have presented the response of varieties to the Yr17 virulent pathotype since this is currently the most damaging on wheat varieties. Varieties with the Yr17 resistance gene are indicated in the table and these will be resistant if this pathotype is not present.

The cool spring conditions in SA in 2008 resulted in some adult plant resistance (APR) being less effective than in other years. This was particularly the case with Wyalkatchem which showed little resistance throughout the season. Most damaging stripe rust infections in SA occurred on this variety. With several new varieties with better resistance now available Wyalkatchem should now be replaced. This will also reduce future risks from stem rust and powdery mildew.

Other wheat foliar diseases

There was no stem or leaf rust reported in wheat crops in South Australia, Victoria, or southern NSW during 2008.

Flag smut appeared in a few crops on the eastern Eyre Peninsula. In each case the susceptible variety Wyalkatchem was infected. Other varieties that are likely to show severe flag smut if left untreated for too long are AGT Scythe and Magenta.

Net form net blotch (NFNB)

Many Keel crops on the northern Yorke Peninsula, Adelaide Plains and Lower North showed high levels of net form net blotch early in the season. In most cases this occurred where Keel was sown into barley stubbles. However, the disease failed to develop during winter and spring such that little damage was visible in crops later in the season.

Glasshouse tests on seedlings and adult plants using isolates collected from Keel during 2007 and 2008 showed the NFNB isolates on Keel had increased virulence on Keel at later growth stages, but that they were all less aggressive (slower growing and less damaging) than isolates collected before 2007 from other varieties. Tests on differential varieties with seedling resistance showed that two of the 2008 isolates more closely resembled much older strains from Western Australia than isolates collected in SA in recent years. The isolates were less virulent on Franklin but more virulent on Hindmarsh and Baudin than isolates collected in SA before 2007.

It is not known whether the lack of infection in crops during spring was due to unfavourable weather conditions or to the low aggressiveness observed in the new strains. It is quite likely that over time the new virulence will combine with increased aggressiveness observed in older isolates and this could lead to more severe damage in future in varieties such as Keel, Hindmarsh and Baudin.

Other barley foliar diseases

Leaf scald was observed at high levels in crops that benefited from good rains. Higher than expected levels were found in some early sown Keel, Fleet and Flagship crops in the Mid-North.

Powdery mildew developed to serious levels in some barley crops in the Mid-North. As with 2007, the high level of powdery mildew was most likely due to growers trying to reduce Rhizoctonia with Dividend fungicide. It is strongly recommended that where Dividend is used that it be combined with a fungicide that controls powdery mildew. This will not only protect the treated crops but also other crops in the district once the effects of their seed treatments wear off.

Leaf rust was at low levels in 2008 mainly due to late sowing of crops and dry conditions on the lower Yorke Peninsula where the rust generally survives between seasons. Leaf rust was more damaging on some crops in the South-East where the rust also commonly survives over summer.

Oat diseases

Oats were largely free of disease in 2008, although red leather leaf was found in several crops and particularly where oats were sown into oat stubbles. Bacterial blight is also a particular threat in wet years where oats are grown as successive crops. Red leather leaf also developed uniformly in a breeders trial, so ratings for this disease have now been added to the oat variety disease table. A fungicide spray trial in 2008 showed that none of the available fungicides provided useful protection against red leather leaf.

Explanation for Resistance Classification

R The disease will not multiply or cause any damage on this variety. This rating is only used where the variety also has seedling resistance.

MR The disease may be visible and multiply but no significant economic losses will occur. This rating signifies strong adult plant resistance.

MS The disease may cause damage but this is unlikely to be more than around 15% except in very severe situations.

S The disease can be severe on this variety and losses of 15-50% can occur.

VS Where a disease is a problem this variety should not be grown. Losses greater than 50% are possible and the variety may create significant problems to other growers.

This classification based on yield loss is only a general guide and is less applicable for the minor diseases such as common root rot, or for the leaf diseases in lower rainfall areas, where losses are rarely severe.

Other information

This fact sheet supplements other information available including the cereal sowing guides (Grain Business, November 2008) and Crop Watch newsletters. Cereal Leaf and Stem Diseases and Cereal Root and Crown Diseases books (2000 editions) are also available from Ground Cover Direct or from Hugh Wallwork in SARDI.

Disease identification

A diagnostic service is available to farmers and industry for diseased plant specimens. Samples of all leaf and aerial plant parts should be kept free of moisture and wrapped in paper not a plastic bag. Roots should be dug up carefully, preserving as much of the root system as possible and preferably kept damp. Samples should be sent to the following address:

SARDI Diagnostic Centre
Plant Research Centre
Hartley Grove
Urrbrae SA 5064

Further information contact:
hugh.wallwork@sa.gov.au

Wheat	Rust			CCN		Septoria tritici blotch	Yellow leaf spot	Powdery mildew	Root lesion nematodes			Crown rot	Common root rot	Flag smut	Black point	Quality in SA
									P. neglectus		*P. thornei*					
	Stem	Stripe#	Leaf	Resistance	Tolerance				Resistance	Tolerance	Resistance					
Annuello	R	MS-S	MR	R	I	S	S	–	MS-S	MI	S	S	–	MR	MS	AH
Axe	MS	MR	MR	S	–	MR-MS	S	MR	S	–	S	S	MS-S	S	MS-S	AH
Barham	MR	#MS-S	MR-MS	MS	–	MS-S	MS-S	MR-MS	MR	–	MS	S	MS-S	MR-MS	MS	Soft
Bowie	S	#S	MR	MR-MS	MT	MS	S	–	MR	MT	MS	S	S	–	MR-MS	Soft
Bullet	R-MR	MS-S	MR-MS	MR	–	S	MR-MS	–	–	–	–	S	-	S	MS	APW
Catalina	MR-MS	MR-MS	R-MR	R	–	MS-S	MS-S	MR-MS	S	–	MS	S	MR-MS	R-MR	–	AH
Chara	MR-MS	MS-S	MS	R	MI	MS	MS-S	–	MS-S	MT	MR	S	S	MR	MS	AH
Corell	MR-MS	MR-MS	MS	MR	–	MR-MS	S-VS	R	S	–	MS	S	MS-S	R	MR-MS	AH
Derrimut	R-MR	#MS^	R	R	–	MS-S	MS-S	MS	S	–	MS-S	S	S	R	S	AH
Espada	R-MR	# MR-MS	R-MR	MS	–	S	MR-MS	–	MS	–	S	S	MS	MS	MS-S	APW
Frame	MS	MR-MS	MS	MR	MT	MS	S-VS	R	MS-S	MT-T	S	S	S	MR	MS	APW
Gladius	MR	#MR-MS	MS	MS	–	S	MS	MR-MS	MS-S	–	MS-S	S	MS	R-MR	MR	AH
Guardian	R-MR	MS	MS	R	–	MS-S	S	MR-MS	S	–	MS	S	MS	S	S	APW
H46	MR-MS	#VS	R	S	MI	VS	MR-MS	S-VS	MS	–	MS-S	S	MS-S	R-MR	MR-MS	APW
CLF Janz	MR	MS	MS	S	I	MS	S	MS	MS-S	MI	S	S	MS-S	R	S	AH
Krichauff	MR	S-VS	S	S	MT	MS	MS	–	MR	MT	MS	S	MS	MR-MS	MR	ASW
Kukri	MR	MR-MS^	R	S	I	MR	MS	–	MR-MS	MT	MS	MS	S	MS	MS	AH
Lincoln	MR	R	R-MR	S	–	S	MR-MS	–	S	–	S	–	MS	R/MR	–	AH
Mace	MR	#MS-S	R	MR-MS	–	MR-MS	MR-MS	–	MR	–	–	–	–	S	MR	-
Magenta	R	MS	MR	MS-S	–	MS	MR	R	–	–	–	–	S-VS	S-VS	S	ASW
Peake	MR-MS^	MR-MS^	R^	R	–	S	MS-S	MS	S	–	MS	S	S	MR-MS	MS-S	AH
Pugsley	MS	#S	MR	MS	MI	MS	S	MS	S	MT	–	S	MS	MR	MS	APW
Ruby	MR-MS	R-MR ¶	R	S	–	MR-MS	MR	MS	–	–	–	S	MS	S	MS	ASW
Scythe	MR	MS-S	MS-S	S	–	MS	S	R	MS	–	MS-S	S	MS	S-VS	MR	APW
Sentinel	R	R-MR	R	S	–	MS-S	MR-MS	R	S	–	MS	MS-S	S	MS-S	–	ASW
Wyalkatchem	MS	S§	R	S	MI	MR-MS	MR	S	MR	MT-T	–	S	S	S	MS	APW
Yitpi	S	MR-MS	MS	MR	MT	MS	S-VS	–	MR-MS	MT-T	–	S	MS	MR	MS	AH
Young	MR	#MS^	MR-MS	R	–	MS	MR-MS	R	S	–	MS	S	MS-S	MS	MR	AH
Durum																
Hyperno	R	MR	R	MS	–	–	–	–	MR-MS	–	–	VS	–	–	MR	Durum
Kalka	MR	MR	MR	MS	MT	MS	MR	–	MR-MS	–	R	VS	MS	R	S	Durum
Saintly	MR	MR	MR	MS	–	–	–	–	MR-MS	–	–	VS	–	–	MR	Durum
Tamaroi	R	MR	MR	MS	–	S	MR	–	MR-MS	MI	R	VS	MS	R	MS	Durum

Wheat cont.

Triticale																
Jaywick	MR-MS	MR-MS	R	R	–	–	–	–	–	–	–	–	–	–	–	Triticale
Hawkeye	R	MR	R	R	–	–	–	–	–	–	–	–	–	–	–	Triticale
Kosciuszko	-	S	S	S	T	–	–	–	–	–	–	–	–	–	–	Triticale
Rufus	MR	R	R	R	T	–	–	–	R-MR	MT	R-MR	–	–	–	–	Triticale
Speedee	R	MS	R	S	T	–	–	–	R-MR	MT	–	S	–	–	–	Triticale
Tahara	R	MR	R	R	T	R	R	–	R-MR	MT	R	S	MS	R	–	Triticale
Treat	R	MR	MR	MS	T	–	R	–	MR-MS	MT	–	S	MS	R	–	Triticale

 # - The stripe rust ratings are for the WA Yr17 strain prevalent in SA in 2007 and also present at low levels in 2008. Varieties with a # have the Yr17 (VPM) seedling resistance and so will be resistant to the older WA and the newer WA Jackie strains..
^ - Some susceptible plants in mix
§ - Wyalkatchem shows stronger stripe rust resistance at higher temperatures. This variety is rated as MS-S nationally.
¶ - Ruby has the resistance gene Yr27 which is no longer effective to a new strain found in NSW in 2008.)
†Tolerance levels are lower for durum receivals.

R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible, VS = very susceptible,
Black point is not a disease but a response to certain humid conditions
T = tolerant, MT = moderately tolerant, MI = moderately intolerant, I = intolerant, VI = very intolerant, – = uncertain

Oats	Rust		*Septoria avenae*	BYDV	CCN		Stem nematode		Bacterial blight	Red leather leaf	*Pratylenchus neglectus*	
	Stem	Leaf			Resistance	Tolerance	Resistance	Tolerance			Resistance	Tolerance
Brusher	MS	R	MR-MS	MS	R	MI	–	I	MS	MR-MS	MR-MS	–
Echidna	S	S	VS	MS	S	VI	R	T	S	MS	MR	MI
Eurabbie	MS	S	MR	MS	MS	MI	MS	MI	S	MR-MS	–	–
Euro	VS	MS	S	MR	R	VI	VS	I	MS	MS	MR	T
Glider	R	R	MR	S	MS	I	R	MT	R	R	–	–
Kangaroo	R	MR	MR	MS	R	MT	–	MI	MS	MS	–	–
Marloo	S	S	MS	MR	R	MT	MS	MI	S	S	–	–
Mitika	R	MR	MS	MS	VS	I	–	MT	MR	MS	–	–
Numbat	S	MR	MS	R	S	I	–	I	S	-	MR	–
Potoroo	S-VS	MS	VS	MS	R	T	MR	MT	S	VS	MR	T
Possum	MS	MS	MS	MS	VS	I	–	MI	S	MS-S	MR	–
Quoll	R	R	MR	MS	S	I	R	T	MS	MS	MR-MS	–
Swan	VS	S	MS	S	R	VI	VS	VI	MS	S	MR-MS	–
Tungoo	MS	MR	MR	MR	R	MT	R	T	MR	R		
Wallaroo	S	S	S	MS	R	MT	MS	MT	MS	MS	MR	MI
Wintaroo	S	S	MR	MR-MS	R	MT	MR-MS	T	MS	MS	MR-MS	–
Yallara	MR	R	MS	MS	R	I	–	I	MS	MS	–	–
Yallara	MR	R	MS	MS	R	I	–	I	MS		–	–

Disease

Barley	Scald	Spot form net blotch	Net form net blotch	Leaf rust	Powdery mildew	CCN		Root lesion nematodes		Barley grass stripe rust	Covered Smut	BYDV	Common root rot	Black point
						Resistance	Tolerance	*P. neglectus*	*P. thornei*					
Barque	S-VS	MR	MS-S	MS	MR	R	T	R-MR	MR	MR	S	S	S	S
Baudin	MS-S	MS-S	MS#	VS	S-VS	S	T	–	–	MR	S	MR	S	MS
Buloke	MR-MS	MS-S	MR	MS-S	MR	S	T	–	–	R	MR	S	MS	S
Capstan	MR#	MS	MS	MS	MR	R	T	MR	–	MR-MS	MR	S	S-VS	MS
Commander	S	S	MS	S	MR	R	T	–	–	R	R	S	MS-S	S
Flagship	MS	MR-MS	MR-MS	MS-S	MR-MS	R	T	R	MR-MS	MR	MR-MS	S	S	S
Fleet	MR-MS	MR	MR-MS	MS	MR-MS	R	T	–	–	MR	MR	S	MS-S	S
Gairdner	R#	S-VS	MR-MS	MS	MR	S	T	MR	MR-MS	R	–	MR	MS-S	MR
Hindmarsh	MR#	S	MR#	MS-S	MS	R	T	–	–	R	MS	S	S	–
Keel	MS	MR	MS#	VS	MR-MS	R	T	MR	MR	MS	R	S	S	S-VS
Maritime	MS-S	MR-MS	R-MR	MS	S	R	T	MR	–	S	MS	S	S	S
Schooner	MS-S	MS-S	MR	S-VS	S	S	T	MR-MS	R	R	MR	S	S	S
Sloop	S	S-VS	MR	S	S	S	T	MS	MR	MR	R	S	S	MS
Sloop SA	S	S-VS	MR	S	S	R	T	MS	R	R	R	S	S	MS
Sloop Vic	S	S	MR	MS-S	MR	R	T	MS	R	R	–	S	–	MS
Yarra	S-VS	MS	MS	R	S	R	T	–	–	R	MS	S	S-VS	S-VS
WI4262	R	MR-MS	MR#	VS	–	R	T	–	–	MR	MS	S	S	–
Quickstar	MR	S	-	R	R	R	T	–	–	–	–	–	–	–
Starmalt	MS	S	-	S	R	S	T	–	–	–	–	–	–	–

#These varieties may be susceptible if alternative strain is present.
R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible, VS = very susceptible ,T = tolerant, – = uncertain

Section 7

Section editor:
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SARDI
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Livestock and Feedbase

Strip Grazing of Cereals and Canola at MAC 2008

Demo

Mark Klante and Alison Frischke
SARDI, Minnipa Agricultural Centre

Best practice

Location
Minnipa
Minnipa Agricultural Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2008 Total: 251 mm
2008 GSR: 139 mm

Paddock History
2007: Wheat
2006: Wheat
2005: Pasture

Soil Type
Red sandy loam

Plot size
Broadacre demonstration

Yield Limiting Factors
Very dry season

Livestock
Type of stock: Sheep
Enterprise type: Self replacing merino

Continues

Key messages

- **Cereal sown early in autumn for feed allows pastures to get established before being grazed, and frees up pasture paddocks so that grass free spraying can be done early.**
- **Hay-freezing a forage crop ensures grass weeds are controlled.**
- **Check the nutritional value of grazed crops at different growth stages to ensure it meets the animals' requirements.**
- **Sowing canola for feed enabled use of surplus grain that was graded but not suitable for sale (low oil content).**
- **Use strip grazing to better utilise feed on hand and help control erosion (especially around watering points).**

Why do the demonstration?

The aim of this demonstration was to provide early feed for stock in autumn, a time of year when pastures haven't established properly, and get our ewes and lambs out of the confinement feedlot and onto good quality feed as soon as possible. The sheep were in confinement feeding during summer and autumn as stubbles were scarce after the poor 2007 season and there was no paddock feed. Pastures on Minnipa Agricultural Centre are medic based which are slow to establish after rain and take some time to grow enough dry matter to allow grazing. In previous seasons with late breaks sheep are fed well into seeding time.

The paddock was sown to barley that was hay-frozen and canola, both providing a grass freeing opportunity and a break in the rotation. There was never intent to harvest the crop. The canola was seed on hand that couldn't be sold (oil content too low), so it was sown for feed in the demonstration.

Knowing the nutritional requirements of stock and the quantity and nutritional value of feed is important so that feed can be supplied to meet demands and optimise production (Table 1). The demonstration was an opportunity to collect local feedbase data, and ensure the ewes with lambs at foot were receiving adequate nutrition.

Stocking rate: 13 – 40 DSE/ha

Environmental Impacts
Soil Health
Soil structure: more even grazing
Compaction risk: low

Social/Practice
Time (hrs): set up fence
Clash with other farming operations: standard management
Labour requirements: labour to shift sheep

Economic
Infrastructure/operating inputs: electric fence, portable trough
Cost of adoption risk: low

The demonstration built on previous Eyre Peninsula Grain & Graze research and extension, highlighting the use of sown cereals for early feed, strip grazing and the importance of feed testing (EPFS Summary 2007, p 75 and p 84).

How was it done?

Paddock South 2/8 (area 85 ha) on Minnipa Agricultural Centre was selected to run the demonstration as it was due for a break from cereal grain production after two years of certified seed production.

After 12 mm on 28 April, 18.5 ha of 44C73 canola was sown @ 7 kg/ha with 18:20 @ 40 kg/ha, and 65.1 ha of Maritime barley @ 55 kg/ha with 18:20 @ 40 kg/ha was sown on 29 April. It was all direct drilled with knife points and press wheels at 30 cm spacings. Fourteen hectares of section B were resown on 27 May due to a malfunction at seeding. Eight hectares of the canola was sprayed with Targa @ 300 mL/ha on 31 July to control grasses along one side of the sown area, and all of the barley was sprayed with Glyphosate @ 650 mL/ha on 30 September as a hay-freeze.

The paddock was split into four sections using three wires of electric fencing. The paddock was split to utilize existing watering points, with one section requiring a temporary watering point. Sections A and B were all barley, while sections C and D were half barley and half canola. This ensured a balanced feed mix, as canola will not meet neutral detergent fibre (NDF) requirements if grazed by itself.

In each of the four sections four enclosures were randomly erected to keep the sheep out and create ungrazed crop sampling points which were left until maturity. Pasture cuts and feed tests were sampled around these enclosures on the day the sheep went into each section, to improve the understanding of pasture quantity and quality. Grazing days and sheep numbers were also recorded.

The first graze on all sections used 220 lactating merino ewes and 220 lambs (6-8 weeks old), which were rated together at 3.2 DSE. The second graze, again on all sections, used 86 dry ewes rated at 1.2 DSE and the 220 merino lambs rated at 1 DSE.

What happened?

Sheep were moved to another section once they had evenly grazed the section they were in. Sections were not completely grazed out, but had enough left to allow plant recovery. Sheep were moved to other paddocks as regenerating pasture became available to rest the sections in the demonstration paddock.

Table 2 presents paddock management and feed quality data. The paddock supported 220 ewes and 220 lambs for 58 days (1st graze A, B, C, D and 2nd graze A), and 86 cull ewes and 220 lambs for 24 days (2nd graze B, C and D).

When sheep were put into each section they would graze very evenly around the watering point for a couple of days, and then move progressively across the paddock. Section A was grazed first and it was noted that the crop recovered well and there wasn't a big difference between the crop outside the enclosures as compared to inside. The other later grazed sections weren't able to recover in the same manner due to the nature of the rainfall events during winter (generally light, and followed by wind and frosts), but still provided a second grazing opportunity.

The electric fencing worked very well with no problems, allowing better utilisation of feed with ewes maintaining their condition and good growth rates in the lambs. Over 4 months worth of grazing was achieved, which included some rest periods where sheep were removed from the paddock. This was more than would have been achieved had the paddock been grazed as a whole.

The sections provided different amounts of dry matter according to the time of year, length of time grazed and location in the paddock (soil type variations). By creating smaller paddocks and increasing stocking rate it meant that sheep were always close to water and feed and therefore grazed the paddock more evenly and in less time, and didn't bare out the area around the trough. Smaller paddocks allowed the grazing to be controlled and reduced selective grazing.

Feed requirements of a lactating ewe and lamb and for maintenance of a dry ewe are given in Table 1 below.

Feed tests of barley taken during the growing period and when hay frozen indicated that as a feed source it had balanced nutrition and met animal requirements (Table 2).

Feed tests of canola verified that NDF (fibre) was too low to meet lactating ewe and lamb requirements, however having the barley in the same section meant that requirements were balanced. Having low fibre in the diet may have caused animal health issues. All other nutritional requirements were met. The sheep seemed to enjoy the canola and grazed it out evenly with the barley.

Table 1 Feed requirement of sheep classes

Feed Component	Lactating ewe and lamb	Maintenance of dry ewe
Crude Protein (CP)	16%	8%
Neutral Detergent Fibre (NDF)	>30%	> 30%, up to 50%
Metabolisable Energy (ME)	11 MJ/kg of DM	8 MJ/kg of DM
Digestability (DOMD)	75%	> 55%

Table 2 Grazing management and feed value of barley and canola in S2/8, MAC 2008

Section		A Barley	B Barley	C Barley & canola	D Barley & canola	A Hay-frozen barley	B Hay-frozen barley	C Hay-frozen barley & canola	D Hay-frozen barley & canola
Treatment		**1st graze**				**2nd graze**			
Size (ha)		17.7	25.1	22.1	18.7	17.7	25.1	22.1	18.7
Stock No.		220	219	219	219	219	306	306	306
DSE rating		3.2	3.2	3.2	3.2	3.2	1.1	1.1	1.1
Stocking pressure DSE/ha		39.8	27.9	31.7	37.5	39.6	13.4	15.2	18
Day in		21 July	30 July	4 Sept	14 Aug	7 Oct	20 Oct	7 Nov	3 Nov
Day out		28 July	8 Aug	23 Sept	27 Aug	16 Oct	3 Nov	13 Nov	7 Nov
Days grazed		7	9	20	13	9	14	6	4
DM utilised/ha (allocation 1kg DM/DSE/day)		278.4	251.1	634	487.5	356.4	187.6	91.2	72
Barley DM start (kg/ha)		206	322	1188	535	802	668	701	386
Canola DM start (kg/ha)				1767	924			576	297
Feed Value Barley	**CP (%)**	33.5		15.4	24.8	15.5			
	NDF (%)	33.2		39.5	38.2	43.0			
	ME (MJ/kg DM)	13.2		12.4	12.9	11.6			
	DOMD (%)	79.9		76.0	78.2	72.0			
Feed Value Canola	**CP (%)**			28.8	25.7				
	NDF (%)			23.6*	23.5*				
	ME (MJ/kg DM)			12.9	12.5				
	DOMD (%)			78.2	76.5				
Ungrazed barley DM (kg/ha)		1189	1252	964	1568				
Ungrazed canola DM (kg/ha)				752	717				

** below nutritional requirements.*

The protein content of both feed types was higher than required in most of the feed tests. High protein content feed is an energy cost to the animal as it needs spend extra energy to process the excess protein which is excreted anyhow. However, ME was also above requirements which would have provided enough extra energy to process the extra protein.

A break even or positive gross margin for the paddock was achieved by the two barley prices in a well below average year and one of the worst on record (Table 3). The depressed gross margins for section B was a result of having to resew part of the section, which meant some crop was behind in maturity and hence feed value.

The method used to calculate the gross margins has probably overestimated the benefits of the grazing crop as you are unlikely to feed a supplement to the equivalent energy value as that obtained from the crop, and it assumes there is no alternative feed available – this was true for several grazing periods but not later in the year.

However, there was extra value gained which was not included in the gross margin analysis; the extra feed grown in other pasture paddocks while sheep were on the demonstration paddock, it provided a grass control opportunity in the rotation without compromising the amount of feed available, and the grazed canola was an opportunity to use unsaleable seed and was a lower risk break crop.

While rain was falling during July and August the 1200 L portable watering point was filled once a week and was adequate to meet water demands. However during October and November while the weather was dry and the feed was dry, the sheep's daily water requirements increased substantially and the tank needed to be filled more frequently (every two days).

What does this mean?

Sowing a paddock early to a feed crop provided a valuable feed source at a time when other medic pastures on the farm were struggling to produce enough dry matter for ewes and lambs.

Table 3 Gross margin summary of paddock S2/8 Minnipa Agricultural Centre, 2008

Section	A	B	C	D	Paddock average
Area (ha)	17.7	25.1	22.1	18.7	
Cost of pasture/ha ($/ha)*	79	79	73	73	
DM utilised/ha (kg/ha)	635	439	725	560	
Grazing value (barley value 1)** ($/ha)	175	121	200	154	
Grazing value (barley value 2) ($/ha)	79	54	90	69	
Gross margin (barley value 1) ($/ha)	97	42	127	82	85
Gross margin (barley value 2) ($/ha)	0	-24	17	-3	-4

**Pasture costs included sowing inputs, herbicides and machinery expenses. Barley was valued at $350/t and feed canola at $200/t.*
***Grazing value was calculated by converting the weight of DM utilised to the dollar value of barley of equivalent energy – based on 1kg/DM/DSE/day. Two barley values were used for gross margin analysis in table 3 as the price varied by $165/t between seeding and harvest. Barley value 1 = $300/t (ABB 23/7/08). Barley value 2 = $135/t (ABB 26/11/08).*

This gave the pastures their best opportunity to establish themselves and have grass management before being utilised for grazing. Hay-freezing a forage crop ensures grass weeds are controlled.

Canola is not a balanced feed source by itself. Ensure another feed source is available to balance NDF.

Electric fencing was an effective means of dividing the paddock up for strip/controlled grazing. The stocking pressure was dramatically increased and, with close management, strip grazing was a more effective grazing strategy as selective grazing was reduced, feed was more evenly grazed and hence feed utilisation improved. Strip/controlled grazing management will be adopted as a standard practice on the Agricultural Centre from now on.

The portable watering system worked well during winter. To use the portable watering system during summer a larger storage capacity would be needed to keep up with greater water demands. Research at Minnipa has shown that during August and September sheep drank 0.1 L water/day, whilst in December and January they drank 3.7 L water/day.

References

Grain & Graze, Free Food for Thought, Grazing Winter Crops Roadshow Workshop Notes

Acknowledgements

We would like to thank Trent Brace and Brenton Spriggs for their technical help, and Daniel Schuppan for grazing management advice and Ken Webber for hay-freezing advice.

Responsive Farming with Canola

Bruce Heddle
Farmer, Minnipa

Best practice

Location
Minnipa
Bruce Heddle

Rainfall
Av Annual: 325 mm
Av GSR: 250 mm
2008 Total: 251 mm
2008 GSR: 138 mm

Paddock History
2007: Wheat
2006: Wheat
2005: Mixed pasture

Soil Type
Sand and Sandy Loam rises; stony shallow red loam flats with dry saline areas.

Plot size
Broadacre

Yield Limiting Factors
Extremely dry late May and June; hot, dry, early finish, predominantly on soil types unsuited to canola.

Livestock
Enterprise type: Self replacing Merinos
Stocking rate: 425 Merino weaner lambs for 2 months on 34 ha unharvested canola and 16 ha of hay stubble. Estimate 1.75 DSE/ha.

Environmental Impacts
Soil Health
Soil structure: Canola leaves useful stubble, highly resistant to wind erosion.
Disease levels: Nil
Chemical use: Nil
Soil Nutrients: Replacement NOT achieved in this season – dependant on residual nutrition from last two crops.
Tillage type: No-till
Compaction risk: Low

Key messages

- **Canola for grain production only remains a high risk enterprise on our farm.**
- **Canola hay provides another option that may reduce risk.**
- **Medic seems to thrive in no-till canola with potential benefits for both the livestock enterprise and soil N status.**
- **Clearfield varieties open up options where SU residues are a potential threat.**
- **Well graded, farm grown seed keeps costs down.**

Why do the trial?

Finding break crops that are suited to our environment and make consistent profit has been a challenge over the last twenty odd years, especially as the wool industry has come under ever increasing pressure. Since 1993 we have experimented with canola as a grain crop with mixed success, generally with good agronomic outcomes, but often not good financial outcomes. However, from the beginning we noticed that sheep seem to thrive on both canola stubble and failed canola crop. Across Australia hay has become a well regarded salvage option for frosted or droughted canola crops, and so this year we decided to sow canola early with very low inputs and depending on how the season progressed either direct it to grazed feed, hay or grain.

How was it done?

The paddock was approximately one third sand and sandy loam and two thirds shallow stone and heavy red loam. It had received a full label rate of trisulfuron in 2006 and produced poor crops due to drought in both 2006 and 2007. I remained concerned about the SU residue, so on 26 April, Clearfield 44C73, which we had harvested and cleaned ourselves was sown @ 3 kg/ha with no fertiliser, using knife points. Halfway through sowing the paddock, the dry sowing plan was abandoned – 12mm of rain fell overnight and the remainder of the paddock was sown into good soil moisture. The crop established very well with between 60 and 80 plants/m^2 along with an excellent medic stand.

What happened?

The two previous crops had been very clean, so the canola and medic remained essentially free of grass. In the past, we have often had to control insects, but this time we decided to gamble on the basis that even if the medic had reduced vigour from any SU residue, it would still at least occupy the gaps that any insect attack left. As it turned out, insects had no impact anyway. Matt Dunn at Tuckey had the same experience in 2008 where his canola crop outgrew the insects, including Byrobia mite.

Despite an extremely dry six week period up to the end of June, a reasonable July and early August meant that the canola still had potential as a grain crop with an average spring, and grazing was not yet an option. However, the average spring failed to eventuate, and it became obvious at late flowering that little chance remained for any tiny yield to be even marketable as grain. Fortunately, the few grass weeds in the paddock were on the sand rises, and in late September the area of the paddock free of stone was cut for hay, with the medic making a significant contribution to the total bulk.

So in an extremely poor season, on one of our poorest paddocks with no stored subsoil moisture, the area cut for hay yielded about 800 kg/ha of excellent quality hay, while the remainder of the paddock has carried about 1.85 DSE/ha (the 'hay stubble' area was a bonus). With a seed cost of about $2.00/ha plus the costs of the sowing operation, the result was relatively successful in a difficult season. Matt Dunn cut canola hay yielding about 2.2 t/ha and said that he'll now increase the seeding rate to 5 kg/ha and focus on hay production rather than seed.

What does this mean?

- Canola may have a role other than as a grain only crop.
- In this environment, if canola is to have a future, the input regime may need to change to make the risk acceptable, especially without subsoil moisture reserves.
- Medic can become a weed and increase soil water use under a canola crop, but is excellent for hay production.
- The ability to salvage a profit when seasons fail requires some forward planning and maybe a change of mindset.

Acknowledgements

Thank you to Matt Dunn for sharing his experience of turning a canola crop into hay. Thank you also to my good wife Kathryn for ironing my shirts and putting Iced Vo-Vo's in my lunchbox.

Strip grazing cereals and canola at Minnipa Agricultural Centre, 2008

Grazing Cereals at Edillilie 2008

Kieran Wauchope and Daniel Schuppan
Rural Solutions SA, Port Lincoln

Research

Location
Edillilie
Terry Secker

Rainfall
2008 May – Dec : 299 mm

Paddock History
2007: Pasture

Soil Type
Infertile sand

Yield Limiting Factors
Late sowing, soil fertility and lack of spring rain.

Livestock
Merino sheep

Social/Practice
Time (hrs): Slightly more hours are required to set up fencing and move stock.
Clash with other farming operations: Having livestock in the paddock when you want to spray growing weeds or apply extra nitrogen can make farm management difficult.

Economic
Infrastructure/operating inputs: sheep handling labour and electric fencing
Cost of adoption risk: dependant on spring
Market stability risk: commodity prices change over the season

Key messages

- **Without a good spring crop yields struggle to recover from heavy grazing.**
- **Wide row spacing on sandy soils make it difficult to produce enough dry matter to graze without risking erosion.**
- **High stocking pressure is essential for even grazing.**
- **Understanding different stock feed requirements is important to ensure demand is met.**
- **Livestock can make timing of chemical and fertiliser applications difficult.**

Why do the trial?

Previous research into grazing cereals has focussed on plot work with mowing used as the method of simulating grazing. The aim of this demonstration was to investigate, on a paddock level, the logistical and agronomic implications of grazing cereals and harvesting for grain yield. In addition to this the 'rules of thumb' suggested from trial plot work needed to be tested for the Lower Eyre Peninsula farming systems.

How was it done?

A 47 ha paddock was sown with a ConservaPak on 12 inch row spacings on 21 May. Flagship barley was sown @ 80 kg/ha with 80 kg/ha 18:20 below the seed. Pre-sowing spray included Credit, Bonus, Trifluralin, Diuron, Hammer and in-crop spray was Hoegrass, Jaguar, LVE MCPA and wetter.

On the 10 July the 47 ha paddock was divided into four sections using a three wire temporary electric fence and the RAPPA system to erect. One section was left ungrazed and the other three were grazed with Merino ewes at different intensities for varying durations. Measurements were taken on available dry matter (DM), crop growth rates, DM at the start and end of grazing, total grazing days and grain yield and quality. The crop was harvested on 18 November.

What happened?

Once the crop emerged regular assessments were made on growth stage, how well the plants were anchored and available DM until there was sufficient ground cover and bulk to carry the mobs of sheep planned for each section. With wide row spacings and sandy soils the stock could not be put on the paddock until 10 July, when the crop was at Zaddocks growth stage (GS) 30. This was later than ideal but there was still only 300 kg/ha of DM available for grazing, which is much less than the previously suggested 800 kg/ha (Grain & Graze, 'Free Food for Thought' – Grazing Winter Crops Roadshow workshop notes, March 2008).

The sections were stocked with Merino ewes at different stages of pregnancy and lactation which influences their feed demands and intakes. Ninety ewes with 6–8 week old lambs at foot rated at 3.2 dry sheep equivalent (DSE) were stocked in the north west paddock while eighty ewes that were just starting to lamb rated at 2 DSE were stocked in each of the other sections.

The stocking pressure (grazing intensity) had an impact on how even the sections were grazed and the grazing period. The north west paddock had the highest grazing pressure of 25 DSE per ha and had the shortest grazing period of 8 days. The sheep in this section were consuming more than the daily growth rate (Table 1) of the crop and the initial 300 kg of DM that was on offer at the start of grazing was also utilised. This section was very evenly grazed to the same height all over. The sheep had to be removed after 8 days due to there only being 50 kg of DM/ha on offer.

The stocking pressure in the south east section was 16 DSE per ha and the stock stayed in the paddock for 11 days. The paddock was unevenly grazed with the crop being at different heights across the paddock. The sheep in this section also started pulling plants out of the ground in one corner of the paddock and were removed as a result.

The stocking pressure in the south west paddock was matched closer to the growth rate of the crop but was still above the growth rate. The paddock was unevenly grazed with the crop being at different heights across the paddock. The stock grazed for 15 days and by this stage the crop was near GS 32, well past the usual recommendation of taking them out by GS 31. Although this was the case the stock did not eat the growing points of the developing crop.

Table 1 shows the approximate growth rates of the crop at different periods calculated from dry matter cuts. It was difficult to match livestock demand with the growth rate of the plants due to growth rate variations.

Between 173 and 202 kg of DM per ha (Table 2) was utilised in the different sections using the method where 1 kg of DM is allocated per DSE per day. Between 60-80% of the feed on offer was estimated to be utilised with only 20-40% wastage and this is due to high stocking pressures and small paddocks.

No problems were experienced with sheep getting through the electric fence.

Stubble cuts showed the paddocks with the most dry matter removed from grazing had the lowest amounts of stubble dry matter, and lowest grain yield (data not shown).

***Table 1** Crop growth rate of Flagship barley at various stages of crop development at Edillilie, 2008*

Period	Growth Rate (kg/ha/day)
27 May - 1 July	4.5
1 July - 10 July	16.7
10 July - 25 July	8.6
27 May - 25 July	7.1

***Table 2** Grazing management, DM utilised and DM available after grazing Flagship barley at Edillilie, 2008*

Section	North West	North East	South West	South East
Grazing Treatment	Heavy graze	Ungrazed	Light graze	Light graze
Size (ha)	11.4	11.7	13.8	9.9
Stock #s	90	0	80	80
DSE rating	3.2	0	2	2
Stocking pressure (DSE/ha)	25.3	0	11.6	16.2
Date stock in	10 July	n/a	10 July	10 July
Date stock out	18 July	n/a	25 July	21 July
Days grazed	8	0	15	11
DSE days	2304	0	2400	1760
DM utilised/ha (allocation 1kgDM/DSE/day)	202.1	0	173.9	177.8
DM on offer at start of grazing (kg/ha)	300	300	300	300
DM on offer at end of grazing (kg/ha)	50	420	n/a	n/a
Stubble DM 8 Dec (t/ha)	1.36	1.86	1.44	1.79

***Table 3** Flagship barley grain yield and quality results after various grazing treatments at Edillilie, 2008*

Section	North West	North East	South West	South East
Grazing Treatment	Heavy graze	Ungrazed	Light graze	Light graze
Yield (t/ha)	1.72	2.41	1.88	2.24
Pay Grade	F2	F1	F2	F2
Test Wt (kg/hL)	61.8	63.2	60	60
Protein (%)	10.3	9.8	10	9.8
Moisture (%)	12.0	12.8	12.7	12.8
Retention (%)	51.7	69.2	60.1	61.2
Screenings (%)	19.9	9.0	17.3	14.2

Effect on grain yield and quality

Grain yield was reduced by between 0.17 t/ha and 0.69 t/ha (Table 3) where stock grazed the developing crop in comparison to the un-grazed yield. Large differences are also observed in grain quality with an increase in screenings from 9% up to 19.9%, resulting in a downgrade from Feed 1 to Feed 2. Additionally the retention and test weight of the grain of the grazed sections was lower than that of the cut off for Feed 1.

Gross Margin analysis of the various treatments

To provide a total gross margin for each section the grain yield and grazing value must be combined. To put a dollar value on the grazing, calculations were made on the total dry matter eaten on an energy basis and then valuing it the same as the dollar value of grain with equivalent

Table 4 Gross margin analysis and cumulative returns of grain and grazing treatments at Edillilie, 2008

Section	North West	North East	South West	South East
Grazing Treatment	Heavy graze	Ungrazed	Light graze	Light graze
Grain value ($/t)*	135	160	135	135
Income ($/ha)	232	385	254	302
Variable Costs ($/ha)**	275	275	275	275
Gross margin for grain ($/ha)	-43	110	-21	27
Value of grazing (barley value 1)*** ($/ha)	60	n/a	52	53
Value of grazing (barley value 2)**** ($/ha)	27	n/a	23	24
Total gross margin - barley value 1 ($/ha)	17	110	31	80
Total gross margin - barley value 2 ($/ha)	-16	110	2	51

**ABB Cash price in Port Lincoln, 26 November 2008*
***Taken from Gross Margin Guide 08, Medium rainfall zone*
****Calculated by DM consumed, valued at $300/t (ABB 23/7/08) - based on 1kg/DM/dse/day*
*****Calculated by DM consumed, valued at $135 (ABB 26/11/08) - based on 1kg/DM/dse/day*
NB $300/t was the value of feed barley at the time the paddock was grazed, $135/t is the value of the barley at time of harvest.

energy. The best grazing section added $60/ha to the gross margin. The return from grazing varies according to grain prices and the amount utilised per hectare.

The effect of grazing was detrimental to the gross margin of the paddock (Table 4). The section that was grazed heavily did not recover well and made a negative return with barley being valued at $135/t. Each grazed section had lower grain gross margins than the un-grazed section, with the two slightly heavier grazed sections having negative returns. With the value of the livestock grazing being added in gross margins for each grazed section, the returns were still well below that of the non-grazed section.

What does this mean?

The gross margin of Flagship barley in a below average spring rainfall year was negatively affected by a short graze at GS 31 to 32. The value from grazing combined with the value of grain did not out-perform the gross margin of the un-grazed crop. Therefore, it is important to select the right sowing time, crop variety, grazing time, paddock and understand how the season may affect the yield of the crop.

Early sowing will obviously improve the chances of producing enough feed early in the year without risking erosion, and eliminate significant yield loss from having to graze at a later growth stage than recommended. This will then ensure the crop can recover in the more reliable months of July and August, rather than hope that September and October produce good climatic conditions.

Sowing crops for grazing on sandy soils would benefit from narrower row spacings. 12 inch row spacing leaves too much ground uncovered and with standard seeding rates it can take too long to produce enough bulk to carry a medium sized mob. There is also a risk that heavy grazing on sandy soils can leave the soil exposed to erosion.

Grazing cereals provides an opportunity for feed for livestock to allow pastures to get established, reduce the cost of supplementary feed and run more livestock. The key to grazing is to understand the animal requirements (daily intake) and the growth rate of the crop. This information can be used to create a feed budget which helps with estimating grazing duration.

The stocking pressure should be matched with plant growth. Therefore the amount of feed consumed per ha per day should match the daily growth rate of the crop per day. Having the correct stocking pressure allows for even grazing of the paddock so the crop doesn't end up patchy with different areas at different stages of maturity.

Due to variations in crop growth rates and livestock feed demand, pasture paddocks should be nearby so if the crop is being over grazed or reaches growth stage 30, then stock can be quickly moved.

The site also demonstrated that temporary electric fence is an efficient way of subdividing paddocks. Sub division can be important to control grazing especially if a small mob of sheep are in a large paddock. It allows the stocking pressure to be increased to improve the efficiency and evenness of grazing.

Acknowledgements

Thanks to Terry Secker, Damien Redden and Frank Wauchope for their cooperation and willingness to help with running this demonstration. This site was supported by the Eyre Peninsula Grain & Graze project, LEADA, National Landcare program, EPNRM and Woolworths.

Grain & Graze
Profit through knowledge
EYRE PENINSULA

Government of South Australia
Eyre Peninsula Natural Resources Management Board

LEADA
Lower Eyre Agricultural Development Association

Australian Government
Department of Agriculture, Fisheries and Forestry
National Landcare Program

Woolworths
the fresh food people

Shrub-based Grazing Systems for Low-Medium Rainfall Zones (Enrich Project)

Research

Neil Ackland

EPNRM, Sustainable Farming Systems

Searching for answers

Location
Elbow Hill
Scott Williams

Rainfall
Av. Annual: 300 mm
Av. GSR: 210 mm
2008 Total: 190 mm
2008 GSR: 141 mm

Paddock History
2007: Regenerated oats/pasture
2006: Oats sown
2005: Oats cut for hay

Soil Type
Strongly alkaline clay/loam and high in magnesia salt

Plot size
1 ha (50 m x 50 m x 4 reps)

Limiting Factors
Magnesia soil constraints and dry

Key messages

- **Grazing perennial native shrubs is being trialled on Eyre Peninsula.**
- **Perennial native shrubs could have the potential to help fill the summer-autumn feed gap, while providing other benefits such as drought management, nutritional value, reduced soil erosion, carbon sequestration and in some species fodder production in a saline environment.**

Why do the trial?

The aim of this trial is identify an alternative grazing system that is sustainable and profitable in the low-medium rainfall zones where cropping is no longer viable due to high risks.

In 2006, as part of a Cooperative Research Centre (CRC) program 'Flora Search', a site at Monarto SA using native shrubs was developed with the aim of researching multi-purpose, healthy grazing systems using perennial shrubs. While this type of work is not new, perennial shrubs have been identified as a potential option to fill the summer feed gap in the low-medium rainfall environment while at the same time reducing wind induced soil erosion.

An opportunity arose in 2008 to partner Future Farm Industries CRC (FFICRC) 'Enrich' to ascertain the true value and potential of woody perennials in a mixed farming system on high-risk grain producing areas. To fast track and further expand this research a partnership was formed between a group of farmers on Eastern Eyre Peninsula, Eyre Peninsula Natural Resources Management (EPNRM) and FFICRC to establish an Enrich site at Elbow Hill 13 km south of Cowell.

How was it done?

After the initial contact and proposal to EPNRM by FFICRC's Enrich program, we located a farmer group that was keen to look into the development of alternative grazing systems and were willing to host the trial. These landholders around Elbow Hill have been struggling in recent years to grow crops and produce sufficient stock fodder due to a lack of rainfall, which in turn has compounded soil constraints like magnesia salt areas.

At Scott Williams' property at Elbow Hill, an area of one hectare was selected to conduct the trial. The site was sprayed and ripped to facilitate a soft weed free environment for tube stock planting. From a potential 50 species of native shrubs that had already been trialled at Monarto, Jason Emms (SARDI research officer for FFICRC), selected 15 different native perennial shrubs that were then planted into blocks of 36 per species and replicated four times. Planting occurred in mid July, with minimal soil moisture prompting an initial watering to aid establishment.

What happened?

Following planting, strong hot northerly winds sand blasted this trial site with some shrubs suffering considerable stripping of foliage. This wind event happened on two occasions, causing shrub death in some species, and as a result some shrub replacement was necessary.

Table1 Tubestock species and mortality rates of Enrich trial sown at Elbow Hill, 2008

Species	Common Name	Mortality rate
Atriplex amnicola	Swamp/river saltbush	28%
Atriplex cinerea	Coastal saltbush	25%
Atriplex nummularia	Eyres green saltbush	31%
Atriplex rhagodioides	River - Silver saltbush	10%
Atriplex semibaccata	Creepy berry saltbush	28%
Chenopodium nitrariaceum	Nitre goosefoot	49%
Enchylaena tomentosa	Ruby saltbush	4%
Eremophila glabra	Dwarf emu bush	25%
Glycine canescens	Silky glycine	100%
Medicago strasseri	Mediterranean lucerne	44%
Rhagodia candolleana	Sea berry saltbush	16%
Rhagodia crassifolia	Fleshy saltbush	52%
Rhagodia parabolica	Mealy saltbush	14%
Rhagodia preissii	Mallee saltbush	33%
Rhagodia spinescens	Thorny/hedge saltbush	53%

Rains in the first three weeks of August placed good moisture in the soil profile and other than the initial watering by hand, plants have survived on rainfall only. Overall the mortality rate of the plants so far has been due to the sand blasting and loss of foliage rather than the lack of moisture. A decision was made to refrain from supplementary watering to better reflect the conditions of broad hectare planting.

Although some species have survived well from 60% - 96%, the survival rate of others is very low from 0%–50% (Table 1).

While there has been no shrub that has significantly performed better than the rest, it is thought that 'Atriplex' along with most other species will survive in sufficient numbers to continue the trial.

What does this mean and where to from here?

To avoid some of the issues that occurred with the establishment of this first site, a balance between weed control and soil surface cover is required, and the direction of the rows in relation to the prevailing winds needs to be considered when establishing future sites.

It is our intent to graze the Elbow Hill site in the latter part of next year (2010), as well as continued monitoring and sampling of leaf material. Two more sites will be planted this year (2009) on EP; at Minnipa and Streaky Bay. With the development of these and other sites across southern Australia, some of the challenges faced when developing a shrub-based grazing system may be overcome.

Further evaluation of shrubs will be required before recommendations can be made about what shrubs are suitable for a feed base. Identifying grazing attributes, testing fodder nutrient value and testing for secondary plant compounds that may contribute towards manipulating microbial activity within animals, are some of the aims of the FFICRC Enrich project.

Acknowledgements

Scott Williams for the use of land for this site, local landholders for their input and support, FFICRC and Jason Emms (SARDI) for their technical advice and assistance, Tony Zwar (EPNRM) and funding through the EPNRM Board & the Australian Government.

Government of South Australia
Eyre Peninsula Natural Resources Management Board

FUTURE FARM INDUSTRIES CRC

CARING FOR OUR COUNTRY

Low Rainfall Grazing Systems and Pasture Study Tour

Daniel Schuppan and Mary Crawford

Rural Solutions SA, Port Lincoln

Key messages

- **Networking with other farmers and professionals leads to new ideas and concepts.**
- **Taking time out to re-evaluate your goals is a valuable exercise, particularly in tough times.**
- **Challenging your ideas is always worthwhile.**

Background

In 2008, a group of farmers from upper Eyre Peninsula participated in a two day bus trip to other low rainfall areas to see what strategies are being used to manage their properties. The trip was part of the 'Cropping and Grazing – A Sustainable Balance' project funded by the EP Natural Resources Management Board.

Program

The tour looked at the following grazing systems and techniques in a number of low rainfall environments en-route to Peterborough:

- Temporary electric fencing systems to improve the utilization of grazing cereals for sheep
- Converting high risk cropping county into profitable grazing systems by looking at paddock layout and watering systems
- Lucerne grazing management with the use of electric fencing
- Rappa electric fencing demonstration
- Morchard ENRICH trial site looking at alternative fodder shrubs
- Grazing management of native grasses and their role in rotation grazing
- Cell grazing systems looking at feed budgeting, pastures, fencing and water systems

Each participant was supplied with a technical and practical manual designed to present information and worksheets so that key messages could be captured. The farmers were able to look at their personal operation, and record ideas they would like to investigate, making an excellent reference document when they returned home.

The bus trip was held over 2 days, staying at Spear Creek over night.

Highlights

The highlight of the trip was a visit to Neil Sleep's property at Peterborough to see how he had adopted a cell grazing management strategy for his property. He changed his land management after attending a 'Grazing for Profit' course in 2004 and has since changed his whole farm management.

The basic principles he has adopted included:

- Allowing a period of time for plants to recover from grazing. Each paddock is rested for 120 days before sheep graze that paddock again. To achieve this 44 paddocks have been created.
- A complex feed budgeting system has been developed based on rainfall, allowing the landholder to calculate the amount of feed available up to 3 months in advance.
- Adjust stocking rates to match carrying capacity. Carrying capacity is calculated by estimating "food on offer" or dry matter production and working out how many DSE that will feed. No more than 50-60% of feed on offer is planned for eating.
- Using short grazing periods. Paddocks are grazed for up to 5 days before moving to the next paddock (reduced selective grazing).
- Using maximum stocking density for a minimum of time. The sheep are managed as one mob and moved from paddock to paddock by opening gates at the central watering point.
- Benefits include reduced time and labour, no need for dogs, and no supplementary feeding.

The time taken to record the amount of available feed at any one time is reaping rewards in allowing him to increase sheep numbers, reduce time checking stock and water, planning the rotation so that sheep are near the shearing shed at the time of shearing and better recovery of native grasses and bushes with new germination of plants in the paddocks.

What was good/ valuable about the trip?

Learning from each other and having their own ideas challenged was seen as very worthwhile and many of the farmers indicated that they would implement a range of new measures on their own properties including:

- Move towards smaller paddocks for sheep
- Fencing to land class
- Property mapping – identifying the good cropping ground from the less profitable cropping ground,
- and all agreed that sheep can be profitable.

Acknowledgements

Thanks to the EPNRM for funding the project, Neil Ackland for driving the bus and many thanks to the farmers who came along and participated.

Government of South Australia

Eyre Peninsula Natural Resources Management Board

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Section 8

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Nutrition

Phosphorus – Keeping Common Sense in Your Fertiliser Decisions

Nigel Wilhelm
SARDI, Minnipa Agricultural Centre

Extension

Key messages

- **Substantial cuts in rates are possible with P fertilisers in 2009 to minimise risk and up front costs for those businesses under severe financial pressure, providing these cuts are made in soils with high P reserves.**
- **If you don't know your soil P reserves, soil test.**
- **MAP or DAP are likely to continue to give the best "bang for your buck" as P fertilisers and to maintain soil phosphorus levels.**
- **However, if you are considering other products, compare different phosphorus sources by calculating the cost of water soluble phosphorus in each source you are interested in relative to MAP or DAP, before making a purchasing decision.**

Why are P fertilisers back on the hot topic list?

A near tripling in price of most P fertilisers over the last couple of years is certainly focussing the mind of all managers and advisers on ways to cut corners with fertiliser use. Unfortunately, it has also promoted a lot of interest in "silver bullet" solutions to management of phosphorus nutrition for our crops and pastures through the use of products other than the standard fertilisers for supplying phosphorus. The high analysis mineral fertilisers such as MAP or DAP are our standard fertilisers but there is now a lot of interest in alternatives such as crushed rock, organic mixtures or rock phosphates. I say unfortunately because although the high prices of fertilisers have focussed attention on their use, it has not changed their behaviour in the field. In other words, things that worked or did not work when standard fertilisers were cheap, still work or do not work now that standard fertilisers are more expensive. What may have changed is the relative cost of these alternative products, no more - no less.

However, before discussing the merits of alternative products for supplying phosphorus to our crops and pastures, I would like to revisit some old, but still relevant, principles of P management.

Strategy for P management in 2009

Firstly, 2009 is a year to exploit previous good histories of fertiliser use. Previous applications of phosphorus do have useful residual benefits with about 80% of a wheat's P requirements coming from soil reserves. Most of the P in soil reserves in paddocks came from the previous application of fertilisers. Make use of these in 2009 by substantially reducing rates where previous histories are good. This is a reasonable, even necessary option for those farm businesses under severe financial pressure (or for those looking to avoid such pressure!). For many businesses planning a fertiliser management strategy for 2009, only fertilising for production in 2009, and not applying extra for crops or pastures to use in 2010 or to further boost soil reserves is probably the most appropriate strategy.

However, cutting back P fertiliser rates must be done in the correct situations. Never has it been more important to undertake soil tests to determine current soil fertility levels. If good records of previous fertiliser use exist and prior soil tests have been taken, more soil tests in 2009 can be avoided. Otherwise, minimum fertiliser rates and choices can only be sensibly estimated with soil reserves as part of the background information. Production in paddocks with high reserves of fertility will not fall off a cliff if fertiliser rates are cut back severely, even to as low as none.

Back in the 1970's and 1980's a huge number of phosphorus response trials were conducted on wheat throughout SA. The vast majority of these trials demonstrated grain yield responses of between 0 and only 20% where soil P reserves were moderate to high. This means that in the absence of any P fertiliser, crops still yielded within 80% of their P adequate neighbours in most paddocks tested. Soil P reserves have mostly climbed since those studies up to 30 years ago, and certainly have taken an extra kick up over the last 5 years in most cropping districts. One of the few silver linings in the last string of low production years is that yields have dropped more than reductions in fertiliser rates, causing a lift in soil P reserves. This means that yields are not going to plummet in 2009 if P fertiliser inputs are cut back, providing those paddocks have reasonable to high reserves of P in the soil.

In all situations except the highly calcareous grey soils, the current Colwell P soil test will make a reasonable estimate of these reserves. For those unusual soils, previous fertiliser use and exports in commodities are the only guide to likely soil P reserves. As a fall back position, it is probably safe to assume that you will get reasonable responses to P fertiliser on these highly calcareous grey soils, no matter what their P history.

When making decisions about P fertiliser use next year, keep your brain focussed on the right issues. Despite the publicity and pub talk about the rocketing prices for P fertilisers, the profitability of using P fertilisers is still very strong. That is not the issue – it is the risk of not realising budgeted yield targets which is the issue. Poor yields at the end of 2009 will mean that the initial investment in fertiliser will not be covered at the end of the season, even though the rates used were "correct" when calculated in early 2009. So, 2009 is not about making a reasonable profit from P fertiliser use for many farmers, it is about minimising risk by keeping up front costs to an absolute minimum. For those farming businesses which can carry the risk, then strategies for determining P fertiliser rates are the same as they have been for the last 20 years or so.

In late 2006, for similar reasons to now, I was investigating the dollars with P fertiliser use. In those studies, using about 5 kg P/ha on 500 ha of wheat would return between $5,000 to $7,000 of clear profit to the farm business if soil reserves in the paddocks were about 20 mg Colwell P/kg and yields were between 1.5 and 3 t/ha. Under current pricing schemes (DAP at $1,200 per tonne and wheat at $270 per tonne), these same figures would be around $12,000 of profit!! However, from a risk point of view, to get this profit, the farmer would have had to invest nearly three times more in fertiliser at the start of the 2009 than he would have for the 2007 season. And prices have now slid back from that peak of $1,200/t.

Reducing P application rates is one important avenue for reducing these upfront costs BUT be very aware that this is only a short term option because this strategy will mine soil reserves of P. In general, these reserves will have to be replaced one day – and it is a lot harder to build them up again than to run them down!! For those farming businesses which can still afford to maintain soil reserves of P in 2009, I believe this is still a very sound strategy.

Efficient application strategies

In situations where phosphorus fertiliser is deemed to be necessary (and this is still going to be the majority of paddocks in 2009), i.e. will return a good profit and financing will stretch that far, this fertiliser should be placed with or near the seed at sowing. This is the most efficient way of applying P fertiliser to broadacre crops. P fertiliser should not be broadcast prior to seeding in 2009 because this approach is only justified in situations where soil P reserves are high and dressings are designed to maintain those reserves – in 2009 simply do not broadcast those paddocks and use the money saved on other inputs which will return better profits.

One new option for managing P nutrition which is doing the rounds at the moment is the use of foliar applied P. The attraction with this approach is that lower rates may be sufficient and timing may be delayed until mid season (when there may be more indications of how crop performance is likely to end up). However, it is my belief that this technique is not yet sufficiently understood to be recommended. It is my understanding that for every case where foliar P has been effective, there have been about ten cases when it has not. Until we can improve this ratio substantially, I think farmers should steer clear of this approach.

I have a similar position for the current role of microbial agents to enhance P nutrition. While this approach has some very attractive long term merits (i.e. potentially releasing some of the fixed P locked away in our paddocks now) our experience so far is that the microbes are really struggling to make their presence felt. A lot of work is continuing with this approach to improve P nutrition with less applied fertiliser but in combination with microbial products to help supplement P supply, but so far, their performances have been too unreliable to recommend this strategy for commercial use.

However, I do believe that we need to develop farming systems which cycle P more efficiently. This essentially means that these farming systems will reduce the amount of P which goes into the strongly fixed pools in the soil (only very, very slowly released back into the available pools) and will also help release P from these fixed pools at the same time. While these improvements in P cycling will become increasingly important if the costs of P fertilisers continue to rise, they are unlikely to replace more than a few kg of P/ha in applied fertiliser. And remember that farming in many ways is a mining operation. Every tonne or kilogram of commodity taken to market is an export of nutrients. While new farming systems may cycle P more efficiently, those exported nutrients must still be replaced, if not tomorrow then certainly at some time in the future, if we hope to retain productive and sustainable systems.

Be very wary of new sources of P for crops and pastures being marketed as a cheaper option than our standard mineral P fertilisers. There are mountains of evidence and experience collected over the hundred years of superphosphate use in Australia that the most effective fertilisers for supplying P to crops and pastures are those which contain reasonable levels of water soluble P (DAP and MAP contain around 20% soluble P). There is very little evidence that anything which purports to enhance or promote P uptake or utilisation (to make up for low levels of actual P in the product) is a cost effective strategy for broadacre crops and pastures in southern Australia. The simple message is to work out how much soluble P you are buying in every tonne of your alternative product. If that is a higher cost per kg of P than in DAP or MAP then really question whether you are making a sound investment. I am not saying that some of these alternatives do not have a place, but review your strategy rigorously if the cost per unit of water soluble P is higher than in DAP or MAP.

Although some astute farmers managed to secure some very good deals with fluid P products for the current season (because they locked in orders before fluid P prices increased in line with granular prices) this is unlikely to be an opportunity in the future. I expect that fluid P is always going to be more expensive per unit of P than granulars, so fluid P products will have to perform better on the farm than their granular counterparts to be cost effective. While the relative gap between fluid and granular products appears to have closed over the last year, the situations where fluid P performs sufficiently better than granular are still restricted to the highly calcareous grey sands of the upper Eyre Peninsula.

A new soil test for P reserves

An additional soil test is now being offered commercially to assist interpretation of the Colwell P test. This is the phosphorus buffering index which estimates the P fixation capacity of soils or the capacity of the soil to convert applied P into forms which crops and pastures can not use. Values of PBI less than 100 are considered low (low fixation capacity) while values over 200 are considered high. Soils with a high PBI will require up to 5 kg P/ha more to raise Colwell P reserves more than one unit than soils with a very low PBI and desirable levels of Colwell P may be up to 10 units higher for these soils than for the low PBI soils. This additional test is a very useful addition to your monitoring programme but probably does not need to be done on every 0-10 cm soil test that you take – it is not likely to change much with time.

See the following article by Sean Mason for an exciting new test for estimating soil P reserves. Although this test may be several years away from a commercial reality, it is showing great promise as a substantially better test than the current Colwell P.

Using Diffusive Gradients in Thin-films (DGT) Technique to Assess the Current Status of Available Phosphorus in Broadacre Cropping Soils

Searching for answers

Information

Sean Mason and Annie McNeill

University of Adelaide, Waite

Key messages

- **Validation of a Diffusive Gradients in Thin-Films (DGT) approach to measuring phosphorus levels in soil continues to produce better estimations of available P compared to traditional soil tests, namely Colwell P.**
- **DGT is showing promise as a soil P test for crops other than wheat (peas, canola and barley).**
- **Farmer surveys suggest that DGT can be used as a predictive tool for P fertiliser decisions.**

Why do the trial?

Consecutive years of drought and fluctuations in fertiliser prices have increased the importance of accurately assessing fertiliser requirements. Improved assessment of the available P status through soil testing will make these difficult and strategic decisions more accurate. It is well documented that current soil tests for P (e.g. Colwell P, Olsen P) have problems in some soils, particularly calcareous soils. The relatively new Diffusive Gradients in Thin-Films (DGT) technology has been recently modified for the assessment of available phosphorus and micro-nutrients in Australian agricultural soils. Initial testing of the technology for prediction of wheat response to P in the glasshouse and in the field has clearly demonstrated the greater accuracy of DGT compared to other soil tests for assessing available P (Colwell P, Olsen P and resin).

The validation of DGT in the field continued in the 2008 growing season in an aim to build on the existing database for wheat and to extend the work to other crop types.

Additional work in 2008 focused on building a database using DGT with farmer strip trials aiming to compare DGT with current crop responses to P.

How was it done?

Replicated field trials

Samples were taken from 17 field sites throughout southern Australia at P response trials through collaboration with Novozymes. Summary of site locations and crop type were; Western Australia (two sites – wheat), South Australia (four sites – two wheat, one canola, one pea), Victoria (four sites – two wheat, one canola, one pea), New South Wales (seven sites – four wheat, one canola, one pea, one chickpea).

Soil samples (0–10cm) were taken at sowing from six replicated control plots (zero P applied) of each trial. Samples were then dried at 40° C in an oven and sieved (< 2 mm). Available P measurements using Colwell P and DGT were performed on each replicate soil sample. Each soil test measurement was related to the response of the crop to the application of P by taking dry matter cuts at mid-late tillering. P nutrition is very important in the early growth stages of a crop so that any P deficiency at this growth stage will reduce dry matter production and may ultimately reduce grain yield.

Dry matter (DM) increases due to P fertiliser applications were expressed as a % relative DM yield calculated as:

% relative DM yield = (DM yield from control plots / highest DM yield obtained) x 100

Farmer Control Strips

Sites (34 in total – 29 wheat and five barley) were located in the Mid North, Yorke Peninsula and Mallee regions of South Australia and both the Wimmera and Mallee districts of Victoria. Farmers were asked to have a control strip (zero P, one seeder width) in their paddock by turning off the fertiliser. Soil samples (0–10 cm) were collected in the control strip for DGT and Colwell P analysis.

Dry matter responses (GS 30) were compared between the control strip and the applied P level on each adjacent side to the strip in the paddock by taking 4 x 1 m random plant cuts in each strip. Grain yields in the control strip and adjacent crop either side were obtained from yield monitors (more than 10 readings in each strip) and in paddocks without yield monitors, grain yields were obtained in the same method as the early dry matter analysis. At the time of writing these samples had not been threshed to obtain actual grain yields. Grain yields were estimated from the total weight of each cut and an assumed harvest index of 0.35 for the 2008 season.

Soil test values were plotted against relative yield (%) to test the ability of each test to predict crop responses to fertiliser P.

Figure 1a

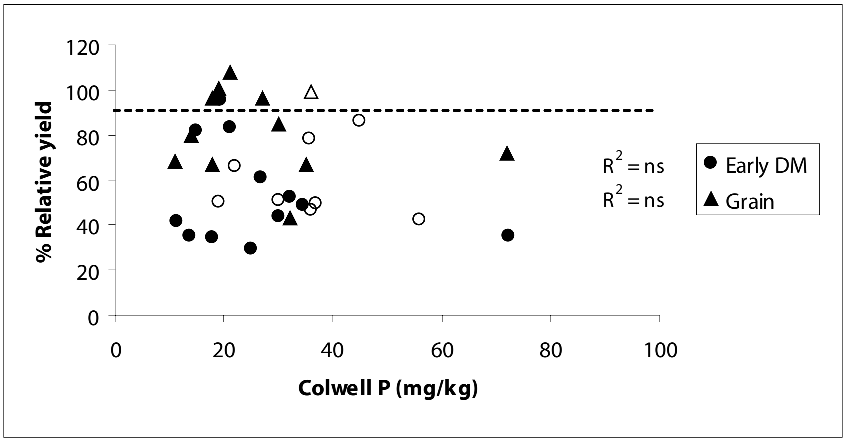

Figure 1b

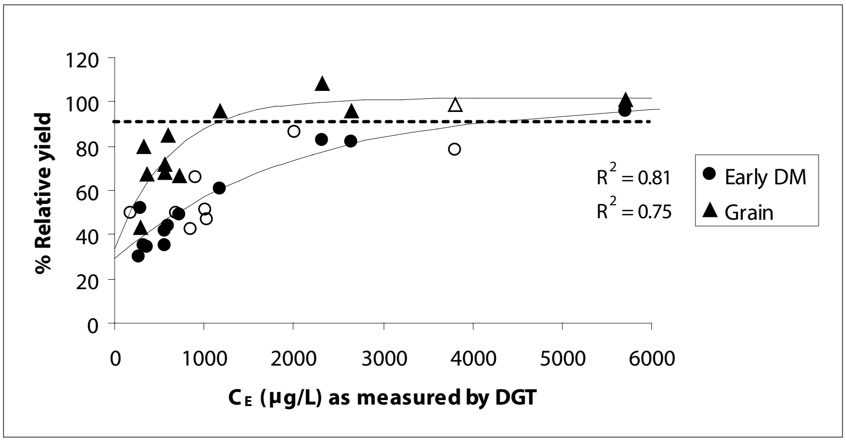

Figure 1 Relationship between crop dry matter yields taken at mid-late tillering and grain yields (expressed as % relative DM yield) with soil available P test value measured using a) Colwell P and b) DGT. Open circles represent 2008 field sites

What happened?

Replicated field trials (Wheat only)

Relationships between relative DM and grain yield (%) and soil test values for control soils are shown in Figure 1. Figure 1 shows the results from 2008 DM as open circles and at the time of writing the grain data for the majority of the 2008 sites had not been received. There was a very poor relationship between Colwell P and either DM or grain, highlighting the ineffectiveness of this soil test across different soil types in predicting response to P (Figure 1a). The DGT technique continues to successfully predicted DM and grain response (Figure 1b). This highlights the superior accuracy of DGT in predicting P response across a range of different soil types compared to the other soil tests.

Early dry matter vs grain response to P

During the period spent validating the new P test (2006-2008) there has been varying climatic seasons but unfortunately all three years have seen a very dry finish to the year putting crops under severe moisture stress. The dry finish has resulted in several sites not demonstrating grain (wheat) responses, although they did show large responses to P in early growth stages. For this reason the relationship between DGT P and grain response is slightly lower compared to that with early dry matter results (Figure 1b) and the critical P deficiency threshold for grain identified from DGT P (1104 μg/L) is also considerably lower than that obtained for earlier growth stages (3955 μg/L). The conundrum is that whilst P is important in early crop growth stages, it may set up a yield potential that simply cannot be fulfilled if there is insufficient moisture available during the later stages. Further studies of grain P response in seasons with more favourable finishes are needed to determine if there is a tighter relationship with DGT P, which would be expected from the dry matter responses – the current project will address this.

Critical P deficiency thresholds for different crop types

The validation of the DGT test so far has mainly focused on assessing the response of wheat to an application of P. Other crop types will have different capabilities for accessing and mobilising P in soil due to variations in root morphology, distribution and function and therefore will have varying phosphorus requirements. In 2008 work on the validation of the DGT test has expanded to assess other crop types and their P requirements with respect to available P in soil as assessed by DGT. Relationships of early dry matter responses for three other crops (peas, canola and barley) with DGT measurements look promising (Figure 2). The order of critical P deficiency thresholds appear to be peas < canola ≤ barley < wheat. The database for these crop types is currently small but will be enlarged with data from future growing seasons. Reliable assessment of the P requirements of these crops will provide the farmer with valuable information in order to maximise P fertiliser efficiency and help to develop a crop rotation plan that will optimise yields on a paddock basis.

Farmer Control Strips

Relating the two soil tests to early dry matter response and grain response revealed that DGT was the superior soil test and could be used in this type of work to help farmers determine their current P levels in their paddocks (Figure 3). Moderate correlations using DGT were obtained for early dry matter ($R^2 = 0.64$) and grain ($R^2 = 0.79$) responses expressed as relative yield, however, no relationship could be obtained for Colwell P measurements. Critical dry matter deficiency threshold for DGT in this survey was 2650 µg/L, which is considerably lower than the threshold established from replicated field trials (3955 µg/L, Figure 3b). In this type of work it is unclear whether the rate of P that was used in the paddock was sufficient to maximise yields for all sites at this growth stage particularly for the sites with higher phosphorus buffering index (PBI) values. If maximum yields were not reached in some cases then this would contribute to the lower deficiency threshold obtained. Critical P deficiency thresholds for grain as assessed by DGT (1104 µg/L) closely matched the threshold established from replicated field trials (1114 µg/L, Figure 3c).

Previously the phosphorus buffering index (PBI) has been used in an attempt to improve the interpretation of the Colwell P measurements (Moody et al. 2007). Determining the critical Colwell P value from the phosphorus buffering index (PBI) measurements from each site (wheat only) did not necessarily improve the grain response prediction for the grain data available at the time of writing. Of the 15 sites, the critical Colwell P and actual Colwell P measurements incorrectly predicted the grain response for 6 sites (40%) with some of these being quite significant.

Overall, the farmer strip results for DGT are very encouraging considering the nature of this project. The control strips were not replicated and in the majority of cases the farmer did not have the ability to balance N inputs. Outliers that showed a greater response than expected could be contributed to the added N

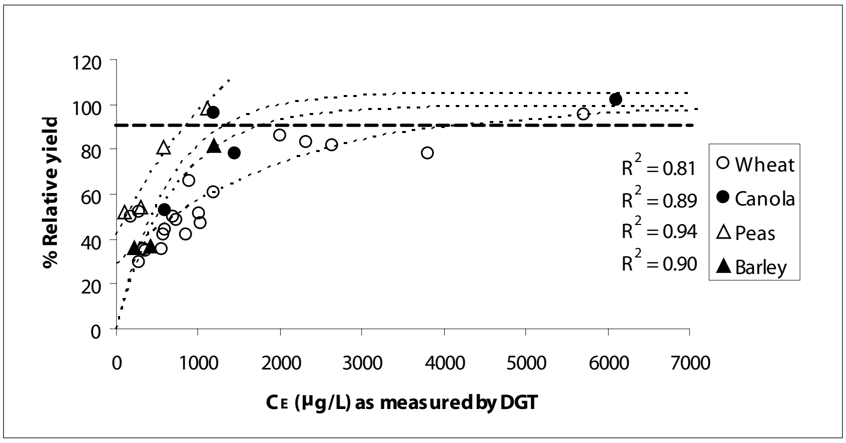

Figure 2 ***Relationship between crop dry matter yields of four different crops taken at mid-late tillering (expressed as % relative DM yield) with DGT***

application, therefore reducing the relationship with DGT. It is also unclear whether the amount of P the farmer applied as their standard rate was enough to maximise yields in some cases. Importantly of the 39 paddocks tested only 11 (28%) had DGT values below the critical P level for grain established so far from replicated field trials.

What does this mean?

- DGT has been shown to be a more accurate predictor of plant P availability in the field than other established soil tests (Colwell and resin), as assessed by early dry matter and grain response to P application.
- Extension of the project has revealed the potential of DGT to accurately assess P requirements of other crop types.
- Farmer strip trial work in 2008 has shown promise in determining fertiliser requirements with use of DGT.
- Further field testing is required to assess the performance of DGT under contrasting climatic seasons. However, DGT is initially showing great promise as a reliable soil test.
- Caution must be used when using Colwell P values on their own for fertiliser recommendations without other soil parameters being assessed.

Acknowledgements

We would like to thank GRDC for funding this work and our collaborators, who have kindly let us tag along with their field trials. These people include Sandford Gleddie, Rob Velthuis (Novozymes), Simon Craig (BCG), John Stuchbery and Associates, Neil Fettell, Bill Bowden, Mark Conyers, Matt McCallum and Sam Holmes.

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Figure 3a

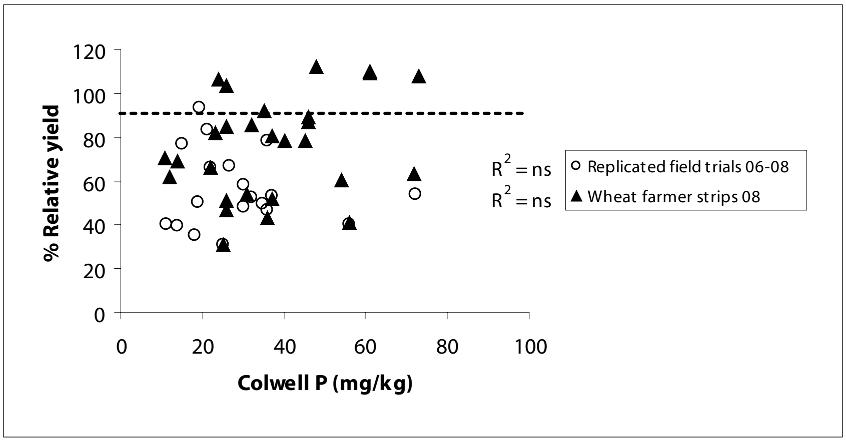

Figure 3b

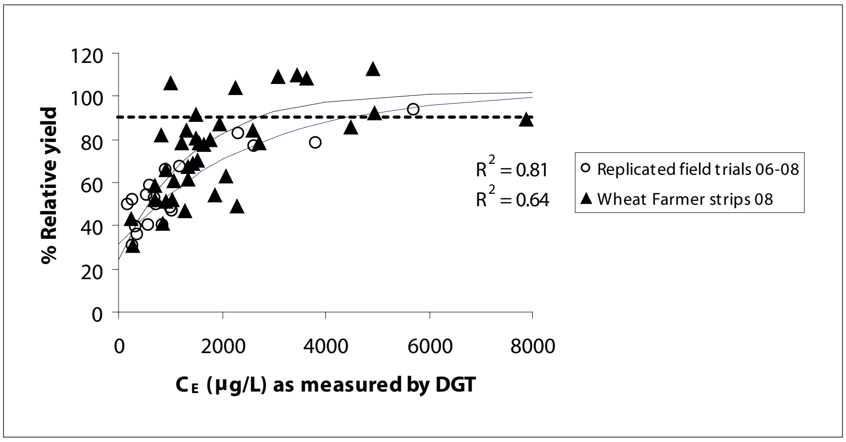

Figure 3c

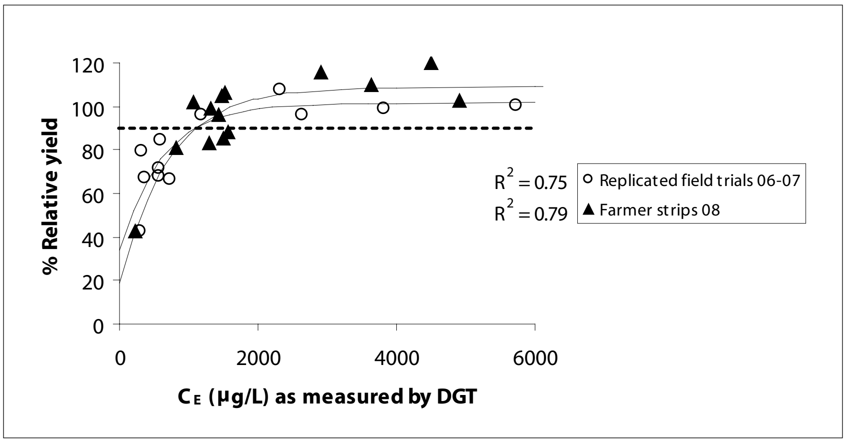

Figure 3 ***Relationship between crop dry matter yields from farmer strips taken at mid-late tillering (expressed as % relative DM yield) with soil available P test value measured using:***
a) Colwell P
b) DGT
c) Grain yield relationship from field trials and farmer strips (data obtained to date) with DGT

Nutrition

Grains Research & Development Corporation

Evaluating Effects of Arbuscular Mycorrhizal (AM) Fungi on Grain Yield of Wheat with Different Forms of P Fertilisers

Huiying (Lisa) Li[1], Sally Smith[1], Dot Brace[2], Kathy Ophel-Keller[3], Bob Holloway[1], and Andrew Smith[1]

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Research

Searching for answers

Location
Cungena
Myles and Kylie Tomney

Rainfall
Av. Annual: 271 mm
Av. GSR: 199 mm
2007 Total: 256 mm
2007 GSR: 136 mm

Paddock History
2007 Wheat
2006: Pasture
2005: Wheat

Soil Type
Grey calcareous sand
Soil test
pH:8.0 (0.01 M $CaCl_2$);
Soil total P: 320 mg/kg;
Colwell P: 39 mg/kg;
Resin P: 5 mg/kg;
$CaCO_3$: 35.5%;
Organic carbon: 0.86%.

Yield Limiting Factors
Water and nutrients (mainly N and P)

Key messages

- **Extent of colonisation by AM was very high (up to 80% root length).**
- **Overall, the results clearly showed that wheat benefited from AM fungi for grain production and quality in a low P soil.**

Why do the trial?

The majority of crops form symbiosis with arbuscular mycorrhizal (AM) fungi in the field. Our previous studies have found that the potential of naturally occurring AM fungi in the calcareous soils on Eyre Peninsula to colonise wheat roots was very high. Plants, including wheat, are normally heavily colonised by AM fungi in these soils. Effects of AM fungi on plant growth and P uptake have been observed in glasshouse experiments with sterilised soils. Some legume plants including medic and clover were highly AM dependent and benefited from them in growth and P uptake. Cereal plants such as wheat could obtain over 50% of their total P uptake by AM hyphae, even though their responses to AM fungi are controversial, from negative to positive depending on the growth stage and P applications. The AM colonized plants are more likely to use AM hyphae than roots to take up P from the soil. Overall previous studies have highlighted the importance of AM fungi in plant P nutrition on the calcareous soils of Eyre Peninsula. However, there is no direct evidence of AM effects on plant growth and P uptake from the field due to the difficulty of killing AM fungi and producing a 'non-mycorrhizal' control.

This study aimed to try to create a 'non-mycorrhizal' control by using fungicide to suppress AM fungi and to evaluate AM effects by comparing the plants grown in the soils with and without fungicide treatments.

How was it done?

The trial had a randomized two-factor design including: three P treatments (no P and granular or fluid forms of P applied at the rate of 12 kg P/ha) and two fungicide treatments (with and without fungicide application). There were four replicates in each treatment, with a total of 24 plots in the trial.

Each plot had an area of 1.5 × 1.5 m, barricaded by galvanised iron sheets extending 10 cm high above the ground and 30 cm below the ground. There was 1.5 m of non-plant space between plots as a buffer zone. For the fungicide treatments, Benomyl was applied at 11.25 g/plot (or 5 g/m^2) of active constituent with 10 L water for each application. At the same time, 10 L water was applied in the no fungicide treatments. There were four applications; at two weeks before and after sowing, at emergence and at the end of tillering.

Wheat (Yitpi) was sown with fertilisers on 30 May 2007. Plant samples for measuring AM colonisation were taken at the start of tillering (18 July), after the third fungicide application and at the

Figure 1a

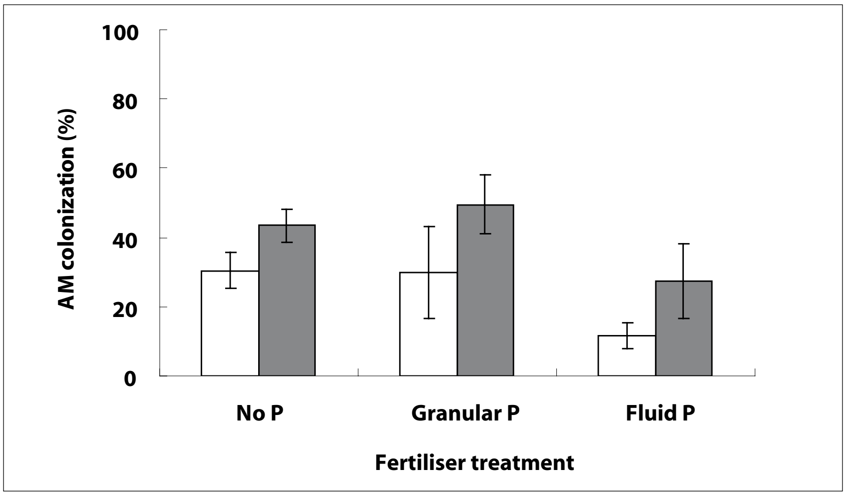

Figure 1b

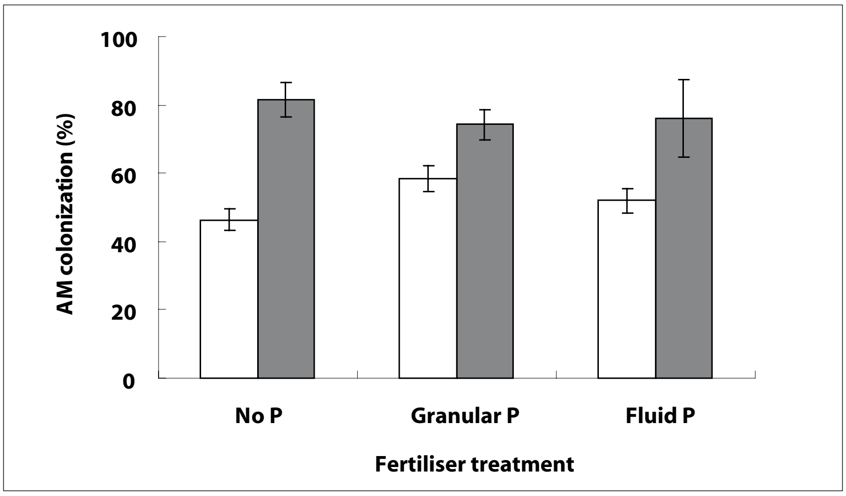

Figure 1 Percent arbuscular mycorrhizal (AM) colonization in the roots of wheat at the start of tillering (a) and at first node (b), grown with no P or granular or fluid P fertilizers applied at the rate of 12 kg P/ha. Bars are means of four replicates ± SEM. The white and black bars are with and without fungicide treatments, respectively

first node stage (16 August), after the fourth fungicide application. Grain yield was assessed by harvesting 1 m^2 of plants in the central area of each plot on 20 November. Soil-borne pathogens were tested in soil and root samples from each plot.

What happened?

AM colonization was well established at the commencement of tillering in the nil fungicide plots, with roots colonized by AM fungi at 40% (Figure 1a), increasing over time up to 80% at the first node stage (Figure 1b). Application of P did not affect AM colonization except at early tillering, where fluid fertilizer slightly decreased AM colonization. Applications of fungicide decreased AM colonization but did not completely eliminate it.

Both grain yield (Figure 2a) and 100-seed weight (Figure 2b) were increased by P applications with larger increases when fluid P was applied, compared to granular P. Application of fungicide decreased grain yield and 100-seed weight only when no P was applied, but increased grain yield when P was applied.

Grain P concentrations were similar (~2 mg/g) between treatments, and consequently the grain P contents (P uptake in the grain) between the treatments had a similar trend to those of grain weight (results not shown).

Soil-borne pathogens were at low levels or below detection in all treatments.

What does it mean?

AM colonization of roots was very high. This confirmed our previous findings for wheat grown in the calcareous soils from Eyre Peninsula. Application of P did not decrease AM colonization, in contrast to the repeated findings from many other studies in which AM colonization usually decreased with P applications. No impact of P application on AM colonization probably resulted from the high P-fixation capability of these calcareous soils. Although the fungicide substantially suppressed AM fungi, it was not sufficient to provide a 'non-mycorrhizal' control. Colonization levels in the fungicide treatments were still relatively high (up to 50%) even compared to the AM levels in other studies with wheat, where AM colonization ranged between 10-30% under field or glasshouse conditions. Therefore in this trial, as in many other field experiments worldwide, it was not possible to see the real AM effects.

The application of P improved grain yield and individual grain size, with larger P effects from fluid fertiliser than from granular form, confirming previous findings that this soil is P-deficient and P-fixing, and fluid P is more effective than granular P. Decreases in AM colonization induced by fungicide decreased grain yield and individual grain size in the no P treatment only, indicating that relatively high level of AM fungi may be needed by plants to maintain grain production and individual grain quality in the low P soil. However, this fungicide effect was reversed when P was applied, probably indicating that as available P increased in these soils, plants may have saved some carbon by reducing AM biomass and relocated this carbon for grain

Figure 2a

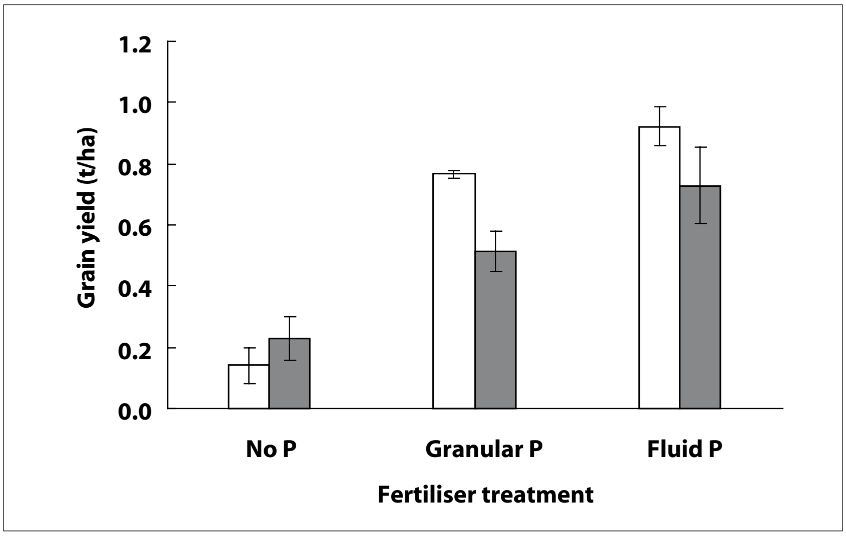

Figure 2b

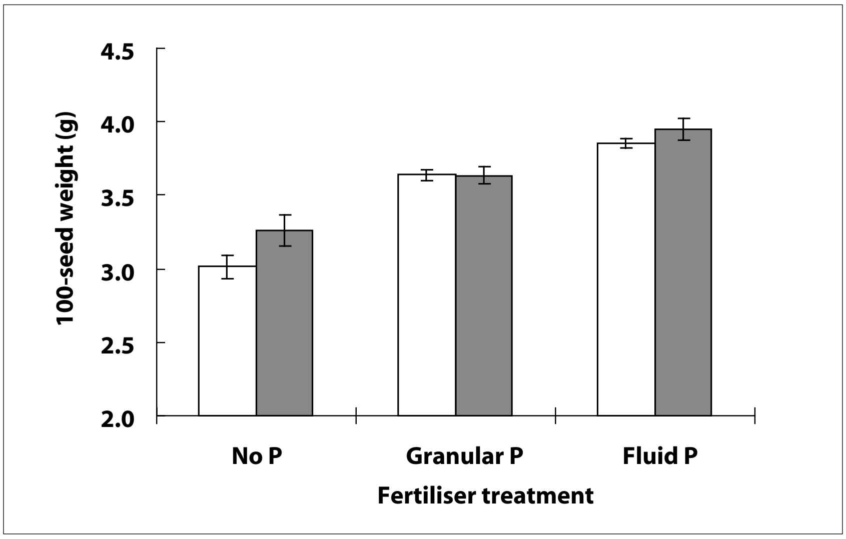

Figure 2 Grain yield (a) and 100-seed weight (b) of wheat grown with no P or granular or fluid P applied at rate of 12 kg/ha. The white and black bars are with and without fungicide treatments, respectively

production. Although there was a positive yield response to the decreases of AM colonization in the fungicide plus P treatments, it's not clear whether plants obtained P mainly via hyphae or roots. It is well known that AM function in P uptake is not necessarily correlated with the AM biomass. Grain P concentration was not affected either by P or by fungicide application, probably indicating that plants may be adapted to maintain a minimum of P concentration in the grain.

Root diseases were at low levels in this trial and so the effects of fungicide on plants could be mainly attributed to AM fungi.

In conclusion, naturally occurring AM fungi are very important components of the agricultural systems on Eyre Peninsula. They are involved in grain and pasture production, and have marked interactions with P availability and fertiliser application. They may also help plants withstand drought, salinity and disease. Further studies are needed to reveal the importance of these roles of AM fungi in agricultural production on Eyre Peninsula.

Acknowledgements

This work was funded by SAGIT (Project no. UA1/05) and ARC-Linkage (Project no. LP066916). We are grateful to Ian Richter for his assistance with the management of the trial. We checked with APVMA and the MSDS of Benomyl for trial safety recommendations.

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Section 9

Section editor:
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Soils

Plant Available Water Capacity of Soils

Jon Hancock[1], Alison Frischke[1] and Neal Dalgliesh[2]

[1]SARDI, Minnipa Agricultural Centre, [2]CSIRO Sustainable Ecosystems, Toowoomba

Key messages

- **Plant available water capacity (PAWC) data is now available for free on Google Earth, with information for over 40 sites across Eyre Peninsula and 500 sites across Australia.**
- **Growers and consultants with internet access can now download information about soil moisture characteristics from a site that best represents their own soil.**

What is plant available water capacity (PAWC)?

PAWC is the amount of water that can be extracted by a particular plant type on a particular soil. Crops differ in their ability to extract soil resources, and consequently, may have differing PAWC's when grown on the same soil type. These differences are a result of variation in rooting depth, crop duration and tolerance to subsoil constraints. Cereal crops for example tend to have higher PAWC's than pulse crops.

How is PAWC useful?

Crops and pastures access nearly all their water from the soil. So the ability of soils to store water and then release it to the crop or pasture can be very important to productivity. It is expected that having an easily accessible source of field measured PAWC data for EP soils will help more grain growers and agronomists gain a better understanding of soil water dynamics and how it affects their production systems. It will help them estimate more realistic potential yields for their local circumstances.

It is essential to know the actual PAWC for local soils to allow existing tools such as the crop growth model APSIM and its farmer friendly web based derivative Yield Prophet to be used to their full potential. Yield prophet is useful for looking at soil water and nitrogen balances during the year, likely grain yields and the probability of responses to nitrogen applications through the season. Yield Prophet has been used at a number of sites across upper Eyre Peninsula and simulated wheat yields reasonably accurately (EPFS Summary 2006, pp 85–86). Growers and agronomists can access Yield Prophet via the website at http://www.yieldprophet.com.au and subscribe for a fee.

How can PAWC data be accessed?

Due to support from GRDC, characteristics of soil profiles for over 500 sites from around Australia are now available for download from the internet at no cost to the user. There are three ways that the data can be accessed and used in crop management:

1. Direct download of the APSoil database to your computer from http://www.apsim.info/apsim Go to 'Estimating Plant

Soils

Available Water Capacity – A Methodology' on this page and follow the link 'Click here to go to the soils page and download the document'. APSoil and the latest APSoil database can be downloaded from there.

2. From the ASRIS website http://www.asris.csiro.au which provides the data geospatially, allowing the user to select a site and to download the data, or probably the simplest method of access is through Google Earth.
3. With Google Earth loaded on the computer it is as simple as clicking on the link which can be found at either of the above web sites to upload the APSRU_KML.kmz soils file. Once loaded, sites can be viewed spatially and data downloaded into Excel. Google Earth can be installed from http://earth.google.com. Either click on the box 'Download Google Earth 4.3' and then 'Agree and Download' or click on the 'Downloads' link and then 'Agree and Download' to download Google Earth.

How is PAWC calculated?

PAWC is the difference between Drained Upper Limit (DUL) or Field Capacity (FC) which define the maximum amount of water that can be held in a soil after drainage, and Crop Lower Limit (CLL) which defines the limit of water extraction of a particular crop grown on a particular soil.

DUL is measured in the field after an area of soil is wet to saturation and allowed to drain. FC is an alternate lab based method where soils are subject to a suction of 10 kPa to mimic DUL and measure the soils ability to hold water. CLL is measured after a crop is grown in field through to maturity, with rainfall excluded from flowering onwards. The potential water extraction of a crop can also be measured in the lab using a suction of 1500 kPa, similar to the suction applied by plants in extracting water from the soil. This provides a measure of the theoretical water availability for a soil. If the CLL is higher than this theoretical extraction level, this indicates the presence of subsoil constraints, limiting the ability of plants to extract soil water in the field.

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Types of work in this publication

The following table shows the major characteristics of the different types of work in this publication. The Editors would like to emphasise that because of their often unreplicated and broad-scale nature, care should be taken when interpreting results from demonstrations.

Type of work	Replication	Size	Work conducted by	How analysed
Demo	**No**	**Normally large plots or paddock size**	**Farmers and agronomists**	**Not statistical, trend comparisons**
Research	**Yes, usually 4**	**Generally small plot**	**Researchers**	**Statistics**
Survey	**Yes**	**Various**	**Various**	**Statistics or trend comparisons**
Extension	**N/A**	**N/A**	**Agronomists and researchers**	**Usually summary of research results**
Information	**N/A**	**N/A**	**N/A**	**N/A**

Soil Compaction Trials 2006–2008

Cathy Paterson and Wade Shepperd
SARDI, Minnipa Agricultural Centre

Research

Searching for answers

Location
2007 LEADA Focus site
Cummins

Rainfall
Av Annual: 425 mm
Av GSR: 344 mm
2008 Total: 318 mm
2008 GSR: 217 mm

Yield
Potential: 2.1 t/ha (W)
Actual: 2.3 t/ha (W)

Paddock History
2007: Wheat
2006: Wheat
2005: Canola

Soil Type
Sandy clay loam

Diseases
Nil

Plot size
20 m x 1.6 m x 4 reps

Yield Limiting Factors
Dry spring

Location
Minnipa
Minnipa Ag Centre
Minnipa Ag Bureau

Rainfall
Av Annual: 368 mm
Av GSR: 242 mm
2008 Total: 251 mm
2008 GSR: 139 mm

Yield
Potential: 1.2 t/ha (W)
Actual: 0.36 t/ha

Paddock History
2007: Canola
2006: Wheat
2005: Wheat

Continues

Key messages

- **Compacted layers exist in EP soils, but there is no economic advantage in mechanically intervening.**
- **Any benefit from deep ripping alone is most likely for two years.**
- **Deep ripping is a high risk option in below average years.**
- **Sandy soils are more responsive to deep ripping.**

Why do the trial?

During the 2003 EPFS farmer meetings, 14 groups nominated soil compaction as an issue which needed further research. Consequently, the EPFS project supported farmers from Buckleboo, Ceduna, Streaky Bay, Piednippie and Koongawa to set up or monitor their own deep ripping demonstrations so they could investigate whether soil compaction was causing them production losses (EPFS Summary 2003, p 121). In addition, the project undertook a soil compaction survey across a range of soil types on upper Eyre Peninsula (EP) during 2004 (EPFS Summary 2005, p 117). SAGIT funded this project to build on a soil compaction survey conducted in 2004 and to develop a more detailed understanding of soil types and management systems that have caused soil compaction on Eyre Peninsula.

Results from 2006 can be found in the EPFS Summary 2006, pp 160-162 the results from 2007 can be found in the EPFS Summary 2007, pp 159-161.

How was it done?

Three replicated trials were established in 2006, at Piednippie, Warramboo and Minnipa Agricultural Centre (MAC), with a further three trials established in 2007, at Cummins, Wangary and Wharminda.

Treatments

In 2008, the treatments in the small plot experiments were:

- Control – district practice
- Deep ripping prior to seeding in 2006 with a custom made ripper (Minnipa, Piednippie and Warramboo)
- Deep ripping prior to seeding in 2007 with a custom made ripper (all small plot sites)
- Deep ripping prior to seeding in 2008 with a custom made ripper (all sites)
- Deep working (up to 20 cm during the seeding pass with knife points)
- Rotational tillage (15 cm for Cummins, Wangary and Wharminda and 20 cm for Piednippie and Warramboo).

Site Details in 2008

Sites established in 2006

Warramboo - Sown 20 May with Clearfield Janz wheat @ 60 kg/ha, and 18:20 fertiliser @ 60 kg/ha, and Urea Zinc coat @ 16 kg/ha. Deep ripped to 45 cm.

Minnipa - Sown on 26 May with Yitpi wheat @ 60 kg/ha, and 18:20 fertiliser @ 60 kg/ha. Deep ripped to 45 cm.

Piednippie - Sown 22 May with Gladius wheat @ 60 kg/ha, and 18:20 fertiliser @ 60 kg/ha, and Urea Zinc coat @ 16 kg/ha. Deep ripped to 25 cm.

Sites established in 2007

Cummins - Sown 21 May with Gladius wheat @ 80 kg/ha, 18:20 fertiliser @ 100 kg/ha. Deep ripped to 45 cm.

Wangary – Sown 21 May with Gladius wheat @ 80kg/ha and

Soil Type
Red calcareous sandy clay loam

Diseases
Nil

Plot size
350 m x 9 m x 3 reps

Yield Limiting Factors
Low soil moisture levels at sowing, wind damage, dry spring

Location
Piednippie
John and Ian Montgomerie
Streaky Bay Ag Bureau

Rainfall
Av Annual: 368 mm
Av GSR: 280 mm
2008 Total: 309 mm
2008 GSR: 218 mm

Yield
Potential: 2.24 t/ha (W)
Actual: 1.6 t/ha

Paddock History
2007: Barley
2006: Barley
2005: Wheat

Soil Type
Sandy Loam/loamy sand/calcrete rock

Diseases
Rhizoctonia

Plot size
20 m x 1.6 m x 4 reps

Yield Limiting Factors
Rhizoctonia, dry spring, wind damage

Location
Warramboo
Trevor, Leon and Simon Veitch
Central Eyre Ag Bureau

Rainfall
Av Annual: 325 mm
Av GSR: 235 mm
2008 Total: 226 mm
2008 GSR: 145 mm

Yield
Potential: 1.1 t/ha (W)
Actual: 0.5 t/ha

Paddock History
2007: Wheat
2006: Wheat
2005: Wheat

Soil Type
Deep siliceous sand

Diseases
Rhizoctonia

Plot size
20 m x 1.6 m x 4 reps

Yield Limiting Factors
Moisture stress, non-wetting sand, Rhizoctonia, accidental early grazing, galah damage, wind damage

Continues

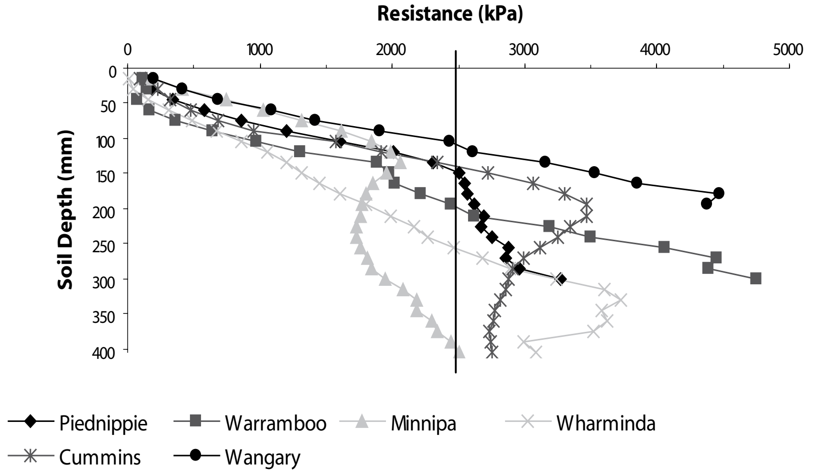

Figure 1 Soil resistance measurements taken at field capacity for all trial sites. Soil resistance over 2500 kPa will restrict growth of roots

20:10:00:12 fertiliser @ 150 kg/ha. Top dressed with Urea on 25 July and 20 August @ 45 kg/ha. Deep ripped to 35 cm.

Wharminda - Sown 20 May with Gladius wheat @ 65 kg/ha, and 18:20 fertiliser @ 65 kg/ha. Deep ripped to 35 cm.

Deep ripping was applied prior to seeding and deep working treatments were applied during the seeding pass.

Measurements included; plant establishment, dry matter - early and harvest, soil characteristics, soil profile description, soil constraints, yield, harvest index, and grain quality.

What happened?

In 2008 growing season rainfall was well below average for all sites. In addition to this, strong wind events on the upper EP after seeding caused damage to emerging crops.

Soil strength

Soil resistance of 2500 kPa at field capacity is the level at which plant root growth is restricted. All small plot trial sites reached soil resistances of more than 2500 kPa within 25 cm, whilst Minnipa reached this limit at a depth of 40 cm (Figure 1).

Soil Moisture

No maturity soil moisture measurements were taken due to rainfall in November and December.

Sites established in 2006

Warramboo
During the first year of the trial at Warramboo there were no differences between any treatments. In 2007 fresh deep ripping increased yield by over 50% compared to the district practice control. In 2008 fresh deep ripping and the 2007 deep ripping increased yield by 21%. There was no response to any other treatment (Table 1). The low plant populations were unfortunately due to stock grazing this trial early.

Piednippie
Piednippie has shown no response to any treatments in either 2006 or 2007, but in 2008 fresh deep ripping increased yield by 17%. There was no response to any other treatment (Table 1).

Minnipa
The broad scale trial at MAC had poor emergence in the rotational and deep worked treatments because wheat seed fell down to the bottom of the workings and the soil developed large clods.

There was a reduction in yield in the rotational tillage (59%), deep worked (34%) and the fresh deep ripped (28%) treatments. The deep worked and the rotational treatments were downgraded to APW1 due to higher screenings.

There was a 12.5% increase in the 2006 deep ripping treatment (Table 1).

Table 1 Summary of deep ripping trial results from soil compaction trials, 2008

Site	Treatment	Emergence (plants/m²)	Test Weight (kg/hL)	Screenings (%)	Protein (%)	Yield (t/ha)	Pay Grade
Warramboo	Control	67 a	80.7 a	2.6 a	11.7 b	0.43	H2
	Deep Ripped 06	77 a	79.9 a	2.9 a	12.5 ab	0.39	H2
	Deep Ripped 07	71 a	79.5 a	3.1 a	12.6 ab	0.52	H2
	Deep worked	72 a	80.4 a	3.3 a	12.0 ab	0.42	H2
	Rotational	62 a	80.5 a	3.1 a	12.3 ab	0.37	H2
	Deep Ripped 08	65 a	80.8 a	2.6 a	12.1 a	0.52	H2
LSD (P=0.05)		*19*	*1.1*	*0.9*	*0.6*	*0.09*	
Piednippie	Control	140 a	80.5 a	3.6 a	11.5 b	1.37	H2
	Deep Ripped 06	145a	80.9 a	3.6 a	11.4 b	1.38	APW1
	Deep Ripped 07	131	82.0 a	3.3 a	11.6 b	1.50 b	H2
	Deep worked	142 a	81.0 a	3.7 a	11.4 b	1.43	APW1
	Rotational	132 a	81.1 a	3.7 a	11.5 b	1.35	APW1
	Deep Ripped 08	126 a	81.9 a	2.7 b	11.9 a	1.60	H2
LSD (P=0.05)		*22*	*1.9*	*0.5*	*0.3*	*0.16*	
MAC	Control	164 a	82	3	15.5	0.32	H1
	Deep ripped 06	164 a	82	2	14.9	0.36	H1
	Deep Ripped 08	158 a	82	3	15.7	0.23	H1
	Deep Worked	140 b	82	5	14.3	0.21	H1
	Rotational	127 b	80	7	14.2	0.13	AGP1
LSD (P=0.05)		*14*	*ns*	*3.4*	*0.6*	*0.06*	
Cummins	Control	180	67	22	17	1.99	FED1
	Deep ripped 07	173	68	22	17	2.31	AGP1
	Deep Ripped 08	176	66	22	17	2.03	FED1
	Deep Worked	176	66	22	17	1.87	FED1
	Rotational	178	68	22	17	1.95	FED1
LSD (P=0.05)		*ns*	*ns*	*ns*	*ns*	*0.35*	
Wharminda	Control	65 a	75.7 b	11.6 ab	11.7 a	0.38	FED1
	Deep ripped 07	71 a	78.5 a	9.1 a	10.8 a	0.43	AGP1
	Deep Ripped 08	69 a	78.4 a	9.8 ab	10.8 a	0.43	AGP1
	Deep Worked	83 a	76.0 ab	10.4 ab	11.6 a	0.45	AGP1
	Rotational	71 a	77.7 ab	9.1 b	11.1 a	0.42	AGP1
LSD (P=0.05)		*18*	*2.6*	*2.4*	*0.7*	*ns*	
Wangary	Control	146	66	6	13	2.76	FED1
	Deep ripped 07	161	67	6	13	2.76	FED1
	Deep Ripped 08	144	68	6	14	2.81	APG1
	Deep Worked	151	66	6	13	2.76	FED1
	Rotational	152	66	6	13	2.69	FED1
LSD (P=0.05)		*ns*	*ns*	*ns*	*ns*	*ns*	

Location
Wangary
Peter and Chris Puckridge

Rainfall
Av Annual: 500 mm
Av GSR: 380 mm
2008 Total: 448 mm
2008 GSR: 293 mm

Yield
Potential: 4.4 t/ha (W)
Actual: 2.8 t/ha

Paddock History
2007: Canola
2006: Wheat
2005: Canola

Soil Type
Sandy loam over buckshot

Diseases
Blackleg

Plot size
20 m x 1.6 m x 4 reps

Yield Limiting Factors
Dry spring, wind damage

Location
Wharminda
John Masters
Wharminda Ag Bureau

Rainfall
Av Annual: 327 mm
Av GSR: 302 mm
2008 Total: 221 mm
2008 GSR: 145 mm

Yield
Potential: 1.2 t/ha (W)
Actual: 0.45 t/ha

Paddock History
2007: Wheat
2006: Grass free pasture
2005: Barley

Soil Type
Siliceous sand over clay

Diseases
Rhizoctonia

Plot size
20 m x 1.6 m x 4 reps

Yield Limiting Factors
Non-wetting sand, moisture stress, wind damage, Galah damage

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GRDC Grains Research & Development Corporation

Sites established in 2007

Cummins

Cummins showed no yield response to any treatments applied in 2007. In 2008 there was a 16% increase in the 2007 deep ripping, while the rotational tillage and deep working caused a yield decrease of 6% and 2% respectively (Table 1). The high screenings and low test weight are a result of the dry spring.

Wharminda

Wharminda showed a 24% increase in yield to deep ripping in 2007, but there was no yield response in 2008. All treatments that involved deeper working, either pre-sowing or during sowing resulted in lower screenings and therefore a higher recieval grade (Table 1).

Wangary

In 2007 deep ripping and deep working increased yield at Wangary by 41% and 28%. There was no response to any treatment in 2008 to any measurements taken.

What does this mean?

With below average rainfall in 2008, crops growing with a compacted layer below the surface may not have been restricted by the amount of water they were able to extract. Modelling in WA has shown that in dry years there is no adverse effect from compacted layers due to little subsoil moisture being available for the crop. This is supported by trials in WA that have shown that in areas with less than 325 mm annual rainfall the response to deep ripping is inconsistent. The soil profile may not become wet at depth so root systems restricted by compacted layers may have access to all available soil moisture in the surface layers and claypans.

There were no yield benefits from any treatments at Wangary and Wharminda, even though the deep ripping operation would have ameliorated the compacted layer. The deep working and the rotational working depth would have also disrupted the compacted layer at these sites.

Piednippie and Warramboo both showed a response to deep ripping operations performed in 2007 and 2008. Any benefits from deep ripping appear to only last for a maximum of two years as there was no response to the deep ripping operation from 2006.

The timing of deep ripping and deeper working is critical. If the soil is too dry (for heavy soils), as was the case at MAC, large clods will form and can adversely affect seeding. The reduced emergence rate at MAC would have contributed to the reduction in yield for both the rotational and deep worked treatments.

Deep ripping is a costly and time consuming exercise, so it is important that the benefits are large and long lasting. From the trial results over the last three years the sandy soils are more responsive to deep ripping. However, there is no economic incentive to change management practice to reduce the effect of compaction on these soil types because any benefits measured were below the cost of deep ripping.

Note that all the seasons over which this project has been conducted have had well below average rainfall. We would expect responses to deep ripping to be larger in higher rainfall years but these increases would have to be sufficiently large to cover the poor benefits in low rainfall years.

However, amelioration of compacted layers can occur naturally, albeit quite slowly, in our soils. No-till, high productivity and controlled traffic can enhance this rate of natural recovery. Our trials suggest that productivity may improve on many soils of the EP if these compacted layers are naturally ameliorated, even if the cost of mechanical intervention was not justified.

Acknowledgements

Thanks to Kay Brace, Trent Brace and the staff at MAC for all their technical assistance during the year. Thanks to Sam Doudle, Nigel Wilhelm, Neil Cordon and Brendan Frischke for their advice during the term of this project. Finally, but most importantly, a big thankyou to the Montgomerie, Puckridge, Veitch and Masters families and MAC and ABB staff for the provision of the trial sites during the last three years.

Soil Compaction Demonstrations 2008

Cathy Paterson and Wade Shepperd
SARDI,
Minnipa Agricultural Centre

Research

Searching for answers

Location
Calca
Ian and Craig Kelsh
Mt Cooper Ag Bureau

Rainfall
2008 Total: 326 mm
2008 GSR: 240 mm

Yield
Potential: 2.6 t/ha (W)
Actual: 1.8 t/ha

Soil Type
Sandy loam over buckshot

Yield Limiting Factors
Dry spring

Location
Charra
Shane Trowbridge
Charra Ag Bureau

Rainfall
2008 Total: 251 mm
2008 GSR: 152 mm

Yield
Potential: 1.6 t/ha (B)
Actual: 1.24 t/ha

Soil Type
Grey calcareous sandy loam

Yield Limiting Factors
Rainfall

Location
Cleve, Cleve Area School
(Joel Heinicke and Mick Scholz)
Crossville Ag Bureau

Rainfall
2008 Total: 295 mm
2008 GSR: 231 mm

Yield
Potential: 2.8 t/ha (O)
Actual: 0.3 t/ha

Continues

Key messages

- **Deep ripping provided a yield benefit at only one of eight compacted sites.**
- **Yield was lost from three sites despite no establishment problems.**
- **Deep ripping was not economic under the seasonal conditions experienced over the last few years.**

Why do the trial?

Soil compaction was nominated as an important issue requiring further research by 14 farmer groups during the 2003 EPFS farmer meetings. Consequently, a project was developed to determine the severity of soil compaction across EP and the effectiveness of deep ripping techniques for improving root growth and crop production. These demonstrations were designed to build on the database of deep ripping responses from six small plot trials undertaken in this project (previous article).

How was it done?

Eight demonstration sites were established in 2008 at Calca, Charra, Cleve, Karcultaby, Karkoo, Mudamuckla, Pt Kenny and Tuckey. These sites were all selected from paddocks characterised as part of the compaction survey conducted in 2007. In each paddock, two replicated strips the width of the farmer's seeder were deep ripped to a depth of 45 cm prior to seeding, with the exception of Calca which was only ripped to 35 cm. Control strips (farmer practice) were left between these strips for comparison. The ripper was equipped with DBS ripping tynes at 45 cm spacings. These areas were sown and managed by the farmers during their normal cropping operations.

Site Details

Calca: Sown on 20 May with Yitpi wheat @ 75 kg/ha, 18:20 @ 70 kg/ha. Urea top dressed @ 50 kg/ha in August.

Charra: Sown on 26 May with Yitpi wheat @ 60 kg/ha, 18:20 @ 60 kg/ha.

Cleve: Sown on 22 May with Wallaroo oats @ 50 kg/ha, (Mega Easy) 16:15 @ 50 kg/ha.

Karcultaby: Sown on 9 June with Wyalkatchem wheat @ 65kg/ha, 10:22 @ 30 kg/ha.

Karkoo: Sown on 29 May with Schooner barley @ 85 kg/ha, 32:10 @ 120 kg/ha.

Mudamuckla: Sown on 21 May with Wyalkatchem wheat @ 55 kg/ha, P @ 5.5 kg/ha.

Port Kenny: Sown with wheat @ 60 kg/ha, 18:20 @ 60 kg/ha.

Tuckey: Sown on 23 May with Keel barley @ 55 kg/ha, 10:22 @ 30 kg/ha and sulphate of ammonia/urea mix @40 kg/ha.

The soil profile at each site was characterised to determine its water holding capacity, presence of subsoil constraints and level of compaction. Crop establishment was measured prior to tillering. Quadrat cuts were taken at crop maturity to determine total dry matter production, grain yield and harvest index. Grain samples were analysed for grain quality.

What happened?

In 2008, growing season rainfall was well below average at all sites.

Soil Type
Sandy clay loam

Yield Limiting Factors
Dry spring

Location
Karcultaby
Matt Cook
Minnipa Ag Bureau

Rainfall
2008 Total: 236 mm
2008 GSR: 123 mm

Yield
Potential: 0.9 t/ha (W)
Actual: 0.21 t/ha

Soil Type
Sandy clay loam

Yield Limiting Factors
Rainfall

Location
Karkoo
Leon and Reece Modra

Rainfall
2008 Total: 311 mm
2008 GSR: 274 mm

Yield
Potential: 3.8 t/ha (B)
Actual: 3.1 t/ha

Soil Type
Sandy loam over clay

Yield Limiting Factors
Dry spring

Location
Mudamuckla
Peter Kuhlmann
Nunjikompita Ag Bureau

Rainfall
2008 Total: 246 mm
2008 GSR: 129 mm

Yield
Potential: 1.4 t/ha (W)
Actual: 0.78 t/ha

Soil Type
Sandy loam

Yield Limiting Factors
Rainfall

Location
Port Kenny
Ken and Nathan Little
Mt Cooper Ag Bureau

Rainfall
2008 Total: 294 mm
2008 GSR: 231 mm

Yield
Potential: 2.4 t/ha (W)
Actual: 2.1 t/ha

Soil Type
Sandy clay loam

Yield Limiting Factors
Dry spring

Continues

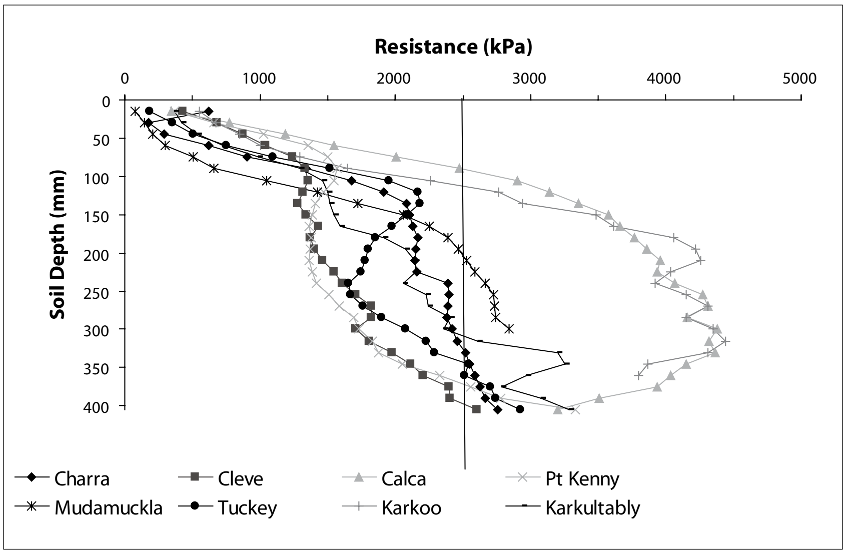

Figure 1 Soil resistance measurements taken at field capacity for all demo sites. Soil resistance over 2500 kPa will restrict growth of roots

Soil strength

Soil resistance of 2500 kPa at field capacity is the level at which plant root growth is restricted. All sites reached soil resistances of more than 2500 kPa within 40 cm (Figure 1).

Deep ripping had no effect on crop emergence or grain quality at any site (Table 1). While deep ripping did not affect grain yield at many of the sites, it reduced yield at Cleve, Karcultaby and Mudamuckla where grain yield declined by 40, 38 and 23% respectively. These three sites also had the lowest grain yields. The only site to benefit from deep ripping was Charra where grain yield increased by 27%.

Table 1 Impact of deep ripping on cereal production at soil compaction demonstrations in 2008

Site	Treatment	Emergence (plants/m^2)	Test weight (kg/hL)	Screen-ings (%)	Protein (%)	Yield (t/ha)
Calca	Deep ripped	180	85	3	13.5	1.78
	Control	173	84	5	13.2	1.80
Charra	Deep ripped	67	71	5	17.2	1.24
	Control	73	74	13	15.1	0.98
Cleve	Deep ripped	113	46	-	-	0.18
	Control	107	45	-	-	0.30
Karcultaby	Deep ripped	111	-	-	-	0.13
	Control	106	-	-	-	0.21
Karkoo	Deep ripped	221	72	12	10.6	3.09
	Control	202	75	7	10.7	3.07
Mudamuckla	Deep ripped	110	83	1	13.2	0.60
	Control	131	86	1	12.7	0.78
Port Kenny	Deep ripped	154	82	4	13.7	2.12
	Control	145	80	16	13.7	2.07
Tuckey	Deep ripped	180	64	100	14.7	1.97
	Control	162	80	40	14.5	2.09

Location
Tuckey
Jason Burton
Tuckey Ag Bureau
Rainfall
2008 Total: 235 mm
2008 GSR: 188 mm
Yield
Potential: 2.23 t/ha (B)
Actual: 2.09 t/ha
Soil Type
Sandy loam
Yield Limiting Factors
Dry spring

What does this mean?

These demonstrations support the results of the last two years of trial work which show that grain yield responses to deep ripping have been small and intermittent. Only one of the eight sites had a yield increase from deep ripping. The reason for the decline in yield with deep ripping at three of the sites is not clear, although some water would almost certainly have been lost as a result of the deep ripping operation and the subsequently loosened profile. Although these yield declines are quite large in percentage terms, due to the very low yields at these sites, it didn't amount to a lot in terms of quantity.

As deep ripping seldom produces positive grain yield responses over a wide range of EP soil types during years of below average rainfall, deep ripping must be regarded with caution in EP environments.

Acknowledgements

Thanks to Kay Brace, Jade Zippel, Sue Buderick and Liam Cook and the staff at MAC for all their technical assistance during the year.

Also, a big thank you to the Burton, Cook, Kelsh, Kuhlmann, Little, Modra and Trowbridge families and the Cleve Area School for the provision of the demonstration sites.

SAGIT

GRDC Grains Research & Development Corporation

Soils

Buckleboo 'Subsoil Enhancer' Demonstration (5th year)

Nigel Wilhelm, Jonathon Hancock and Alison Frischke
SARDI, Minnipa Agricultural Centre

Research

Searching for answers

Location
Sand (Larwood)
Rainfall
Av Annual: 290 mm
Av GSR: 230 mm
2008 Total: 308 mm
2008 GSR: 177 mm
Yield
Potential: 1.7 t/ha (W)
Actual: 0.6 t/ha
Paddock History
2007: Wheat
2006: Wheat
2005: Canola
Soil Type
Sand over clay
Diseases
Nil
Plot size
7 m x 3 m x 2 reps
Yield Limiting Factors
Dry spring, possible frost

Location
Loam (Lienert)
Rainfall
Av Annual: 325 mm
Av GSR: 250 mm
2008 Total: 270 mm
2008 GSR: 162 mm
Yield
Potential: 1.5 t/ha (W)
Actual: 0.6 t/ha
Paddock History
2007: Wheat
2006: Wheat
2005: Wheat

Continues

Key message

- **There is no incentive for Buckleboo farmers to change their standard fertiliser applications to a more expensive fertiliser strategy.**

Why do the trial?

These demonstrations, initiated by the Buckleboo Farm Improvement Group (BIG FIG), were designed to test whether deep ripping, nutrition and/or gypsum applications can increase the depth of soil profile accessed by crops and increase grain yield.

They aimed to answer the following questions over a number of years and soil types;

- Is there a benefit from deep ripping?
- Are fluid fertilisers more effective than granular fertilisers?
- Is deep placed fertiliser (40 cm) better than conventionally placed fertiliser (5 cm)?
- Are higher rates of deep placed fertiliser better than standard rates?
- Does the application of gypsum improve yield and/or access to subsoil moisture by improving soil structure?

Previous results were published in EPFS Summary 2004, pp 115-118, EPFS Summary 2005, pp 122-123, EPFS Summary 2006, p 149 and EPFS Summary 2007, pp 151-153.

This program was scheduled to finish after the 2007 season but the BIG FIG group were keen to manage it for one more year, in the hope that the treatments would finally be exposed to a good production season (in vain as it turned out). The EPFS team from Minnipa helped them monitor the trials as best they could with very limited resources.

How was it done?

In 2004 the BIG FIG gained sponsorship to build a precision seeder and set up long term demonstrations on four different soil types of the Buckleboo district (sand, red, grey and loam). The precision seeder, equipped with Primary Sales hydraulic tines is capable of delivering granular or fluid fertilisers to a depth of 40 cm. Two gypsum treatments (2 t/ha in 2004 and 2006 or 5 t/ha in 2004 only) were each applied to a strip running the length of each demonstration with control strips (no gypsum) on either side. Two replications of the different nutrition and ripping treatments (Table 1) were applied perpendicular to the gypsum strips and were in the same location each year.

Wyalkatchem wheat was sown dry on 17 April after all sites were sprayed with 1 L/ha of Triflur X and 400 g/ha Diuron. In 2008, 27:12 was used instead of 18:20 because it was the only fertiliser available. This means that N and P rates did not completely match between granular and fluid treatments. No in-crop sprays were required. Grain yields were assessed by plot header cuts from every plot.

What happened?

Despite the best of intentions, the 2008 season for the Buckleboo district was another dry one! The conditions were so dry that the red site completely failed and no plots were harvested. In addition, production on the grey site was also very poor and sheep were used to graze out the crop in the paddock. Unfortunately, this meant that the trial was also grazed out, which meant no results from that site either.

Soil Type
Sandy loam over clay at depth

Diseases
Nil

Plot size
7 m x 3 m x 2 reps

Yield Limiting Factors
Drought conditions, especially in spring

Production levels were also very poor at the loam and sand sites, although frost may have caused additional problems on the sand site (Table 2). As with the previous poor seasons, fertiliser treatments provided little benefit in 2008 at either site. In fact, on the loam site, any extra nutrition to district practice reduced grain yields. Deep ripping (and previously delved plots sown with high fertiliser rates in 2008, data not presented) all yielded poorly at this site. All treatments at the sand site yielded the same as district practice (a miserly 2 bags per acre). Unlike all previous years, gypsum did not benefit grain production on the sand site in 2008, although if frost had been a factor there, any benefits could have been lost by harvest.

What does this mean?

This trial work has shown that there is no reason for Buckleboo farmers to change from their traditional fertiliser practice, using low rates of NP fertiliser at seeding, because little benefit was achieved under a dry run of seasons from more expensive fertiliser strategies. None of the alternative nutrition techniques outperformed district practice over the last three very dry seasons. Some small yield benefits were produced with gypsum on the sand but economic returns would still have been marginal, given the poor run of seasons.

Acknowledgements

Thanks to co-operators, Tony Larwood, Graeme Baldock and Bill and 'Gadj' Lienert for providing the demonstration sites. Special thanks to Fertisol and Agrichem for providing the fluid brews.

Thanks to Sam Doudle for helping establish these demonstrations, Jono, Cathy and Ali for helping with the trials over the last couple of seasons and Wade Shepperd, Ian Richter and Brenton Spriggs for technical assistance.

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SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

BUCKLEBOO FARM IMPROVEMENT GROUP

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Table 1 Nutrition and Placement Treatments for Buckleboo Demonstrations

Treatment Number	Name	Fertiliser rate and type		Fertiliser Placement
		Granular @ seeding	Fluid @ seeding	
1	District Practice	65 kg/ha 27:12 (12 N + 13 P)	-	Shallow
2	Rip Only	65 kg/ha 27:12 (12 N + 13 P)	-	Shallow
3	Shallow Fluids	-	11.7 N + 13P + 1Zn + 1Mn, + 0.5Cu	Shallow
4	Deep Fluids	25 kg/ha 27:12 placed shallow	7.2N + 8P + 1Zn + 1Mn, + 0.5Cu	Fluid placed deep
5	Deep Fluids - super brew	25 kg/ha 27:12 placed shallow	20 N + 15P + 1Zn + 1Mn + 0.5Cu	Fluid placed deep

Table 2 Effect of Nutrition and Placement Treatments on wheat yields at two Buckleboo Demonstration sites

Name	Grain yield, (t/ha, ± *standard error of mean*)					
	Sand			Loam		
	No gypsum	5 t/ha gypsum in 2004	2 t/ha gypsum in 2004 and 2006	No gypsum	5 t/ha gypsum in 2004	2 t/ha gypsum in 2004 and 2006
District Practice	0.50 ± *0.05*	0.45 ± *0.04*	0.40 ± *0.00*	0.55 ± *0.03*	0.65 ± *0.13*	0.58 ± *0.05*
Rip Only	0.40 ± *0.04*	0.43 ± *0.14*	0.40 ± *0.04*	0.41 ± *0.04*	0.48 ± *0.02*	0.54 ± *0.11*
Shallow Fluids	0.45 ± *0.02*	0.43 ± *0.01*	0.42 ± *0.06*	0.54 ± *0.03*	0.50 ± *0.10*	0.57 ± *0.06*
Deep Fluids	0.41 ± *0.06*	0.44 ± *0.06*	0.53 ± *0.06*	0.44 ± *0.04*	0.49 ± *0.03*	0.47 ± *0.09*
Deep Fluids - super brew	0.50 ± *0.04*	0.52 ± *0.09*	0.49 ± *0.16*	0.27 ± *0.04*	0.48 ± *0.03*	0.26 ± *0.08*
Averages	**0.46 ± *0.02***	**0.48 ± *0.03***	**0.47 ± *0.03***	**0.40 ± *0.02***	**0.44 ± *0.05***	**0.45 ± *0.04***

Estimating yield at the Nundroo Sticky Beak day, 2008

Section editor:
Naomi Scholz
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Sharing Information

Carbon Trading Scheme

Nigel Wilhelm
SARDI, Minnipa Agricultural Centre

The current federal government is committed to the introduction of a carbon trading scheme into Australia's economy. This scheme is targeted to begin in 2010 and its intention is to reduce the amount of carbon being emitted by Australia's industry. The scheme is a key feature of the government's plan to reduce global warming. Even though agriculture is planned not to enter the scheme until 2013, the scheme will impact on agriculture from its start. Given that this scheme is likely to have a large impact on Australia's economy and that agriculture will be part of the scheme, one way or another, I thought it timely to answer a few "frequently asked questions" for you, as best I can.

Why will there be a carbon trading scheme?

The reason for the scheme is captured in its official title. The proper name is the, "Carbon Pollution Reduction Scheme" (CPRS). So, although it is commonly known as a carbon trading scheme, its purpose is not to create a new market or any sort of economic activity. Its primary purpose is to reduce the production of greenhouse gases by Australian industry in an attempt to mitigate the extent of climate change. It is expected that the scheme will cost some industries even though there may also be profits to be made by those companies or industries that can trap (sequester) carbon or substantially reduce their current levels of carbon emissions.

How will the scheme work?

The type of scheme the Rudd government is planning is a 'cap and trade' scheme. This means that a maximum amount of carbon emissions by Australian industries will be set. A press release prior to Christmas announced that this maximum amount (cap) will be set at the higher range of the options being contemplated. This means that Australia's industries will have relatively small reduction targets to meet once the scheme is underway.

Each major company in the scheme will have an emissions target set for them and they will have to either reduce their emissions to meet that target every year or buy carbon credits. These credits will be available at market set values from companies who have either reduced their emissions to below their cap or they conduct carbon-sequestering activities.

The government will also keep a number of carbon credits in reserve, which it will provide to industries who can successfully argue that they are competing heavily with other companies who are not operating under a carbon emissions scheme themselves (e.g. in foreign countries) or they have some other hardship argument.

What will carbon be worth under the CPRS?

Although very few experts are confident about predicting the likely value of carbon under the current scheme, partly because the details are still being finalised, estimates have been published. Most estimates are in the range of \$20-40 per tonne but with the proposed relatively low cap released late in 2008, the initial values of likely to be in the lower end of this range. However, some estimates (based on the cost of reducing carbon emissions for the major industries such as coal fired power stations) are as high as \$300 per tonne of carbon.

Is agriculture going to be part of the CPR scheme?

The official position regarding agriculture and this scheme is that the full scheme will be introduced into Australia in 2010 without agriculture. Agriculture will be reviewed in 2013 in the expectation that it will be included under the scheme in 2015. Current estimates allocate almost 20% of total carbon emissions from Australian industry to agriculture so it seems unlikely that agriculture will "escape" the scheme.

One of the reasons that agriculture is not being included in the scheme initially is because it a sector which is very hard to manage under the scheme. The scheme works most easily with companies which have few sites, are major carbon emitters and emissions can be easily monitored, e.g. a power station. Tens of thousands of individual agricultural operators, with diffuse and relatively low outputs of carbon emissions are very difficult to monitor and manage.

Experts predict that because of the difficult nature of agriculture in terms of the CPR scheme, agriculture will be managed upstream and downstream. This means that its products will be assessed under the scheme at a point in the sale chain (e.g. at the abattoirs for stock) and inputs will assessed prior to use (e.g. diesel and agri-chemicals). Individual farms are unlikely to be included under the scheme and most farms fall well under the current guidelines for inclusion in the scheme (both in terms of their scale of operation and amount of carbon emissions). But the total industry is most likely to be included.

Even though agriculture will not be included in the scheme initially, it will still be affected by it. Costs of inputs for agriculture are expected to increase under the scheme because many of them are energy-intensive to produce (and are thus large carbon emitters during production). Obvious examples here are fuel and fertilisers.

Agriculture can sequester carbon, so won't it benefit from the scheme?

Many agricultural enterprises have the potential to build carbon levels on their properties because they are growing plants and at least some of these plants will be returned to the soil and become incorporated into the organic matter. Since plants grow by absorbing carbon dioxide out of the air and converting it into plant structures, any carbon trapped in plant material is taking carbon dioxide out of the atmosphere and can be considered for carbon credits. This principle is sound but there are many problems with realising these credits in practice. Ruminant animals (e.g. sheep and cattle) are major emitters of greenhouse gases and are responsible for the majority of greenhouse gas emissions allocated to agriculture.

For carbon to be trapped (sequestered) for the long term, it must enter the humus fraction of soil organic matter. Humus also contains other elements such as nitrogen, phosphorus and sulphur. The value of these nutrients, which could be as high as $200/ tonne of CO_2 equivalents will certainly defray any value from the sequestered carbon.

Another issue which has delayed the introduction of agriculture into the CPR scheme is the difficulty in monitoring and assessing carbon sequestration in broadacre enterprises. And for all but high rainfall zones, the rates of carbon sequestering may be too low to be reliably accounted.

For example, N12 is a continuously cropped paddock on Minnipa Ag Centre with a light soil type for the centre. Over the last 20 years, organic carbon has gone up from 0.8% to 1.2%. This represents a total potential income of $40/ha/yr (at a value of $40/t CO_2 equivalents), less the fraction which is still active (perhaps 50%), so about $10/ha/ yr. And this is a best case scenario (many studies have shown little or no increase in organic carbon over many years of agricultural management). However, this paddock has also developed suppression against rhizoctonia. Organic matter is probably a key factor in this suppression, which might be worth about $60/ha/yr if it reduces the impact of rhizoctonia losses by 15% ($250/t for grain, yields averaging 1.5 t/ha and suppression "protects" yields by 15%). Increased organic matter will also improve bucket size and help hold nutrients and reduce erosion risk.

So carbon sequestration (or building organic matter as we normally call it) in agricultural soils under normal production systems is still going to be about its agronomic benefits in the future, rather than any major windfall gains from the CPR scheme. At this stage, only forests will be accepted as carbon credits. These are defined as being over 2 m tall and at least 20% canopy cover. This means that permanent plantings such as saltbush, alleys or perennial grassy pastures will not qualify.

THE WILDERNESS SOCIETY

Executive Summaries of SAGIT Funded Projects

The SA Grain Industry Trust Fund (SAGIT) was established in 1991 to administer the voluntary research grain levy. That levy is currently 20 cents per tonne and is payable on all grains.

The Trust uses the funds collected via the levy and its reserves to support research and development into the growing, harvesting, storage, processing and marketing of grain in SA and for the dissemination of technical information to the State's grains industry. The average annual spend on projects is about $1.2M. A call for projects is made each year, with most projects having a three year term.

The following summaries are from recent SAGIT funded projects that have particular significance to Eyre Peninsula. The full copies of final reports and progress reports of all SAGIT funded projects are available to download from the SAGIT website www.sagit.com.au/latestresearchreports.

Validation of DNA Soil Assays for Key Pulse Pathogens

A specific DNA test for Phoma X has been developed and used to survey soil and pea plants sampled from the cropping region of South Australia. The study concluded that the fungus is widespread in South Australia and can cause severe damage to pea plants, including death of the primary tiller. This is the first time in the world that Phoma X has been identified as part of the blackspot complex on field peas. *P. koolunga* levels in soils are not correlated to those of *Mycosphaerella pinodes* and *Phoma medicaginis var. pinodella*, the other fungi which cause blackspot disease on field peas. These differences could reflect the varying ability of the fungi to survive in soil. The level of *P. koolunga* in soils measured by the DNA assay was directly correlated to blackspot disease severity on plants. The DNA test, which will be added to the Predicta B service, will assist farmers to select paddocks with low inoculum loads of *P. koolunga*. Combined with the previously developed DNA test for blackspot this should enable growers to avoid paddocks with both inoculum types.

For more information contact: Jenny Davidson, Ph: (08) 8303 9389, Email: davidson.jenny@saugov.sa.gov.au

Discovering Reproductive Frost (RFT) Genes and Creating Novel RFT Field Pea Plant Material by Utilising Classical and Molecular Technologies

A total of 108 diverse collections of field pea around the world were screened using a frost-scoring key developed through this project. Two selections, SARDI-1 and SARDI-2, had the greatest tolerance to radiant frost at the reproductive stages (flowering and podding) when tested under both artificial and natural radiant frost conditions. A natural frost test was conducted during the 2006/07 season at Mintaro near Clare. A total of 44 advanced genetic combinations were made with SARDI-1 and 42 with SARDI-2, using Kaspa as the other parent.

Five of these lines have been selected for the breeding program based on their superior tolerance to both parents under radiant frost conditions. Molecular techniques have shown that the genetic inheritance of reproductive frost tolerance in field pea is controlled by multiple genes and is a recessive trait. Four different mapping populations have been developed and the newly developed frost tolerant germplasm is now included in the national field pea breeding program.

For more information contact: Dr M Ahmad Ph: (08) 8303 9483, Email: ahmad.maqbool@saugov.sa.gov.au

Applying New Technologies to Understand Varietal Performance of Wheat

Growers are responding to production challenges by growing more cereals and using Precision Agriculture (PA) to vary fertiliser rates between soil zones. They now need more information on the performance of cultivars in consecutive cereal rotations and in different zones, and on tolerance to soilborne pathogens that will emerge in these systems. Disease tolerance needs to be assessed in the field and very few of these trials are being undertaken at present. Cereal variety evaluation trials may be able to assist.

This project has examined the use of PA zoning for use in evaluation of disease tolerance of different varieties, and recommends the following:

- Cultivar evaluation sites should be characterised for soilborne pathogens.
- Sites with multiple soilborne pathogens should be avoided.
- Sites with significant take-all and Rhizoctonia should be avoided unless new cultivars have some tolerance.
- Sites should be located to target emerging farm practices e.g. stubble retention, sowing between rows, sowing dry etc.
- The emphasis on selecting a range of soil types etc. to characterise the main production zones within a region should continue, and soil types which are characteristic of most profitable zones should be selected.

Research needs to be done to monitor soilborne disease trends in the new farming systems and identify potential risks before the industry suffers large losses.

For more information: Dr John Heap, Ph: (08) 8303 9444, Email: heap.john@saugov.sa.gov.au

Managing Root Diseases on Upper Eyre Peninsula through Disease Suppression

- Potential suppression of root disease, mainly rhizoctonia appears to be present in at least some paddocks on upper EP. Suppression offers the best prospects for substantial and long term control of Rhizoctonia in these environments.
- The factors with significant influence on disease suppression levels were average grain yield over the ten years prior to sample collection and soil collection time (higher in summer than in-crop).
- Canola can reduce rhizoctonia inoculum to levels similar to a long fallow, provided grassy and broadleaved weeds are controlled.
- However, rhizoctonia continues to be a major disease problem in upper Eyre Peninsula farming systems and further research is required to more fully understand the dynamics and interactions between soil carbon and nitrogen, the soil environment, the disease, the microbial community and farm management decisions.
- Rhizoctonia disease score in-crop from fifty paddocks in 2007 showed P inputs, average cereal grain yield over ten years and calcium carbonate content of the soil influenced the incidence of disease in crop. The addition of P reduced disease symptoms. The disease scores identified that current rhizoctonia disease levels reflected the long term yield achieved.
- Leaf tissue nutrient analysis of the surveyed paddocks showed deficiencies in P and Zn are present on EP.

For more information: Dr Nigel Wilhelm, Ph: (08) 8680 5104, Email: wilhelm.nigel@saugov.sa.gov.au

Developing Break Crop Options on Upper Eyre Peninsula

To provide grain growers in low rainfall districts with viable break crop options, selection and evaluation in oilseeds (canola and both canola quality and biodiesel potential mustards) and faba beans was conducted on Minnipa Agricultural Centre on upper Eyre Peninsula from 2005 to 2007.

While no new varieties have been released specifically from this program to date, important findings and developments are:

- Selection for early maturity is a critical factor in developing oilseed varieties capable of delivering viable yields in low rainfall environments. Minnipa has proven to be an excellent site for this, to complement selection in the low rainfall Murray Mallee.
- The value of early maturing canola varieties such as Tarcoola has been demonstrated, while a number of promising lines of canola and mustard have been identified for low rainfall environments.
- Mustards have not been shown to have an inherent yield advantage over canola in low rainfall districts of Eyre Peninsula. This could change as breeding and selection develop earlier maturing, higher yielding and oil content mustards.
- Faba beans have not been able to match the yields and reliability of field peas as a pulse crop option for low rainfall districts. Faba bean lines showing better adaptation to low rainfall conditions have been identified, and these are now in advanced evaluation (NVT) trials.

For more information: Jim Egan, Ph: (08) 8688 3424, Email: egan.jim@saugov.sa.gov.au

Seasonal Climate Forecasts for SA Grains – Looking forward

Outcomes of this project include: supporting producers to distinguish the difference between climate change and variability and to make better decisions. These outcomes were reached by researching the usefulness of seasonal climate forecasts for grain growers use in SA and producing a booklet for producers about when to use seasonal forecasts and when to ignore them. The seasonal climate outlook book was delivered initially to over 250 producers in workshops and farmer discussion sessions, where they were helped to prepare management plans for seasonal variability and climate change using other supportive tools and services. The workshops were also used to find out about what type of producers needed to know about climate change. A second booklet was produced to provide this information with a large focus on adaptation to climate change.

In the latter part of the project, climate indicator signs were erected in 3 major grain growing regions of SA. They allow producers to view climate support information at field days and farmer walks and via consultants, in an easy to understand interpreted format. They have provided a great prompt for discussion and a summary of climate information alongside soil water levels, yield forecasts and nitrogen recommendations.

For more information: Melissa Rebbeck, Ph: (08) 8303 9639, Email: rebbeck.melissa@saugov.sa.gov.au

Microspore Culture Technologies for Field Pea and Oat Breeding

Isolated microspore culture is an important biotechnology for generating doubled haploid plants which allows new varieties to be bred 3 to 5 years more rapidly than with conventional breeding methods alone. This project aimed to develop isolated microspore culture methods for oat and field pea based on the barley protocol.

This was a very challenging project because no other laboratories in the world have successfully produced haploid or doubled haploid plants from isolated microspores of either field pea or oat. Over the course of this project we were successful in producing plants from oat microspores but did not succeed with field pea. The successful oat method requires the use of "conditioned" culture medium obtained from barley microspore cultures together with long cold pre-treatment of microspores and medium with high pH. Some genotypes have greater success than others.

The method developed for oat will be further developed through the SAGIT project S0308R, which also includes developing a similar method for wheat and is supported by Australian Grain Technologies and Longreach Plant Breeders. The aim is to apply the technique successfully to commercial oat and wheat breeding programs.

For more information: Dr Phil Davies, Ph: (08) 8303 9494, Email: davies.phil@saugov.sa.gov.au

Publication of Variety Sowing Guide, Harvest Report and New Variety Brochures

This project annually provides SA grain producers with independently prepared, timely and comprehensive data necessary for an informed decision on the most profitable and sustainable crop varieties and their management within SA farming systems. The data were provided in the form of annual *Crop Variety Sowing Guides* and *Crop Harvest Reports* together with new crop variety management brochures.

The *SA Crop Variety Sowing Guides* and *Crop Harvest Reports* prepared and published from this project were distributed to more than 8,500 grain producers through the *Grain Business* magazine with the sowing guides also distributed to more than 750 seed retailers and commercial agronomists through a 'seed distributors' targeted publication. Additionally, all publications prepared through this project were posted on the SARDI web site with links to other sites such as Ezigrain and copies also made available through the Prime Notes CD ROM.

New variety management brochures and technical information published from this project were distributed through the seed industry outlets, PIRSA and other agronomists and agricultural field days throughout South Australia with copies also posted on the SARDI web site.

For more information: Rob Wheeler, Ph: (08) 8303 9480, Email: wheeler.rob@saugov.sa.gov.au

Weed Mapping Within Paddocks for Targeted Weed Control

Weed management challenges have become increasingly difficult with the escalation of herbicide resistance and rising input costs. The advent of Precision Agriculture (PA) adoption in Australia and the results from overseas research suggest that there are potential economic and environmental gains from Site Specific Weed Management (SSWM). This project aimed to assemble equipment, techniques and knowledge to provide capacity to do research into SSWM. As a result GRDC has agreed to fund a three-year SSWM project based with SARDI (Dr John Heap; 2008-2011). The GRDC project has now begun and is heavily reliant on the outcomes from this SAGIT project.

This project developed and demonstrated field techniques for biomass mapping using ground and airborne sensing systems, and refined computer-based procedures to analyse airborne imagery.

For more information: Dr John Heap, Ph: (08) 8303 9444, Email: heap.john@saugov.sa.gov.au

A Review of the Vertebrate Pests and Asparagus Weed Management Programs

Rob Coventry and Meg Goecker
Eyre Peninsula Natural Resources Management Board

Key messages

- **The Vertebrate Pests and Asparagus Weed Management Programs have made significant and substantial contributions to natural resource management (NRM) outcomes on Eyre Peninsula.**
- **Pest animals and plants are known to have substantial impacts on primary industry and the environment.**
- **A wide range of land managers consider integrated pest management (IPM) as a core function of NRM and the conduit for involvement in NRM generally.**
- **The review recommended adopting and supporting the 'satellite groups' model as a key regional NRM delivery mechanism and extended as a conduit for a wider range of NRM activities.**

Why do the trial?

Vertebrate Pests and Asparagus Weed Management Programs have been funded for over seven years on Eyre Peninsula through various funding grants. It was considered timely to undertake a review of these programs based on both their funding-linked objectives and achievements and their wider contribution towards the aims and objectives of the Eyre Peninsula Natural Resources Management Board, in order to offer informed advice for the development of control programs into the future.

How was it done?

- Engage consultant (interPART & Associates) to undertake an independent review process,
- Four step review process undertaken:
  - Agreement on review, including project inception meeting to determine scope, method and programming of activities, program logic.
  - Data collection, including document and literature review, key informant interviews, case studies and surveys.
  - Analysis of information, including qualitative and quantitative and process based information.
  - Consolidation of findings, including summit workshop and final report.
- Final report presented to Eyre Peninsula Natural Resources Management Board

What happened?

55 interviews were conducted with key informants who had involvement with the programs in various functions. Some of the findings associated with these interviews are:

- The Asparagus Weed Program delivered activities and outcomes largely in accordance with planned intentions. Noteworthy achievements relate to:
  - community awareness and engagement encompassing a range of interrelated activities and products
  - development of innovative partnerships
  - cutting edge development of biological control practices
  - monitoring and administration practices
- All of these offer lessons in best practice for weed management, and wider pest management and biosecurity programs.
- The pest management program across Eyre Peninsula commands a high level of respect and support amongst those who are participating, with the approach taken by Authorised Officers frequently cited as a key contributing factor in this (i.e. an engagement and awareness-raising rather than compliance focus).

76 people responded to the Review initiated survey which was widely distributed throughout the region. Some insights from these surveys include:

- Pest plants were mentioned less frequently than animals; box thorn control was mentioned more frequently than bridal creeper.
- Bridal creeper was frequently cited as a weed requiring attention... but also identified that management is logistically difficult, it is slow to see results and is not a priority amid other 'productivity' impacting weeds.
- Sixty-one (80%) respondents cited productivity gains as the primary reason why they participated in baiting programs.

- 44 (58%) of people indicated that protecting native species was an important reason for baiting.

A summit workshop was held in Wudinna with a range of program participants to discuss some of the preliminary findings of the review and to share a range of stories and experiences associated with the programs. Participants were also asked to rank a number of Key Informant Case Studies which provided insights into how people are involved with the programs, to be included in the final review.

The interpretation of data, collation of survey information and other program associated information was completed and a final review document presented to the Eyre Peninsula Natural Resources Management Board in July 2008.

The review concludes that the Vertebrate Pest and Asparagus Weed Management Programs have made significant contributions to NRM outcomes on Eyre Peninsula. These programs have developed a range of best practice initiatives that have increased stakeholder engagement in pest management and generated positive environmental and productivity outcomes.

Key features required for effective and efficient pest management work include:

- having a strong network of capable community-based groups through which to implement
- having credible, locally-based Authorised/Project officers who can adapt and integrate programs to the sub-regional context
- offering free baits and on-ground support - as an incentive, conduit for awareness raising and mobilising engagement, and demonstration of Board commitment
- having a dedicated communication, education and engagement role to support on-ground efforts and extend engagement and thus coverage, which has currently plateaued
- developing adaptive, responsive, strategically focused programs based on good monitoring, practical research and science
- supported by a regional NRM body displaying a culture and capacity for genuine partnership, engagement and resourcing

The evaluation has also confirmed that pest plants and animals continue to present a major risk to the ecological, economic, social and cultural fabric of the Eyre Peninsula. As such, pest management must remain a prominent, ongoing and adequately resourced program.

What does this mean?

Contained within the review are twenty two key recommendations including:

- That the IPM/Biosecurity Program be reinvigorated through development of a cohesive, region wide delivery model that captures sub-regional diversity; and incorporates ongoing asparagus weed management.
- That the 'satellite groups' model be adopted and supported as a key regional NRM delivery mechanism and extended as a conduit for a wider range of NRM activities.
- That free baits continue to be made available to land managers, with efficiencies gained by strengthening partnerships with other stakeholders.
- That management to eradicate bridal veil from Eyre Peninsula continue.
- That local champions be identified and effectively engaged to support the IPM/ Biosecurity and other NRM Programs.

The Eyre Peninsula Natural Resources Management Board is currently developing responses to the recommendations from this review for inclusion in the Regional Eyre Peninsula NRM Plan.

Copies of the review document can be obtained by contacting the Eyre Peninsula Natural Resources Management Board office on (08) 8682 7555, or via the web at www.epnrm.sa.gov.au

Acknowledgements

Kerry Thomas and Barry Lincoln, interPART & Associates

Adrian Simpson & Iggy Honan, Eyre Peninsula Natural Resources Management Board

Dave Armstrong & Leigh Amey, DEH Venus Bay

All landholders and participants in both the Asparagus Weeds control program and the Integrated Pest Management programs, for their active involvement in the programs and their review.

Government of South Australia
Eyre Peninsula Natural Resources Management Board

Natural Heritage Trust
Helping Communities Helping Australia

WEST COAST INTEGRATED PEST MANAGEMENT PROGRAM

Eyre Peninsula Bridal Creeper Control Group

WildEyre: Practical Conservation Action Planning for Western Eyre Peninsula

Rob Coventry and Louise Mortimer

Eyre Peninsula Natural Resources Management Board

Searching for answers

Key messages

- **WildEyre is a landscape-scale Conservation Action Planning (CAP) process that aims to identify natural assets and their associated threats or pressures, plan for realistic conservation and management activities in order to rehabilitate degraded systems, conserve and manage existing systems as well as to reinstate natural communities and ecosystems where they have been lost from the natural environment.**
- **The focus is on a holistic approach to land management, not just for conservation outcomes in the short and medium-term, but for a sustainable long-term environment.**

Why do the trial?

People living and working on the land know how precious it is. They rely on their land to provide them with an income, and they know that when the condition of the land declines, production is usually soon to follow. On Eyre Peninsula, there are many different natural systems, communities and assets that are in various states of health or decline, some due to land clearance, some due to changes in climate, some due to a range of influences both current and past.

These natural systems don't exist in isolation to each other so it is logical to approach the management and rehabilitation of these systems in a manner that is complementary and holistic at a landscape scale. Many organisations and individuals have an interest in the management and rehabilitation of the natural systems of Eyre Peninsula, so it seemed equally logical to combine the collective experience of initially a small number of these organisations to prepare the first stage of the WildEyre conservation action plan.

How was it done?

Conservation Action Planning (CAP) is an integrated process for planning, implementing and measuring the success of conservation projects. CAP was developed by the Nature Conservancy in the United States and has been tested and refined over the past 15 years by a wide range of projects around the world. The CAP process typically involves 6-8 representatives from numerous land management and conservation organisations that unite to develop a shared ecological vision for a particular landscape. The process identifies the species and ecosystems that are to be targeted; assesses their health and analyses their threats, and finally develops targeted, realistic conservation goals and strategies that are specifically designed to allow land managers to measure project success.

In 2007, representatives from a variety of organisations involved in landscape conservation on Eyre Peninsula started developing a Conservation Action Plan (CAP) for a 1.2 million ha area of Eyre Peninsula. The project has become known as WildEyre and encompasses the area between Sheringa to Streaky Bay and inland to the Wilderness Protection areas of Hincks and Hambidge. This area was primarily selected due to the vast network of private conservation areas (heritage agreements and other privately protected areas), Conservation Parks and Wilderness areas and their relative health and extent compared to other agricultural areas on Eyre Peninsula.

The first iteration of the WildEyre CAP is a collaborative project involving staff from the Eyre Peninsula Natural Resources Management Board, Greening Australia (SA), The Wilderness Society (SA), and The Department for Environment and Heritage (SA).

What happened?

Through a range of meetings and some selected site visits during 2008, the first iteration of the WildEyre plan was developed. This plan identified eight distinct ecological assets within the CAP area for inclusion, these included:

- Sandy coasts and dunes
- Rocky coasts and cliff-tops
- Sheltered coastal bays & islands (e.g. Venus and Bairds Bays)
- Sub-coastal wetlands (e.g. Lake Newland)
- Coastal and inland limestone plains Mallee (e.g. Tungketta and Calca)

- Sand Mallee communities (e.g. Hambidge Wilderness Protection Area)
- Sand Mallee dune-top remnants
- Red Gum Grassy woodland
- Native Pine, Sheoak, Mallee box Grassy woodlands
- Granite outcrops

For each of these ecological assets the main threats to their integrity as a functioning natural system were identified and strategic actions to address these threats were established.

Some of the threats identified included:

- Introduced animal and plant species (foxes, rabbits, African boxthorn)
- Inadequate hydrological regimes
- Unsustainable stock management practices
- Over abundant native species
- Lack of knowledge of systems core functioning requirements
- Inappropriate fire regime

Objectives for each ecological asset were then determined to address the threats identified, and these objectives in turn were broken down into strategic actions, enabling the refinement of the activities required and the degree of funds that may be required to achieve each of the actions. An example of the strategic actions identified include:

Strategic action: Determine appropriate fire regimes for fire sensitive species in project area

- **Action step #1:** Identify appropriate fire regimes for Mallee Fowl (e.g. 1/3 of area 0-20 years, 1/3 of area 20-50 years, and remainder >50 years)
- **Action step #2:** Identify appropriate fire regimes for Sandhill Dunnart (e.g. require habitat in sand mallee areas to be burnt in last 5 years due to requirement of Triodia regeneration)
- **Action step #3:** Identify appropriate fire regimes for specific flora species

In addition to the ecological assets, a range of threats to conservation management success in general were identified as foundational activities and these centre on the ability of organisations to work in partnership to achieve this shared vision of ecological sustainability.

Importantly, the majority of strategic actions have been fully costed, based on current knowledge and information to provide a realistic understanding of the investment requirements needed to have a sustained positive influence on these ecological assets. In essence this provides for a shopping list of activities ready to be taken off the shelf and implemented as funding becomes available.

With the completion of the first iteration in mid-2008, WildEyre CAP participants submitted an application for funding to the Australian Federal Government's Caring For Our Country NRM Open Grants Scheme. This application was successful in obtaining a grant to allow the WildEyre CAP project to begin undertaking key baseline activities and projects identified within the plan. These activities include developing a seed-bank for vegetation communities within the WildEyre geographic area and undertaking baseline monitoring and evaluation using the EP Bushland Condition Monitoring process developed by the Nature Conservation Society.

The WildEyre group is now seeking to engage with landholders and interested members of the community of Eyre Peninsula to further develop and refine the objectives, strategies and ultimately the activities required to achieve a sustainable and integrated system of natural assets.

What does this mean?

The unique partnerships formed through the ongoing development of WildEyre will provide greater opportunities for investment in the region from local, national and possibly international investors. It is believed that by working in partnership, each organisation can achieve far greater outcomes and sustained success than would be achieved in isolation and this can only benefit the natural systems and communities of Eyre Peninsula. This cooperative approach will also ensure the efficient use of resources in land management projects and providing a long-term, strategic and sustainable commitment to conservation on Eyre Peninsula.

The WildEyre project has given rise to funding being prioritised into the area already, including a large amount of environmental weed control being done in sections of coastal sand dunes between Sheringa and Haslam. A number of landholders have also received funding to undertake projects such as revegetation within targeted communities, and the erection of fences to exclude stock for the protection of threatened species like Malleefowl and the West Coast Mint-bush.

The use of a well refined and iterative planning mechanism to plan for the future management of the WildEyre area will see the ability to include new information and methods of rehabilitation without the need to develop entirely new plans into the future.

Acknowledgements

Simon Bey and Todd Berkinshaw – Greening Australia, Andrew Freeman and Justine Graham – Eyre Peninsula Natural Resources Management Board, Matt Turner – The Wilderness Society, Emma Coates and Louisa Halliday – Department for Environment and Heritage.

Government of South Australia
Eyre Peninsula Natural Resources Management Board

Greening Australia

Government of South Australia
Department for Environment and Heritage

THE WILDERNESS SOCIETY

LEADA: Lower Eyre Agricultural Development Association Report

Mark Modra
Chairman

Another tough year has stretched our resources and commitment; a year of "could have been" with so much potential. However, continual economic and climatic challenges mean that we can't stand still, we need to look forward to do what we do better and to improve new and current ideas. Imagination is more important than knowledge (Albert Einstein).

Farmer ideas and interest from Lower Eyre Peninsula gave us 14 separate trial sites across our region for 2008, looking at cropping and livestock systems with consideration to risk management. These sites have produced valuable information and provided a meeting point for many farmer groups, a place to get together and discuss how they can implement new practices in their system and how to deal with the seasonal conditions they were experiencing.

Our main field day was held on the Burns property at our focus site in September and attracted over 80 farmers. Thanks must go to our sponsors who helped make the day a great success. Topics covered included new pastures, water use efficiency, canola, wheat and barley management and end of season weed control options.

In October we undertook a blackleg survey of canola, taking samples in over 80 paddocks to measure levels of infection. In such a dry year we didn't expect to find many spores but we saw signs of blackleg resistance breakdown in one of the new Canola varieties, highlighting that we have much to do in regards to rotations and disease management.

A current focus we now have is on Integrated Pest Management, looking at how to manage our pest insects and grubs with approaches other than those based on chemical applications.

We would like to thank you, our members, for your support. In tough times we often need to simplify and cut costs, but we also need to look at other options and opportunities to move forward. Your support of LEADA can help us do that for you. We value your ideas, questions and challenges – these help us drive our research work which aims to improve the sustainability and profitability of your farming system.

I am excited by the enthusiasm, knowledge and commitment of the LEADA committee, continually putting forward good ideas and refining our research. Please continue to pass on your ideas and suggestions to these people.

Current committee members are:

- Mark Modra (Chairman)
- Andrew Ware (Secretary)
- Michael Treloar (Treasurer)
- Anthony Fatchen
- David Giddings
- Jordan Wilksch
- Kingsley McDonald
- Mark Dennis
- Marty Chandler (Agronomist, Landmark Cummins)
- Tim Richardson (Agronomist, Carrs Seeds Cummins)
- Richard May (Agronomist, Lincoln Rural Supplies Cummins)
- Ron Simpson (Agronomist, Bawdens Rural Supplies Tumby Bay)
- Jim Egan (SARDI Researcher)
- Neil Ackland (Publicity Officer)
- Kieran Wauchope (Coordinator)

Once again I would like to sincerely thank you, and our sponsors, for all your support and we look forward to sharing a year with greater prosperity for all.

LEADA Lower Eyre Agricultural Development Association

Combating Herbicide Resistance on Upper North Sandy Loam Soils

Charlton Jeisman
UNFS Project Coordinator, Rural Solutions SA, Jamestown

Demo

Searching for answers

Location
Nelshaby
Ross & Gary Roberts
Upper North Farming Systems

Rainfall
Av. Annual: 340 mm
Av. GSR: 230 mm
2008 Total: 322 mm
2008 GSR: 192 mm

Yield
Potential: 1.9 t/ha (W)
Actual: 2.5 t/ha (W)

Paddock History
2007: Lupins
2006: Barley
2005: Wheat

Soil Type
Neutral-alkaline red sandy loam

Plot size
6 m x 60 m, non-replicated

Environmental Impacts

Soil Health
Soil structure: good, gradational
Disease levels: low
Chemical use: moderate
Soil nutrients: good balance
Tillage type: minimum till
Compaction risk: moderate
Ground cover or plants/m^2: 60%
Perennial or annual plants: annual
Grazing pressure: 6 DSE/ha

Water Use
Water use efficiency: reasonable
Runoff potential: low
Effluent run-off risk: low

Key messages

- **Boxer Gold and Dual Gold demonstrated excellent control of annual ryegrass.**
- **Rotate chemicals and adopt integrated weed management practices to remain sustainable.**
- **Good herbicide contact with plants is essential for optimal weed control.**
- **Maintain herbicide rates to delay the development of herbicide resistance.**

Why do the demonstration?

The aim of the demonstration was to use pre-sowing pre-emergent herbicides to control annual ryegrass *Lolium rigidum*, in a paddock where group A and group B herbicide resistance was suspected.

Using the same chemicals repeatedly to control the same weed species will eventually cause resistance among plant populations. It is important to adopt an integrated weed management approach to maintain good weed control and avoid relying solely on one or even two herbicides. Since our 2008 trial paddock had some weed problems, we decided to use the opportunity to exhibit a herbicide demonstration and compare the effects of both new and established pre-emergent herbicides on ryegrass control.

How was it done?

At the beginning of the season, ryegrass seeds from the paddock were sent for laboratory analysis and tested for efficacy of five different herbicides (Table 2).

The herbicide demonstration involved 6 m x 60 m plots on a site that had not been sprayed in 2008 prior to these treatments. Herbicides were applied three hours prior to sowing (Table 1). On 2 May, Correll wheat was sown across the plots (perpendicular to spray direction) at 60 kg/ha with 28:13 fertiliser applied with the seed @ 50 kg/ha. Some weeds were emerging at the time of spraying, including lupins (10-20 cm), radish, small ryegrass and three-cornered jack. No post-emergent herbicides were applied to the demonstration, and it was not replicated.

On 28 May ryegrass plants were counted. The wheat crop was at growth stage 2.1 (early tillering). On 21 October two 30 m strips from

Table 1 Herbicide treatments

Treatment (and mode of action group)
Triflur Excel (D) @ 1 L/ha + Dual Gold (K) @ 300 mL/ha
Boxer Gold (EK) @ 2.5 L/ha
Triflur Excel (D) @ 1 L/ha + Power Max (M) @ 1 L/ha
Power Max (M) @ 1 L/ha
Triflur Excel (D) @ 1.5 L/ha + Power Max (M) @ 1 L/ha
Triflur Excel (D) @ 1 L/ha + Logran (B) @ 35 L/ha
Triflur Excel (D) @ 1 L/ha + Avadex Extra (E) @ 1.6 L/ha

Table 2 Results of herbicide resistance test using five different herbicides of different groups

Herbicide	Product Rate (g or mL/ha)	Herbicide Group	Paddock Sample Trial		Standard S Survival (%)	Standard R Survival (%)
			Survival (%)	Rating		
Hoegrass + 0.2% BS1000	1000	A-FOP	100	RRR	0	100
Achieve + 1% Supercharge	350	A-DIM	100	RRR	0	80
Select + 1% Hasten	300	A-DIM	90	RR	0	60
Hussar + 1% Hasten	200	B-SU	80	RRR	0	100
Triflur X	1000	D	0	S	0	55

Resistance Rating: RRR – strong resistance, RR – medium-level resistance, S – no resistance detected

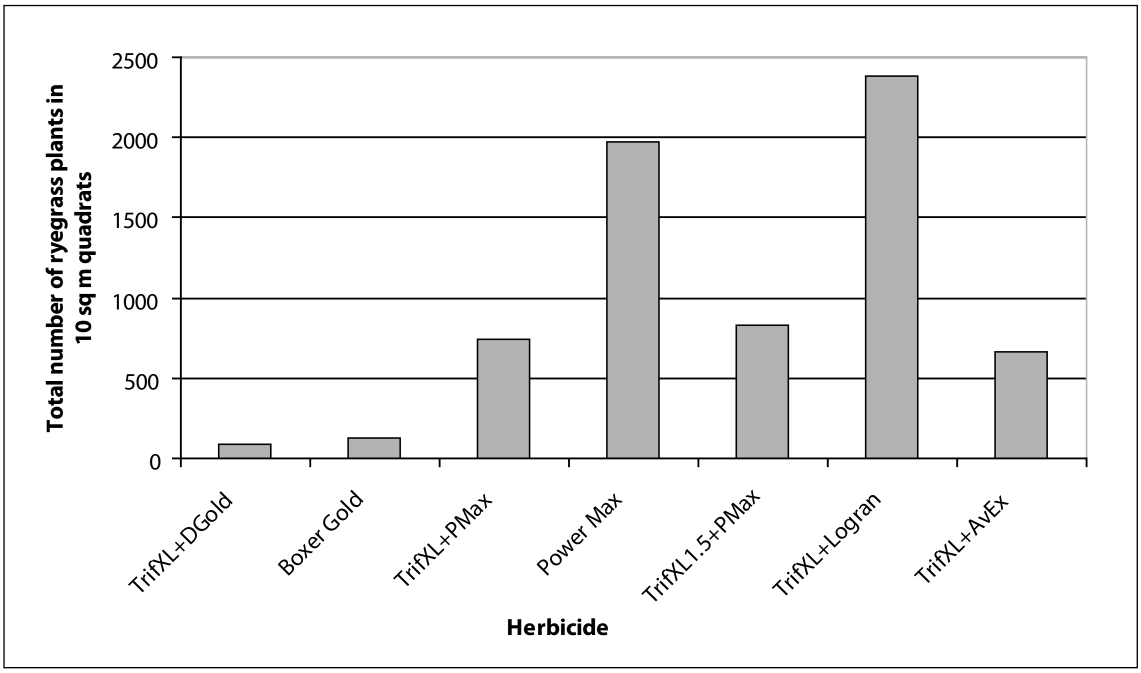

***Figure 1** Ryegrass distribution in herbicide demonstration, May 2008, showing the total number of plants recorded in ten quadrats*

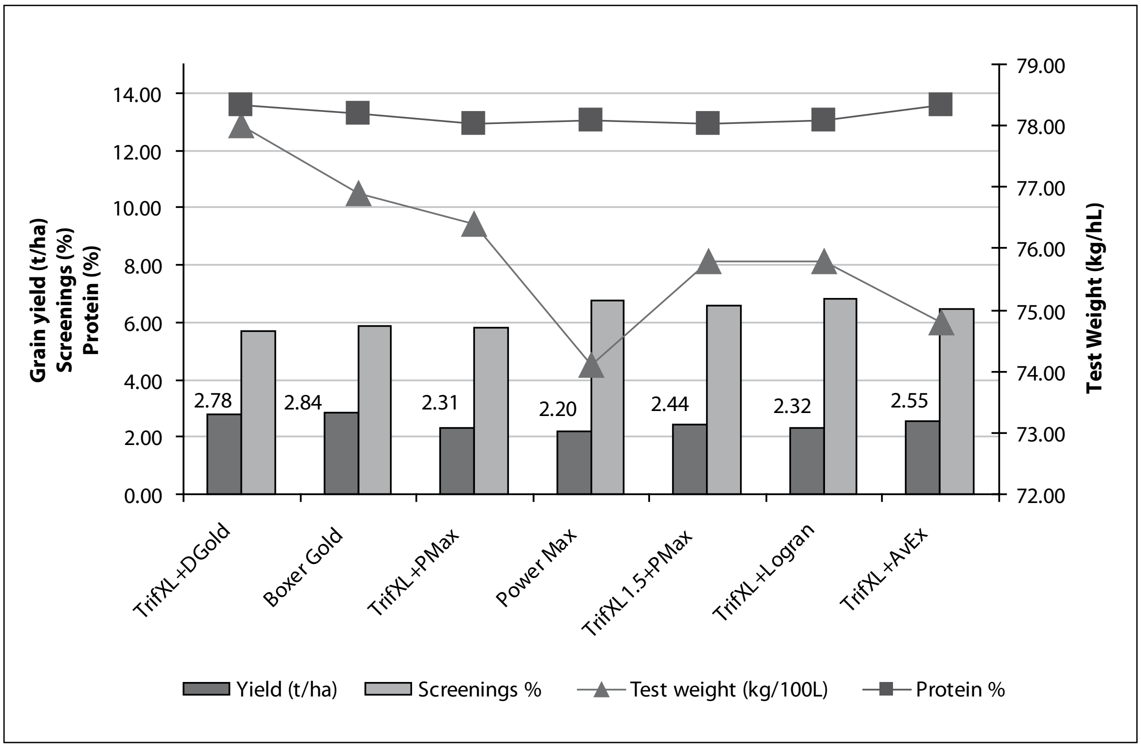

***Figure 2** Grain yield and quality for each herbicide mix*

each treatment were harvested, and grain quality was analysed.

What happened?

The herbicide resistance test results (Table 2) showed ryegrass seed was strongly resistant to Hoegrass, Achieve and Hussar, while it exhibited intermediate resistance to Select. There was no resistance to Trifluralin at 1 L/ha.

Excellent control of ryegrass by the Trifluralin Excel + Dual Gold was achieved, and also with Boxer Gold. The other mixes with Trifluralin Excel showed less effective ryegrass control, particularly when using Logran (group B). Trifluralin Excel + RoundUp Power Max at both 1 L/ha (Trifluralin) and 1.5 L/ha (Trifluralin) appeared to have better control than when using Power Max alone, due to group D in the Excel mixture, however there were still around 200-300 plants/m^2 (Figure 1).

Trifluralin Excel + Avadex Extra showed reasonable control of ryegrass, except for the last 10 m where the herbicide ran out. This is most probably a result of the group E chemical in the mixture. Only a small number of ryegrass plants emerged toward the last 10 m of the Trifluralin Excel + Dual Gold treatment.

The highest yielding treatments were Trifluralin Excel + Dual Gold and Boxer Gold; both possessing similar grain qualities (Figure 2). These treatments had a big advantage over all other treatments, particularly in terms of test weight, grain yield and screenings. This would have been due to reduced competition for moisture, nitrogen and sunlight, enabling the grain to adequately fill.

What does this mean?

The excellent control of ryegrass demonstrated by Trifluralin Excel + Dual Gold and Boxer Gold, suggests group E and group K chemicals are still active in controlling ryegrass in this paddock. There is no sign of resistance to these groups in this ryegrass population. The benefits of good ryegrass control of higher grain yield and grain quality were clearly shown at this site.

Avadex Extra (also group E) demonstrated fairly good ryegrass control. If an integrated approach is used, these newer chemicals will have a much longer life, as it will take much longer to develop resistance compared to multiple applications per year of the same chemical.

Trifluralin never provides 100% control in paddock situations due to its method of application and inconsistency of coverage, and therefore may explain the survival of some plants from all Trifluralin Excel mixtures (except with Dual Gold). The high ryegrass survival following Logran supports the high level of resistance to group B chemicals.

Acknowledgements

The Upper North Farming Systems project operates through funding from GRDC. Thanks to Ross and Gary Roberts (farmers, Nelshaby) for the use of their land. Thanks to Nigel Wilhelm and Peter Telfer (SARDI) for the trial design, sowing and harvesting operations and expertise throughout the year.

Grains Research & Development Corporation

Low Rainfall Collaboration Project Update

Geoff Thomas[1] and Nigel Wilhelm[2]

[1] Project Manager, Thomas Project Services, [2] Scientific Adviser, SARDI, Waite.

The Low Rainfall Collaboration Project (LRCP) is a GRDC funded project, which supports farming systems projects on Upper EP, Upper North and Mallee in SA, Mallee and Birchip in Victoria and Central West in NSW, has now been operating for five years. It has two part time staff, Geoff Thomas and Nigel Wilhelm.

Despite being hampered by the poor season, LRCP can boast a number of important achievements over the past 12 months.

Improving communication and sharing of results between the groups is an important part of the project and has been achieved through the regular newsletter, the calendar of events, the annual workshop, group visits and providing advice to groups on planning and applications for funding. These activities not only inform the groups but are also important in developing an *esprit de corps* when things are tough.

LRCP has been hands on in many aspects of R&D including ensuring high rigour in the work being done and in arranging funding and trials with the groups on subjects as diverse as deep fertiliser placement, summer feeding of lambs, lucerne establishment, summer weed management using PA and canola for low rainfall areas. Nigel in particular has provided an ongoing source of advice to the groups and is providing important technical leadership in the important areas of improving soil biology and increasing the efficiency with which we use soil water.

A number of important initiatives have been taken in the area of farm systems and business. With the poor seasons, LRCP took the initiative, with GRDC support to produce the Low Risk Farming Guides for 2008 and 2009. These guides provided a step by step process for farmers to work out their next season's program with the bank, and examine the pros and cons of the various decisions which need to be made. The guides have been widely distributed and augmented by workshops in many areas.

LRCP has also arranged funding for Bill Long of Ardrossan to do a Masters at Charles Sturt University which will examine the value of the various tools available to farmers to support their decisions. Ed Hunt has also been funded to do a pilot project with Birching Cropping Group to extend the results of the Profit/Risk Management work produced as an initiative of the EP Grain & Graze and EPFS II projects.

Evaluation is an essential part of any program if farmers are to get top value from their levy. LRCP is providing the drive in a comprehensive approach to determine what impact various practices have on water use efficiency and why farmers do and don't adopt those practices. This is an essential step in fine tuning our research and extension programs to meet the needs not only of farmers but funding bodies such as GRDC and to keep the whole grains industry moving forward.

Water Use Efficiency and Farming Systems Groups

Nigel Wilhelm
SARDI, Minnipa Agricultural Centre

Why do the research?

In the current round of funding by GRDC for farming systems projects and their research, GRDC has clearly stated several goals it intends to achieve through these projects. In general terms they are to validate and integrate improved crop production practices and technologies into full cropping, or mixed farming, systems to improve water use efficiency at both the crop and system scale. More specifically, the key water use efficiency objective for this program is to achieve quantitative and measurable improvements in crop and systems water use efficiency (kg grain/ha/mm) across the GRDC's Southern and Western Regions within five years through systems based RD&E. GRDC is investing up to $11.5 million over the next 5 years in projects under this initiative targeted at identifying and ameliorating the major constraints to production to lift average water use efficiency (WUE) across these regions by 10%.

It is widely recognised that there is a considerable gap between actual and potential yields across Australia. A recent review commissioned by the GRDC, "Strategic planning for Investment based on Agroecological Zones", showed that in some zones the water use efficiency (kg of grain produced per mm of soil water available for plant use) is well below that of the environmental potential. The low water use efficiency (WUE) can be due to problems associated with soil constraints, weeds, pests and disease, inadequate nutrition, or other agronomic factors. Field evidence shows that while some growers take full advantage of existing research and obtain yields at the water limited potential, there are many others that have unresolved constraints with yields well below the available water limit. To this end the GRDC has funded farming systems and research projects to validate and integrate practices and technologies into local farming systems through participatory RD&E across the GRDC's Southern and Western Regions, with the ultimate aim of increasing average WUE within these 2 regions by 10 percent.

In February 2008, a meeting was held in Adelaide to discuss these issues with representatives from all farming systems (FS) projects and WUE research teams. A second meeting of this WUE group was held in December 2008 with the aim of specifically addressing the WUE goals of GRDC. It is developing operational plans and protocols for the FS projects to undertake their own WUE research. It also helped develop firmer links between the research teams and FS projects to more efficiently research WUE issues across the regions.

How will it be done?

A four-tiered approach is required for these goals to be successfully achieved.

Tier 1.

For GRDC to achieve its regional goals of improved WUE it will have to undertake a survey to compare regional production against rainfall near the end of the current 5 year period. It already has a baseline study conducted by ABARE for the early 2000's but it will need to decide whether this study constitutes a suitable baseline for this part of the goal. GRDC will be required to undertake this study because FS groups to do not provide blanket coverage of all districts within the cropping zones of Southern and Western regions.

GRDC needs to demonstrate to its stakeholders that its investments are improving the industry as a whole. It has chosen to do so by investigating and promoting farming practices which improve productivity, as monitored by increases in WUE. It needs to present these findings for the whole industry (i.e. for the major crops aggregated across the whole continent). These areas extend beyond the FS group regions but only need to be at a coarse aggregated scale (so provide little help for understanding systems or planning R&D priorities).

Tier 2.

Each FS group needs to show to GRDC, its members and its region that it is improving the industry by meeting the WUE target of a 10% increase and improving the capacity of farmers in their region of influence.

Tier 3.

At the farm level, research will need to develop techniques and then measure whole farm WUE. In this way, the impact of individual farm practices on WUE can be quantified. These activities will require strong coordination between the FS projects and research teams.

The impact of farm practices and management options need to be defined in terms of not only productivity but also in terms of the water balance. These impacts will have to be defined for individual soil types (or land types) and season types, ie. their extent and reliability at producing benefits (or losses). These practices need to be indexed so that a farmer or adviser can combine commodities or enterprises into a whole of farm WUE outcome (other than through $). For example, a farmer or adviser needs to be able to compare a rotation of, for example:

no-till lentils in heavy wheat stubble (low biomass, high value, no stubble residues, some left over water)

+ feed barley (high biomass, low value, high stubble residues, no left over water)

with

volunteer pasture (low productivity, multiple values, little residues, no left over water)

+ canola (moderate productivity, high value, some residues, no left over water)

and make a decision as to which one is the most water use efficient.

Tier 4.

FS projects will need to survey the extent and frequency of adoption of improved practices in their districts. The impact of these practices on WUE will have been determined in Tier 3 and thus the full change in WUE across the project's area of influence can be estimated. One of the incentives for a FS project to promote improvements in WUE efficiency is that it can generate direct returns to the grower. Providing no costs are incurred, every 10% increase in WUE can produce an extra $90/ha in wheat production (and an extra 500 kg DM/ha for erosion protection, grazing and/or enhanced soil fertility). These surveys will need to identify how successfully improved practices have been implemented and also why they have not been adopted (where relevant). The latter will give an indication of how far productivity or WUE may increase within current knowledge.

This survey will have many KASA (knowledge, awareness, skills and attitude) elements as well as extent of farming practices and must survey outside the FS project membership, even though members may still be collated as a separate group.

Tier 3 is central to this continuum of activities because once there is robust and reliable knowledge or estimates of the impact of practices on water use and productivity, this information in combination with Tier 4 will build Tier 2.

An increase in area of practices which increase WUE from year 0 to year 5 x the degree of success of each practice x their individual contributions to increases in WUE = regional change in WUE (when summed over all the practices surveyed). Attitudinal aspects of the survey will estimate how large future improvements may be. And we would now argue, once Tier 2 is developed for FS regions there will be little need for Tier 1 to be developed separately. Since Tier 2 is built upon a survey of discrete and tangible farming practices, GRDC only need to sufficiently survey for those practices between FS regions to reliably estimate if the adoption and success levels are appreciably different to areas within FS regions and then combine the results.

In this way, research activities can concentrate on individual components of farm practices such as techniques to increase storage of water over summer, identifying impact of stubble type, load and management on water storage or value of controlled traffic for increasing transpiration.

FS systems can support the WUE research teams by providing relevant environments for the research investigations and identification of appropriate practices but also to survey extent and success of those practices in their region.

Improvements without increasing water use efficiency

GRDC and all the support staff for the WUE initiative recognise that improved profits for farming businesses can be made in the absence of increases in WUE. In fact, for many businesses under severe financial pressures, these may be the only options available in the immediate future. These options include such practices as reducing cropping area or cutting back on inputs. Either of these options can really help farm profitability in the short term but have no impact on WUE.

The WUE initiative does not preclude activities by FS groups to help farm businesses survive the current poor run of conditions with approaches which may not increase WUE, but the WUE goals must still be a target for every FS group.

Cutting Crops for Hay

This guide is a summary of the BCG experience cutting droughted and frosted crops for hay.

Which crops to target?

- Crops that don't have enough moisture to fill grain – particularly crops that started off well but experienced drought stress in spring.
- Frost damaged crops where frost has damaged the head and affected grain filling.
- Crops that are likely to return more by cutting for hay than harvesting for grain, eg. cereals grown on high nitrogen paddocks without enough soil moisture to finish grain fill.

How do I make the decision?

Inspect the paddock carefully

- Inspect the developing grain head and check for any sign of damage to the grain sites. Is there any sign of tipping/lost florets from drought or frost? Is the head still green or has it gone white/brown? If the head is still within the stem, split the stem open to inspect the head.
- Sometimes the head will fill even when it is stuck inside the boot – especially in barley. But grain will not form where the head has turned white or brown. Check the head size and the likelihood of filling the head of these crops that are stuck inside the boot.
- How much green leaf area is remaining? In drought situations the plant can remove all of the nutrients from its leaves to support flowering and only the stems remain green. These crops are the least likely to be able to respond to rain as the leaf area (the "factory" for grain production) is lost.

Do the sums

Grain yield - When drought conditions set in before/at flowering, a true grain yield assessment is very difficult because there are many unknowns – e.g. how many grains will fill? how big will the grains be? will it rain? Previous experience, crop simulation models such as Yield Prophet® or basic water use efficiency equations can be used as a tool for estimating the likely grain yield outcome.

Hay yield - It is relatively easy to estimate hay yield. The methods suggested below will help to calculate good hay yield estimates on which to base decisions.

METHOD 1: A quick way to estimate hay yield in the field
1. Cut 1m² of crop - at the height you will cut at (NOT ground level)
2. Weigh this fresh material using airseeder scales or similar to calculate **kg/m²** fresh weight
3. Multiply this figure by 10 to calculate **t/ha** fresh weight
4. To account for moisture and baling losses assume 20-30%* of the fresh weight will make it into the bale. Multiply step 3 figure by 0.2 or 0.3 to calculate **HAY YIELD t/ha**
5. Repeat at 4 or 5 locations across the paddock

METHOD 2: Accurate calculation using actual dry weight
1. Cut 1m² of crop – at the height you will cut at (NOT ground level)
2. Dry in the oven at low temperature (50°C) and weigh after a minimum of 24 hours to calculate **kg/m²** dry weight at approx 12% moisture
3. Multiply this figure by 10 to calculate **t/ha** dry matter
4. Assume 80-90%# of the dry weight (t/ha) will make it into the bale. Multiply step 3 figure by 0.8 or 0.9 to calculate **HAY YIELD t/ha**
5. Repeat at 4 or 5 locations across the paddock

** The percentage conversion increases with crop maturity. For crops that have flowered and are into grain fill, assume closer to 30% as the estimate of final hay yield. Less mature/fresher crops use 20-25% as the estimate of final yield.*

 # Final hay yield will depend on losses after cutting, such as those due to weather, raking or baler setup.

EXAMPLE:
Five 1m² cuts on a barley paddock weighed an average of 1.09kg/m² fresh weight
1.09 x 10 = 10.9t/ha of fresh material
10.9 x 25% = 2.7t/ha – estimated hay yield

Sharing info

When and where to start cutting

Order of cutting: Start with crops that will be the least likely to respond to rain.

Delaying cutting already very stressed crops will further dry down the leaf which can reduce quality and make the crop more difficult to bale (greater leaf loss).

Hold off cutting crops that are more likely to respond to rain until the most stressed crops have been cut. These crops will most likely keep growing and increase in hay yield. (These crops also have more chance of being harvested for grain if rain eventuates).

Cutting height: Realistically how low will you be able to cut this crop?

The rule of thumb for export quality oaten hay is "beer can height". This rule helps to maintain the quality of very thick crops by keeping them up off the ground, avoiding any dirt contamination and keeping the poor quality part of the stem out of the hay.

Droughted crops can be cut much lower than this depending on the presence of rocks or stone in the paddock and how smooth the soil surface is with clods.

Try to strike a compromise between yield, quality (no contamination) and ease on machinery.

Approx 35-40% of a cereal crop's bulk is below 12.5cm (data from BCG trial work at Manangatang 2007). Cutting lower than 12.5cm, if possible, will increase hay yield but will also expose the paddock to risk of erosion. You might decide some paddocks are not appropriate for hay as they will be too exposed over summer.

Cutting equipment: *Do you own any equipment that will do the job?*

Droughted crops are often short and don't contain a lot of bulk. When they are cut with narrow mowers the windrows are too narrow to bale without raking, but the raking process damages the hay by knocking leaves off. In 2006 and 2007 droughted crops in the Wimmera and Mallee were successfully cut using headers with draper fronts setup in the windrow position (so the output goes to one side).

The advantage of this cutting method is that losses can be minimised by going up and back in the paddock to put two windrows together, effectively doubling the size of the windrow and making it viable to bale failed crops that otherwise would experience too many losses during mower cutting and raking.

This method will double the size of the windrow, eg. a 11m (36ft) front will bring together a 22m (72ft) windrow – vastly improving the chances of a short crop being able to be baled.

Curing: If the head has not emerged from the boot at cutting time, the hay will take a long time to cure - usually up to 6 weeks or more in the September/October period.

Conditioning: Will decrease the time between cutting and baling but also increase the risk of rain damage.

If using a conditioner, try to leave some of the cut crop unconditioned. That way if a large rainfall event does eventuate the quality of the unconditioned hay will be maintained.

At baling, hay should be around 12-14% moisture, however moisture probes sometimes cannot detect the moisture trapped in the heads of droughted hay.

Tip: the best way to check there is no moisture left in the nodes or the head before baling is to lie some heads and nodes on a piece of flat metal then bash with a hammer to check there is no moisture left.

What about canola?

The above calculations can also be used to estimate canola hay yield.

Earlier cutting of canola will improve hay quality but also produces lower yields. Unless there are good premiums available for high quality canola hay, the optimum time of cutting is at **late flowering**.

Cutting late in pod fill reduces hay quality and does not add much to hay yield. Crops close to windrowing time have no leaves remaining, test poorly for quality and are very difficult to market.

Canola crops that are unlikely to be harvested will decline in colour and drop leaves with each day. If the crop is wilted and no longer growing it will not be increasing in dry weight but will be declining in quality as the leaves continue to drop. These crops should be cut as soon as possible!

Most dairy farmers prefer canola to be conditioned, which can improve hay quality. Careful marketing is required as the demand for canola hay is usually less than lucerne or clover hay of similar quality, as these hay types have been the traditional preference.

Costs

Contract costs will vary depending on the area on offer to cut and bale and the proximity of the contractor to your paddocks. Expect to pay around:

- $35 - $46/ha ($14.50 - $19/acre) for cutting, with the higher costs for self propelled windrowers.
- Approx $30/t or $17-18/bale for an 8 x 4 x 3 six string baler.

Storage

Unless hay is sold in the paddock you will need to think about where to store the bales until they are sold. Stacking bales in the paddock will cause damage to the top bales but little to those underneath and is acceptable if it is likely hay will be sold within 6 months. Expect uncovered hay to sell at a slight discount to shedded hay.

Example:		
INCOME:	2.7t/ha @ $250/t	**$675/ha**
COSTS:		
Cutting		$45/ha
Baling	2.7t/ha x $30	$81/ha
TOTAL COSTS		**-$126/ha**
MARGIN		**$549/ha**

At $300/t for grain this crop would have to yield 1.8t/ha in grain to match the hay margin *before* costs.

Make informed decisions

The best decisions are those made after consideration of all the information available at the time and consideration of all consequences. Making the decision to cut a crop for hay is a hard decision to make but it does not need to be difficult.Conduct estimates of hay yield and make a realistic assessment of the crop's ability to make harvestable grain before calling the contractors. If your assessments and calculations show that hay is the best outcome for the crop then take action on that decision as soon as possible. Seek support from your agronomist/consultant and/or experienced friends or neighbours to help you make the decision.

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Acronyms and Abbreviations

ABA	Advisory Board of Agriculture
ABS	Australian Bureau of Statistics
AFPIP	Australian Field Pea Improvement Program
AGO	Australian Greenhouse Office
AGT	Australian Grain Technologies
AH	Australian Hard (Wheat)
AM fungi	Arbuscular Mycorrhizal Fungi
APSIM	Agricultural Production Simulator
APW	Australian Prime Wheat
AR	Annual Rainfall
ASBV	Australian Sheep Breeding Value
AWI	Australian Wool Innovation
BCG	Birchip Cropping Group
BYDV	Barley Yellow Dwarf Virus
CBWA	Canola Breeders Western Australia
CCN	Cereal Cyst Nematode
CLL	Crop Lower Limit
DAP	Di-ammonium Phosphate (18:20:00)
DCC	Department of Climate Change
DM	Dry Matter
DPI	Department of Primary Industries
DSE	Dry Sheep Equivalent
DWLBC	Department of Water, Land and Biodiversity Conservation
EP	Eyre Peninsula
EPARF	Eyre Peninsula Agricultural Research Foundation
EPFS	Eyre Peninsula Farming Systems
EPR	End Point Royalty
FC	Field Capacity
GM	Gross Margin
GRDC	Grains Research and Development Corporation
GSR	Growing Season Rainfall
IPM	Integrated Pest Management
LEADA	Lower Eyre Agricultural Development Association
LEP	Lower Eyre Peninsula
LRCP	Low Rainfall Collaborative Project
LSD Test	Least Significant Difference Test
MAC	Minnipa Agricultural Centre
ME	Metabolisable Energy
MLA	Meat & Livestock Australia
MRI	Magnetic Resonance Imaging
NDF	Neutral Detergent Fibre
NLP	National Landcare Program
NRM	Natural Resource Management
NVT	National Variety Trials
PAWC	Plant Available Water Capacity
PDRF	Premier's Drought Relief Fund
PEM	*Pantoea agglomerans*, *Exiguobacterium acetylicum* and *Microbacteria*
pg	Picogram
PIRD	Producers Initiated Research Development
RDE	Research, Development and Extension
RDTS	Root Disease Testing Service
SAFF	South Australian Farmers Federation
SAGIT	South Australian Grain Industry Trust
SANTFA	South Australian No Till Farmers Association
SARDI	South Australian Research and Development Institute
SBU	Seed Bed Utilisation
SGA	Sheep Genetics Australia
SU	Sulfuronyl Ureas
TE	Trace Elements
TT	Triazine Tolerant
UNFS	Upper North Farming Systems
WAA	Water Affecting Activities
WP	Wilting Point
WUE	Water Use Efficiency
YEB	Youngest Emerged Blade
YP	Yield Prophet

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GRDC's Eyre Peninsula Farming Systems Project

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...maximising returns to growers while improving the natural resources and increasing social capital...

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