Eyre Peninsula Farming Systems Summary 2012

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2012

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The Eyre Peninsula Agricultural Research Foundation (EPARF) has made a significant contribution to research and development projects and activities across the Eyre Peninsula for many years and Viterra is pleased to continue to support the foundation in 2013.

Following the acquisition of Viterra by Glencore in late 2012, the company's focus is on maintaining a high level of service delivery for our grower and commercial customers while ensuring we operate the business efficiently.

We are committed to continuing to improve the performance of the Viterra grain storage and handling network, which will retain the Viterra brand. We will work cooperatively with all users of the storage and handling system to operate a network that works for the whole industry. This includes maintaining strong productive relationships with growers and supporting the involvement of strategic site committees, as well as reviewing our harvest performance on an annual basis.

All grain marketing activities are being consolidated into Glencore Grain, delivering first class marketing networks and access to the best markets for your grain. By integrating the two grain marketing and trading functions we are able to extend our combined global marketing and logistics capability and financial strength to more growers.

We hope you find this book a valuable resource for the coming season and we are pleased that our sponsorship assists EPARF in delivering valuable information for your business.

David Mattiske
Managing Director, Australia & New Zealand

GRDC Foreword

In this electronic age, farming systems groups use a wide range of mechanisms to communicate the outcomes from their activities to the local grains industry. Despite this, annual reports like the EP Farming Systems Summary remain vitally important. For many growers and their advisers, the traditional 'hard copy' annual report remains invaluable, standing the test of time to survive in the farm office or behind the seat in the ute, misplaced for periods, resurfacing at opportune times to provide gems of information!

GRDC acknowledges the significant and longstanding collaboration that underpins the work reported in this summary. The commitment in particular of SARDI, University of Adelaide, SAGIT, CSIRO, EPARF, EP Natural Resources Management Board, local agribusiness and growers to this collaboration is noted and very much appreciated.

One of the key aims of the GRDC's Strategic R&D Plan 2012-17 is to better align national research, development and extension (RD&E) programs with growers needs on a regional basis. GRDC's partnerships with grower driven groups such as EPARF and organisation operating regional facilities such as the Minnipa Agricultural Centre are a practical way of delivering on this aim.

To increase GRDC's capacity to actively listen and engage with growers, GRDC established Regional Cropping Solutions (RCS) Networks in 2012 within the Southern Region. There are four Networks operating in the Southern Region focused on the rainfall (production) zones: Low (LRZ), Medium (MRZ), High (HRZ) and Irrigation. Supported by four RCS Facilitators, these Networks comprise a membership of 42 growers, advisors and researchers, drawn from across the Region. Details of the Networks and their membership can be found on the GRDC website (www.grdc.com.au/RCSN).

The RCS Networks work to support the GRDC Southern Panel in identifying and understanding local cropping issues and determine how best to tackle them. The Networks also play a central role in GRDC's new Fast Track investments for RD&E.

On a local basis, Dr Nigel Wilhelm (MAC Research Leader) is the Facilitator for the LRZ RCS Network. I encourage growers and advisors from the EP to make contact with Nigel or members of the LRZ RCS Network with issues affecting grain production in the local region. This does not replace the opportunity to make contact with members of the GRDC Southern Panel, but increases the chances that a GRDC contact is only just down the road from your place!

Andrew Rice

Manager – Regional Grower Services (South)

GRDC

Eyre Peninsula Farming Systems Summary 2012

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 The Printing Press

March 2013

Front Cover:

(Clockwise) EPARF Board members Matthew Dunn and Bryan Smith; sunset over MAC; harvest 2012; sampling trials at Mudamuckla.

Back Cover:

(From top to bottom) Ian Richter, Therese McBeath and Cathy Paterson at MAC focus site; plot header; taking measurements in lamb survival project.

Inside Back Cover:

Photos from various Eyre Peninsula agricultural events in 2012.

Cover design: The Printing Press

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Contents

Minnipa Agricultural Centre Update

Welcome to the Eyre Peninsula Farming Systems Summary 2012. This summary of research results from 2012 is proudly supported by Viterra and the Grains Research & Development Corporation (GRDC) through the Eyre Peninsula Farming Systems project (EPFS 3), and the GRDC and Caring for our Country funded Eyre Peninsula Grain & Graze project (EP G&G2). 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.

Research highlights

2012 has seen the final year of field trials from the GRDC funded Eyre Peninsula Farming Systems 3 project, and some interesting information has been generated regarding phosphorus (see Nutrition chapter). Other areas of particular interest include the results from the Lamb Survival project (Livestock chapter) and the GRDC Crop Sequencing project (Farming Systems chapter).

Staff news

Suzie Holbery commenced her role as a Research Officer at MAC in April 2012, working on the Crop Sequencing and Establishing New Perennials projects. Suzie completed a Bachelor of Science at the University of Melbourne, then gained a Certificate III in Agriculture at the Longreach Agriculture College. Suzie has worked for the Department of Primary Industries at Toorak Research Station in Julia Creek QLD, as a laboratory assistant at the Tick Fever Centre in Brisbane, in the Northern Territory as overseer of a Brahman Cattle stud near Katherine and more recently in Saskatchewan, Canada where she worked as a Machinery Operator for a large corporate cropping operation.

Some event highlights from 2012

2012 was a busy year for major events at MAC, including a pre-seeding ‘Don’t Come a Croppa’ field day, EPARF Member’s day, Women’s Field Day, Student Field Day and MAC Annual Field Day. See MAC Events 2012 article for more information.

MAC staff are involved in the Ag Excellence Alliance Social Media Project, which is providing support for us to develop YouTube videos about the trials and extension messages being generated at Minnipa. Visit the EPARF website www.minnipaagriculturalcentre.com.au for links to the videos on weed control, Rhizoctonia management, P replacement strategies and the Sheep Genetics project.

Projects

New projects to commence in 2013:

EPARF have been shortlisted by GRDC for funding for a new farming systems project EPFS4 – ‘Maintaining profitable farming systems with retained stubble on upper Eyre Peninsula’. The project is due to commence in July 2013. A number of other project applications have been submitted to various funding bodies such as SAGIT and the Australian Government.

Current funded projects include:

- **Eyre Peninsula Farming Systems 3 – Responsive Farming Systems,** GRDC funded, partnership with University of Adelaide, researchers: Cathy Paterson/Roy Latta/Nigel Wilhelm, CSIRO collaborator: Therese McBeath
- **Eyre Peninsula Grain & Graze 2,** GRDC/Caring for our Country funded, partnership with University of Adelaide, researchers: Jessica Crettenden/Roy Latta
- **Crop Sequencing** funded by GRDC and Low Rainfall Collaboration, researchers: Roy Latta/Suzie Holbery
- **Profit & Risk Project,** funded by GRDC and Low Rainfall Collaboration, coordinator: Naomi Scholz
- **Demonstrating best management for Rhizoctonia on upper EP,** funded by SAGIT, researcher: Amanda Cook
- **Variety trials** (wheat, barley, canola, peas etc.) **and commercial contract research,** coordinator: Leigh Davis
- **Increased rate of adoption of Sheep Genetics/MERINOSELECT Breeding Values on Eyre Peninsula,** funded by Australian Wool Innovations, researchers: Jessica Crettenden/Roy Latta
- **Introduce New Perennials and Systems Adapted to Semi-arable Farm Land on Eyre Peninsula,** funded by Caring for our Country, researcher: Roy Latta/Suzie Holbery
- **Farmers leading and learning about the soil carbon frontier,** funded by the Australian Government’s Action on the Ground program and GRDC, in partnership with Ag Excellence Alliance, researcher: Amanda Cook

• **Increasing carbon storage in alkaline sodic soils through improved productivity and greater organic carbon retention,** funded by the Australian Government's Filling the Research Gap program in partnership with the University of Adelaide, researcher: Roy Latta/Suzie Holbery

• **Improved nitrogen efficiency across biophysical regions of the Eyre Peninsula,** funded by the Australian Government's Action on the Ground program, in partnership with EPNRM, researcher: Roy Latta

• **Lamb survival in low rainfall areas,** funded by the SA Sheep Advisory Group, researcher: Jessica Crettenden/Suzie Holbery

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.

We look forward to seeing you all at farming system events throughout 2013, and all the best for a productive season!

Naomi Scholz/Roy Latta

MAC Staff and Roles

Roy Latta	Senior Research Scientist
Nigel Wilhelm	Visiting Senior Research Scientist
Mark Klante	Farm Manager
Dot Brace	Senior Administration Officer
Leala Hoffmann	Administration Officer
Naomi Scholz	Project Manager
Linden Masters	Farming Systems Specialist (EP Farming Systems & EPNRM)
Amanda Cook	Senior Research Officer (Rhizoctonia, Stubble Management)
Catherine Paterson	Research Officer (EP Farming Systems)
Jessica Crettenden	Research Officer (EP Grain & Graze)
Suzie Holbery	Research Officer (Perennials, Alkaline Soils, Crop Sequencing)
Leigh Davis	Agricultural Officer (NVT, Contract Research)
Wade Shepperd	Agricultural Officer (EP Farming Systems, Rhizoctonia)
Brenton Spriggs	Agricultural Officer (NVT, Contract Research)
Ian Richter	Agricultural Officer (Alkaline Soils, Crop Sequencing)
Brett McEvoy	Agricultural Officer (MAC Farm)
Trent Brace	Agricultural Officer (MAC Farm)
Sue Budarick	Casual Field Assistant
Jake Pecina	Casual Field Assistant

DATES TO REMEMBER

EPARF Members' Day: Understanding N in EP Cropping Systems Wednesday 10 April 2013

MAC Annual Field Day: Wednesday 11 September 2013

To contact us at the Minnipa Agricultural Centre, please call 8680 5104.

EPARF Sponsors 2012

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EP Grain

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Eyre Peninsula Agricultural Research Foundation Report 2012

Matthew Dunn, Chair

Board Members

Farmers: Matthew Dunn, Simon Guerin, Peter Kuhlmann (retired 2012), Craig James, Bryan Smith, Mark Fitzgerald, Shannon Mayfield (elected 2012)

Special Skills and Expertise

Geoff Thomas (retired 2012), Andy Bates, Mark Stanley (elected 2012)

SARDI

Prof Simon Maddocks

MAC

Roy Latta (Leader), Dot Brace (EO)

University of Adelaide

Dr Glenn McDonald

LEADA

Jordan Wilksch

EPNRM

Annie Lane

Members

303 (up from 189 in 2010)

Vision Statement

To be an independent advisory organisation providing strategic support for the enhancement of agriculture.

Mission Statement

To proactively support all sectors of agricultural research on Eyre Peninsula including the building of partnerships in promoting research, development and extension.

Objectives

Build capacity of the agricultural sector through education and training.

- Promote the advancement and practical application of agricultural scientific research, development and extension in dryland farming systems relevant to Eyre Peninsula and like environments across Australia.
- Provide advice and strategic direction on short, medium and long term needs of the agricultural sector to include current, innovation and future issues.
- Conduct agricultural activities and ensure that farmers, agribusiness and the scientific community are an integral part of the planning.
- Establish interaction with various industry bodies, negotiate funding opportunities and utilise reserves to leverage other funds.
- Be responsive and relevant to our farmer and industry members.

Finance

EPARF is a foundation and its income is from membership, sponsorship and reimbursements. Its expenditure is on administration support, meeting expenses, leveraging and services to members.

Staff

There are currently 18 staff working at MAC. The past 12 months have been very stable with staff movements. We gladly welcome Suzie Holbery who is involved with several of the projects currently running. Jake Pecina successfully completed a school based apprenticeship for Certificate III in Agriculture. We are always looking for new opportunities to build up staff and therefore the capacity for MAC to produce great research.

2012 Sponsors

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	Rabobank
BRONZE	Bank SA
	AgFarm
	CBH Grain
	EP Grain
	Letcher & Moroney Accountants
	GrainCorp

Election of Board Members

There are 6 farmer members on the Board and each year, two members are elected for a three year term. Bryan Smith and Peter Kuhlmann completed their term. Peter Kuhlman chose not to re-nominate and we sincerely thank him for his invaluable input to the EPARF Board. Peter is the last of the founding members, being on the Board for 8 years in which he has been Chairperson for 3 years. **Congratulations Peter Kuhlman for being awarded the Australian Farmer of the Year 2012,** for which EPARF nominated him. This recognition at the highest level shows us the talents that Peter has offered to Minnipa, the grains industry and many of you. Thank you Peter.

Shannon Mayfield, a Nuffield Scholar from Kimba nominated for a position on the Board and we look forward to his insightful participation on EPARF.

Geoff Thomas, who was invited as a Special Skills Expert, retired from the Board this year. Geoff's input into Low Rainfall Agriculture Research in Australia is second to none. He has an enormous amount of contacts Australia wide and has been a robust contributor to EPARF for 9 years. We all thank you Geoff for being a part of MAC.

We are pleased to announce that Mark Stanley will step into the role of Special Skills and Expertise and we look forward to his contribution in seeking out more revenue and funding streams.

The new Chairperson for 2013 and beyond is Simon Guerin, and I invite all EPARF members to have input into the Minnipa Agricultural Centre research.

2012 EPARF Member's Day

$pray Technology – Getting the best value out of the spray $

160 people attended this event which was well organised, timely and well received. Over 75% of attending farmers intended to do something different as a result of knowledge gained on the day.

Minnipa Research, Review and Management Committee

This is a sub-committee of EPARF and was formed to look at current and future research opportunities. This comprises of a dedicated group of board members who are putting in many days of exciting work. This committee, under the chair of Bryan Smith, has the flexibility to pull in all the expertise they require to lift research on Eyre Peninsula. Currently there are around 16 projects that are being rigorously researched by MAC staff. The focus of the RRMC recently has been on developing the next stage of Eyre Peninsula Farming Systems 4 project.

Board Conference/Training/ Representation

Craig James – Ag Institute of Australia SA Conference based on food security

Simon Guerin, Matthew Dunn – Not for Profit Board training

Matthew Dunn, Peter Kuhlmann, Glenn McDonald and Simon Maddocks - Ag Ex Alliance Forum

Matthew Dunn – Spirit of Excellence in Agriculture Awards

Andy Bates, Bruce Heddle - appointed on GRDC Low Rainfall Regional Cropping Solutions committee

We congratulate Nigel Wilhelm as SARDI's new Farming System Science Leader, which is a research role. Nigel is a valuable resource to staff queries and supports science at MAC. Nigel has also been appointed as the Low Rainfall Zone Regional Cropping Solutions (RCS) Facilitator for GRDC.

Appreciation and thanks

- The SA Government through SARDI for its continued support of the Minnipa Agricultural Centre, GRDC, NRM, the Federal Government and all of our industry funders and partners. Your continued commitment is vital for our farming communities.
- A special thank you to our dedicated team for being able to maintain a well run, functional research program and various events.
- Executive Officer, Dot for her commitment and support of our EPARF board.
- To our members 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.

Eyre Peninsula Agricultural Research Foundation Members 2012

Adams	Daniel	CUMMINS SA
Agars	Brad	LOCK SA
Agars	Michael	PORT LINCOLN SA
Agars	Steve	PORT LINCOLN SA
Ashton	Brian	PORT LINCOLN SA
Baillie	Terry	TUMBY BAY SA
Baldock	Andrew	KIMBA SA
Baldock	Graeme	KIMBA SA
Baldock	Heather	KIMBA SA
Bammann	Geoff	CLEVE SA
Bammann	Paul	CLEVE SA
Barns	Ashley	WUDINNA SA
Bates	Andy	STREAKY BAY SA
Beattie	Warren	CEDUNA SA
Beinke	Lance	KIMBA SA
Beinke	Xavier	KYANCUTTA SA
Beinke	Josh	KYANCUTTA SA
Beinke	Peter	KIMBA SA
Bergmann	Brenton	CEDUNA SA
Blumson	Bill	SMOKY BAY SA
Blumson	Vinnie	SMOKY BAY SA
Bowey	Daniel	LOCK SA
Boylan	Damien	WUDINNA SA
Brace	Reg	POOCHERA SA
Brace	Dion	POOCHERA SA
Brace	Jason	POOCHERA SA
Brands	Bill	MINNIPA SA
Brown	Paul	CEDUNA SA
Brown	Lachlan	CEDUNA SA
Bubner	Daryl	CEDUNA SA
Burrows	Ian	LOCK SA
Burrows	Warren	LOCK SA
Burton	Jason	RUDALL SA
Butterfield	Ashley	KIMBA SA
Cant	Brian	CLEVE SA
Carey	Paul	STREAKY BAY SA
Carey	Shaun	STREAKY BAY SA
Carey	Peter	MINNIPA SA
Carey	Matthew	STREAKY BAY SA
Carey	Damian	STREAKY BAY SA
Carmody	Steven	COWELL SA
Chandler	Milton	CEDUNA SA
Chase	Symon	COWELL SA
Cook	Matt	MINNIPA SA
Crettenden	Brent	LOCK SA
Cronin	Brent	STREAKY BAY SA
Cronin	Pat	STREAKY BAY SA
Crossman	Colin	KYANCUTTA SA
Cummins	Richard	LOCK SA
Cummins	Neil	LOCK SA
Cummins	Lyn	LOCK SA
Daniel	Neil	STREAKY BAY SA
Daniell	Wes	MINNIPA SA
Dart	Robert	KIMBA SA
Dart	Kevin	KIMBA SA
De La Perrelle	Stuart	PORT LINCOLN SA
Dodgson	Terry	MINNIPA SA
Dolling	Mark	CLEVE SA
Dolling	Paul	CLEVE SA
DuBois	Ryan	WUDINNA SA
Dunn	Matthew	RUDALL SA
Dunn	Mignon	RUDALL SA
Durdin	Barry J	PORT LINCOLN SA
Edmonds	Graeme	WUDINNA SA
Elleway	David	KIELPA SA
Elleway	Ray	KIELPA SA
Endean	Jim	MINNIPA SA
Evans	Jim	CEDUNA SA
Evans	Michael	CLEVE SA
Evans	Tony	CLEVE SA
Eylward	Andre	STREAKY BAY SA

Fitzgerald	Mark	TUMBY BAY SA	Horne	Jennifer	WHARMINDA SA
Fitzgerald	Leigh	KIMBA SA	Howard	Tim	CEDUNA SA
Fitzgerald	Rohan	KYANCUTTA SA	Hull	Geoff	STREAKY BAY SA
Fitzgerald	Clem	KIMBA SA	Hull	Jake	STREAKY BAY SA
Forrest	Scott	MINNIPA SA	Hull	Leroy	STREAKY BAY SA
Foster	Daniel	WUDINNA SA	Hull	Rohan	STREAKY BAY SA
Foster	Matt	WUDINNA SA	Hull	Jesse	PORT KENNY SA
Foxwell	David	CLEVE SA	Hunt	Ed	PORT NEILL SA
Foxwell	Tony	CLEVE SA	Hunt	Evan	PORT NEILL SA
Francis	Brett	KIMBA SA	Hurrell	Leon	LOCK SA
Freeman	Shaun	CEDUNA SA	Hutchings	Warwick	MINNIPA SA
Freeth	John	KIMBA SA	James	Craig	CLEVE SA
Freeth	Thomas	KIMBA SA	Jensen	Nik	KIMBA SA
Fromm	Jerel	MINNIPA SA	Jericho	Neville	MINNIPA SA
Fromm	Jon	MINNIPA SA	Jericho	Marcia	MINNIPA SA
Gill	Isaac	MANGALO SA	Jericho	Janeen	POOCHERA SA
Gill	Simon	MANGALO SA	Jolly	San	CLARE SA
Gillmore	Trevor	STREAKY BAY SA	Kaden	Paul	COWELL SA
Glover	Kieran	LOCK SA	Kammerman	Mark	WUDINNA SA
Gosling	Trevor	POOCHERA SA	Kammerman	Cherie	WUDINNA SA
Grund	John	KIMBA SA	Kay	Dylan	LOCK SA
Grund	Gary	KIMBA SA	Kay	Saxton	LOCK SA
Guerin	Simon	PORT KENNY SA	Kelsh	Craig	PORT KENNY SA
Guest	Terry	SALMON GUMS WA	Kenchington	Cassy	KIMBA SA
Gunn	Angus	PORT KENNY SA	Kobelt	Rex	CLEVE SA
Gunn	Ian	PORT KENNY SA	Kobelt	Myra	CLEVE SA
Hamence	Les	WIRRULLA SA	Koch	Daryl	KIMBA SA
Harris	John	KIMBA SA	Koch	Jeffrey	KIMBA SA
Heath	Basil	PORT LINCOLN SA	Kuhlmann	Peter	GLENELG STH SA
Heath	Andrew	PORT LINCOLN SA	Kwaterski	Robert	MINNIPA SA
Heddle	Bruce	MINNIPA SA	Lawrie	Andrew	TUMBY BAY SA
Hegarty	Kieran	WARRAMBOO SA	LeBrun	Dion	TUMBY BAY SA
Henderson	Tom	ELLISTON SA	LeBrun	Maria	TUMBY BAY SA
Hentschke	Andrew	LOCK SA	LeBrun	Leonard	TUMBY BAY SA
Herde	Bill	RUDALL SA	Lee	Howard	STREAKY BAY SA
Hetzel	Andrew	LOCK SA	Lienert	Bill	KIMBA SA
Hitch	Max	PORT LINCOLN SA	Lienert	Roger	ARNO BAY SA
Hitchcock	Peter	LOCK SA	Little	Nathan	PORT KENNY SA
Hitchock	Nathan	LOCK SA	Little	Ken	PORT KENNY SA
Hood	Ian	PORT KENNY SA	Longmire	Jeffrey	LOCK SA
Hood	Mark	PORT KENNY SA	Longmire	Ben	LOCK SA
Horgan	John	STREAKY BAY SA	Longmire	Andrew	SALMON GUMS WA
Horgan	Mark	STREAKY BAY SA	Lymn	Chris	WUDINNA SA

Lymn	Allen	WUDINNA SA
Lynch	Brenton	STREAKY BAY SA
Lynch	Christopher	STREAKY BAY SA
Lynch	Bradley	STREAKY BAY SA
Lynch	Joel	POOCHERA SA
Lynch	Craig	POOCHERA SA
Maitland	Stephen	KIMBA SA
Major	Justine	KIMBA SA
Major	Andrew	KIMBA SA
Malcolm	Shane	ARNO BAY SA
Malcolm	Beth	ARNO BAY SA
Marshall	Jayne	WUDINNA SA
Mash	Matthew	MINNIPA SA
Masters	John	ARNO BAY SA
Matthews	Wes	KYANCUTTA SA
Matthews	Todd	KYANCUTTA SA
May	Nigel	ELLISTON SA
May	Debbie	ELLISTON SA
May	Paul	KYANCUTTA SA
May	Ashley	KYANCUTTA SA
Mayfield	Shannon	KIMBA SA
Michael	John	WUDINNA SA
Michael	Ashley	WUDINNA SA
Millard	Darren	ARNO BAY SA
Mills	Leonie	COWELL SA
Montgomerie	John	STREAKY BAY SA
Montgomerie	Ian	STREAKY BAY SA
Mudge	Caroline	STREAKY BAY SA
Mudge	Darren	STREAKY BAY SA
Mullan	Damien	WUDINNA SA
Murray	Lynton	PENONG SA
Murray	Amy	PENONG SA
Murray	Blake	PENONG SA
Murray	Jordon	PENONG SA
Newton	Len	ELLISTON SA
Nicholls	Anthony	CEDUNA SA
Noble	Ian	WHARMINDA SA
Noble	Jackie	WHARMINDA SA
Norris	Daryl	RUDALL SA
Northcott	Shaun	LOCK SA
O'Brien	Darren	KYANCUTTA SA
O'Brien	Brett	KYANCUTTA SA
O'Brien	Craig	KYANCUTTA SA
Oswald	John	YANINEE SA
Oswald	Clint	YANINEE SA
Ottens	Tim	WHARMINDA SA
Pearce	Brett	LOCK SA
Pedler	Joe	HINDMARSH SA
Petch	Shannon	STREAKY BAY SA
Phillis	Jamie	UNGARRA SA
Polkinghorne	Andrew	LOCK SA
Pollock	James	MINNIPA SA
Pope	Lindsay	WARRAMBOO SA
Powell	Clint	KIMBA SA
Preiss	Kevin	ARNO BAY SA
Prime	Peter	WHARMINDA SA
Prime	Andrew	WHARMINDA SA
Prime	Chris	WHARMINDA SA
Prime	Calab	WHARMINDA SA
Prime	Jarrod	WHARMINDA SA
Prime	Joel	PORT NEILL SA
Ramsey	Rowan	KIMBA SA
Ramsey	Courtney	KIMBA SA
Ranford	Ben	CLEVE SA
Rayson	Peter	KIMBA SA
Reed	Peter	ELLISTON SA
Ryan	Martin	KIMBA SA
Sampson	Brett	WARRAMBOO SA
Sampson	Kane	WARRAMBOO SA
Sampson	Veronica	WARRAMBOO SA
Sampson	Allen	KAPUNDA SA
Schmucker	Terry	KYANCUTTA SA
Schmucker	Thomas	KYANCUTTA SA
Scholz	Lyle	YANINEE SA
Scholz	Micheal	YANINEE SA
Scholz	Nigel	WUDINNA SA
Scholz	Neville	WUDINNA SA
Scholz	Greg	WUDINNA SA
Scholz	Gareth	MINNIPA SA
Scholz	Leigh	MINNIPA SA
Scholz	Stuart	WUNINNA SA
Scholz	Yvonne	WUDINNA SA
Schwarz	Noel	CEDUNA SA
Scott	Nigel	CLEVE SA
Seal	Brook	KIMBA SA
Shipard	Bill	PENONG SA
Siebert	Paul	LOCK SA
Simpson	John	WUDINNA SA
Siviour	Mark	LOCK SA
Siviour	Dean	ARNO BAY SA

Siviour	Sam	ARNO BAY SA	Wauchope	Eugene	WUDINNA SA
Smith	Barry	COWELL SA	Webb	Paul	COWELL SA
Smith	Reid	MAITLAND SA	Webber	Ken	PORT LINCOLN SA
Smith	Bryan	COORABIE SA	Wendland	David	MINNIPA SA
Sparrow	Dustin	WUDINNA SA	Wheare	Craig	LOCK SA
Story	Rodger	COWELL SA	Wheaton	Philip	STREAKY BAY SA
Story	Suzanne	COWELL SA	Wibberley	Brian	PORT LINCOLN SA
Suljagic	Aleks	CLEVE SA	Wilkins	Gregor	YANINEE SA
Swaffer	Michael	PORT LINCOLN SA	Wilkins	Stefan	YANINEE SA
Thomas	Geoff	BLACKWOOD SA	Wilksch	Jordan	YEELANNA SA
Tomney	Jarad	STREAKY BAY SA	Williams	Dene	KIMBA SA
Traeger	Sarah	CLEVE SA	Williams	Dion	STREAKY BAY SA
Trezona	Neville	STREAKY BAY SA	Williams	David	PORT NEILL SA
Trowbridge	Shane	CEDUNA SA	Willmott	Dean	KIMBA SA
Turnbull	Mark	CLEVE SA	Wiseman	Lyall	LOCK SA
Turnbull	John	CLEVE SA	Wiseman	Carly	LOCK SA
Turner	Quentin	ARNO BAY SA	Woolford	Peter	KIMBA SA
Van der Hucht	Peter	WUDINNA SA	Woolford	James	KIMBA SA
Van loon	Tim	WARRAMBOO SA	Woolford	Nathan	KIMBA SA
Vater	Daniel	GLEN OSMOND SA	Woolford	Graham	KIMBA SA
Veitch	Simon	WUDINNA SA	Woolford	Barb	KIMBA SA
Veitch	Leon	WARRAMBOO SA	Woolford	Dion	KIMBA SA
Viljoen	Paulus	CEDUNA SA	Woolford	Simon	KIMBA SA
Vorstenbosch	Daniel	WARRAMBOO SA	Woolford	Michael	CLEVE SA
Waters	Graham	WUDINNA SA	Zacher	Michael	LOCK SA
Waters	Dallas	WUDINNA SA	Zerk	Michael	LOCK SA
Waters	Tristan	WUDINNA SA	Zerna	Allan	COWELL SA
Watson	Peter	WIRRULLA SA	Zibbell	Lisa	KIMBA SA

EPARF Board Members 2012

MAC Events 2012

Naomi Scholz
SARDI, Minnipa Agricultural Centre

144 people attended **'Snot the snails'** workshops held in January at Tumby Bay, Streaky Bay, Elliston and Charra for practical advice on managing snails from Yorke Peninsula experiences.

The **AWI Sheep Genetics project** was officially launched at Minnipa Agricultural Centre (MAC) in January, with 30 farmers, merino stud breeders and industry representatives present.

13 upper **EP harvest report farmer meetings** were held in March with about 200 farmers and industry representatives attending to discuss results of research and current future issues affecting agriculture locally.

Young Farmer group meetings were held at Minnipa, Lock and Port Kenny, discussing soils, business management, machinery and a range of other items.

The Year Ahead - Don't Come a Croppa workshop providing detailed information on a range of topics relating to the 2012 cropping program was held at MAC in March with 65 farmers and industry representatives attending.

The annual **EPARF Member Day** was held at MAC in June with 160 attending the day. The day focused on getting the best value out of the spray dollar. Speakers were Dr Chris Preston University of Adelaide, Craig Day, Spray Safe and Save, Jorg Kitt and John Both from Nufarm Australia. Thanks to EPARF sponsors for supporting the event.

Over 500 students from surrounding schools visited the Port Lincoln High School **Careers Expo** in June. Linden Masters promoted potential agricultural career paths to students.

The MAC biennial **Women's Field Day** was held in September, with approximately 60 women attending from Eyre Peninsula and beyond. The event boasted a range of speakers and topics highlighting the role of women in agriculture and farming within our landscapes. Funding support from NRM Community grants program, event supported by Rabobank, Grains Farm Biosecurity Program and Partners in Grain.

16 farmer group **sticky beak days** were held across upper EP in September with 530 farmers, agribusiness reps, advisors and MAC staff. Common items of discussion included Crown rot on western EP, juncea and canola comparisons, planning for low sheep feed in autumn, cereal varieties and management of grass weeds in crop.

180 farmers, researchers and advisors attended the **MAC Annual Field Day** in September to inspect a wide range of trials and listen to speakers on grain grower representation, soil quality and DGT P testing. Morning and afternoon tea was provided by Rabobank. Post event beverages were supplied by AGT and Pioneer Seeds.

A **Student Information Day** was held at Minnipa Ag Centre on 9 October, with 48 high school students and 10 teachers from 7 different schools across Eyre Peninsula gaining exposure to what we do at MAC, increasing the profile of agriculture as a career opportunity and promoting University pathways in science and particularly agriculture. Funding was provided by SAGIT. Morning tea was provided by Grain Growers Ltd, lunch provided by AgFarm.

For event programs, evaluations and photos visit the EPARF
website: www.minnipaagriculturalcentre.com.au

Eyre Peninsula seasonal summary 2012

Linden Masters[1] and Brett Masters[2]

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

OVERVIEW

The 2012 season has been described as a mixed bag with crops producing better than expected yields with of one of the lowest spring rainfall averages. As one lower Eyre Peninsula (EP) grower said "we grew decile 5 yields on decile 4 growing season rainfall with decile 6 prices". The start of the season tracked close to a decile 5. However following the final reasonable rain on 25 August, rainfall through to harvest was minimal with the final growing season rainfall total only being in the decile 1-3 range in many districts.

Widespread thunderstorm activity in February and March generated stored subsoil moisture and set the season up in many districts of central, eastern and lower EP which allowed many growers to begin sowing in mid April. However there were a number of western and central EP districts that did not receive these early rains resulting in large variations of up to four weeks in crop sowing times in these areas. Cold conditions from June to mid August meant crop development in the areas that missed out on the early rains was well behind, due to being sown later. The variation in sowing time and early crop development was reflected in final crop yields.

Throughout the season it was observed that crops did not appear to be as bulky with reduced numbers of tillers compared to recent seasons. There was also some frost damage reported in central and eastern EP districts. Disease levels were generally low, however many growers applied fungicide for the prevention of Net Form Net Blotch and Stripe rust. Crown rot was an issue and Rhizoctonia levels were high in some western EP districts due to late sowing and cold winter temperatures. Despite the lack of rain, conditions remained mild to grain fill and no extreme temperatures during spring allowed heads to fill on very limited moisture. Some growers also consider that limited crop growth due to the cold conditions during winter may have conserved some sub soil moisture enabling it to be used for grain fill late in the season.

Crops matured more quickly than in recent years with harvest underway in many districts by mid October. Most growers were finished harvest by early December with some commenting it was the first year many were not held up by grain moisture. Many growers were surprised at the yields and lack of screenings when crops were harvested (less than 2% screenings on average). Yields were average to slightly below average in the earlier sown areas but well below average in those districts that did not receive the early rains. Grain quality was also highly variable with generally high protein levels on western EP, mixed protein levels in central and eastern EP and generally low protein on lighter texture soils on lower EP.

Pulse and canola/*Brassica juncea* crop yields in western and eastern EP districts were disappointing. Pea crops looked good early but a lack of rain resulted in limited pod fill. Canola yields in lower EP were variable but "better than expected". There was an increase in *B. juncea* Xceed Oasis CL sown across upper Eyre Peninsula as a low rainfall break crop option.

Grain prices were high which compensated to some extent for the lower yields.

DISRTICT REPORTS

Western Eyre

Grain yields in western and central Eyre Peninsula districts were highly variable depending on time of sowing. Some crops in the central EP area were sown early following thunderstorms. Kyancutta, Warramboo and Koongawa received an extra 25 mm of rain in a thunderstorm in late August, resulting in some excellent yields in this region. Yields in excess of 3 t/ha were also reported in the more reliable areas around Mt Cooper.

Wheat crops in the districts around Wudinna and south of Minnipa achieved average yields. Areas north and west of Poochera to Nundroo had below average yields around 0.4-0.6 t/ha depending on time of sowing. Elliston received above average yields but snails are a continuing problem in this region. Streaky Bay crops yielded well below average.

Due to the lack of bulk in cereal paddocks in the far west districts, growers are anticipating reduced stubble feed supplies over summer and many have decided to reduce stocking pressure early.

Eastern Eyre

Early thunderstorm activity in February and March increased soil moisture levels and enabled seeding to begin early in coastal districts. However districts that missed out on these early rains were well behind with seeding and in crop development for the rest of the season, particularly around Murlong and north of Kimba. Crop germination on non wetting sands was also an issue in the area with late opening rains pressuring growers to sow into less than ideal moisture conditions. Heavy rains in the Cleve Hills in late May caused trafficability issues for growers and delayed seeding significantly.

Despite a generally dry spring, coastal districts recorded above average growing season rainfall (decile 6). However continuing dry conditions to harvest resulted in inland districts only recording decile 2 growing season rainfall.

Like upper EP, grain yields were variable depending on timing of seeding. Good early and winter rains in the coastal districts around Franklin Harbour, Arno Bay, Wharminda and Port Neill resulted in average to above average yields. Yields around Lock and Darke Peak were slightly below average. There was also some frost damage reported in Darke Peak, Kimba and Rudall districts. Despite canola and pulse crops looking good early in the season, the lack of rain at grain fill resulted in generally poor yields. Grain quality varied with good protein inland but any heavier crops on sand or back on high stubble loads from the previous season had lower protein.

Lower Eyre

Good rains in early April allowed most growers in the district to begin their seeding programs. Dry conditions in mid May brought seeding to a stop for a fortnight in many lower EP districts, resulting in up to a month's difference in sowing date on some properties. The difference in sowing time was reflected in crop development and final grain yield. Above average rainfall and cold conditions from June to August resulted in some waterlogging being observed in crops south of Cummins.

Disease levels were generally low throughout the season with many growers applying preventative sprays for stripe rust, net blotch and powdery mildew. Snails were observed over a wider area this season, however unfavourable seasonal conditions and an increase in grower baiting reduced the numbers of snails observed in crop. However, lucerne flea was a persistent pest causing damage to new growth on crops and pasture throughout the season.

Dry conditions resulted in rapid crop maturity with growers beginning harvest in mid October and most growers having finished by early to mid December. Grain yields varied significantly between districts reflecting differences in soil type and sowing time. Average to above average yields (in excess of 2.8 t/ha) were reported on lighter texture soils and red brown earths around Karkoo, Yeelanna, Cummins and Ungarra. Yields on ironstone sand over clay around Edillillie and Koppio were well below average with very low protein.

MAC Farm Report 2012

Mark Klante
SARDI, Minnipa Agricultural Centre

INFORMATION

Try this yourself now

Location:
Minnipa Ag Centre
Rainfall
Av. Annual: 320 mm
Av. GSR: 241 mm
2012 Total: 253 mm
2012 GSR: 185 mm

Key outcomes

- **MAC wheat and barley yields both averaged 1.6 t/ha.**
- **80% of total farm area was cropped.**
- **331 breeding ewes produced 129% lambs at marking.**
- **360 tonnes of seed sold to growers, certified and off header.**

Background

The performance of the Minnipa Agricultural Centre (MAC) commercial farm is an essential component in the delivery of relevant research, development and extension to Eyre Peninsula. The effective use of research information and improved technology is an integral part of the role of the MAC farm.

2012 season

In March we harvested 2.5 tonnes of medic seed from paddock N5S. Sowing commenced on 26 April with 10 kg/ha of our harvested medic seed and 1 kg/ha Angel medic seed. This was followed by dry sowing of Scope barley on 3 May and Kord wheat on 22 May. Following 25 mm of rain on 24 May seeding commenced in earnest and finished on 6 June. Seeding went well, with a mechanical problem resulting in a day and a half of lost time. There were white peg trials in 10 paddocks and whole paddock demos in N1, S7 and the competition paddocks. Wheat was sown on 570 ha (53% of farm area), barley 200 ha (18%), canola 65 ha (6%) and medic pasture was either sown or regenerated on 240 ha (22%).

What happened?

The average farm wheat yield of 1.6 t/ha was limited in some paddocks by grass competition. Barley also yielded an average 1.6 t/ha. Canola yielded 0.5 t/ha. We received 185 mm of growing season rainfall (GSR), falling on 60 days, compared to 252 mm of GSR in 2011. The crops benefited from 100 mm of rainfall in June and July with the last daily rainfall event above 10 mm occurring on the 22 June. Harvest commenced on 29 October (Scope barley) and finished on 14 November (Axe wheat). Using the modified French and Schultz yield calculator, we could potentially have achieved yields of wheat 1.7 t/ha, barley 2.1 t/ha and canola 1.2 t/ha.

Livestock

331 ewes were joined on 1 February 2012

Scanning percentage (27 April) 538 lambs = 163%

Lambing percentage 542 lambs = 164%

Marking percentage 429 lambs = 130%

For more in depth results see the lamb survival project results in the article 'Identifying causes for lamb losses in low rainfall mixed farming regions'.

Seed Grain

360 tonne of seed grain was sold to growers via certified seed and off the header, providing quality grain to the industry on Eyre Peninsula.

Acknowledgements

MAC farm staff Brett McEvoy and Trent Brace.

Table 1 Harvest results, 2012

Paddock	Paddock History 08-11	Crop 2012	Sowing Date 2012	Yield (t/ha)	Protein (%)
North 1	W W W W	Medic	26 April		
North 2	W B P W	Kord CL Plus	23 May	1.50	11
North 3	W W Pe P	Scout	3 June	1.45	13
North 4	P P W W	Hindmarsh	14 June	1.35	13
North 5 N	W W B P	Angel medic			
North 5 S	B B P P	Mace	25 June	1.80	14
North 6 E	P W W W	Scope	4 June	Spraytopped	Grazed
North 6 W	W W B Pe	Mace	27 June	1.90	11
North 7/8	B W W W	Scope	5 June	1.40	12
North 9	Pe O P W	Axe	1 June	1.45	12
North 10	W B Pe W	Medic	30 April		
North 11	W W W W	Medic	30 April		
North 12	B W W C	Kord CL Plus	22 May	1.86	12
South 1	W W W W	Scope	3 April	2.00	10
South 1 Scrub	W W B B	Scope	3 April	1.50	
South 2/8	W W P W	Mace	30 May	1.90	11
South 2/8	W P P W	Wyalkatchem	31 May	1.60	12
South 3 S	P P W W	Axe	1 June	1.08	12
South 3 N	C W W C	Mace	27 May	1.30	10
South 4	W W W B	Pasture			
South 5	W Pe W W	ATR Stingray	30 May	0.55	
South 6 E	W W B P	Medic	1 May		
South 6 W	W W B Pe	Grenade/Shield	6 June		12
South 7	W W P W	Medic			
South 9	P W W P	Kord CL Plus	24 May	2.00	12
South 10	W W W P	Cobra/Phantom	4 June	1.40	11

P = pasture, Pe = field pea, W = wheat, B = barley, O = oats, C = canola

"A grower group that specifically addresses issues and finds solutions to improve farming systems in your area"

LEADA is committed to providing support and attracting research activity to the Lower Eyre Peninsula (LEP). It is driven by local issues and the search for solutions that suit local systems.

LEADA's 2012 achievements and 2013 focus

2012 was one of those rare years, where yields were average to above average on LEP, with below average growing season rainfall, including a very dry spring. This gave many growers on LEP outstanding water use efficiency (WUE). This result was quite fitting as 2013 will see the conclusion to LEADA's WUE project with GRDC, where LEADA is aiming to improve WUE across LEP by 10%.

LEADA conducted a successful field trial program in 2012. Refining nitrogen and fungicide management on both wheat and barley gave improvements to yield and WUE across three soil types on LEP. LEADA was also able to evaluate the newly released blackleg resistance groups in 2012 and found that the grouping structure worked effectively and will provide an invaluable tool into the future that will keep our canola industry sustainable.

Extension activities continue to be a key focus of the group. Pleasing attendance numbers were recorded at our annual expo and spring field day as well as at the various pasture information and training days held during the year.

2012 saw several changes to the management of the LEADA group. David Giddings stood down as chair after two years in the role and executive officer, Kieran Wauchope, took up a new opportunity in the private sector. LEADA is very grateful for the time and effort they both contributed to the group. David and Kieran will continue on with LEADA as members of the committee. Jordan Wilksch takes over as the new chair, while Brenton Growden is filling the executive officer role until a more permanent solution can be found.

Our links with GRDC, the Australian Government, State NRM, Rural Solutions SA, SARDI, EPARF and the Eyre Peninsula NRM Board were further strengthened throughout the year. This positive collaboration is resulting in a greater research and extension effort on sustainable and profitable farming systems for the LEP.

2013 will see a shift in focus as the WUE funding concludes. Negotiations are underway to secure more funding that will address some of the key issues facing LEP growers, including weed management and snail control. Collaborative work with blackleg management, cereal nutrition and cereal disease management are expected to continue.

Future research objectives:
Canola – managing increasing intensities of canola rotations (canola made up 1/4 of all crops grown on LEP and is likely to increase significantly, growing canola in a low N environment).
All crop type management – targeting N use, precision ag for improved variable rate of nutrition and soil amelioration, ryegrass management, increasing soil carbon, snail control, discovering new break crops.
Livestock – integrating into our cropping systems, use as weed managers, cell grazing and perennial pasture management.

LEADA is key to integrating the latest research into sustainable, practical and profitable farming systems and instigates collaboration between regions, issues and researchers.

Contact:
Jordan Wilksch, Chair 0428 865055
Brenton Growden, EO 0428 761 502

Committee members:
Daniel Adams, Martin Burns, Shane Nelligan, Mark Modra, Stewart Modra, Bruce Morgan, Luke Moroney, Nigel Myers, Dustin Parker, John Richardson, Tim Richardson, Scott Siviour, Michael Treloar and Jordan Wilksch, supported by Neil Ackland (EPNRMB), Roy Latta and Andrew Ware (SARDI).

Understanding trial results and statistics

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 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 "$P \leq 0.05$". 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.

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.

Results from 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 (4 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 *LSD (P=0.05)*	$P \leq 0.05$ *0.33*

Statistical analysis indicates that there is a fertiliser treatment effect on yields. $P \leq 0.05$ 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 offices has additional information on conducting on-farm trials. Thanks to Jim Egan for the original article.

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

Some useful conversions

Area

1 ha (hectare) = 10,000 m^2 (square 100 m by 100m)

1 acre = 0.4047 ha (1 chain (22 yards) by 10 chain)

1 ha = 2.471 acres

Mass

1 t (metric tonne) = 1,000 kg

1 imperial tonne = 1,016 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 = 1,000 mL (millilitres)

Speed

1 km/hr = 0.62 miles/hr

10 km/hr = 6.2 miles/hr

15 km/hr = 9.3 miles/hr

10 km/hr = 167 metres/minute = 2.78 metres/second

Pressure

10 psi(pounds per sq inch) = 0.69 bar = 69 kPa (kiloPascals)

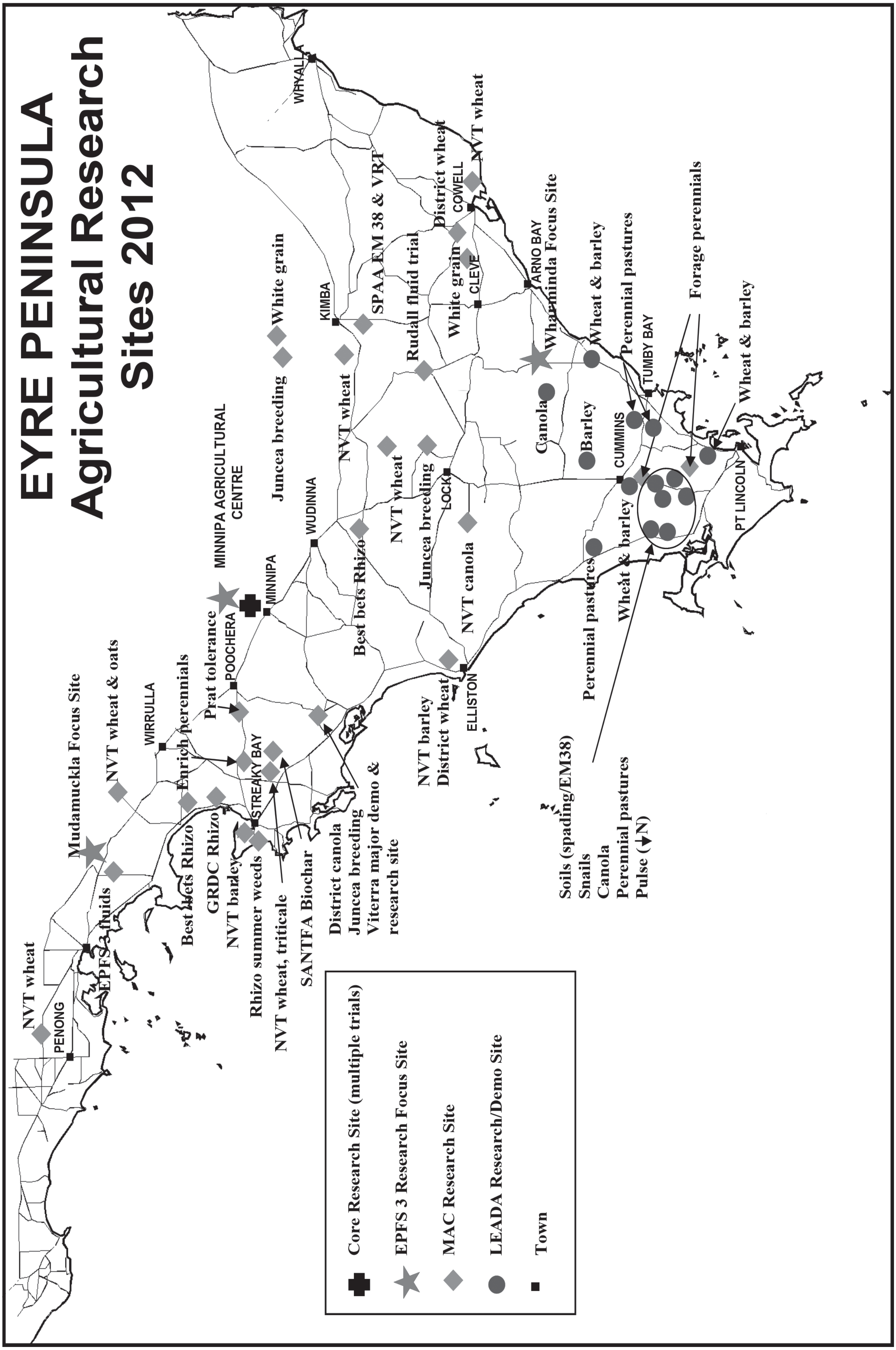
25 psi = 1.7 bar = 172 kPa

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 2012
WHYALLA
COWELL
NVT wheat
District wheat
SPAA EM 38 & VRT
Rudall fluid trial
White grain
CLEVE
ARNO BAY
Wharminda Focus Site
KIMBA
White grain
Juncea breeding
NVT wheat
MINNIPA AGRICULTURAL CENTRE
MINNIPA
WUDINNA
NVT wheat
Juncea breeding
LOCK
NVT canola
Best bets Rhizo
POOCHERA
Prat tolerance
WIRRULLA
Enrich perennials
NVT wheat & oats
Mudamuckla Focus Site
STREAKY BAY
ELLISTON
NVT barley
District wheat
Canola
Barley
Wheat & barley
Perennial pastures
TUMBY BAY
CUMMINS
Forage perennials
Wheat & barley
PT LINCOLN
Wheat & barley
Perennial pastures
Soils (spading/EM38)
Snails
Canola
Perennial pastures
Pulse (↓N)
NVT wheat
PENONG
EPFS 3 fluids
Best bets Rhizo
GRDC Rhizo
NVT barley
Rhizo summer weeds
NVT wheat, triticale
SANTFA Biochar
District canola
Juncea breeding
Viterra major demo & research site
Core Research Site (multiple trials)
EPFS 3 Research Focus Site
MAC Research Site
LEADA Research/Demo Site
Town

Section

1

Cereals

Section Editor:

Jessica Crettenden

SARDI

Minnipa Agricultural Centre

Cereals

The 2012 production figures for Western Eyre Peninsula were approximately 431,500 t wheat, 77,000 t barley, 9,000 t oats, 1,050 t triticale. Eastern Eyre Peninsula 521,500 t wheat, 129,600 t barley, 4,000 t oats, 5,200 t triticale. Lower Eyre Peninsula 357,800 t wheat, 220,000 t barley, 5,440 t oats, 1,300 t triticale.
[PIRSA Crop & Pasture Report SA, January 2013]

Triticale variety yield performance

2012 and long term (2005-2012) expressed as % of site average yield and as t/ha

Variety	2012 (as % of site average)				Long term average across sites within region (2005-2012) as % site average			
					Lower Eyre		Upper Eyre	
	Greenpatch	Minnipa	Streaky Bay	Wharminda	% sites av.	# Trials	% sites av.	# Trials
Abacus	-	-	-	-				
Berkshire	87	121	92	106	105	8	103	8
Bogong	100	89	105	99	110	12	106	11
Canobolas	99	94	100	112	105	12	102	11
Chopper	96	114	107	101	103	10	99	10
Endeavour	88	-	-	89	85	6		
Fusion	107	124	107	130	110	6	106	6
Goanna	100	77	94	100	97	4	90	4
Hawkeye	99	93	95	96	105	14	103	13
Jaywick	88	116	96	96	102	14	99	13
Rufus	100	86	100	110	97	12	95	12
Tahara	103	75	106	89	96	16	98	15
Tuckerbox	104	-	-	83	93	8		
Yowie	90	78	93	90	98	6	94	6
Yukuri	98	-	-	78	90	8		
Site av. yield t/ha	**2.18**	**0.94**	**1.19**	**1.42**	**2.86**		**1.93**	
LSD (P=0.05) as %	*7*	*18*	*9*	*14*				
Date Sown	13 June	27 May	7 June	22 May				
Soil Type	L	L	LSCL	NWS				
J-M/A-O rain (mm)	33/442	63/185	5/181	39/209				
pH (water)	5.6	8.6	8.5	6.6				
previous crop	canola	barley	pasture	pasture				
Stress factors	de	b,cr,dl	dl, lb	dl				

Soil types: S=sand, C=clay, L=loam, NWS=non wetting sand

Site stress factors: de=pre-anthesis moisture stress, b=boron toxicity, cr=crown rot, dl=dry post anthesis, lb=late break

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 *2012 and long term (2008-2012) expressed as t/ha and % of site average yield*

Variety	Upper, Eastern and Western Eyre Peninsula										Mid and Lower Eyre Peninsula					
	2011 (as % site average)							Long Term av. across sites (08-12)			2012 (as % site average)			Long Term av across sites (08-12)		
	Kimba	Minnipa	Mitchelville	Nunjikompita	Penong	Streaky Bay	Warramboo	t/ha	as % site av.	# Trials	Cummins	Rudall	Ungarra	t/ha	% site av.	# Trials
AGT Katana	95	112	113	91	97	98	96	2.24	108	24	97	106	105	4.21	105	13
Axe	103	102	96	93	111	99	108	2.12	102	24	91	102	105	4.07	101	13
Catalina	92	86	94	91	99	92	98	2.08	100	24	95	92	92	4.01	100	13
Clearfield Jnz	80	94	94	85	81	94	94	1.95	94	24	97	89	87	3.89	97	11
Cobra	96	99	102	96	74	96	100	2.27	110	13	110	90	97	4.27	107	6
Corack	106	119	127	101	111	105	114	2.40	116	18	102	112	99	4.42	110	8
Correll	93	98	99	98	97	104	96	2.17	105	24	100	94	96	4.15	103	13
Dart	108	115	93	94	108	92	98	2.11	102	7	104	102	103	4.06	101	4
Derrimut	97	108	114	94	100	96	91	2.11	102	24	99	91	96	4.11	102	13
Emu Rock	108	117	120	109	128	102	105	2.29	110	18	107	119	114	4.27	106	8
Espada	104	111	101	114	108	111	100	2.25	108	24	97	103	103	4.23	105	13
Estoc	99	104	104	93	90	102	102	2.17	105	24	100	101	96	4.15	103	13
Gladius	100	101	93	102	100	94	101	2.16	104	24	92	101	94	4.12	103	13
Grenade CL Plus	108	110	100	114	108	108	92	2.08	101	13	99	103	100	4.03	100	6
Justica CL Plus	93	92	100	101	95	97	90	2.09	101	18	94	96	98	4.04	101	8
Kord CL Plus								2.13	103	11				4.01	100	5
Lincoln	93	70	77	91	75	92	96	2.06	99	24	101	89	85	4.01	100	13
Mace	111	110	114	106	118	113	114	2.39	115	24	106	117	107	4.36	109	11
Magenta	91	95	106	96	83	103	95	2.20	106	24	98	102	101	4.15	103	13
Peake	101	109	113	102	104	96	102	2.12	103	24	101	93	100	4.10	102	13
Phantom	97	90	87	98	95	106	88	2.14	103	18	105	84	101	4.15	103	8
Scout	100	103	89	91	99	98	98	2.27	110	24	103	92	101	4.38	109	11
Shield	99	98	105	111	118	104	96	2.17	105	13	101	99	98	4.12	103	6
Wallup								2.18	105	6	96	103	97	4.11	103	7
Wyalkatchem	92	94	100	94	92	106	95	2.27	110	24	104	102	99	4.25	106	13
Young	99	90	103	93	96	89	100	2.20	106	18	93	103	98	4.16	104	10
Yitpi								2.09	101	17				4.07	101	10
Site av. yield (t/ha)	**1.32**	**1.71**	**2.29**	**0.61**	**0.72**	**1.24**	**1.74**	**2.07**	**2.07**		**4.71**	**2.47**	**3.09**	**4.01**	**4.01**	
LSD (%) (P=0.05)	*5*	*8*	*10*	*8*	*8*	*9*	*7*				*8*	*5*	*6*			
Date Sown	29 May	27 May	4 May	7 June	6 June	7 June	29 May				14 May	28 May	31 May			
Soil Type	LS	L	LS	LSCL	SCL	LSCL	SL				CL	SL	SL			
J-M / A-O rain (mm)	99/163	63/185	58/192	18/136	22/137	5/181	70/234				28/256	39/203	30/250			
pH (Water)	8.1	8.6	7.2	8.8	8.8	8.5	8.1				7.5	6.0	5.5			
Previous Crop	canola	barley	pasture	pasture	pasture	pasture	pasture				canola	pasture	canola			
Stress Factors	de, dl	b, cr, dl	de, dl, ta	dl	dl, lb	dl, lb	de, dl				dl, es	dl	de, dl			

Soil type: S=sand, L=loam, C=clay, Li=light, M=medium, H=heavy, F=fine
Site stress factors: de=preanthesis moisture stress, es=eye spot, b=boron toxicity, cr=crown rot, dl=dry post anthesis, ta=take all, lb=late break
Data source: NVT & SARDI/GRDC (long term data based on weighted analysis of sites, 2000-2010) Data analysis by GRDC funded National Statistics Group

SA Barley variety yield performance *2012 and long term (2008 - 2012) expressed as t/ha and % of site average yield*

Variety	LOWER EYRE PENINSULA					UPPER EYRE PENINSULA							
	2012 (% site average)		Long Term average across sites (2008-2012)			2012 (as % site average)					Long Term average across sites (2008-2012)		
	Cummins	Wanilla	t/ha	as % site av.	# Trials	Darke Peak	Elliston	Minnipa	Streaky Bay	Wharminda	t/ha	as % site av.	# Trials
Barque	93	113	3.72	97	12	94	97	102	113	103	2.53	107	17
Bass	97	87	3.89	102	9	92	98	101	96	100	2.34	99	13
Baudin	97	100	3.55	93	12					103	2.18	93	10
Buloke	102	107	3.85	101	12	93	101	96	101	109	2.44	103	17
Capstan	107	105	4.13	108	7					99			
Commander	99	92	3.98	104	12	96	98	106	100	101	2.58	109	17
Fathom	104	116	4.06	106	9	118	105	127	133	113	2.78	118	10
Flagship	90	102	3.69	97	12	102	95	94	99	103	2.42	102	17
Fleet	101	118	4.03	105	12	111	104	123	112	114	2.72	115	17
Flinders	94	104	3.98	104	9	91	103	86	87	96	2.42	103	10
Gairdner	100	100	3.67	96	10					97	2.33	99	4
Grange	105	103				102	112	92	80	92			
Henley	104	91	4.04	106	11					99	2.51	107	9
Hindmarsh	101	93	4.14	108	12	130	98	113	118	116	2.64	112	17
Keel	97	98	3.68	96	12	99	95	115	125	100	2.61	110	16
Maritime	96	104	3.70	97	12	99	98	91	98	104	2.39	101	17
Oxford	105	93	4.24	111	11	80	95	77	64	77	2.52	107	13
Schooner	82	94	3.45	90	12	100	76	90	98	93	2.20	93	17
Scope	103	123	3.80	99	11	98	106	95	102	105	2.38	101	13
Sloop SA	90	92	3.57	93	12	100	95	93	105	97	2.28	97	17
Westminster	96	78	3.94	103	7					77			
Wimmera	102	100	4.05	106	9					102			
Site av. yield t/ha	**5.20**	**3.79**	**3.82**			**2.32**	**2.88**	**2.55**	**1.74**	**2.65**	**2.36**		
LSD (P=0.05) as %	*4*	*13*				*11*	*8*	*8*	*9*	*11*			
Date Sown	14 May	15 May				29 May	22 May	25 May	1 June	22 May			
Soil Type	CL	S				SL	S	L	SL	NWS			
J-M/A-O rain (mm)	28/256	40/391				60/189	38/328	63/185	29/177	39/209			
pH_{water}	7.5	6.1				7.7	8.3	8.6	8.4	6.6			
Previous Crop	canola	canola				pasture	pasture	barley	pasture	pasture			
Site Stress Factors	dl	h?				de, dl, rh	di	b, cr, dl	dL	dL			

Soil type: S = sand, L = loam, C = clay, Li = light, M = medium, H = heavy, F = fine, NW = non wetting, / = separates top soil from sub soil
Site stress factors: b=boron toxicity, cr=crown rot, de=dry pre-anthesis, dl=dry post anthesis, h=IMI residues, r=rhizoctonia
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

2012 and long term (2005-2012) expressed as % of site average yield and as t/ha

	2012 (as % site average)		Long Term average across sites within region (2005 - 2011) as % site average and number of trials			
Region	**Lower Eyre**	**Upper Eyre**	**Lower Eyre**		**Upper Eyre**	
Variety	**Greenpatch**	**Nunjikompita**	**% sites av.**	**# Trials**	**% sites av.**	**# Trials**
Bannister	116	105				
Dunnart	94	102	3.46	6	1.66	10
Euro	101	91	3.40	7	1.50	12
Mitika	90	90	3.46	7	1.57	12
Possum	94	103	3.44	7	1.59	12
Potoroo	96	107	3.44	7	1.66	12
Wombat	106	86	3.62	4	1.66	7
Yallara	99	106	3.35	7	1.53	12
Site av. yield (t/ha)	**2.42**	**0.59**	**3.59**		**1.64**	
LSD (%) (P=0.05)	*9*	*9*				
Date sown	13 June	20 June				
Soil Type	L	LSCL				
pH (water)	5.6	8.8				
J-M/A-O rain (mm)	33/442	18/136				
Previous crop	canola	pasture				
Stress factors	de	de,dl,lb				

Soil types: S=sand, C=clay, L=loam, F=fine

Stress factors: lb=late break, de=dry early, dl=dry late

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

Witera (Mt Cooper), Elliston, Wharminda and Cowell district wheat and barley trials

Leigh Davis[1], Andrew Ware[2], Brian Purdie[2], Cathy Paterson[1], Ashley Flint[2] and Brenton Spriggs[1]

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RESEARCH

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Location: Witera
Craig Kelsh
Mt Cooper Ag Bureau

Rainfall
Av. Annual: 423 mm
Av. GSR: 332 mm
2012 Total: 332 mm
2012 GSR: 294 mm

Yield
Potential: 4.06 t/ha (W)
Actual: 2.0 t/ha

Paddock History
2012: Wheat (Scout)
2011: Grass free pasture
2010: Barley (Fleet)
2009: Wheat (Wyalkatchem)
2008: Grass free pasture

Soil Type
Clay sandy clay loam

Yield Limiting Factors
Some weed competition

Location: Elliston
Nigel and Debbie May
Elliston Ag Bureau

Rainfall
Av. Annual: 427 mm
Av. GSR: 353 mm
2012 Total: 375 mm
2012 GSR: 328 mm

Yield
Potential: 4.36 t/ha (W)
Actual: 2.85 t/ha (W)

Paddock History
2011: Pasture
2010: Barley
2009: Grass free pasture

Soil Type
Sand

Yield Limiting Factors
None

Key messages

- **Yitpi and Mace performed well in the Witera wheat trial.**
- **The highest yields were recorded in Hindmarsh, Fathom (WI4483) and Skipper in the Witera barley trial.**
- **Scout, Yitpi and Mace achieved 3 t/ha in the Elliston district wheat trial.**
- **Mace and Cobra show highest yields at Wharminda.**
- **Mace and Wyalkatchem perform well in Franklin Harbour trial.**

Why do the trial?

The wheat and barley variety demonstrations were identified as priorities by local agricultural bureaus to compare current varieties to potential new varieties in soil types and rainfall regions where wheat and barley National Variety Trials (NVT) are not conducted.

Witera District Wheat and Barley Trials

How was it done?

Fifteen wheat varieties and 12 barley varieties, replicated 3 times, were sown on 3 June with both trials receiving 63 kg/ha of 19:13:0:9.4 and 64 kg/ha of 46:0:0:0 (urea) fertiliser at seeding. On 15 August, 54 kg/ha of urea was applied to increase yield potential. 1 L/ha Roundup PowerMax, 1 L/ha Triflur X, 70 ml/ha Hammer and 1 L/ha Lorsban were applied to both trials pre seeding and 1.2 L/ha Bromicide MA was applied for broad-leaved weed control on 24 July.

What happened?

Yitpi and Mace performed well at Witera in 2012 yielding 2.29 t/ha and 2.28 t/ha respectively (Table 1). Varieties in 2012 were tested under challenging conditions with a late start to the opening rains and a short growing season due to lack of rain in spring. The average yield across all varieties in the trial was 2 t/ha. Test weights were exceptionally high and screenings low which was surprising considering the short season. The trial did not receive any fungicides and there was no disease in the wheat trial.

Hindmarsh, Fathom (WI4483) and Skipper produced the highest yields (Table 2). The barley trial did not receive any fungicide sprays and consequently there was some net blotch observed in the trial. Skipper was the best performing malting variety.

Elliston District Wheat Trials

How was it done?

Fifteen wheat varieties, replicated 3 times, were sown on 22 May with 100 kg/ha of DAP fertiliser and 3 L/ha of Zn, Mn and Cu foliar mix. The site received 1 L/ha glyphosate 570 g/L, 0.1 L/ha oxyfluorfen and 1 L/ha of trifluralin prior to sowing. 1.4 L/ha Bromicide MA, 0.25 L/ha Cloquintocet-Mexyl and 0.5 L/ha of an oil/wetter was applied mid-tillering in early July to control post emergent weeds. There were two applications of various fungicides to control rust on 9 August and 19 September. Bait was spread to control snails in September.

What happened?

Scout, Yitpi and Mace produced over 3 t/ha at the Elliston District wheat trial in 2012 with the trial averaging 2.85 t/ha (Table 3). Protein levels were low in 2012 along with high screenings levels in some varieties which would have attracted a downgrade at the silos.

The long term yields, relative to Yitpi, (Table 4) show that over the last 7 years a trend towards longer season Yitpi types (Yitpi and Scout) performing well at Elliston.

Location: Wharminda
Tim Ottens
Wharminda Ag Bureau

Rainfall
Av. Annual: 337 mm
Av. GSR: 252 mm
2012 Total: 253 mm
2012 GSR: 209 mm

Yield
Potential: 2.37 t/ha (W)
Actual: 1.51 t/ha

Paddock History
2011: Grass free pasture
2010: Wheat
2009: Wheat

Soil Type
Sand

Yield Limiting Factors
None

Location: Cowell
Mason, Bevan, Cindy and Scott Siviour
Franklin Harbour Ag Bureau

Rainfall
Av. Annual: 300 mm
Av. GSR: 256 mm
2011 Total: 313 mm
2011 GSR: 200 mm

Yield
Potential: 2.2 t/ha (W)
Actual: 2.4 t/ha (Mace)

Paddock History
2012: Wheat
2011: Grassy pasture
2010: Oats
2009: Wheat
2008: Pasture

Soil Type
Red clay loam

Yield Limiting Factors
None

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Table 1 Grain yield and quality of wheat varieties sown at Witera in 2012

Variety	Yield (t/ha)	Test Weight (kg/hL)	Protein (%)	Screenings (%)
Yitpi	2.29	79.7	11.6	0.6
Mace	2.28	80.8	10.2	1.8
Estoc	2.18	81.8	11.7	0.9
Wyalkatchem	2.08	81.3	9.9	0.6
Justica	2.07	79.7	11.6	1.3
Corack	2.02	80.3	10.0	0.9
Espada	2.02	79.8	11.2	0.8
Gladius	2.00	81.2	11.2	0.8
Correll	1.98	78.7	11.1	1.4
Scout	1.94	83.3	10.4	0.7
Kord	1.91	80.5	11.6	0.7
Cobra	1.89	79.5	10.6	0.7
Axe	1.88	81.5	11.2	0.7
Lincoln	1.75	80.2	10.6	1.7
Mean	**1.73**	**82.0**	**11.5**	**1.2**
CV	*7.33*			
LSD (P=0.05)	*0.26*			

Table 2 Grain yield and quality of barley sown at Witera in 2012

Variety	Yield (t/ha)	Protein (%)	Test Weight (%)	Screenings (%)
Hindmarsh	3.82	11.9	66	3.3
Fathom	3.79	12.7	63	2.2
Skipper	3.79	13.0	66	2.1
Fleet	3.65	13.0	63	1.9
Commander	3.48	12.2	66	4.8
Buloke	3.46	12.7	64	5.8
Scope	3.46	12.6	66	4.4
Keel	3.44	12.8	63	5.7
Sloop	3.32	12.8	65	3.5
Schooner	3.29	13.1	67	2.3
Flagship	3.22	12.4	68	3.0
Oxford	3.07	12.6	65	5.7
Mean	**3.48**	**12.7**	**65**	**3.7**
CV	*4.63*			
LSD (P=0.05)	*0.30*			

Wharminda District Wheat Trials

How was it done?

Fifteen wheat varieties, replicated 3 times were sown on 22 May with 100 kg/ha of DAP fertiliser. On 3 July 3 L/ha of Zn, Mn & Cu foliar mix was applied and urea @ 50 kg/ha was applied on 11 July. The trial chemical regime consists of Paraquat, Diquat @ 1 L/ha, Flutriafol @ 0.4 L/ha, Trifluralin @ 1 L/ha, and Oxyfluorfen @ 0.1 L/ha at seeding. Carfentrazone-ethyl @ 0.09 L/ha and MCPA Amine @ 0.5 L/ha was applied for broadleaf control. Fungicides: Flutriafol @ 0.4 L/ha (applied on fertiliser), and Azoxystobin, Cyproconazol @ 0.50 L/ha were used for controlling leaf diseases.

What happened?

Mace and Cobra recorded the highest yields in the district trial at Wharminda with yields of 1.95 t/ha and 1.81 t/ha respectively (Table 5). Protein levels were slightly low and some varieties had poor results with high screenings.

Table 3 Grain yield and quality of wheat varieties sown at Elliston, 2012

Variety	Yield (t/ha)	% of Site Mean	Test Weight (kg/hL)	Protein (%)	Screenings (%)
Scout	3.26	114	84	8.2	5.4
Yitpi	3.08	108	82	8.3	5.5
Mace	3.06	107	83	8.2	2.9
Wyalkatchem	2.99	105	84	8.5	2.4
Cobra	2.96	104	82	8.6	4.6
Estoc	2.96	104	86	8.4	3.4
Correll	2.96	104	82	8.9	5.8
Corack	2.89	101	83	8.8	3.4
Katana	2.84	100	85	8.7	4.1
Axe	2.82	99	82	9.2	3.8
Espada	2.82	99	82	8.8	4.6
Justica	2.67	94	81	9.1	3.3
Gladius	2.66	93	82	9.1	4.8
Lincoln	2.49	87	83	9.7	7.0
Kord	2.30	81	83	9.5	7.6
Mean	**2.85**				
CV	*5.08*				
LSD (P=0.05)	*0.37*	*13*			

Table 4 Long term yield of wheat varieties in Elliston trials as a percentage of Yitpi, 2006-2012

Variety	2012	2011	2010	2009	2008	2007	2006	Average
Axe	92	83	82	58	91	103	120	90
Corack	94	85	-	-	-	-	-	90
Correll	96	84	95	85	85	104	136	98
Espada	92	104	101	76	105	-	-	96
Estoc	96	100	105	-	-	-	-	101
Frame	-	-	94	88	94	83	95	91
Gladius	86	90	91	83	91	112	103	94
Justica	87	81	-	-	-	-	-	84
AGT Katana	92	100	-	-	-	-	-	96
Kord	75	100	-	-	-	-	-	88
Lincoln	81	102	96	78	-	-	-	89
Mace	99	99	89	80	-	-	-	92
Scout	106	103	102	-	-	-	-	104
Wyalkatchem	97	85	87	78	88	102	115	93
Yitpi	100	100	100	100	100	100	100	100
Yitpi (t/ha)	**3.08**	**4.04**	**4.01**	**4.10**	**2.48**	**2.21**	**0.98**	**2.99**

Table 5 Grain yield and quality of wheat varieties sown at Wharminda, 2012

Variety	Yield (t/ha)	% of Site Mean	Test Weight (kg/hL)	Protein (%)	Screenings (%)
Mace	1.95	129	81.9	9.4	2.7
Cobra	1.81	120	81.8	9.9	3.4
Yitpi	1.66	110	81.3	9.9	5.3
Katana	1.66	110	82.1	10.3	4.2
Correll	1.62	107	78.7	9.4	5.7
Espada	1.61	107	80.4	10.0	5.3
Wyalkatchem	1.56	103	81.0	9.9	2.6
Gladius	1.49	99	80.5	9.9	4.0
Lincoln	1.43	95	80.6	9.6	6.9
Kord	1.39	93	80.6	10.3	4.4
Scout	1.39	92	81.6	9.4	6.7
Corack	1.38	91	81.9	9.5	3.8
Axe	1.33	88	79.7	11.1	2.2
Estoc	1.21	81	80.2	10.3	5.9
Justica	1.12	74	79.1	10.2	4.2
Mean	**1.51**				
CV	*12.17*				
LSD (P=0.05)	*0.32*	*21*			

Table 6 Grain yield and quality of wheat varieties sown at Franklin Harbour, 2012

Variety	Yield (t/ha)	% of Site Mean	Test Weight (kg/hL)	Protein (%)	Screenings (%)
Mace	2.42	112	85.8	9.6	2.7
Wyalkatchem	2.19	102	85.1	9.8	1.9
Lincoln	2.17	100	85.2	10.0	4.1
Estoc	2.14	99	86.8	11.0	1.5
Gladius	2.11	98	84.8	10.9	3.4
Catalina	2.10	97	86.8	10.6	2.3
Scout	2.11	98	86.6	10.2	3.0
Axe	2.03	94	85.9	10.3	2.4
Mean	**2.16**				
CV	*6.1*				
LSD (P=0.05)	*0.23*				

Franklin Harbour District Wheat Trials

How was it done?

Eight wheat varieties, replicated 3 times were sown on 3 June with DAP @ 60 kg/ha. The site was worked up on 3 March and was sprayed on 1 June with Glyphosate @ 1 L/ha, Ester 680 @ 125ml/ha, Logran 750 WG @ 32 g/ha with 1% wetter.

What happened?

Mace yielded 2.4 t/ha and led the way in the district trial at Wharminda (Table 6). Protein levels were slightly low with only Estoc, Gladius and Catalina having levels above 10.5%. Test weights were excellent and screenings were below 5% for all varieties.

The varieties tested at Witera, Elliston, Franklin Harbour and Wharminda were selected to be the best bet options. For more extensive options and details on any variety characteristics visit the National Variety Trials (NVT) website at www.nvtonline.com.au or refer to the NVT Cereal Performance Tables and the Cereal Variety Disease Guide.

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Roundup PowerMax – registered trademark of Nufarm,TriflurX – registered trademark of Nufarm, Lorsban – registered trademark of Dow Agrowsciences, BromicideMA – registered trademark of Nufarm, Lontrel – registered trademark of Dow Agrowsciences and Chemwet 1000 – registered trademark of Nufarm.

Barley breeding for low rainfall environments

RESEARCH

Stewart Coventry[1], Leigh Davis[2], Delphine Fleury[3] and Jason Eglinton[1]

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Searching for Answers

Location:
Minnipa Agricultural Centre
North 4

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2012 Total: 253 mm
2012 GSR: 185 mm

Yield
Potential: 2.05 t/ha (B)
Actual: 1.1 t/ha

Paddock History
2012: Hindmarsh barley
2011: Mace wheat
2010: Mace wheat
2009: Grass free pasture

Soil Type
Red loam

Fertiliser
19:13:0:S9.4 @ 96 kg/ha
1.5L/ha Zn sulphate (liquid 16% Zn)

Management
1.2 L/ha Bromicide MA + 80ml/ha Lontrel
400ml/ha Amistar Xtra

Plot Size
5 m x 1.6 m

Key messages

- **Fathom is well adapted to the upper Eyre Peninsula and was bred using wild barley genetics.**
- **Today's knowledge is tomorrow's gain.**

Why do the trial?

The University of Adelaide (UA) barley program has a long history of breeding for low rainfall environments and conducting research to identify better yielding barley lines and the genetic basis of drought tolerance. This was reported over 10 years ago in the EPFS Summary 1999-2005, and the launch of Fathom barley at the 2012 Minnipa Agricultural Centre field day was evidence that research outcomes integrated into a barley breeding program will produce beneficial varieties. So what is the Fathom story?

How was it done?

A collaborative breeding project was initiated with the International Centre for Agricultural Research in Dry Areas (ICARDA) based in Syria to introduce material from the Middle East and evaluate this in national drought trials, of which trials at Minnipa were part of. It was identified that the sister line to the feed barley Fleet, called WI3806, was very well adapted to the upper EP (UEP) by combining yield and grain size traits from Mundah, Keel and Barque in its pedigree (EPFS Summary 2006, p 27). Parallel to this, a project was initiated to dissect the genetics of drought tolerance from a wild barley which is a weed type version of cultivated barley.

In order to 'tame' the wild barley genes, a new approach called Advanced Backcross QTL (ABQTL) analysis was initiated in 1998 that allowed the simultaneous identification of wild barley drought tolerance genes in a cultivated barley genetic background. An ABQTL population with Barque as the recurrent parent was evaluated in the national drought trials (2002-2004), including at Minnipa. One specific region of interest was a gene on chromosome 2H from wild barley that increased yields above Barque. This new technique allowed the identification of a specific line (13D-020) from the ABQTL population that had all the advantageous traits from Barque, in addition to the wild barley yield gene. This was immediately crossed with WI3806 which was identified earlier to produce a low rainfall barley variety.

This 13D-20/WI3806 cross was made in 2003. The best lines from the cross entered breeding yield trials in 2006, national breeding trials in 2008, and Fathom was selected for National Variety Trials (NVT) in 2010. In 2012 the variety Fathom was launched at the Minnipa Field Day. It took 14 years from the first cross of the ABQTL research population (1998) to the commercial release of Fathom (2012). Although a long time, this is fast for going from knowing nothing of the drought tolerance of the wild barley to integrating the wild barley gene for drought tolerance into a high yielding commercial feed barley. In 2012 the next generation barley drought mapping populations were run for their first year yield trials at Minnipa.

What happened?

Presented are the results for Fathom between 2008 and 2012 during which time the variety has been in advanced yield trials with the UA barley program and in the NVT system. Currently the feed barley options in the UEP farming system are Keel, Barque, Maritime, Hindmarsh and Fleet.

Fathom has yielded very well in the seasons of 2008-2012. The average yield for Minnipa in 2010, a high decile growing season rainfall, was 4.38 t/ha. The past two seasons (2011 and 2012) have been lower decile seasons and represent a better test of the drought tolerance of Fathom. It is estimated from the 2013 SARDI Sowing Guide that Fathom out-yields Hindmarsh by 2% using the UEP NVT data. Grain size of Fathom is similar to Fleet. Fathom has test weights slightly better than Fleet, high retention values and screenings values similar to Fleet in NVT trials (Table 2).

Table 1 2008-2012 yield of Fathom from UA barley program trials and UEP NVT sites*

	UA National 2008*	UA National 2009**	UEP NVT 2010	UEP NVT 2011	UEP NVT 2012	UA MRC 2012
Fathom	127	128	119	169	132	128
Fleet	108	118	117	154	126	113
Hindmarsh	123	122	115	152	127	122
Keel	122	119	126	101	119	122

** mean grain yield is expressed as a % of Schooner*

***2008 and 2009 yield is from a multi-location analysis and expressed as a % of Schooner*

Table 2 2008-2012 physical grain quality of Fathom in UA barley program trials and NVT*

	UA National Retention 2008	UA National 2009**	NVT National Screenings 2010	NVT National Screenings 2011	NVT 2010-2011 Test Weight
Fathom	133	118	1.9	2.9	66.4
Fleet	125	113	2.6	2.7	66.1
Hindmarsh	104	100	3.5	6.7	67.5
Keel	100	100	4.2	12.4	65.8

**all traits are from a multi-locational analysis. Retention is expressed as a % of Keel. Test weight is in kg/hl and screenings is expressed as a percentage.*

Table 3 Site summary of 2012 drought trials for the population Fleet/Commander

Site	Mean Site Yield (t/ha)	Site CV (%)	Fleet (t/ha)	Commander (t/ha)	WI4304 (t/ha)	Hindharsh (t/ha)	Yield Range (t/ha)	Seeding Date 2012
Minnipa	1.2	14.7	1.3	1.2	1.2	1.2	0.2-1.6	11 June
Roseworthy	3.2	10.7	3.0	3.3	3.4	3.7	0.5-4.8	27 June
Swan Hill	2.7	8.8	2.8	2.8	2.4	2.9	0.5-3.4	13 June

The agronomic features of Fathom make it favourable for the UEP; it has early maturity similar to Keel and Hindmarsh and a long coleoptile like Fleet which allows for better establishment on sandy soils or for deeper sowing. It has a semi-erect growth habit like Barque and vigorous early growth that makes it weed competitive. The plant height is medium-tall (similar to Fleet), good standability (equal to Hindmarsh) and better boron tolerance. Fathom is moderately resistant to all diseases except leaf rust, which is similar to the other varieties but much better than Keel, and is moderately susceptible to the Net Form of Net Blotch, but resistant to the race that attacks Maritime.

The next generation barley drought mapping populations have been run for the first year yield trials at Minnipa in 2012. There are 3 populations that segregate for drought tolerance traits; Fleet/Commander, Fleet/WI4304, and Commander/WI4304. These parents were chosen as they are varieties or elite breeding lines with different mechanisms of drought tolerance.

The aim is to evaluate these populations in low rainfall environments to identify the genetics of drought tolerance and will be evaluated in the field for a number of years, with parallel genotyping and genetic analysis occurring.

These populations have been grown at Minnipa, Roseworthy and Swan Hill. The trial details for these experiments are displayed in Table 3.

Table 3 shows that there were a range of site mean yields with Minnipa having the lowest at 1.2 t/ha with the parental lines and Hindmarsh variety yielding around the trial average. At all sites there were lines from the populations that were significantly higher yielding than the parents Fleet, Commander and WI4304. The higher yielding lines at Minnipa indicate that there are drought tolerance genes conferring higher yields that can be explored further. If an interesting gene is identified in any of these populations then introducing these genes into the next generation barley may be a possibility.

What does this mean?

The time frame from research to commercial release of a variety is 15 or more years, so what genetic research is invested in now determines the long term future yield gains. New technology is used to speed up research outputs, however there is still a lag to commercialisation just because of the nature of commercial testing and acceptance of a new variety into a market, especially a malting variety. Given this though, investment into today's knowledge is tomorrow's gain.

Acknowledgements

The authors wish to acknowledge the financial support of GRDC, Viterra and SAGIT.

Grains Research & Development Corporation

Wheat seed source and seed size effects on grain yield

RESEARCH

Shafiya Hussein[1] and Glenn McDonald[2]

[1]SARDI, Waite Campus, [2]University of Adelaide

Searching for Answers

Location:
Minnipa Agricultural Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2012 Total: 253 mm
2012 GSR: 185 mm
Yield
Potential: 1.65 t/ha (W)
Actual: 1.34 t/ha
Paddock History
2011: Scout barley
2010: Scout barley
2009: Pasture
Soil Type
Brown loam
Diseases
Crown rot
Yield Limiting Factors
Early finish and Crown rot

Key messages

- **Seed size was the most consistent seed trait that influenced growth and yield.**
- **Sowing larger seed increased plant establishment compared with medium size seed, increased early vigour and improved yield by 3%.**
- **Varieties with greater early vigour also tended to produce higher yields.**
- **Wheat seed source had no effect on plant density or percent plant establishment and had an inconsistent effect on yield.**

Why do the trial?

Good quality seed is an important foundation of productive crops. Seed quality relates to the size and mineral composition of seed. Large seed has a bigger embryo and provides more nutrients for early growth, which can lead to good establishment and vigorous growth. The source of seed is can also be important since location influences seed nutrient content. However, there have been mixed reports of the effects of these seed characteristics on wheat yield. This trial was conducted to examine the influence of seed size and seed source on growth and wheat yield. The trial was repeated at Minnipa and Turretfield, but the focus of the article will be on the results from Minnipa.

How was it done?

Seven wheat varieties (AGT Katana, Emu Rock, Estoc, Gladius, Mace, Magenta and Scout) were selected from the 2011 NVT trials from diverse locations across SA (Booleroo, Mitchellville, Nangari, Nunjikompita, Turretfield, Wanbi and Wolseley). Site selection was based on an analysis of grain of the variety Mace (Table 1) and aimed to identify sites with a range in grain protein, grain phosphorus (P) and trace elements.

The seed was sieved into large and medium size fractions, either greater than 2.8 mm diameter (47 g/1000 seeds) or 2.5 to 2.8 mm diameter (38 g/1000 seeds) and sown at the Minnipa Agricultural Centre. The trial was sown on 11 June at a rate of 150 plants/m^2 in plots 5 m x 6 rows (9.5 inch row spacing). Nitrogen, P and S were supplied as 63 kg/ha of 19:13:0:9. Measurements of plant establishment, early vigour (using a Greenseeker® on 6 and 27 August) and grain yield were made. The Normalized Difference Vegetation Index (NDVI) measurements were calibrated against biomass estimates from the border plots. Crown rot was present and the severity was estimated by assessing the number of white heads in each plot.

What happened?

Sowing larger seed increased the plant population from 117 to 127 plants/m^2. Scout and Estoc had the highest establishment, and Emu Rock and AGT Katana the lowest. A similar effect of seed size and variety was observed at Turretfield suggesting that the differences were directly associated with seed characteristics rather than conditions during germination and emergence. Seed source did not influence establishment.

Although the effects were small, large seed produced greater early growth and improved yields by 3% (Table 2). At Turretfield (mean yield = 3200 kg/ha) there was also a 3% yield increase from large seed. A yield increase of about 60 kg/ha would be required to cover the cost of grading (assuming grading costing $18/t and wheat at $295/t).

Seed source influenced growth and yield during the growing season but the response depended on seed size and variety. Table 3 shows an example for seed from Nunjikompita and Turretfield. Significant increase in yield from using large seed only occurred with seed from Nunjikompita and then only in the varieties Gladius and Scout.

Emu Rock produced the highest average yields and Gladius and Scout the lowest (Table 4). Gladius and Scout were the least vigorous varieties, while Emu Rock was relatively vigorous. The differences in grain yield among the varieties were positively correlated with the NDVI values measured on 27 August (r = 0.66, P = 0.10).

Table 1 Grain protein and nutrient concentrations of ungraded seed of Mace from the 7 seed sources used in the experiment

Seed source	GPC	P	S	Mn	Zn	Cu
	(%)	(mg/kg)				
Booleroo	12.9	2800	1650	49	15	4.6
Mitchellville	8.7	2700	1300	39	17	4.1
Nangari	9.3	2000	1430	35	12	4.1
Nunjikompita	10.8	2100	1440	37	15	4.7
Turretfield	13.0	3200	1620	47	16	5.0
Wanbi	10.6	3000	1380	33	11	1.4
Wolseley	11.6	3000	1610	36	29	4.5

Table 2 The average effect of seed size on plant number, early growth (assessed as NDVI) and grain yield at Minnipa in 2012. The estimated crop biomass (kg/ha) equivalent to the NDVI value is shown in brackets.

Seed Size	Plants/m^2	NDVI[A]		Grain yield (kg/ha)
		6 August	27 August	
Medium	117	0.291 (1370)	0.420 (1760)	1323
Large	127	0.308 (1420)	0.439 (1820)	1361
LSD (P=0.05)	*5*	*0.0045*	*0.0044*	*38*

[A] full canopy closure occurs when the NDVI is around 0.8

Table 3 The interaction effect of variety, seed source and seed size on grain yield at Minnipa in 2012

Variety	Seed Source	Grain yeild (kg/ha)		Yield change (kg/ha)
		Medium seed	Large Seed	
AGT Katana	Nunjikompita	1297	1375	78
	Turretfield	1275	1494	219
Emu Rock	Nunjikompita	1583	1690	107
	Turretfield	1653	1475	-178
Estoc	Nunjikompita	1260	1438	178
	Turretfield	1186	1435	249
Gladius	Nunjikompita	1019	1346	327
	Turretfield	1271	1123	-148
Mace	Nunjikompita	1404	1249	-155
	Turretfield	1364	1472	108
Magenta	Nunjikompita	1294	1327	33
	Turretfield	1420	1316	-104
Scout	Nunjikompita	940	1323	383
	Turretfield	1275	1442	167
LSD (P=0.05)	*Within the same Variety. Source combination 266* *Other comparisons: 272*			

Table 4 Mean grain yields of 7 wheat varieties grown at Minnipa in 2012. The estimated crop biomass (kg/ha) equivalent to the NDVI value is shown in brackets

Variety	NDVI		Grain yield (kg/ha)
	6 August	27 August	
Emu Rock	0.304 (1410)	0.455 (1870)	1542
Mace	0.303 (1410)	0.419 (1760)	1390
Magenta	0.312 (1440)	0.467 (1910)	1366
AGT Katana	0.293 (1380)	0.445 (1840)	1337
Estoc	0.300(1400)	0.407 (1720)	1318
Scout	0.292 (1370)	0.397 (1690)	1225
Gladius	0.297(1390)	0.417 (1750)	1218
LSD (P=0.05)	*0.0136*	*0.0259*	*75*

Gladius and Scout also had the higher severity of crown rot and Emu Rock the least, and there was a general negative relationship between the severity of crown rot and yield among the variety and seed size treatments ($r = -0.71$, $P<0.05$).

What does this mean?

Seed size was the trait that was most consistently associated with yields. Large seeds promoted better crop establishment, early crop vigour and yield. A similar effect was observed at Turretfield, suggesting plump grain may also be advantageous under more favorable seasons.

The work highlighted the importance of early vigour to yield, even in a year with a dry spring. Vigorous growth associated with large seed or with varieties promoted early growth and yield.

In this experiment, seed source did not have a consistent effect on yield. There was evidence that it may influence early vigour but the influence of site was also depended on the variety and seed size.

Maturity was an important influence on the yields of varieties in 2012. Emu Rock is an early season maturing wheat; its very large grain size and Minnipa's early dry finish provided a competitive edge over mid season varieties such as Gladius, Magenta, Scout and mid-late varieties such as Estoc and Mace.

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Efficiency of wheat and barley varieties in a P deficient soil

RESEARCH

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Searching for answers

Location:
Minnipa Agricultural Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2012 Total: 253 mm
2012 GSR: 185 mm
Yield
Potential:1.7 t/ha (W)
Paddock History
2011: Peas
2010: Wheat
2009: Wheat
Soil Type
Red sandy loam over light clay

Key messages

- **Even under dry seasonal conditions, wheat and barley responded strongly to P fertiliser.**
- **The yield response to P in barley was linear between 0 and 16 kg P/ha.**
- **Wheat showed a curvilinear response but the economic optimum was close to 16 kg P/ha.**
- **Although barley yielded more than wheat, the P use efficiency of wheat and barley were comparable.**
- **The DGT test for soil P was more sensitive to the spatial variation in soil P than Colwell P and was able to predict the optimum P rate for wheat.**
- **Even in the relative small area of the experiments, DGT P varied 7-fold, highlighting the importance of appropriate sampling to achieve reliable results for soil tests.**

Why do the trial?

The imperative for efficient use of phosphorus (P) in broad acre agriculture has been highlighted recently due to concerns about the finite amount of P fertiliser resources and the likelihood of increased fertiliser prices contributing to greater production costs in the future. Maximising yields on the basis of providing adequate P nutrition can be achieved by applying sufficient amounts of P fertiliser on soils where P is limited. The overall contribution to P uptake of the P fertiliser is small (5-30%) and therefore the rest of the crop's P requirements needs to be supplied from existing soil P reserves. Wheat and barley are the two major crops grown in southern Australia but the phosphorus use efficiency (PUE) of specific varieties of each is relatively unknown. McDonald *et al.* (EPFS Summary 2011, p 127) reported results on the overall response of wheat and barley varieties to an application of P, but efficiency in terms of amounts of P required to maximise yields wasn't assessed due to a single addition of P. Information relating to both the overall response of each variety to P application and actual fertiliser P requirements of each variety would be invaluable.

How was it done?

Two replicated field trials (wheat and barley) were established at Minnipa Agricultural Centre in the Airport paddock. The DGT test for available P indicates the soil to be P deficient (20 μg/L, critical – 50 μg/L) but the Colwell P test did not indicate deficiency (28 mg/kg, PBI – 82, critical Colwell P – 26 mg/kg).

Six varieties of wheat and barley (Table 1) were sown at 5 rates of P: 0, 2, 4, 8 and 16 kg P/ha. The varieties sown were selected from a range of current commercial varieties and some old varieties that have been reported to show differences in P responses. The P was applied as triple superphosphate, drilled with the seed at sowing. Early crop growth was assessed by taking a biomass sample on 26 August when the plants were at early stem elongation. At the same time, a soil sample was taken from between the rows in each plot to measure Colwell P and DGT P.

The PUE is defined as the yield at zero P (0P) relative to the maximum yield. The P requirement was assessed by fitting a curve through the yield response data and estimating the P rate that gave 95% maximum yield. The economic optimum P rate for wheat (i.e. when the marginal return = costs of the additional P) was calculated based on a price of wheat (H1-H2) of $293/t, and a fertilizer price of $650/t (MAP).

What happened?

The DGT test was more sensitive to the spatial variation in topsoil P in both experiments and the variation in DGT values was about twice that of Colwell P (Table 1).

Responses to P applications were obtained in biomass production and in grain yield. There was no significant difference in the yields among the wheat and barley varieties, nor was there a Variety by P interaction. In other words, for both wheat and barley the yield differences among the 6 varieties were too small to pick up significant differences in their responsiveness to P. Therefore only the average responses in wheat and barley are considered.

Barley yielded more than wheat and but had a similar PUE (Table 2). The yield advantage of barley tended to be greater at the lower P rates.

Table 1 Comparison of the spatial variation in Colwell P and DGT P in the wheat and barley trials, MAC 2012. The mean and the range in values and the coefficient of variation (CV) are shown

Crop	Colwell P (mg/kg)		DGT (µg/L)	
	Mean	CV (%)	Mean	CV (%)
Wheat (Correll, Gladius, Mace, RAC875, Scout, Wyalkatchem)	25.1 (16-45)	19	18.8 (6-43)	39
Barley (Barque73, Commander, Fleet, Galleon, Hindmarcsh, Yarra)	30.1 (17-50)	22	21.3 (10-67)	44

Table 2 The mean grain yield (t/ha) and the PUE of wheat and barley at Minnipa in 2012 and the yield of barley relative to that of wheat at each P rate

Crop	P rate (kg P/ha)					PUE (%)
	0	2	4	8	16	
Wheat	1.91	1.97	2.12	2.20	2.37	80
Barley	2.12	2.20	2.17	2.33	2.55	83
Relative yield (%)	111	112	102	106	107	

Overall, growth and yield responded up to the highest rate of P and there was little evidence of a plateau in growth and yield. The average responses (Figure 1) show that the yield response to P was lower than the response in early biomass, especially in wheat, and that barley was more P efficient than wheat in this experiment because its relative biomass production and yield at 0P was greater than wheat.

Wheat showed a linear response to P in early biomass production and an optimum P rate was not detected. The optimum P rate for early biomass production in barley was more than 16 kg P/ha. At maturity the P rate in wheat that produced 95% of the maximum yield was 17 kg P/ha, while the response in barley was linear. From the wheat DGT database, the predicted relative yield for this site was 67% with a required P rate of 17 kg P/ha. The economic optimum rate was estimated to be 15-18 kg P/ha.

What does this mean?

The DGT test was more sensitive to the spatial variation in soil P and was better able to predict the P response at the site than Colwell P.

Intensive sampling of both trials demonstrated the large degree of spatial variation that can occur, with a 7-fold difference in DGT P in both the wheat and barley trials. This highlights the importance of appropriate sampling methods to provide a representative sample for soil analysis.

There was a strong response to P and the yields did not plateau. Highest yields were achieved at the highest rate of P. The observation that the economic optimum P rate for wheat was close to the highest rate of P used suggests that under fertilisation with P may be a false economy in a highly responsive soil.

On average wheat and barley showed similar levels of P efficiency. This agrees with past work that has indicated that there is more variation among varieties of wheat and barley than there is between wheat and barley.

The extended periods of dry conditions in 2012 would have restricted the movement of P through the soil to the roots by diffusion and this may have contributed to the strong response to P.

Acknowledgements

The experiments were run with the financial support of SAGIT (UA1201).

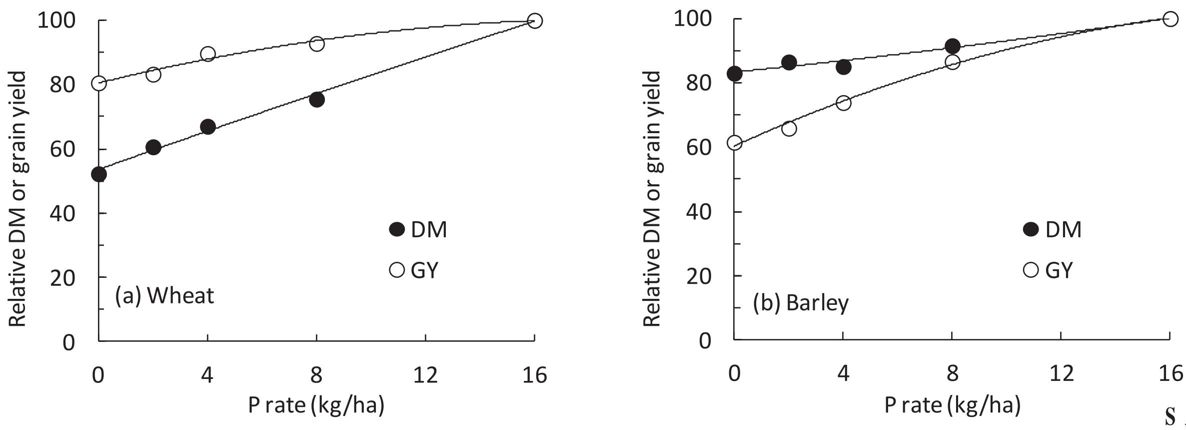

Figure 1 The average responses to P in (a) wheat and (b) barley for crop dry matter at stem elongation and for grain yield. The data is shown as a relative response (expressed as %) where biomass or yield at 16 kg P/ha =100%

Protein achievement and grain yield in new wheat varieties

James Edwards, Haydn Kuchel and the AGT Roseworthy breeding team
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RESEARCH

Key messages

- **High yielding wheat varieties that have recently been adopted by growers in South Australia are better at accumulating protein than older, lower yielding varieties.**
- **Although new varieties produce more protein per hectare, their higher yield means that grain protein content (expressed as a % of grain weight) is actually lower.**
- **As growers are paid more for grain yield than protein content, the newer wheat varieties have been, on average, a higher gross margin option.**
- **Mace seems to respond very positively to N application, perhaps providing growers the option to improve their profits by increasing N supply to the crop.**

Why do the trial?

With the adoption of new high yielding wheat varieties, farmers have been reporting lower grain protein percentage when compared to older varieties that have previously been grown. This research was conducted to find out how big this difference in protein percentage is, what financial impact it has, and help growers maximise the return on nitrogen (N) application.

Why is this important?

Slipping just one grade from AH2 to APW over the past 10 years would have cost growers an average $16/t or 6% of their gross income. However, new varieties are also higher yielding, leading to an increase in income. So we need to know how growers can best manipulate N inputs to manage both grain yield and grain protein in these new varieties. To do this, it is important that we understand if the underlying cause of this reduction in grain protein content is due to a change in the genetics of the new varieties, or can also be manipulated through interactions with management practices.

How was it done?

The quantity of protein in wheat grain is largely determined by N (a key constituent of protein) supply and availability to the plant. Within the plant there are actually 3 components that drive grain protein percentage; (1) the plant's ability to uptake N (2) the plant's ability to remobilise N from its vegetative tissues and store it in the grain (3) the ratio of starch to N that is finally loaded into the grain. For example, in drought stressed environments, starch deposition is much slower than protein formation, which leads to an increase in the percentage of the grain which is made of protein. The opposite is also true in seasons and locations that experience a more favourable finish to the season. To investigate the N use efficiency (NUE) and N response of South Australian wheat varieties, two sets of data were used. Firstly, the National Variety Trials (NVT) grain yield and protein data from 2008-2011, and secondly, a set of NUE trials conducted by AGT.

NVT grain yield and protein data

A study was also performed using grain yield and grain protein percentage from 2009-2011 NVT data in South Australia. Trials affected by severe rust infection were removed from the dataset prior to the analysis. The average grain yield, grain protein, screenings and hectolitre weights (HLW) were calculated for varieties that were present in all of the South Australian NVT trials during the 2009-2011 period.

AGT NUE trials

Eight NUE field experiments were run by AGT from 2009-2012. These experiments included between 24 and 37 entries that consisted of important varieties and advanced breeder's lines, with a core group of 8 varieties common to each experiment. The experiments had 3 replicates and either 3 (16, 39, 85 kg N/ha) or 4 (16, 39, 62, 85 kg N/ha) N treatments. The N was applied in furrow at seeding time with an additional 42 kg N/ha of N applied, prior to the initiation of stem elongation, to all treatments in 2 of the experiments which had sufficient moisture available. All other aspects of experimental management followed local best practice. Experiments were run at Cummins, Rudall, Mintaro, Pinnaroo and Roseworthy.

What happened?

Highest yielding = lowest protein (The NVT story)

Figure 1 illustrates that varieties with the highest average grain yields also had the lowest grain protein contents. Conversely, varieties with the lowest grain yield achieved the highest grain protein. This result strongly supports the hypothesis that N supply had not been sufficient to ensure that grain protein content was maintained for the higher yielding varieties.

Rather, for these elite varieties, protein content was diluted by higher levels of starch deposition during grain fill. This hypothesis can be confirmed further by comparing the protein yields (kg/ha of protein) of each of the varieties. The protein yield of each variety can be calculated by multiplying the grain yield of each variety by its corresponding protein percentage (Figure 2).

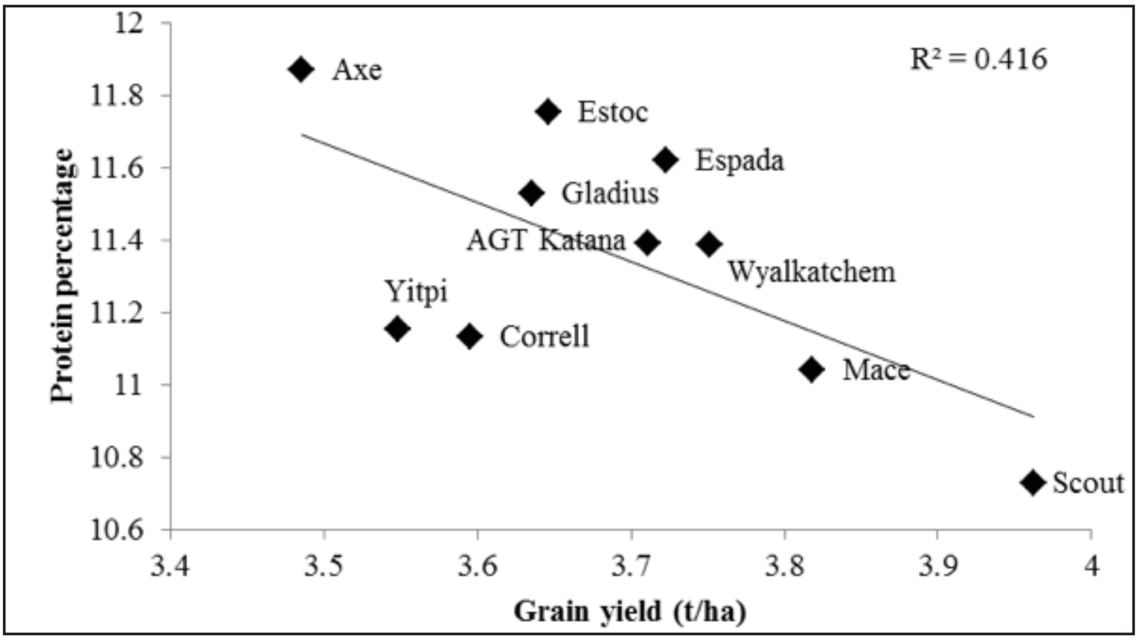

Figure 1 The average grain yield plotted against the average grain protein of varieties present in all South Australian NVT trials during the 2009-2011 period

This figure allows us to more fairly compare the relative NUE of each variety. The question; "which, if any, varieties extract and mobilise N more effectively and therefore provide growers with greater overall protein production?" can then be answered. It was found that the majority of the varieties from this trial performed within a narrow range of just 15 kg/ha of protein, except for Correll and Yitpi that were both low yielding and low protein.

Are these varieties responsive to N?

With the NVT data it can be concluded that most varieties produce a similar amount of grain protein per hectare, but that higher yielding varieties are usually the most profitable because growers are paid more for total grain production rather than grain protein percentage. However, an important question still remains. Do new elite yielding varieties respond differently to N application, and can growers use this to their advantage?

The average N response in the 8 NUE experiments is illustrated by Figure 3. In these experiments that AGT has run in SA over the last 4 years, grain yield respond to N application was observed 6 times and in 5 of these experiments, the response was positive. However, at Pinnaroo in the dry season of 2012, increased N application actually lead to a reduction in grain yield.

On average across the 8 experiments, grain yield increased by 2.6 kg/ha for every kg of N applied above the lowest rate (16 kg/ha). This response is only half that required to be economic, if one kg of N costs $1.30 (Urea $600/t) and one kg of wheat is worth $2.52 (long term APW price $252/t) a response of 5.2 kg/ha for every kg of N applied is required to breakeven for the cost of N alone, without the cost of application.

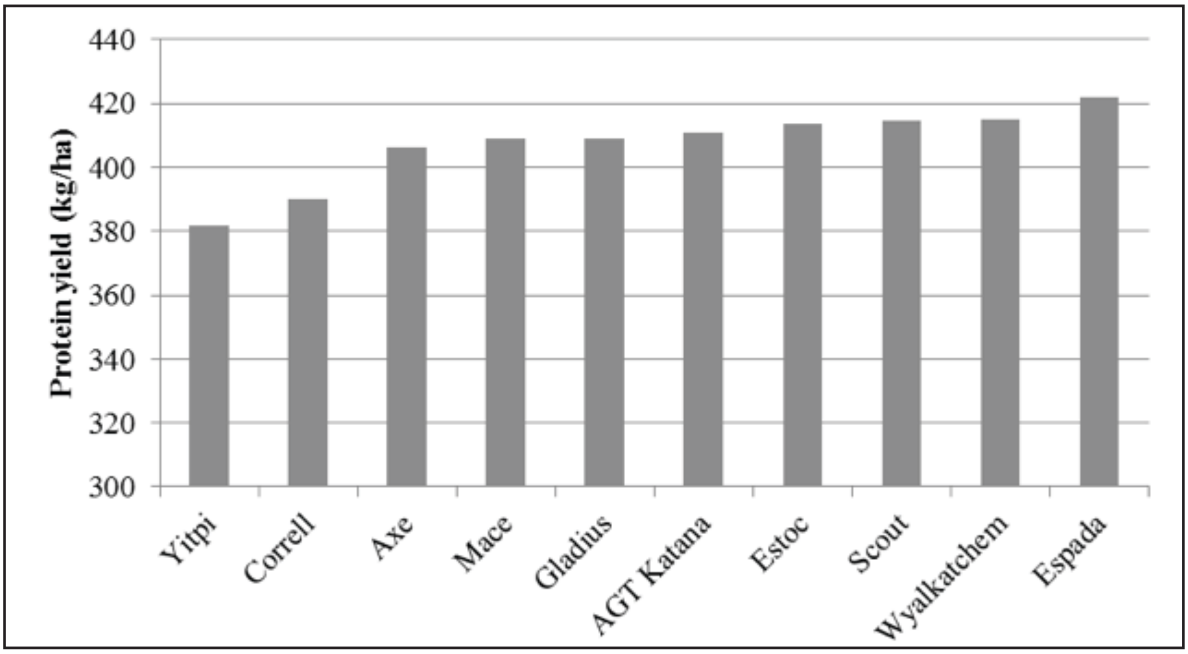

Figure 2 The average protein yield of 10 varieties present in all South Australian NVT trials during the 2009-2011 period

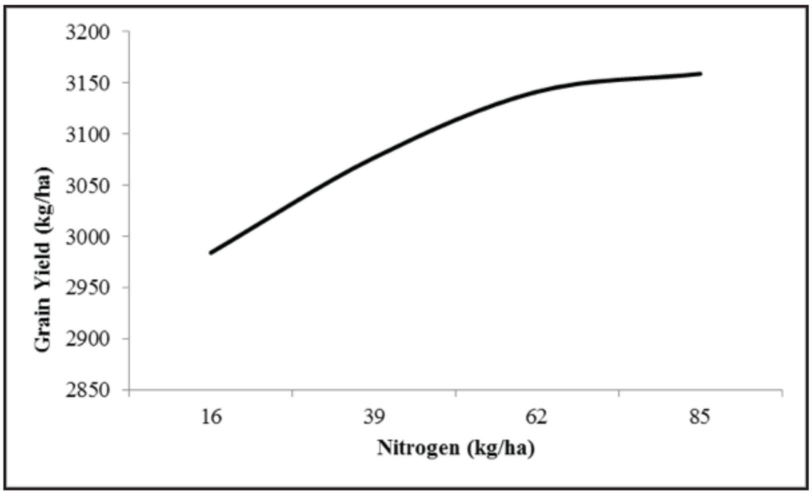

Figure 3 The average N response in the 8 NUE experiments

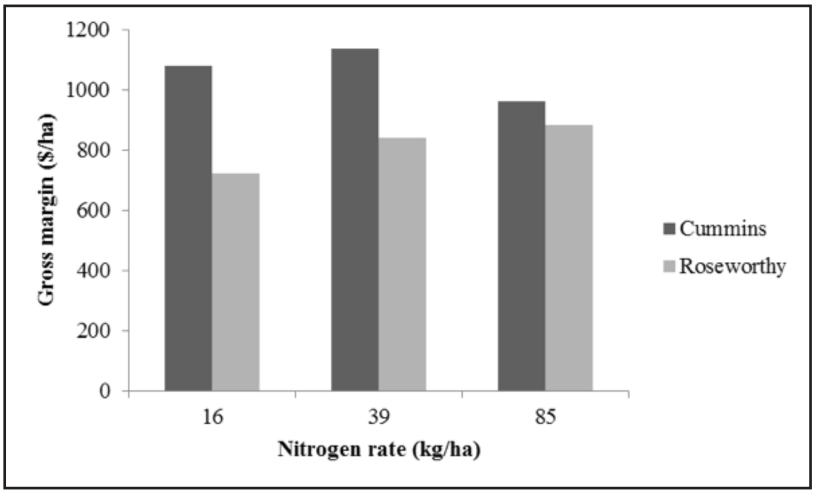

Figure 4 The gross margins achieved by Mace, when grown under 3 different N regimes at Cummins and Roseworthy

Interestingly, across these 6 experiments, varieties only differed in their grain yield response to N application at 3 sites; Pinaroo in 2009, Mintaro in 2010 and Roseworthy in 2011. When these sites were then reanalysed as one dataset, N response was consistent across sites. This demonstrates that the response to N is entirely due to the inherent genetic response of the varieties and not the location effect.

At the 3 sites where varieties differed in their response to N,

Mace had the greatest response to N with a grain yield increase of 7.5 kg/ha for every kg of N applied, while Yitpi's response was the poorest at 6.9 kg/ha for every kg of N applied. Mace's response to N was also more linear than Yitpi's which tended to plateau off at higher rates of N application. In other words, even with the addition of more N, Mace maintains its NUE, while the other varieties become less efficient at N as more N is applied. When protein, grain size, test weight and black point were used to calculate relative return on N application in 2011, Mace's return (adjusted for the cost of N application) tended to be maximised at the moderate (Cummins) or high (Roseworthy) rates of N application (Figure 4).

What impact does N have on grain size, screenings and Hectolitre Weight (HLW)?

Although increased N application generally increases grain yields there are potential negative implications for physical grain quality that need to be considered. Increased N application reduced thousand grain weights in all 8 experiments with significant interactions between variety and N treatments in 7 of the experiments. Although this impact on grain size appears to be very strong, the percentage of screenings, which is the receival standard at the silo, only increased as a consequence of N application at 3 of the experiments. Increased N application reduced HLW in three and increased HLW in one experiment, respectively. There were significant interactions between variety and N treatments for HLW in 4 experiments.

What does this mean?

- Claims of 'high protein achievement' should be treated with caution by growers – high grain protein concentration (%) is usually associated with lower grain yield achievement and therefore lower financial returns.
- Although it can be disappointing to miss out on higher quality grades due to lower protein concentration, growing higher yielding varieties has been shown on average to increase return through higher productivity.
- Other receival standards such as screenings loss, black point and sprouting susceptibility, as well as test weight are probably more important than protein concentration to take into consideration when selecting wheat varieties.
- Some wheat varieties, such as Mace, do seem to respond more strongly to N application, suggesting that growers may be able to apply greater N to these varieties as a way to extract greater returns.

Acknowledgements

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The environmental drivers of high screenings and low hectolitre weight

James Edwards and Haydn Kuchel

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Key messages

- **This study has identified some regions, such as Agzone 1 in WA, the upper Eyre Peninsula in SA and the Wimmera in Victoria, are more likely to suffer from high screenings than others, such as the lower Eyre Peninsula or the York Peninsula.**
- **Over the 3 years of the study, low hectolitre weight appeared to be more consistently related to the region, rather than the variety, with Agzone 1 suffering the lowest and the Eyre Peninsula the highest hectolitre weights.**
- **Of the environmental characteristics studied, high temperatures and growing season rainfall had the biggest effect on screenings and hectolitre weight, respectively.**
- **Varieties with a genetic predisposition to either low hectolitre weights or high screenings loss were more affected by stressful growing conditions than their superior physical grain quality counter parts.**

Why do the trial?

Grain size and shape related defects can be devastating to farm profitability. Slipping from AH1 to GP over the 3 years of this study cost growers an average $71/t. With cliff face pricing, this may have occurred simply because a load of wheat had 6% rather than 5% screenings, or a hectolitre of 73 kg/hL rather than 74 kg/hL. In real terms, this represents a 24% reduction in income for a single unit change in grain size or shape. Therefore, as a key determinant of on-farm profitability, receival characteristics such as screening loss (ScrnL) and low hectolitre weight (LoHLW) are an important target for manipulation through both breeding and agronomic improvement.

Consequently, growers have adopted agronomic strategies that reduce the likelihood of downgrading at receival through high ScrnL or LoHLW. Adjusting seeding rate, timing and quantity of fertiliser application and sowing rate along with variety selection are all strategies that can be used to reduce ScrnL and maximize HLW. Although selection of varieties with large grain and good hectolitre weight is a successful risk minimisation strategy, for other unrelated reasons (i.e. disease resistance, quality classification, yield performance) this is not always feasible. Additionally, it is likely that the minimum receival standards for HLW will increase from 74 kg/hL to 76 kg/hL in the near future, increasing the frequency of downgrading at point of delivery. Consequently, whilst the development of varieties with improved HLW and ScrnL is paramount, there is also a need to better understand the environmental drivers of ScrnL and LoHLW and the regional risks of growing varieties with a propensity for lower HLW or higher ScrnL.

How was it done?

A desktop study was performed using physical grain quality data (screenings over a 2 mm sieve and HLW) from the 2008 to 2010 National Variety Trials (NVT) in Western Australia, South Australia and Victoria. Environmental characterisation data was derived from Bureau of Meteorology records for each trial. Trials determined, from the performance of a selection of probe genotypes, to be affected by severe rust infection were removed from the dataset prior to the analysis.

In total 258 location-year combinations were used to investigate the environmental impacts on screenings and 253 for HLW. Each environment was classified with respect to 13 variables relating to rainfall, temperature and radiation during 4 growth stages: vegetative, flowering, grain fill and ripening. The average screenings and HLW, plus averages for 5 different subgroups of probe genotypes, with specific tendency for high or low screenings and HLW, were also calculated for each trial (Table 1).

What happened?

Regional risks of growing varieties with poor physical grain quality

As expected, physical grain quality (PGQ) was affected by both regional and seasonal variation in growing conditions. For HLW, the NVT region had the single largest effect (23% of between trial variation), and the year effect was the smallest (3.1% of between trial variation). The relative importance of the sources of variation was very similar for the 3 HLW groups (HLW, LoHLW and HiHLW), suggesting that the drivers of HLW are likely to be similar regardless of the variety being grown. A similar observation was made for the ScrnL groups, although region did not explain as much of the variation between sites for the Janz related lines as for the other ScrnL groups.

Over the 3 years of this study, WA Agzone1 achieved the lowest average HLW and second highest ScrnL. Interestingly, the upper Eyre Peninsula in SA achieved the highest average HLW, but suffered from a relatively high ScrnL (Table 2). Overall, the environmental correlation between HLW and ScrnL was 12%, indicating that although they respond to some similar environmental variables, they need to be considered as independent PGQ attributes.

Of particular interest in this study, is the response of genotypes with known PGQ problems. We asked the question: do these lines respond to environmental stresses differently than lines known to be superior for PGQ? This study showed that for both HLW and ScrnL, lines with poor PGQ are likely to be relatively worse than their superior PGQ counterparts at sites where average PGQ is poor. In other words, where ScrnL is already high, varieties carrying the Cre1 gene or derived from Janz suffered their worst relative ScrnL. This genetics by environment (GxE) pattern is often described as a scale effect and highlights the importance of variety selection. The relationship for HLW was not as strong as that observed for ScrnL. Although LoHLW lines performed relatively worse at sites where the average HLW was low, other factors appear to be acting on these lines as compared to their higher HLW counterparts.

Table 1 A description of the physical grain quality attributes assessed for each of the NVT sites

Quality Attribute	Description
HLW	The average hectolitre weight of varieties in the trial
LoHLW	The average hectolitre weight of varieties with a known tendency for low hectolitre weight (Axe, Correll, Espada, Gladius, Westonia)
HiHLW	The average hectolitre weight of varieties with a known tendency for high hectolitre weight (AGT Katana, Frame, Wyalkatchem, Yitpi)
ScrnL	The average screenings loss of varieties in the trial
LoScrnL	The average screenings loss of varieties with a known tendency for low screenings loss (Frame, Yitpi, Wyalkatchem)
Cre1ScrnL	The average screening loss of varieties that carry Cre1 (a CCN resistance gene linked to small grain) (Annuello, Bullet, Derrimut, Guardian, Peak)
JnzScrnL	The average screening loss of varieties with small grain derived from Janz (Janz, CF JNZ, Carinya)

Table 2 The average HLW and ScrnL performance at NVT regions in WA, SA and Vic from 2008 to 2010

State	Region	HLW	ScrnL
WA	Agzone1	73.2	8.1
WA	Agzone2	76.2	4.4
WA	Agzone3	75.8	2.7
WA	Agzone4	74.2	8.4
WA	Agzone5	76.2	2.5
WA	Agzone6	74.2	2.0
SA	Lower EP	79.3	2.4
SA	Mallee	78.5	1.5
SA	Mid North	76.7	2.9
SA	South East	76.4	4.4
SA	Upper EP	79.3	4.1
SA	Yorke Peninsula	78.6	2.1
Vic	Murray Mallee	77.7	4.5
Vic	North Central	75.6	1.5
Vic	North East	75.4	1.5
Vic	Wimmera	73.5	5.6

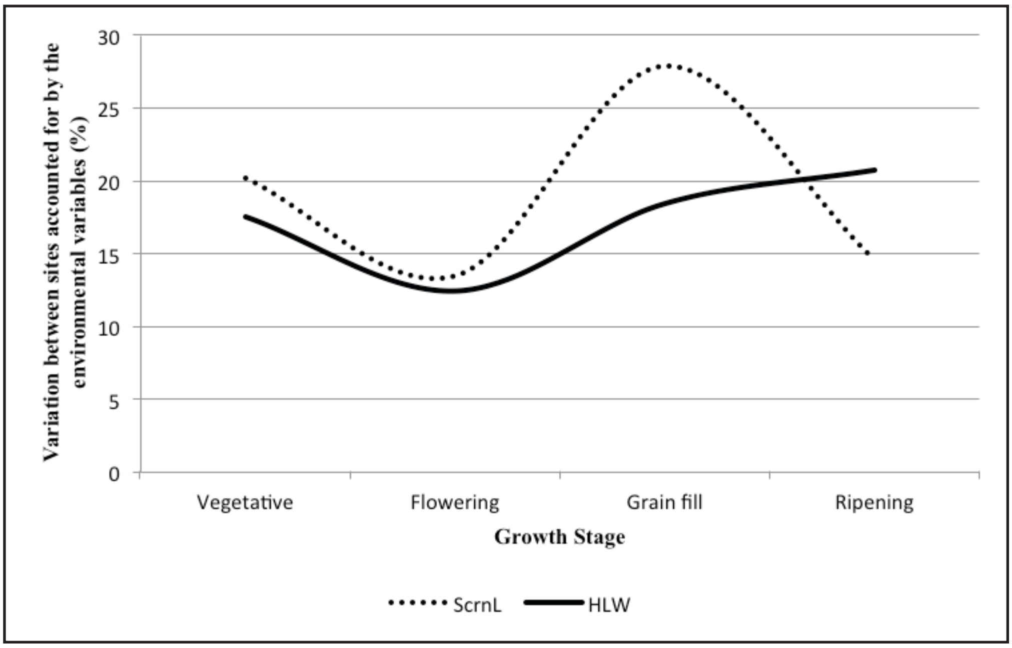

Figure 1 The contribution of environmental variables to HLW and ScrnL during the wheat life cycle

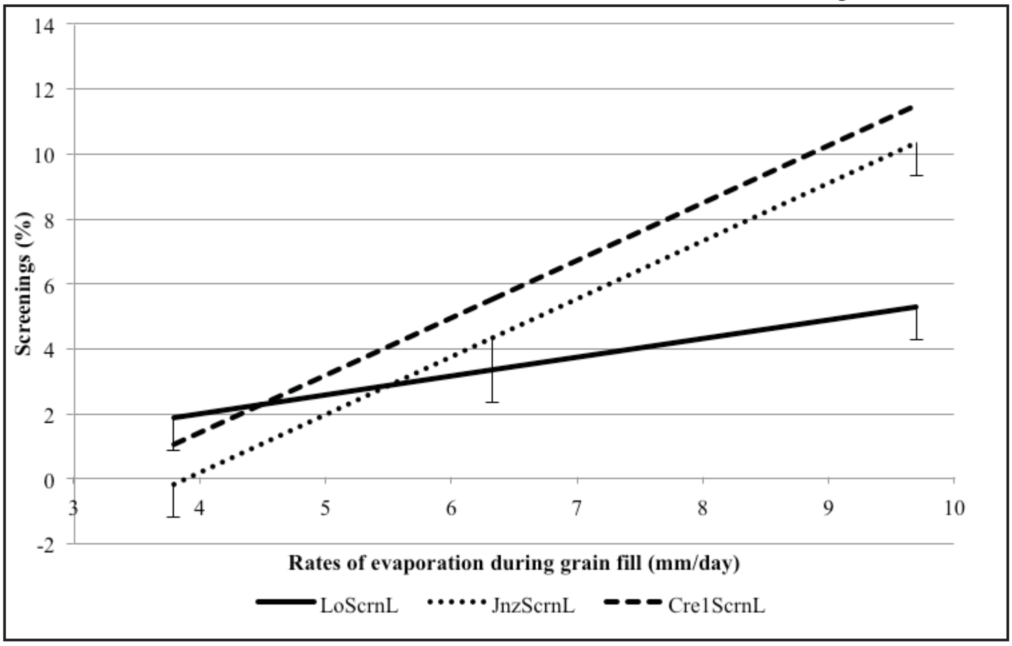

Figure 2 The differential response of genotypes to evaporation rates during grain fill

Environmental variables exert their influence on physical grain quality over the whole wheat life cycle

Significant relationships were observed between PGQ and temperature, light and rainfall related environmental variables (EVs) at each of the 4 growth stages. The significant EVs during grain fill explained nearly 30% of the variance between sites for ScrnL (Figure 1).

In the Mediterranean environment of southern Australia where yield potential, established during wet winters is rarely met during dry springs, it is not surprising that the conditions during grain fill are critical to determining grain size and therefore ScrnL. Interestingly, it is not rainfall that drove ScrnL during grain fill in this dataset; it was the number of hot days experienced at each site, vapour pressure deficit and diffuse radiation. For every day over 30°C during grain fill, the proportion of grain less than 2 mm increased by 0.6%. So the difference between making AH and GP could be just two hot days! Although the effect of the rainfall related EVs during each growth stage was less than the temperature related terms, more than 11% of the difference between ScrnL at sites could be explained by the ratio between reproductive and vegetative rainfall. When vegetative (corresponding approximately to winter) rainfall is proportionally greater than reproductive (spring) rainfall, the ScrnL at a site increases.

The story for HLW was similar to ScrnL. However, grain ripening was the most critical stage for the relationship between EVs and site HLW performance (Figure 1). The average evaporation and the sum of the thermal time explained over 20% of the variation observed for HLW, between sites. The number of hot days experienced at a site over flowering actually increased HLW, whereas over the ripening period it led to a slight decrease in HLW.

Varieties with higher inherent screenings loss have a larger response to environmental variables

A comparison of the responses of the subgroups for ScrnL showed that genotypes derived from Janz, or genotypes with the Cre1 CCN resistance gene had a much greater response to the level of evaporation at a site during grain fill (Figure 2).

During flowering, genotypes with the Cre1 CCN resistance gene also suffered a greater increase in ScrnL than the LoScrnL and JanzScrnL groups as the average maximum temperature increased. During the vegetative and ripening growth stages, there was no difference in the response of the genotypic subgroups. For HLW there were no significant differences in the response of the LoHLW and HiHLW groups to the EVs.

What does this mean?

- Small changes in the inherent PGQ of a wheat variety can have a big impact on on-farm profitability.
- Not surprisingly, growing conditions during grain fill have the largest impact on PGQ, although the impacts of these conditions on PGQ are not the same for all wheat varieties.
- The largest driver of ScrnL during grain fill was the number of hot days (>30°C).
- Some regions are more prone to down grading through screenings loss or low HLW. In particular Agzones 1, 2 and 4 in WA and intriguingly the South East of SA and Victorian Wimmera suffer from either elevated screenings loss or low HLW.
- At sites where HLW is low, the difference between high and low HLW wheat varieties is greatest; increasing the relative risk of growing a variety with inherently low HLW.
- Varieties derived from Janz, and those carrying the Cre1 CCN resistance gene, had a greater negative response to high evaporation rates during grain fill than varieties with inherently low screenings loss.

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A more comprehensive version of this article is available at: www.ausgraintech.com

Section

2

Section Editor:
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Break Crops

Break Crops

The 2012 production figures for Western Eyre Peninsula were approximately 2,500 t peas, 720 t lupins, 40 t vetch, 2,550 t canola. Eastern Eyre Peninsula produced approximately 3,000 t peas, 3,000 t lupins, 100 t beans, 100 t chickpeas, 200 t vetch and 4,620 t canola. Lower Eyre Peninsula produced approximately 6,050 t peas, 28,730 t lupins, 8,400 t beans, 200 t chickpeas, 2,400 t lentils, 500 t vetch and 87,000 t canola.
[PIRSA Crop & Pasture Report SA, January 2013]

Field pea variety trial yield performance 2012
(as a % of site mean) and long term (2005-2012) average across sites (as % of site mean)

	Lower Eyre Peninsula				Upper Eyre Peninsula		
Variety/Line	**2012**		**2005-2012**		**2012**	**2005-2012**	
	Lock	**Yeelanna**	**% Site mean**	**Trial #**	**Minnipa**	**% Site Mean**	**Trial #**
Kaspa	100	99	96	15	104	103	7
Parafield	93	98	94	15	93	96	7
PBA Gunyah	96	99	99	13	106	102	6
PBA Oura	104	102	104	12	101	104	7
PBA Pearl	108	110	111	8	107	108	4
PBA Percy	99	94	102	6	108	104	5
PBA Twilight	87	94	96	12	104	102	6
Sturt	-	-	102	7	111	107	7
Yarrum	-	-	97	13	92	103	7
OZP0805	98	89	99	10	98	101	4
OZP1103**	96	97	97	2	90	97	2
Site mean yield (t/ha)	**1.92**	**2.87**	**1.86**		**1.53**	**1.65**	
LSD (P=0.05) as %	*12*	*12*			*16*		
Date sown	29 May	1 June			27 April		
Soil type	SL	CL			L		
Previous crop	wheat	barley			barley		
Rainfall (mm) J-M/A-O	22/177	55/223			63/185		
pH (water)	7.7	8.3			8.6		
Site stress factors	de,dl,w				dl,ht		

** = Dual purpose type
Soil Types: S=sand, C=Clay, L=loam
Site stress factors: de=pre flowering moisture stress, dl=post flowering moisture stress, ht=high temperatures during flowering/pod fill, w=weed competition

Data source: *SARDI/GRDC, PBA & NVT (long term data based on weighted analysis of sites and courtesy National Statistics Program).*

EP Faba bean variety trial yield performance 2012

2012 and predicted regional performance, expressed as % of site average yield

Variety	Lower Eyre Peninsula				Upper Eyre Peninsula			
	2012	Long term average across sites			2012	Long term average across sites		
	Cockaleechie	t/ha	% Site Mean	# Trials	Lock	t/ha	% Site Mean	# Trials
Farah	92	2.34	99	11	101	1.68	99	4
Fiesta	102	2.39	100	11	99	1.68	99	4
Fiord	97	2.33	98	10	-	1.50	88	2
Nura	100	2.35	99	11	93	1.62	95	4
PBA Rana	89	2.20	92	8	98	1.54	91	2
Site av. yield (t/ha)	**2.70**	**2.38**			**1.86**	**1.70**		
LSD (P=0.05) as %	*12*							
Date sown	17 May				28 May			
Soil type	SL				SL			
pH (water)	8.3				7.7			
Apr - Oct rain (mm)	223				177			
Site stress factors								

Soil Types: S=sand, L=loam

Data source: SARDI/GRDC, NVT and PBA - Australian Faba Bean Breeding Program.

2006-2012 MET data analysis by National Statistics Program

EP Lupin variety trial yield performance 2012

2012 and predicted regional performance, expressed as % of site average yield

Variety	Lower Eyre Peninsula					Upper Eyre Peninsula			
	2012		Long term average across sites			2012	Long term average across sites		
	Wanilla	Ungarra	t/ha	% of Site Mean	# Trials	Tooligie	t/ha	% of Site Mean	# Trials
Jenabillup	95	105	2.08	105	13	104	1.71	104	6
Jindalee	84	75	1.72	87	16	77	1.49	90	7
Mandelup	97	97	2.05	104	16	96	1.67	101	7
PBA Gunyidi	99	99	2.04	103	9	103	1.69	102	5
Wonga	86	93	1.88	95	15	96	1.59	96	7
Site av. yield (t/ha)	**2.61**	**1.90**	**1.98**			**0.93**	**1.65**		
LSD (P=0.05) as %	*7*	*11*				*14*			
Date sown	8 May	7 May				25 May			
Soil type	S	SL				SL			
pH (water)	5.7	5.7				6.2			
Apr - Oct rain (mm)	391	250				177			
Site stress factors									

Soil types: S=sand, L = Loam

Data source: SARDI/GRDC & NVT

2006 - 2012 MET data analysis by National Statistics Program

EP Desi & Kabuli chickpea variety trial yield performance 2012

(as a % of site mean) and long term (2005-2012) average across sites (as a % of site mean)

Variety	LOWER EYRE PENINSULA			UPPER EYRE PENINSULA		
	2012	2005-2012		2005	2005-2012	
	Yeelanna	% Site mean	Trial #	Lock	% Site mean	Trial #
Desi trials						
Ambar					103	3*
Genesis 509		92	5		87	4
Genesis 079#	107	102	5	103	99	5
Genesis 090#	118	95	7	104	87	6
Howzat		98	5		92	3*
Neelam	100			105	106	3*
PBA Boundary						
PBA HatTrick		92	4		86	4
PBA Slasher	114	103	7	106	104	6
PBA Striker	87	105	6	105	109	5
CICA0717	93	103	5	103	105	5
Site mean yield (t/ha)	**1.25**	**1.80**		**1.52**	**1.88**	
LSD % (P=0.05)	*14.4*			*11.8*		
Kabuli trials						
Almaz	105	92	7			
Genesis 079#	84	115	7			
Genesis 090#	96	108	7			
Genesis 114	86	89	7			
Genesis Kalkee	101	91	3*			
CICA0859	100	105	3*			
Site mean yield (t/ha)	**1.17**	**1.33**				
LSD % (P=0.05)	*15.4*					
Date sown	1 June			29 May		
Soil Type	CL			SL		
Rainfall (mm) J-M/A-O	55/223			22/177		
pH (H_2O)	8.3			7.7		
Previous Crop	Wheat			Wheat		
Site stress factors	hdS, dl			de,dl,w		

 # Small kabuli type

Soil type: S=sand, C=clay, L = loam

Site stress factors: dl=post flowering moisure stress, w=weed competition, de=pre flowering moisture stress, hdS=herbicide *damage (simazine)*

Data source: SARDI/GRDC, PBA & NVT (long term data based on weighted analysis of sites and courtesy National Statistics Program).

**Varieties have only had limited evaluation at these sites, treat results with caution*

EP Lentil variety trial yield performance 2012

(as % of site mean yield) and long term (2005-2012) average across sites (as a % of site mean)

Variety	LOWER EYRE PENINSULA		
	2012	2005 - 2012	
	Yeelanna	% site mean	Trial #
Aldinga		90	6
Boomer		100	6
Nipper	95	96	8
Northfield		85	7
Nugget	111	96	8
PBA Ace (CIPAL803)	98	107	5
PBA Blitz	113	103	6
PBA Bolt (CIPAL801)	96	103	4
PBA Bounty		100	7
PBA Flash	99	104	8
PBA Herald XT	68	89	4
PBA Jumbo	84	102	7
CIPAL1101	88		
Site mean yield (t/ha)	**1.86**	**1.53**	
LSD % (P=0.05)	*13.4*		
Date sown	1 June		
Soil Type	CL		
Rainfall (mm) J-O/A-O	55/223		
pH ($H_2$0)	8.3		
Previous Crop	Wheat		
Site stress factors	dl		

Soil type: C=clay, L=loam

Site stress factors: dl = post flowering moisture stress

**Varieties have only had limited evaluation at these sites, treat results with caution*

Data source: SARDI/GRDC, PBA & NVT (long term data based on weighted analysis of sites and courtesy National Statistics Program)

EP and Mallee canola variety trial yield performance

(2012 performance expressed as % of site average yield)

Varieties	Lower Eyre Peninsula		Upper Eyre Peninsula			Murray Mallee	
	2012		2012			2012	
	Mt Hope	Yeelanna	Tooligie	Minnipa	Mt Cooper	Lameroo	Group
AV Garnet	99	104	106			115	Conventional
AV Zircon	97	96	68			93	
CB Agamax	105	95	113			108	
CB Tango C	96	86	116			104	
Hyola 50	103	93	110	No valid results	No valid results	110	
SARDI515M	-	-	88			70	
Victory V3001	-	-	-				
Victory V3002	-	-	-				
Victory V3003	-	-	-				
Site Av. Yield (t/ha)	**2.14**	**1.79**	**0.52**			**0.97**	
LSD (%) (P=0.05)	*5*	*8*	*19*			*24*	
Archer	96	89	-	78	101		Imidazolinone Tolerant
Carbine	-	-	115	97	103	112	
Hyola 474CL	92	93	85			100	
Hyola 575CL	96	89	-	106	100		
Pioneer 43C80 (CL)	-	-	116	98	96	94	
Pioneer 43Y85 (CL)	-	-	109			101	
Pioneer 44Y84 (CL)	103	102	132	115	101	115	
Pioneer 45Y82 (CL)	96	98	113	105	102	106	
Pioneer 45Y86 (CL)	104	109	-	104	103		
Xceed Oasis CL			81	104	84	91	
Site Av. Yield (t/ha)	**2.05**	**1.50**	**0.58**	**0.56**	**1.59**	**0.98**	
LSD (%) (P=0.05)	*6*	*11*	*17*	*12*	*13*	*4*	
ATR Cobbler	97	88	106		93	105	Triazine Tolerant
ATR Gem	108	112	107		100	107	
ATR Snapper	94	89	128		107	129	
ATR Stingray	105	108	107		109	108	
Bonanza TT	88	91	85		90	85	
CB Atomic HT	-	-	-		107		
CB Henty HT	-	-	-				
CB Jardee HT	101	100	-		95		
CB Junee HT	101	87	106		91	107	
Crusher TT	106	109	-	No valid results			
CB Sturt TT	-	-	113		107	114	
CB Telfer	-	-	116		95	116	
Hyola 555TT	99	118	-				
Hyola 559TT	105	111	113		106	112	
Hyola 656TT	103	101	-		103		
Jackpot TT	107	102	92		100	92	
Monola 413TT	95	94	117				
Monola 506TT	83	92	-				
Monola 605TT	88	86	-				
Thumper TT	99	101	-		97		
Site Av. Yield (t/ha)	**1.85**	**1.64**	**0.73**		**1.61**	**0.73**	
LSD (%) (P=0.05)	*7*	*10*	*13*		*8*	*9*	
Date sown	3 May	4 May	4 May	27 May	1 June	29 May	
Soil type	LS	CL	SL	L		SL	
pH (water)	5.4	6.0	7.8			8.4	
Apr-Oct rain (mm)	384	223	216	185	294	188	
Previous Year	Wheat	Wheat	Barley			Wheat	
Site stress factors				es			

Soil type: S=sand, C=clay, L=loam, F=fine, K=coarse, M=medium, Li=light, H=heavy, Z=silt, /=divides topsoil from subsoil
Site stress factors: es=establishment
Data source: SARDI/GRDC, PBA & NVT

NB Minnipa, Mt Cooper and Lameroo sites are not part of the NVT system but were established with similar protocols

Canola varieties available in South Australia in 2013, what may do well in the low rainfall zone

Trent Potter[1] and Andrew Ware[2]

[1] Yerunga Crop Research, [2]SARDI, Port Lincoln

RESEARCH

Key messages

- **Latest information on canola variety yield performance can be found at www.nvtonline.com.au**
- **Growers should be encouraged to change canola varieties every two or three years to reduce the risk of blackleg**
- **Variety selection should be made in conjuction with the latest version of the blackleg risk assessor (available at www.grdc.com.au)**

Why do this research?

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.

Due to the high levels of blackleg in many areas in SA, it is very important that canola crops are grown at least 500 metres away from last year's canola paddock. As well, if you have used the same variety for three years or more there is an increased chance of blackleg that can attack that variety. Therefore it is even more important to keep the same variety at least 500 metres away from stubble of that variety.

There has been a wide range of new varieties available for 2012 sowings. Many of these varieties are hybrids and the likelihood is that in future many more hybrids will be released. When you make your choice about new varieties you should rely on NVT data from the NVT website and any of your own ideas from observing trials in 2012.

What happened?

On central EP some canola was sown on a small rainfall event in the first week of May; however the majority of upper EP canola had to wait until towards late May due to the dry start to the season. In the southern Mallee, near Lameroo, commercial crops were sown in early April but then went through a very dry phase until late May. Trials at Lameroo were sown into good moisture on 30 May. The yields produced in the trials were good considering the season cut out after early September. The mild conditions in spring assisted crops to reach the yield levels achieved.

Of the conventional varieties, there was little difference between AV-Garnet, Hyola 50, CB Tango C and CB Agamax. At the lower yielding sites, best grain yields of the Clearfield varieties were produced by Pioneer 44Y84, Pioneer 45Y82, Carbine and Hyola 575CL. In both the conventional and Clearfield trials the *Brassica juncea* entries performed poorer than the canola and this may be attributed to the mild finish to the season as **B. juncea** has been seen to perform better than canola when the seasonal finish is hot. The highest yielding triazine tolerant canola varieties were ATR-Snapper, CB Telfer, CB Sturt TT and Hyola 559TT.

Notes on recently released canola varieties (grown in 2012)

Official blackleg resistance ratings from 2012 are now included for varieties released for 2012. Ratings for varieties being released in 2013 are still being determined so comments from companies are included.

Conventional varieties

CB Agamax New Release 2011. Early-mid maturing hybrid. Canola Breeders indicate excellent yield in low to medium rainfall, excellent early vigour and good oil content. Blackleg resistance rating MS. Tested in NVT trials since 2010. Marketed by Canola Breeders.

CB Taurus First released 2009. Very late maturing, "winter" type canola hybrid. Winter grazing option in high rainfall zones. Canola Breeders indicate excellent yield, excellent early vigour and good oil content. Blackleg resistance rating MR (P). Marketed by Canola Breeders.

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Clearfield varieties

Hyola 575CL (tested as K9317). Mid-early season hybrid. Pacific Seeds indicate high grain yield and oil content about 1% more than Hyola 571CL. Medium plant height. Blackleg resistance rating R. Tested in SA NVT trials since 2010. Bred and marketed by Pacific Seeds.

44Y84 CL Early/early-mid season hybrid. Blackleg resistance rating MR if treated with a fungicide, MR-MS if bare seed. Included in NVT trials in 2010, tested ever since. Bred and marketed by Pioneer Hi-Bred.

Hyola® 474CL Mid-early maturing CL Hybrid. Pacific Seeds indicate higher yield than Hyola 571CL, very high oil and high protein content. Medium-tall plant height. Ideally fits medium-low to high rainfall areas including irrigation, and exhibits excellent hybrid vigour. Blackleg resistance rating R (P). Tested in NVT trials in 2011 and 2012. Bred and marketed by Pacific Seeds. New release for 2012.

43Y85CL (tested as 08N102I). Early maturing hybrid Clearfield canola. Blackleg resistance MR, and equivalent oil content to 44C79. Selected for short plant height and standability. Tested in NVT trials in 2011 and 2012. Bred and marketed by Pioneer Hi-Bred.

Triazine tolerant varieties

CB Junee HT™ (trialled as CHYB-127). New release 2011. Early-maturing TT hybrid. Canola Breeders indicate excellent yield, good early vigour and good oil content. Blackleg resistance rating MS-S. Tested in NVT trials in 2010 for the first time. Bred and marketed by Canola Breeders.

Crusher TT Mid maturing OP TT variety. Pacific Seeds indicate good oil and good protein content. Medium-tall plant height. Ideally fits medium to very high rainfall areas including irrigation, exhibits good early vigour and good standability. Blackleg resistance rating MS. Tested in NVT trials since 2010. Bred and marketed by Pacific Seeds.

Thumper TT (tested as T2214). Mid to mid-late maturing double haploid OP TT variety. Pacific Seeds indicate very high yield, excellent oil and good protein content. Medium plant height. Ideally fits high to very high rainfall areas including irrigation, exhibits good early vigour and excellent standability. Blackleg resistance rating R-MR. Tested in NVT trials since 2010. Bred and marketed by Pacific Seeds.

Hyola 555TT (tested as T2522) Mid-early maturing TT Hybrid (TT version of Hyola 433). Pacific Seeds indicate excellent yield, excellent oil and high protein content. Ideally fits medium-low right through to high rainfall areas. This Hybrid exhibits good TT Hybrid vigour, medium plant height and excellent standability. Blackleg resistance rating MR. Tested in NVT trials since 2010. Bred and marketed by Pacific Seeds.

Hyola 444TT (tested as T98002). Early maturing TT Hybrid. Pacific Seeds indicate excellent yield, excellent oil and high protein content. Medium-short plant height. Ideally fits low to medium-high rainfall areas and exhibits good TT Hybrid vigour and good standability. Blackleg resistance rating MR. Tested in NVT trials since 2010. Bred and marketed by Pacific Seeds.

ATR-Snapper (tested as NT0049). Early-mid maturing medium-short height. High oil and protein content. Blackleg resistance rating MS. Bred by Canola Alliance. Marketed by Nuseed Pty Ltd.

ATR-Stingray (tested as NT0045). Early maturing. Short height. High oil and protein content. Blackleg resistance rating MR. Bred by AgSeed Research and DPI Victoria. Marketed by Nuseed Pty Ltd.

Jackpot TT Mid-early maturing OP TT variety. Pacific Seeds indicate very high yield, very high oil and very high protein content. Medium-short height. Ideally fits low to medium-high rainfall areas, exhibits good early vigour. Blackleg resistance rating of MR (P). Tested in NVT trials since 2011. Bred and marketed by Pacific Seeds.

Bonanza TT Early maturing double haploid OP TT variety. Pacific Seeds indicate good yield for maturity. Good oil and very high protein content. Short plant height suited for direct heading. Ideally fits low to medium rainfall areas, exhibits excellent early vigour similar to some TT Hybrids. Blackleg resistance rating of MR (P). Tested in NVT trials in 2011 and 2012. Bred and marketed by Pacific Seeds.

ATR Gem (tested as NT0107). Early-mid maturity triazine tolerant open pollinated variety with better blackleg resistance and vigour than TawrifficTT (MR(P)). Slightly shorter than TawrifficTT and with slightly higher oil content. Bred and marketed by Nuseed. Tested in NVT trials since 2011.

Notes on new varieties released for 2013

Conventional varieties

CB™ Tango C (tested as CHYB-187). Early-mid maturing conventional hybrid. Vigorous early growth. Expected to be grown in low rainfall regions. Blackleg resistance rating MR (P) if treated with fungicide, and medium-high seed oil content. First year NVT testing in 2011. Bred by Canola Breeders.

Hyola® 930 Winter hybrid canola with oil levels similar to Hyola® 50. Provisional Blackleg rating of R. Matures 4 to 5 weeks later than Hyola® 50.Suitable for autumn, early winter or spring sowing. Suited to grazing in winter. Marketed by Pacific Seeds.

Break Crops

Clearfield varieties

Pioneer® 45Y86(CL) New release (coded 07N406I). Mid maturing hybrid. Pioneer indicate high yielding with excellent standing ability and high oil. Replacement for 46Y83 (CL). Suited for dual-purpose (graze & grain) option in full-season environments. Pioneer Research blackleg rating of MR. Tested in NVT trials 2010-2012. Bred and marketed by DuPont Pioneer.

XCEED™ VT X121 CL Hybrid Clearfield® tolerant juncea canola. Four days later than VT Oasis CL. Excellent early vigour and branching ability and has high oil content. VT X121 CL has excellent pod shattering tolerance and is suitable for direct harvest. Bred by Viterra in conjunction with GRDC. Viterra anticipate a blackleg resistance rating of R (resistant).

Hyola® 971CL Winter hybrid canola with oil levels similar to Hyola® 50. Provisional Blackleg rating of R. Matures 4 to 5 weeks later than Hyola® 50.Suitable for autumn, early winter or spring sowing. Suited to grazing in winter. Marketed by Pacific Seeds.

Archer (coded SMHC105CL). Mid-late maturing hybrid. Heritage Seeds indicate high yield and high-very high oil content. Medium plant height. Heritage Seeds also indicate blackleg resistance rating MR. Tested in NVT trials 2011 and 2012. Marketed by Heritage Seeds.

Carbine (coded SMHC111CL). Early-mid maturing hybrid. Heritage Seeds indicate high yield and high-very high oil content. Medium plant height. Heritage Seeds also indicate blackleg resistance rating MR. Tested in NVT trials 2011 and 2012. Marketed by Heritage Seeds.

Triazine tolerant varieties

CB™ Henty HT (tested as CHYB-148 HT®). Mid-maturity TT hybrid for medium to high rainfall regions. CB trials indicate moderately resistant to blackleg if treated with a fungicide. First year NVT testing in 2011 but not tested in 2012. Bred by Canola Breeders.

CB™ Sturt HT (tested as CBWA-106 TT). Early maturity open-pollinated variety for low to medium rainfall regions to replace Tanami. First year NVT testing in 2011. Bred by Canola Breeders.

CB™ Nitro HT (tested as CHYB1380TT). Mid maturity variety, under evaluation. Slightly earlier maturity to CBTM Jardee HT. First year NVT testing in 2012. Bred by Canola Breeders.

CB™ Atomic HT (tested as CHYB1368TT). Early-mid maturity variety, under evaluation. Similar maturity to CBTM Junee HT. First year NVT testing in 2012. Bred by Canola Breeders.

Hyola 559TT Mid to early mid TT hybrid. Medium plant height and good early plant vigour. Pacific Seeds suggest blackleg resistance rating of R-MR(P). Tested in NVT trials in 2011 and 2012. Bred and marketed by Pacific Seeds.

Hyola 656TT Mid to mid-late TT hybrid. Medium to tall plant height, suited to early sowing. Pacific Seeds suggest blackleg resistance rating of R-MR(P). Tested in NVT trials in 2012. Bred and marketed by Pacific Seeds.

Outclassed, but still available:

ATR-Cobbler, CB Tanami, Tawriffic TT, Hyola® 76, Monola™ 76TT and Monola™ 77TT, Hyola 444TT, Hyola 433, Fighter TT, CB Junee HT, CB Mallee HT, CB Scaddan.

Withdrawn

Pioneer® 46Y83(CL)

What does this mean?

When choosing a suitable canola variety consideration of maturity, weed species, herbicide tolerance, early vigour, yield and oil content, previous canola varieties in the rotation and the distance from stubble and/or fungicide use. When you make your choice about new varieties you should rely on NVT data from the NVT website and any of your own ideas from observing trials in 2012. It really pays to look at NVT trials as many canola varieties are only tested for one year prior to release so you need to get a feel of how they have grown in your region.

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Farmer experiences with canola and Xceed Oasis CL in 2012

Bruce Heddle[1] and Linden Masters[2]

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RESEARCH

Searching for Answers

Location:
Minnipa
The Heddle Family
Rainfall
Av. Annual: 350 mm
Av. GSR: 250 mm
2012 Total: 215 mm (30 mm rain 28 Feb to 2 Mar)
2012 GSR: 185 mm
Yield
44C79 (CL) 0.74 t/ha @ 40% oil
Stingray (TT) 0.82 t/ha @ 42% oil
Oasis CL (*B. juncea*) 0.54 t/ha @ 46% oil
Barley sown dry, mid-May and wheat sown wet, late May alongside yielded about 1.45 t/ha.
Paddock History
2011: Wheat 2.95 t/ha, remaining stubble slashed
2010: Medic pasture
2009: Wheat
Soil Type
Sandy clay loams with small areas of grey calcareous sand
Area Type
Approximately 33 ha of each variety
Time of Sowing
22 April
Yield Limiting Factors
A dry spell after sowing and a very dry spring.
Strong winds after windrowing damaged some rows badly.
Farmer's experiences with canola and Xceed Oasis CL, 2012

What did you do?

Yield comparison of Stingray TT Canola, 44C79 Clearfield Canola and Xceed Oasis CL *(Brassica juncea).*

How did you do it?

Certified seed of each variety was sown @ 3 kg/ha with 40kg 18:20:0:0 (DAP) placed with the seed on 22 April using knife points and press wheels. Soil moisture was adequate to marginal. Sowing depth was 30 mm which was ideal for the 44C79 and the Stingray, with positive establishment and excellent plant populations. The Oasis CL had a much more staggered germination and far greater plant number variability. The challenge with this variety was that any shallower and the seed was in soil too dry to sustain emergence and any deeper into wetter soil made it struggle to emerge.

Clethodim was applied along with Intevix or Atrazine as appropriate on 21 June under ideal conditions. No insect control was required at any time. 20 units of nitrogen and 9 units of sulphur were applied as a liquid solution of urea and sulphate of ammonia by streaming on 26 July, with a total of 10 mm of rain on 26 and 27 July.

What happened?

44C79 and Stingray displayed significantly greater early vigour and robustness, especially on the most calcareous soil types under marginal moisture. No significant rain fell for about 30 days after sowing, really exacerbating the effects. Despite this setback for the Juncea, it did display an ability to hold on and finish in a very dry spring.

The 44C79 was swathed and suffered some wind damage in the rows while the Stingray was direct headed with no pre harvest losses at all. Some areas of Oasis CL grew to be about 1.75 metres tall so we swathed it, and due to its very different growth habit, it made an extremely compact and wind resistant row which was totally untouched by the wind. If we grow these varieties again, we would intend to direct head Stingray but windrow tall crops of the other two. The Oasis CL displayed a tendency in small areas not windrowed to stay green well into wheat harvest time, which is not something we want to deal with – part of the appeal of Canola as a crop is that it stretches the harvest window.

What does this mean?

Brassic juncea is at a stage of development behind the canola *(B. napus)* varieties, however the Oasis CL has demonstrated some really desireable traits, most notably its outstanding late season toughness and excellent oil content in a dry spring. The lack of seed size and early vigour makes establishment more difficult, especially on the calcareous grey soil which seems to be drier at the best of times.

Other farmer experiences

Darren & Caroline Mudge, Wirrulla

The Mudge family started growing mustard in 1993 and it has become part of their ongoing rotation. A new oilseed Xceed Oasis CL (*Brassica juncea* or Juncea) was being promoted for low rainfall areas and they wanted to compare it to their current variety, ATR Cobbler. Another positive was the ability to direct head Xceed Oasis CL and they were keen to test this option.

How you did it and what happened?

ATR Cobbler canola was sown after a good rain on 28 May and Xceed Oasis CL a week later, after weeds germinated. The canola and Juncea was sown with an airseeder, knife points and press wheels, using fluid fertiliser mix with 5 units of P and 40 kg of sulphate of ammonia.

Juncea established and grew well but yielded only half that of canola. The yield was Cobbler 0.23 t/ha and Xceed Oasis CL was 0.1 t/ha. The Xceed Oasis CL also had to be cleaned to remove turnip seed.

What does this mean?

We will try Xceed Oasis CL (Juncea) for another year. The appeal is that it appears not to shatter as much. We had some loss but having the potential to direct head the crop would be a bonus. Darren said he was a bit confused why it did not yield as expected and would give it another go before making a final decision.

Bryan Smith, Coorabie

Brian had grown canola (43C80) before and decided to try Xceed Oasis CL (Juncea) as it “was supposed to have a yield benefit in a low rainfall environment”.

How you did it and what happened?

Sowing the canola started on 28 May after the first good rain (later than he would normally like). The Xceed Oasis CL was sown with the same air seeder as 43C80 canola but reduced the seeding rate to 2 kg/ha. Fertiliser was 50 kg of DAP and 60 kg of sulphate of ammonia on both crops. Both varieties were swathed for harvest. A small patch of Xceed Oasis CL was left for 3 weeks after it was ripe with no apparent shattering.

Both varieties yielded the same, 0.3 t/ha, but Xceed Oasis CL had 42% oil compared to 43C80 at 38%. The disadvantage with Xceed Oasis CL was a 10% price penalty and it had to be trucked to Murdinga. The canola went to Cummins where fertilizer could be back loaded.

What does this mean?

Xceed Oasis CL did not have a yield penalty and Bryan thought the greatest advantage was that it could be directly headed. This is a good way for people to get into “canola” without having specialised machinery for harvesting canola. It was a very short season with sowing starting at end of May, but the Clearfield spray technology allowed excellent grass control which has set this paddock up for next season.

Dion and Nev Trezona, Piednippie

Dion was looking for a cleaning crop to reduce Pimpernel. In the 2011 season he sowed CB Telfer (a TT canola variety) but mice reduced the plant numbers. However the wheat crop in the paddock in 2012 went over 1 t/ha whereas the average was only 0.4 t/ha for the rest of the program. Dion wanted to use Clearfield spray technology and Xceed Oasis CL was being promoted in the area by Viterra, so he decided to try the new variety. He also felt it was an advantage with the closed loop marketing system as the crop purchase was guaranteed.

How you did it and what happened?

70 ha was sown dry on 26 May with a Morris Express disc machine. The seeding rate was 4 kg/ha with 70 kg/ha of DAP. Urea was spread mid-June at 30 kg/ha. The Intervix didn’t work really well as it was sprayed too early and there was a later germination of broad-leaved weeds, but it did control the Pimpernel. The yield of Xceed Oasis CL was 0.2 t/ha.

What does this mean?

Dion thought it was a good learning curve, and realized he needed to do more late crop monitoring as ‘grubs’ were an issue in early pod setting. Trezona’s will grow an oilseed as a break crop next year with the incentive of $500/t, the ability to control a broad-leaved weed problem and grasses, as well as a potential yield increase in the following wheat crop.

Paul & Jack Kaden, Cowell

Kaden’s have been continuously cropping on some of their country for 10-12 years and were looking for a different break crop. After hearing many different views they decided to compare Xceed Oasis CL and canola 43C80. This was one of the first times *Brassica juncea* has been grown in the Franklin Harbour area.

How you did it and what happened?

The season had a good start but they didn’t get the seed until the end of May so seeding was later than ideal. There was no rain in the last two months of the season which resulted in a yield penalty. Yields were similar with both crops at 0.3-0.4 t/ha. Both crops were direct headed and Xceed Oasis CL was able to be reapt at higher speed.

Uneven ripening of the Xceed Oasis CL resulted in the crop being harvested at the end of harvest to avoid using the grain dryer. The 43C80 canola crop was harvested early in the program and dried in a grain drier. When trying to dry Xceed Oasis CL, its smaller seed blew out of the grain drier, so this crop was left until it fully ripened in the paddock and harvested last in the program.

What does this mean?

Kaden’s will look at sowing an oilseed again next season.

Farren Frischke, Koongawa

Farren decided not to grow Juncea as he felt he could get similar yields from canola without having to pay a 10% price penalty and be tied to only one buyer. He sowed ATR Stingray and was pleased with the results and will use this variety next season. Uneven ripening of oilseeds due to different soil types in the paddock was a problem for many croppers this season.

Field pea varieties and agronomy for low rainfall regions

RESEARCH

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Almost ready

Location:
Minnipa Agricultural Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2012 Total: 253 mm
20112 GSR: 185 mm
Yield
Potential (pulses): 1.2 t/ha
Actual: 1.5 t/ha
Paddock History
2012: Canola and legume trials
2011: Wyalkatchem wheat
2010: Espada wheat
2009: Kaspa peas
Soil Type
Red sandy loam
Yield Limiting Factors
High temperatures during flowering/pod fill
Late season rainfall

Key messages

- **Field pea yields were above average at Minnipa in 2012, averaging 1.5 t/ha. This is exceptional compared with other seasons of similar rainfall.**
- **There was little variation in yield between varieties, and most varieties performed similarly to Kaspa and the site mean.**
- **Agronomy trials showed no sowing date or stubble management response for grain yield in 2012. Haying off of early sown peas may have contributed to this.**
- **A long term yield penalty of 10 kg/ha/day from delayed sowing highlights the importance of sowing field peas early in this area.**

Why do the trial?

Pulse Breeding Australia (PBA) is focussed on developing field pea cultivars that will increase and stabilise production in environments characterized by variable soil types and low rainfall, of which Minnipa is a key evaluation site. The Southern Region Pulse Agronomy Project is also committed to this objective, developing agronomic management strategies that will maximise performance of new pulse varieties, primarily in the medium to low rainfall areas of Australia. Previous agronomic research conducted by this project on lentils in the mid north of South Australia has shown significant benefits of inter-row sowing into standing cereal stubbles in relation to yield and increased standing plant height. In a trial at Pinery (Mid North) in 2012 an 11% yield advantage was generated across all crops tested (field pea, lentil, chickpea) by sowing into standing versus slashed stubble. A trial at Minnipa in 2011 showed that substantial height and lodging resistance improvements can also be generated by sowing field pea into standing versus slashed stubble, although no yield differences were recorded. These results are thought to be due to providing a trellis to support the stem of the plant, potentially aiding harvestability of the crop which is often a significant constraint to production in these environments.

How was it done?

A replicated advanced (Stage 3) PBA field pea breeding trial containing 11 commercial entries and 173 advanced breeding lines was sown into standing stubble and good soil moisture levels on 27 April at Minnipa.

An agronomic field pea inter-row by time of sowing trial with 6 varieties (Kaspa, Parafield, PBA Gunyah, PBA Twilight, PBA Oura and PBA Pearl) was sown on 27 April (early) and 1 June (late) also at Minnipa. Stubble treatments were Standing (wheat stubble 25 cm high, ~1.7 t/ha), Slashed (pre sowing, ~ 1.7 t/ha) and Burnt (pre sowing) stubble. All plots were sown inter-row at 25 cm spacings.

Both trials were sown with 62 kg/ha of DAP. Metribuzin was applied post-sowing pre-emergent at 180 g/ha. Brodal plus MCPA Amine (120 ml/ha each) was applied for in crop weed control in mid-July. The agronomy trial was sprayed with Mancozeb during flowering for protection against black spot. Insect sprays were applied as required. Scores for establishment, early vigour, disease, flowering, height, maturity, lodging, shattering and selection potential were recorded during the year and grain yields were measured at harvest.

What happened?

Annual rainfall (253 mm) was close to average at Minnipa in 2012, although growing season rainfall (185 mm) was below average (decile 3). Grain yields were high (averaging 1.5 t/ha), which is exceptional compared to other seasons with the similar rainfall totals (Table 2). Measured grain yield was surprisingly higher than that predicted by the French-Schultz model (1.2 t/ha). The combination of a very early sowing date, good stored soil moisture levels, good early winter rainfall amounts and generally mild winter temperatures are likely to have led to this result.

Early season conditions were very favourable for plant growth and yield potential was very high at the start of spring. However yields were limited by late season moisture stress and several high temperature events during late flowering/early pod fill, although these factors do not appear to have compromised performance of later maturing varieties. Some variation in growth was observed, particularly in the sowing date trial, and may be due to subsoil boron content. Little disease was observed in 2012.

1. Stage 3 PBA breeding trial

Grain yield averaged 1.53 t/ha in the PBA Pea breeding trial in 2012. As in previous seasons where grain yield has been higher than 1.5 t/ha, little variation in yield between varieties occurred. Yield of the late flowering variety Kaspa was similar to the site mean. Only 16 of the 184 lines in this trial yielded significantly lower than Kaspa, and only three lines yielded significantly higher than Kaspa.

PBA Percy was the highest yielding commercial variety, 4% better than Kaspa. PBA Percy is the earliest flowering line in this trial (commenced flowering 22 days earlier than Kaspa in 2012, Table 1). PBA Percy has a trailing plant type similar to Parafield, which may deter some growers, but features improved yield and bacterial blight resistance over this variety. Recent earlier maturing releases PBA Gunyah, PBA Twilight and PBA Oura performed similarly to Kaspa in this trial, and across all five PBA trials in the state. These four earlier maturing recent releases have generally performed similarly to Kaspa in the recent run of favourable seasons (Table 2), but will generally be better suited to lower yielding situations.

OZP1203 was the highest yielding entry in the 2011 trial at Minnipa (25% higher yield than Kaspa). This has continued to do well, yielding 3% above Kaspa at Minnipa and 8% higher across the state in 2012 (Table 1). The advanced breeding line 06H064P-3 was the highest yielding entry in the 2012 trial (21% higher than Kaspa), and performed well across all SA PBA sites. Another advanced breeding line (06H408P-1) significantly out-yielded Kaspa by 19% at Minnipa in 2012, and was also the highest yielding line across all five PBA trials in the state (averaging 15% yield above Kaspa). These results demonstrate the depth of the PBA breeding collection and the ability of various new lines to perform well over sites and seasons, a key breeding target. This evaluation will be continued to verify results across variable seasons.

Table 1 Grain yield and characteristics of selected field pea lines in the 2012 Minnipa PBA trial

Variety	Plant Type	Grain Type	Flower Date	Grain Yield (% Kaspa) Minnipa Yield (% Kaspa) 2012	Mean 5 SA sites 2012	Minnipa 2005-2012
Kaspa	SL	Dun (K)	17 Aug	1.59 t/ha	2.05 t/ha	1.70 t/ha
PBA Gunyah	SL	Dun (K)	12 Aug	101	104	99
PBA Twilight	SL	Dun (K)	6 Aug	100	104	99
PBA Oura	SL	Dun	9 Aug	97	102	101
PBA Percy	C	Dun	26 Jul	104	106	101
Parafield	C	Dun	13 Aug	89	96	93
PBA Pearl	SL	White	8 Aug	103	109	105
OZP0805 (2013)	SL	Dun (K)	11 Aug	94	102	98
OZP1101	SL	Dun (K)	16 Aug	101	110	102
OZP1103 (2013) **	C	Dun	14 Aug	86	100	94
OZP1203	SL	Dun (K)	16 Aug	103	108	99
OZP1208	SL	Dun	14 Aug	101	110	99
06H064P-3	SL	Dun (K)	9 Aug	121	109	101
06H408P-1	SL	Dun (K)	14 Aug	119	115	101
Site Mean (t/ha)				**1.53**	**2.16**	
CV (%)				8.96	7.17	
LSD % (P=0.05)				*16.0*		

** SA PBA sites include Minnipa, Kadina, Snowtown, Balaklava and Turretfield*
SL = Semi-leafless, C = Conventional, K = Kaspa type
2013 = variety release planned for 2013
*** = dual purpose variety*

Table 2 Grain yields (t/ha) of Parafield, Kaspa, and recent PBA field pea releases compared with rainfall and sowing date at Minnipa in advanced pea breeding trials, 2005-2012

Line/Year	2005	2006	2007	2008	2009	2010	2011	2012	2005 - 2012
Parafield	0.92	0.61	0.99	<0.2	2.24	2.76	1.67	1.41	1.59
Kaspa	0.86	0.54	1.04	<0.2	2.61	2.93	2.02	1.59	1.70
PBA Gunyah		0.68	1.12	<0.2	2.20	2.91	1.72	1.61	1.68
PBA Twilight		0.80	1.13	<0.2	2.19	2.94	1.72	1.59	1.68
PBA Oura			1.02	<0.2	2.51	2.97	1.73	1.54	1.71
PBA Percy				<0.2	2.39	2.92	1.90	1.65	1.71
GSR (mm)	264	111	141	139	333	345	252	185	219
AR (mm)	334	236	286	251	421	410	404	253	322
Date sown	24 May	15 May	8 May	20 May	4 May	31 May	18 May	27 April	

Table 3 Field pea variety yield, Minnipa 2012

Variety	Kaspa	Parafield	PBA Gunyah	PBA Oura	PBA Pearl	PBA Twilight	*LSD (P<0.05)*
Yield	1.51^{e}	1.23^{a}	1.39^{cd}	1.24^{ab}	1.33^{bc}	1.35^{cd}	*0.099*

2. Sowing date by stubble management agronomy trial

No significant sowing date or stubble management response occurred in this trial in 2012. The absence of a sowing date response is surprising given the extent of the delay in sowing (35 days) and the rapid season finish. It is possible that the early sown peas may have hayed off due to the favourable early conditions, high early biomass production and rapid season finish, negating a sowing date response. A significant variety response was noted in this trial. Kaspa significantly outyielded all other varieties by 8-19%, with Parafield and PBA Oura lowest yielding (Table 3). Recent releases PBA Gunyah, PBA Twilight and PBA Pearl (white) all performed similarly, but behind Kaspa. PBA Percy, the highest yielding commercial variety in the PBA trial, was not included in this sowing date trial.

What does this mean?

Field peas performed exceptionally well at Minnipa in 2012, despite a decile 3 growing season and a rapid season finish. This is likely due to good stored soil moisture levels, good early winter rainfall amounts and generally mild winter temperatures. Yield potential was also maximised by sowing earlier than usual, although no sowing date response was generated in a sowing date trial. Lack of disease and minimal yield limiting factors led to low discrimination in yield between varieties. These exceptional yield performances highlight field pea prospects as a valuable break crop option, particularly compared to other break crops last year. The lack of sowing date response is particularly surprising given the seasonal conditions and magnitude of sowing delay. It is likely that the early sown peas may have hayed off slightly due to the favourable early conditions, high biomass and rapid finish. Despite this however, the long term (2007-2012) data shows a 10 kg/ha/day yield loss from delayed sowing highlighting the importance of early sowing in this area.

Kaspa remains an option for low rainfall environments since it has the combination of round dun seed, pod shatter resistance, improved standing ability, good early vigour and grain yield. However its best relative yields have been achieved in the higher yielding seasons. The earlier maturing recent releases PBA Gunyah, PBA Twilight, PBA Oura, PBA Percy and PBA Pearl will provide greater yield stability than Kaspa in the lower yielding short seasons with rapid finishes, or in years where early sowing cannot be achieved. PBA Gunyah and PBA Twilight also have the same plant and seed type benefits of Kaspa which are favoured for their milling quality and harvestability over wrinkled dun seed. PBA Pearl produces white grain, which is likely to limit its uptake in South Australia, but long term data shows a 5% yield advantage over Kaspa at Minnipa, and 10% higher across the state.

Previous work conducted by this project in South Australia's Mid North has shown that sowing pulses into standing cereal stubble can benefit yield. However, no yield response has yet been generated from stubble management in trials at Minnipa to date. Substantial differences in growth were achieved from stubble management in the 2011 trial at Minnipa, and it is thought that the increased growth and height may aid harvestability of field pea, particularly in shorter seasons with less biomass. However, regardless of the perceived yield or harvestability benefits, retaining standing cereal stubble is still seen as having benefits in reducing damage from wind erosion in regions characterised by light textured soils and where sheep are still a common part of the farming system. This trial will be continued in 2013 to again validate these findings across variable seasonal conditions.

Vetch breeding trials at MAC, 2012

Stuart Nagel, Rade Matic and Gregg Kirby

SARDI, Waite

RESEARCH

Searching for answers

Location:
Minnipa Ag Centre, South 5
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2012 Total: 253 mm
2012 GSR: 185 mm
Yield
Potential: 0.9 t/ha (pulses)
Actual: 0.48-1.03 t/ha
Paddock History
2012: Canola and legume trials
2011: Wyalkatchem wheat
2010: Espada wheat
2009: Kaspa peas
Soil Type
Red sandy loam
Plot Size
12 m x 1.25 m x 3 reps

Key messages

- **Vetch is a versatile crop that can be used for grain, pasture, hay/silage or green/brown manure.**
- **Common vetches can be successfully grown in lower to mid rainfall areas of southern Australia where no other legume crops perform consistently.**
- **Vetch offers disease and weed breaks in rotation and also return significant amounts of nitrogen to the soil.**
- **Advanced breeding lines were trialled and compared to existing varieties at Minnipa this season.**
- **Several new vetch species that have shown potential in very low rainfall areas were also trialled on Eyre Peninsula for the first time in 2012.**

Why do the trial?

In 2012 The National Vetch Breeding Program (NVBP) conducted two trials on Eyre Peninsula at Minnipa Agricultural Centre (MAC): a trial comparing grain production of advanced lines and existing varieties (S4 trial) and another trial involving a range of new vetch species (New Species trial) targeted at fodder production in low rainfall environments. The new species trial is investigating two new vetch species *Vicia palaestina* (leaf dense vetch – LDV), and *V. obicularis* (small erect vetch) which have shown potential in low rainfall environments, but have never been grown on Eyre Peninsula before.

How was it done?

The trials were sown on 18 May 2012 with minimum inputs, no fertilizer or inoculum. Pre-emergent herbicides Diuron and Metribuzin were used on the S4 trial and only Diuron on the New Species trial, along with a pre-emergent insecticide on both trials. The New Species trial was cut for hay on 11 October and the S4 trial was harvested for grain at maturity.

What happened?

The S4 trial emerged well and had strong early vigour, looking particularly good at the time of the Minnipa Field Day in September. The dry finish to the season limited grain yield potential (Table 1), however the plants did produce good bulk early and with a little more rainfall in September would have produced better yields. Two lines trialled (SA-34823 and SA-35103) are to be released as new varieties, these lines are better adapted to lower rainfall areas than current varieties, and have out yielded all current varieties in grain and hay production over the last 5 years (Table 2). In 2013 we intend to conduct further S4 trials at Minnipa and are going to include a hay trial of advanced lines to demonstrate the yield potential of these lines in this environment.

Table 1 Grain yield of Minnipa S4 vetch, 2012

Line	Mean yield (t/ha)
SA 34748	0.81
SA 34822	1.03
SA 34823**	0.91
SA 34848	0.72
SA 34883	0.99
SA 34884	0.93
SA 35019	0.77
SA 35036	0.74
SA 35103**	0.84
Blanchefleur	0.75
Morava	0.48
Rasina	0.68

*** These lines are to be released as new varieties*

Table 2 Grain yield and dry matter (t/ha), for two new and three existing vetch varieties, from a minimum of 4 sites/year in South Australia

Variety	2008 mean		2009 mean		2010 mean		2011 mean		2012 mean		OAM*	OAM*
	Grain	Hay	Grain	Hay	Grain	Hay	Grain	Hay	Grain	Hay	Grain	Hay
34823	2.26	6.52	2.05	4.50	2.84	5.56	3.20	4.82	1.95	6.49	2.64	5.58
35103	2.06	6.62	1.84	4.25	2.77	5.31	2.90	4.20	1.68	6.27	2.25	5.33
Blanchefleur	1.91		1.65		2.70		2.10		1.46		1.96	
Morava	1.57	6.01	1.07	4.39	2.39	5.52	2.60	4.04	1.38	5.91	1.80	5.17
Rasina	1.83	6.06	1.65	3.83	2.42	5.21	2.90	3.94	1.50	5.67	2.06	4.94

**OAM is overall mean.*

Break Crops

Table 3 Minnipa New Species trial fodder yield (t/ha), 2012

Species	Line	Dry Matter green (t/ha)	Dry Matter dry (t/ha)
V. orbicularis	33118	5.2	2.3
V. palaestina	37292	4.6	2.4
V. palaestina	37293	4.5	2.2
V. palaestina	37331	4.2	1.7
V. palaestina	37332	5.2	2.4
V. palaestina	37355	5.0	3.1
V. palaestina	37361	4.6	2.1
V. sativa	Morava	8.5	4.0

The New Species trial was somewhat disappointing as it showed poor early vigour and did not compete well with weeds, particularly wild turnips. The weed population compromised the results as they tended to crowd out the vetch (Table 3). Again due to the lack of rainfall in September and October the anticipated late season growth that these lines are known for, did not eventuate. The fact that these new species could not out-yield Morava in this environment was disappointing. This trial will be repeated again in 2013 to verify results before any recommendations can be made on the potential of these species.

What does this mean?

The common vetch lines to be released showed good results in comparison to existing varieties. Fodder trials will be interesting, providing good information for those interested in green/brown manure as well as fodder. The New Species trial was disappointing, but further work is required as they have performed well in other areas of the state.

Acknowledgements

The National Vetch Breeding Program would like to acknowledge the ongoing support and funding provided to the breeding program by the GRDC which has provided funding for research into vetch since 1992. As well as the support of SAGIT which has been actively funding research into new vetch species for low rainfall regions of southern Australia since 2008.

Disease

Better prediction and management of Rhizoctonia disease in cereals

RESEARCH

Vadakattu Gupta[2], Amanda Cook[1], Alan McKay[3], Wade Shepperd[1], Ian Richter[1], Kathy Ophel-Keller[3] and David Roget[4]

[1]SARDI, Minnipa Agricultural Centre , [2]CSIRO Waite campus, [3]SARDI, Waite, [4]Private Consultant

Searching for answers

Location:
Streaky Bay
J Williams and B Goosay
Streaky Bay Ag Bureau

Rainfall
Av. Annual: 340 mm
Av. GSR: 274 mm
2012 Total: 201 mm
2012 GSR: 163 mm

Yield
Potential: 1.3 t/ha (W)
Actual: 0.7 t/ha (W)

Paddock History
2012: All treatments Mace wheat
2008-12: Trial treatments
2007: Barley

Soil
Highly calcareous grey loamy sand

Plot Size
40 m x 1.48 m x 4 reps

Other Factors
Snails

Key messages

- **Cereals build up Rhizoctonia inoculum from sowing to crop maturity in all environments.**
- **Experiments across the lower rainfall cropping region in southern Australia indicated that grass free canola, mustard, chickpeas, field peas, vetch, medic pasture and fallow can result in significant reductions in Rhizoctonia inoculum in a cropping sequence.**
- **Management practices which prolong soil moisture over the summer period, such as summer weed control, will reduce Rhizoctonia inoculum.**
- **Higher microbial activity at the start of the season resulted in lower disease incidence even in the presence of higher inoculum.**
- **Rhizoctonia inoculum levels at sowing were significantly lower in cultivated treatments compared to no-till, however in the trials to date, the decline in inoculum with cultivation has not always been sufficient to provide a yield benefit.**

Why do the trial?

Rhizoctonia continues to be an important but complex disease in the southern agricultural region, especially on upper Eyre Peninsula. This is the second to last season of this trial in a second round of funding of a national GRDC project. The aim of this research is to improve long term control of Rhizoctonia by increasing our understanding of the interactions between disease inoculum and natural soil suppressive activity and to improve the prediction and management of the disease.

How was it done?

A trial was established at Streaky Bay in 2008. In 2012 the Rhizoctonia disease and inoculum levels were compared between two different tillage systems; conventional cultivation (29 March - wide sweeps; 26 April - narrow points) and no-till and with several rotations. In the 2011/12 summer, the strategic cultivation treatment had no weed control allowing a few Lincoln weed plants (*Diplotaxis tenuifolia)* to establish over summer.

The trial was sown on 1 June 2012 into reasonable moisture with Mace wheat @ 70 kg/ha with DAP @ 60 kg/ha and urea @ 35 kg/ha in all plots. The trial area received 1 L/ha of glyphosate, 1 L/ha of Trifluralin and 100 ml/ha Striker pre seeding; and 750 ml/ha of Tigrex® post sowing.

Sampling included Rhizoctonia pathogen DNA levels at sowing, root disease incidence, dry matter and microbial activity. At harvest, 40 m of plots were harvested for grain yield and quality.

What happened?

Lack of adequate rainfall from September onwards (through the anthesis and grain filling periods) resulted in overall lower grain yields in 2012 than the previous 4 years. However, wheat grain yields were significantly higher after canola (20%), fallow (51%) and pasture (54%) grown in 2011 as compared to the no-till continuous wheat (Figure 1). In general, benefits from non-cereal crop rotations on grain yields were consistent through the 4 years of the experiment (2009-12). The effects of cultivation treatments were variable, for example strategic cultivation (cultivation after first rainfall prior to sowing; 26 April) in the continuous wheat treatment resulted in higher grain yields, whereas conventional cultivation provided no significant benefits in grain yield, although it reduced Rhizoctonia inoculum levels at sowing.

In general, Rhizoctonia inoculum levels at sowing were similar to that observed in 2009 and 2010 but lower than in 2011(Figure 2). The effect of rotation on the inoculum was similar to that observed in previous years confirming the beneficial effect of non-cereal crops and fallow in reducing Rhizoctonia pathogen inoculum levels at sowing. Rhizoctonia inoculum levels were lowest immediately after grass free canola, medic pasture and fallow, and highest following cereal. However, the reduction in the inoculum level lasts only for one year as inoculum builds up on the following cereal crop.

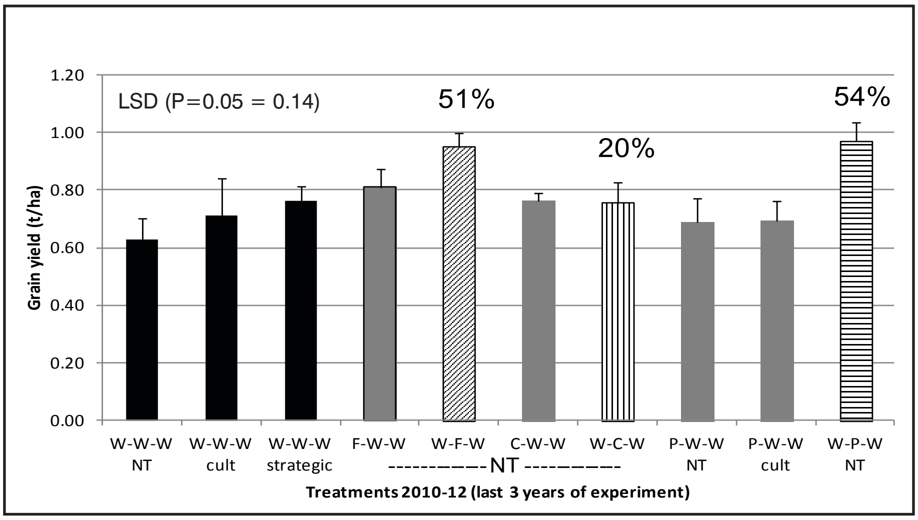

Figure 1 Crop rotation and cultivation effects on wheat grain yield (t/ha) at Streaky Bay, 2012
Percent values for specific treatments represent yield benefit compared to Continuous wheat treatment (W-W-W NT). F=fallow, C=canola, P=pasture-grass free, NT=no-till and cult=cultivated

Observations from 6 other experiments in the lower rainfall cropping region in southern Australia (SA, Vic and NSW) indicated that grass free canola, mustard, chickpeas, field peas, vetch, medic pasture and fallow can result in significant reductions in the Rhizoctonia inoculum in a cropping sequence. In general, the effect of non-cereal crops on reducing inoculum was greater than the effect of summer cultivation in continuous wheat rotation (Figure 2). Rhizoctonia inoculum levels were generally higher in the surface 0-5 cm soil compared to that in 5-10 cm soil. A significant build-up in the Rhizoctonia inoculum levels was seen in all treatments within the 2012 wheat cropping season and at the harvest inoculum DNA levels were more than 600 pg DNA/g soil in all treatments. Therefore, following the dry spring in 2012, risk of Rhizoctonia is likely to be high in 2013 if the lack of rain in summer/autumn continues. Rhizoctonia disease risk will be even greater for crops with slow early root growth (e.g. caused by cold soil, low N, compaction layers etc.).

Cereal crops build-up the inoculum until crop maturity and the increase is significantly higher in the surface 0-5 cm soil. Infection of crown roots and subsequent growth of Rhizoctonia fungus contributes significantly to this inoculum build-up within the cereal crops. Lower inoculum levels following non-cereal rotations reflected in lower disease incidence compared to that in continuous wheat (Figure 3) and the results are consistent during the 4 seasons of the experiment. These results clearly indicate that crop rotation can be used as an effective management tool against Rhizoctonia disease.

Rhizoctonia disease incidence, as measured at 7 weeks after sowing, was generally higher in 2012 compared to that in previous years (Table 1). The level of Rhizoctonia disease incidence is due to a combination of inoculum level, level of microbial activity, N levels at seeding and soil temperature and moisture during the seedling growth stage.

Microbial activity levels were low during 2012 compared to that in the previous two years (Table 1) which corresponded with higher disease incidence even with similar inoculum levels. In addition, minimum temperatures during the seedling stage in 2012 were lower (0.5-1.5°C during June to August) compared to the previous three seasons which would have contributed to the higher disease incidence.

Table 1 Seasonal differences in the soil microbial activity and diversity and the incidence of Rhizoctonia disease in wheat crop

Crop Season	Catabolic diversity	Microbial activity	Disease incidence
2009	7.5	0.15	2.95
2010	14.0	0.26	1.75
2011	9.1	0.20	1.95
2012	8.3	0.18	3.12

Note: catabolic diversity is an index of microbial diversity based on ability to utilize different carbon substrates.

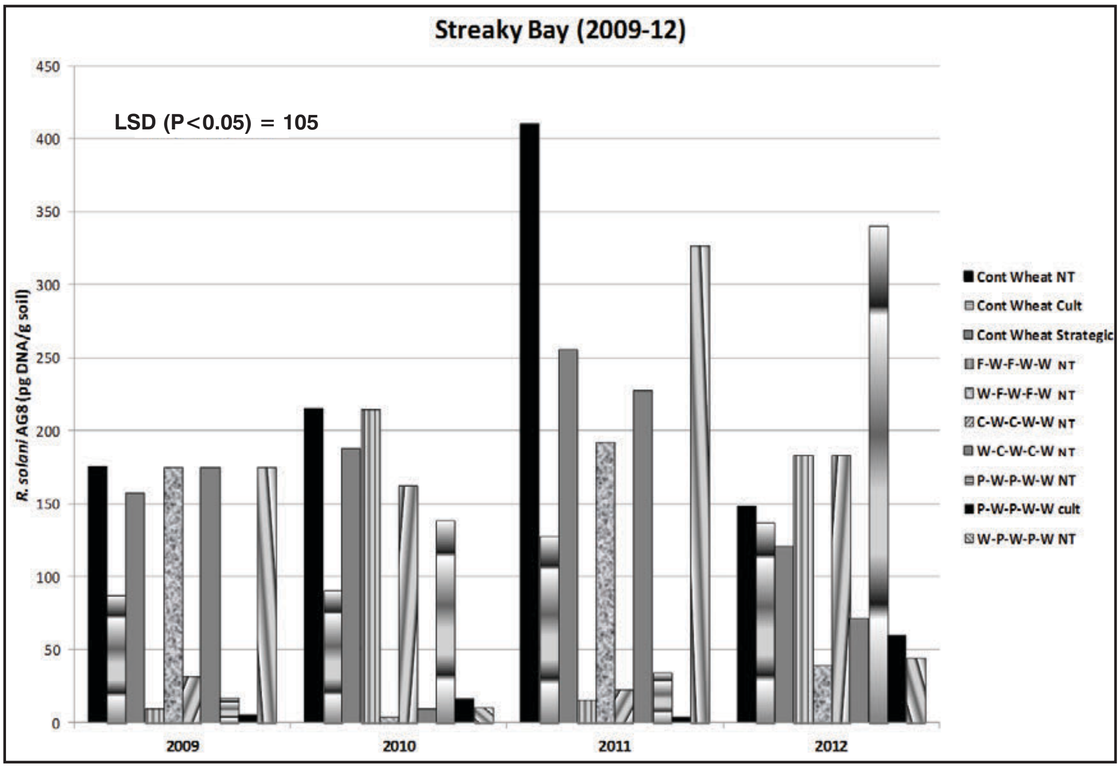

Figure 2 Crop rotation and cultivation effects on the Rhizoctonia solani AG8 inoculum levels in soil at sowing of wheat crops during 2009 to 2012. Legend indicates crop type / treatment from 2008-12. *Wheat was grown in all plots during 2012. F=fallow, C=canola, P=pasture, NT=no-till and cult=cultivated*

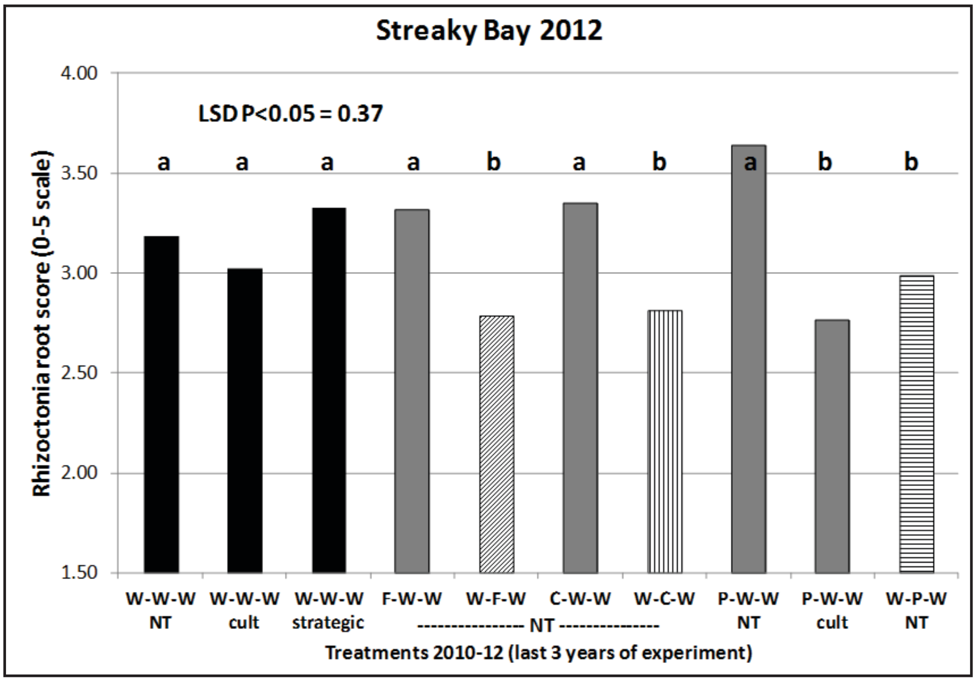

Figure 3 Rhizoctonia disease incidence in wheat crop during 2012 as influenced by crop rotation and tillage treatments
Treatment averages with different letters are significantly different from each other at P<0.05.

Severe damage from Rhizoctonia infection during the seedling stage (up to 6-8 weeks after germination) generally results in characteristic patches. However, when crops are sown early into warm soils, seminal roots can escape severe Rhizoctonia damage but as the temperature drops below 10°C, the crown roots and seminal roots can still be infected resulting in above-ground symptoms appearing as a general unevenness of the crop instead of distinct patches. If the damage to crop roots continues throughout the spring, it can result in reductions in plant tiller number and grain yield. Crown root infection in the 2012 wheat crop was generally higher (53-80%) compared to that in previous years (average 46%).

What does this mean?

1. Four years of measurements indicate that grass free canola and medic pastures reduced Rhizoctonia inoculum level which resulted in significant increases in yield. The effect of rotation crops is similar to that after a weed free fallow.
2. Crown root infection late into the crop season results in the build-up of *Rhizoctonia solani AG8* inoculum in cereal crops, especially in the surface 0-5 cm soil although inoculum build-up is also seen in the 5-10 cm soil. Observation of infected crown roots late in the season could provide a visual indication of the inoculum build-up.
3. Rhizoctonia inoculum levels generally peak at crop maturity and rain post maturity of a crop causes a decline in inoculum. Major rainfall events over summer can reduce inoculum from a high to low risk situation.
4. Multiple significant summer rainfall events that keep soil moist cause Rhizoctonia to decline but prolonged dry periods that allow the soil to dry out would result in the recovery of inoculum levels.
5. Rhizoctonia damage to crown roots can result in significant loss (>10%) in wheat grain yield.

Future research will:

- improve our understanding of the role of summer weeds and other rotation crops.
- develop more reliable disease prediction based on Rhizoctonia inoculum levels and possibly tests for microbial community structure that affect disease risk.
- develop techniques to band fungicides to improve disease control (Fungicide project – SARDI).

Disease

Acknowledgements

Financial support for this project is provided by the GRDC and CSIRO. Thanks to the Williams and Goosay families for allowing us to have trials on their property.

CSIRO GRDC Grains Research & Development Corporation SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Farmer best bet demonstrations for Rhizoctonia management

Amanda Cook[1], Nigel Wilhelm[1], Wade Shepperd[1], Ian Richter[1] and Peter Telfer[2]

[1]SARDI, Minnipa Agricultural Centre, [2]SARDI, Waite

Searching for answers

Location:
Warramboo
Rainfall
Av. Annual: 300 mm
2012 Total: 204 mm
2012 GSR: 141 mm
Yield
Potential: 1.0 t/ha (W)
Actual: 1.3-1.5 t/ha (W)
Soil
Calcareous loamy sand

Location:
Wynarka (near Karoonda)
Rainfall
Av. Annual: 335 mm
Av. GSR: 238 mm
2012 Total: 294 mm
2012 GSR: 1221 mm
Yield
Potential: 2.6 t/ha (B)
Actual: 3.7 t/ha (B)
Soil
Sand over sandy loam

Location:
Streaky Bay
Rainfall
Av. Annual: 298 mm
Av. GSR: 243 mm
2012 Total: 205 mm
2012 GSR: 156 mm
Yield
Potential: 1.2 t/ha (W)
Actual: 1.0 t/ha (W)
Soil
Highly calcareous grey loamy sand

Key messages

- **2012 was a set up year for the Rhizoctonia best bets demonstrations.**
- **Fungicides banded with fluid fertilisers at seeding did not reduce Rhizoctonia in the following cereal crop.**

Why do the demonstration?

After a resurgence in Rhizoctonia research over the last decade, our understanding of this difficult to manage disease has increased substantially. The aim of the project summarised in this article is to use the latest findings from this Rhizoctonia research to demonstrate the collective value of 'best bet' strategies in broad acre environments of the upper EP in comparison to current farming practices. This SAGIT funded project will be looking at the impact of break crops on Rhizoctonia inoculum in 2013 and of crop management on disease expression in the following cereal crop. However, the opportunity was also taken to monitor some farmer activities in 2012 which may impact on Rhizoctonia.

How was it done?

Within the demonstration areas of the paddock four replicated sampling lines were established to measure and collect data. Three sites were monitored – banded fungicides at Warramboo and Wynarka (southern Mallee) and canola at Piednippie. Paddock history, PreDicta B disease inoculum levels (RDTS), soil moisture, soil fertility, plant density, Rhizoctonia patch and root score, grain yield and quality were taken from both the "district practice" part of the paddock and "Rhizoctonia control" part. Each demonstration had treatments located parallel to each other, a minimum of one seeder width and greater than 500 m in length. The sampling lines were established across the treatments.

Kane & Veronica Sampson, Warramboo

In 2012 Kane included fungicides in a fluid fertiliser but he also applied some strips without fungicide, so the +/- fungicide strips were monitored for Rhizoctonia disease incidence. The paddock was sown on 28 May with Axe wheat @ 65 kg/ha using fluid fertiliser with 6 units P, 9 units N and trace elements (TE) of 1.5 kg/ha each of elemental Mn and Zn. The previous paddock rotation was; 2011 Mace wheat; 2010 pasture; 2009 barley.

Three fungicide treatments were used, one had active ingredient (Triadimefron 125 g/L) @ 500 ml/ha, another had an active ingredient of 250 g/L Flutrifol @ 400 ml/ha. The control was the fluid fertiliser and TE mix only. Note: these fungicides are registered for control of cereal leaf diseases (mainly rusts) not Rhizoctonia. One of each fungicide and one control were sown with two seeder widths and approximately 1 km in length. They were located parallel to each other along the paddock fence line. Four sampling lines within each strip were monitored during the season. 4 x 10 m strips were harvested with the small plot harvester for grain yield and quality.

What happened?

The PreDicta B disease inoculum levels of risk were all in the below detection/low level for Take-all, Crown Rot, Cereal Cyst Nematode and Pratylenchus neglectus. The *Rhizoctonia solani AG8* risk was high with 296 pg DNA/g soil.

The paddock had undulating sandhills with shallow flats and the initial soil data taken from four sites across the soil and treatments areas and bulked (Table 1) shows a soil pH of 7.9 with adequate phosphorus and nitrogen levels.

Table 1 Initial soil data for Warramboo fungicide demonstration, 2012

Soil depth (cm)	Water volumetric (mm)	Nitrate N (mg/kg)	Ammonium N (mg/kg)	Estimated Mineral N 0-60 cm (kg/ha)	Colwell P (mg/kg)	Organic C (mg/kg)	EC (dS/m)	pH ($CaCl_2$)	Chloride (mg/kg)
0-10	12	2	2	5	34	2.4	0.35	7.9	1.92
10-40	40	24	1	86					
40-70	29	8	1	29					
70-100	Rock at depth (in flats - rock in 50-60 cm zone)								

Table 2 The effect of banded fungicides on dry matter, disease and grain yield of wheat at Warramboo, 2012

	Control	Flutrifol	Triadimefron	*F prob (P=0.05)*
Early dry matter (g/plant)	0.12	0.12	0.11	*ns**
Rhizoctonia patch score**	1.9	1.4	1.7	*ns*
Rhizoctonia patch severity***	1.2	1.0	1.3	*ns*
Rhizoctonia root infection****	1.0	1.3	1.1	*ns*
Average number of crown roots	10.3	9.3	7.6	*ns*
% Rhizoctonia crown roots infection	83	45	77	*LSD=21*
Grain yield (t/ha)	1.57	1.54	1.27	*LSD=0.10*
Grain protein (%)	13.8	13.3	13.7	*ns*
Grain moisture (%)	9.5	9.5	9.6	*ns*
Screenings in grain (%)	3.5	2.3	4.4	*ns*
1000 grain weight (g)	30.9	33.3	29.1	*ns*
Test weight (g/hL)	77.2	76.1	77.4	*ns*

** ns=all treatments similar, ** number plants affected by Rhizoctonia of 5 selected plants across a row, scored every 2m, *** scored every 2m where 0=no Rhizoctonia damage and 5=severe Rhizoctonia damage, **** plants roots visually scored for Rhizoctonia root damage where 0=no Rhizoctonia damage and 5=severe Rhizoctonia damage.*

In 2012 there was less than expected Rhizoctonia disease incidence as the paddock was the last sown in cold conditions. There were no differences with the added fungicides to Rhizoctonia disease incidence, root infection and plant growth early in the season (Table 2). However, there was some Yellow Leaf Spot (YLS) in the crop early and although it isn't registered for YLS control, the Flutrifol treatment looked slightly better earlier in the season. There was a difference with crown root infection later in the season, but this did not improve grain yield at maturity. The lower yield in the Triadimefron may be due to the location of this treatment in the shallower zone of the paddock rather than the sides of the sand hills where the other treatments were located.

The results at harvest suggested that Triadamefron reduced grain yield but there were no differences measured in grain quality.

Stuart Pope, Wynarka (near Karoonda), southern Mallee

In 2012 Stuart used fungicides in his fluid fertiliser, so the demonstration was monitored for any differences in disease incidence in barley.

The paddock received regular summer sprays to keep the paddock clean of weeds. The paddock was sown with Scope barley on 21 May with a Morris Concept seeder in a one pass operation. Fertiliser was 27:12 banded below the seed @ 75 kg/ha. Five L/ha of a fluid trace element mix was also banded under the seed with 80 g/L of Zn sulphate, 60 g/L of Mn sulphate and 20 g/L of Cu sulphate.

Herbicides used prior to seeding were Glyphosate and MCPA amine two weeks before seeding, then Gramoxone, Trifluralin and Metribuzin immediately prior to seeding. The paddock also had 40 g/ha of On Duty® applied in June for brome grass control. The previous paddock history was; 2011 Mace wheat (2.3 t/ha); 2010 lupins; 2009 barley.

The fungicide used was 250 gm/L Flutrifol at a rate of 400 ml/ha. Note: this fungicide treatment is registered for control of cereal leaf diseases (rusts) not Rhizoctonia. The control was one seeder width where the fluid delivery system was turned off, so this area received 75 kg/ha of granular fertiliser at seeding but no fungicide and no fluid trace element mix. 50 kg/ha of urea was also applied to the whole paddock in late July.

Two control strips were sown, one seeder width wide with the fungicide treatment located either side and between them. Four sampling points were located within each treatment, giving 12 fungicide and 8 control measurements. 10 m strips were harvested at 4 points within each of the 3 treatments, with the small plot harvester for grain yield and quality.

Table 3 Soil data for the Wynarka (Mallee) paddock demonstration, 2012

Soil depth (cm)	Water volumetric (%)	Nitrate N NO_3 (mg/kg)	Ammonium N NH_4 (mg/kg)	Total Mineral N 0-60 cm (kg/ha)	Colwell P (mg/kg)	Organic C (%)	EC (dS/m)	pH ($CaCl_2$)
0-10	8.4	5	8	16	5	0.77	0.07	6.7
10-40	9.8	3	3	22	3			
40-70	26.3	7	4	40	7			
70-100	27.4	9	2	40	9			

Table 4 The effect of fungicides and trace elements on dry matter, disease and yield of barley at Wynarka (Mallee), 2012

	Control	Flutrifol + Trace Element mix	*F prob (P=0.05*
Plant establishment (plants/m^2)	120	123	*ns**
Early dry matter (g/plant)	0.63	0.61	*ns*
Rhizoctonia patch score**	1.05	0.66	*ns*
Rhizoctonia patch severity***	0.93	0.55	*ns*
Rhizoctonia root infection****	1.29	1.31	*ns*
Average number of crown roots	8.7	9.0	*ns*
% Rhizoctonia crown roots infection	3.19	3.84	*ns*
Grain yield (t/ha)	3.70	3.92	*ns*
Grain protein (%)	9.92	9.96	*ns*
Grain moisture (%)	10.8	10.8	*ns*
Screenings in grain (%)	6.2	4.1	*ns*
1000 grain weight (g)	77.2	76.1	*ns*
Test weight (g/hL)	89.8	90.2	*ns*

** ns=all treatments similar, ** number plants affected by Rhizoctonia of 5 selected plants across a row, scored every 2m, *** scored every 2m where 0=no Rhizoctonia damage and 5=severe Rhizoctonia damage, **** plants roots visually scored for Rhizoctonia root damage where 0=no Rhizoctonia damage and 5=severe Rhizoctonia damage.*

What happened?

The PreDicta B disease inoculum levels of risk were all in the below detection/low level for Take-all, Crown Rot, Cereal Cyst Nematode and *Pratylenchus neglectus*. The *Rhizoctonia solani AG8* risk was low with 2-24 pg DNA/g soil.

The soil type is sand over sandy loam (Karoonda dune swale) with a pH of 6.7, and lower nitrogen at depth compared to the EP soils.

A good break to the season, early sowing in warmer conditions and good nutrition levels allowed the crop to establish well. The low initial Rhizoctonia inoculum level and the seasonal conditions resulted in low Rhizoctonia symptoms in this paddock this season.

The Mallee and Warramboo sites, sown to barley and wheat respectively, showed large differences in Rhizoctonia crown root infection despite a similar number of crown roots (Table 4). Crown roots develop depending on the seasonal conditions and the number of tillers. Barley is generally more susceptible to Rhizoctonia infection and Rhizoctonia disease symptoms but the initial Rhizoctonia inoculum level was much lower at the Mallee site. Greater infection may have also occurred at the Warramboo site due to plant stress, especially lack of soil moisture from August onwards.

There were no differences due to treatments in grain yield or grain quality at this site.

Dion, Nev and Karen Trezona, Piednippie

A paddock with a high grass history was sown to canola in 2011. The paddock had a seeder strip which was a fallow with some medic and a few weeds (melon and milk thistle). This area was monitored in the 2012 season after being over-sown with wheat, for any differences in Rhizoctonia disease incidence.

The paddock was sown with Mace wheat @ 60 kg/ha on 12 June with 50 kg/ha of DAP (18:20:0:0). The previous paddock history was; 2011 Telfer canola (TT); 2010: Marloo oats, 2009 Wyalkatchem wheat.

The 2011 canola crop was CB Telfer, which is a TT canola. It was sown @ 3 kg/ha with 65 kg/ha DAP (18:20:0:0). It received a post sowing application of Terbyne®, then Targa® (grass control) and Lorsban® (insect control) approximately 6 weeks after sowing. The active ingredient in Terbyne® is Terbuthylazine (750g/kg), a triazine herbicide. Terbyne® is a group C herbicide which provides pre-emergent weed control in pulses and TT canola which has less of a plant back period than atrazine or simazine.

Table 5 Initial soil data for paddock demonstration, Piednippie 2012

Soil depth (cm)	Water volumetric (mm)	Nitrate N NO_3 (mg/kg)	Ammonium N NH_4 (mg/kg)	Total Mineral N 0-60 cm (kg/ha)	Colwell P (mg/kg)	Organic C (mg/kg)	EC (dS/m)	pH ($CaCl_2$)	Chloride (mg/kg)
0-10	9	1.0	1.00	3	34	1.45	0.26	7.70	1.87
10-40	30	31.3	2.50	135			0.92		
40-70	25	50.0	4.05	112			1.45		
70-100	24	72.6	5.63	108			2.14		

Table 6 The effect of two break options on wheat dry matter, disease and yield at Piednippie, 2012

	TT Canola	Fallow/medic	*F prob (P=0.05)*
Early dry matter (g/plant)	0.17	0.16	*ns**
Rhizoctonia patch score**	0.75	1.07	*ns*
Rhizoctonia patch severity***	0.3	0.6	*ns*
Rhizoctonia root infection****	0.9	0.8	*ns*
Average number of crown roots	7.0	8.0	*ns*
% Rhizoctonia crown roots infection	4.2	5.5	*ns*
Grain yield (t/ha)	0.96	0.97	*ns*
Grain protein (%)	11.7	11.7	*ns*
Grain moisture (%)	9.5	9.5	*ns*
Screenings in grain (%)	2.2	6.7	*LSD=1.4*
1000 grain weight (g)	35.9	32.9	*ns*
Test weight (g/hL)	80.5	78.5	*LSD=1.9*

** ns=all treatments similar, ** number plants affected by Rhizoctonia of 5 selected plants across a row, scored every 2m, *** scored every 2m where 0=no Rhizoctonia damage and 5=severe Rhizoctonia damage, **** plants roots visually scored for Rhizoctonia root damage where 0=no Rhizoctonia damage and 5=severe Rhizoctonia damage.*

GPS co-ordinates of the fallow strip were taken at the first sampling and marker pegs were placed in the fence line. The whole paddock was sown by the farmer. The canola strip monitored during the season was located one seeder width east of the fallow strip. Four sampling points were located within each treatment. 4 x 10 m strips were harvested with the small plot harvester for grain yield and quality.

What happened?

The PreDicta B disease inoculum levels of risk for the canola and fallow areas were all in the below detection level for Take-all, Crown Rot, Cereal Cyst Nematode and low risk for *Pratylenchus neglectus.* The *Rhizoctonia solani AG8* risk was high with 212 pg DNA/g soil after canola and medium 116 pg DNA/g soil after the fallow.

The soil test data showed a soil pH of 7.7 in a grey calcareous sandy loam with adequate phosphorus levels and high nitrogen levels (Table 5).

There were no differences in Rhizoctonia disease incidence or yield in the paddock demonstration (Table 6). The Rhizoctonia inoculum level was higher than expected in both the canola and fallow/medic but this may have been due to several factors; a simazine type product being used in 2011 on the canola crop which might increase root damage; lower plant density in the canola crop due to mice damage; and a history of grass issues in this paddock. There were some differences in grain quality with the canola area having less screenings and a higher test weight.

What does this mean?

Two of the farmers involved were using fungicide treatments with fluid systems and these were monitored for differences in Rhizoctonia disease incidence. There were no differences in early Rhizoctonia disease incidence in any of the fungicide treatments used by farmers in 2012.

Previous research on Eyre Peninsula with canola has shown a reduction in Rhizoctonia inoculum levels and differences in disease incidence following canola compared to cereals. On Eyre Peninsula fallow treatments and medic treatments have also reduced Rhizoctonia inoculum disease levels compared to cereals. Following a canola crop the paddock is generally sown to wheat and sown earlier as grass weeds have been controlled in the previous season. These factors give the plants a greater chance to be less affected by Rhizoctonia as seen at Piednippie, and this paddock was the highest yielding paddock on this farm in 2012.

The impact of break crops on Rhizoctonia inoculum and of crop management on disease expression in the following cereal crop will continue to be monitored in 2013.

Acknowledgements

Thanks to the Sampson, Trezona and Pope families for having these demonstrations on their properties. Thanks to Tanja Morgan, Chris McDonough, Rebecca Tonkin, Ian Ludwig and others involved in helping with the Mallee site.

Rhizoctonia inoculum levels and rotations

Amanda Cook[1], Wade Shepperd[1], Nigel Wilhelm[2] and Ian Richter[1]

[1]SARDI, Minnipa Agricultural Centre , [2]SARDI, Waite

RESEARCH

Searching for answers

Location: Streaky Bay
K & D Williams
Streaky Bay Ag Bureau

Rainfall
Av. Annual: 298 mm
Av. GSR: 243 mm

Soil
High calcareous grey loamy sand

Plot Size
60 m x 1.48 m

Disease
Rhizoctonia

Livestock
Trial was not grazed since 2004

Key messages

- **Canola and medic will reduce Rhizoctonia inoculum but only one year of cereal will result in high levels of Rhizoctonia inoculum again.**
- **Disease suppression has not developed in this environment despite it happening within the same time frame in other environments.**

Why do the trial?

A long term trial was established at Streaky Bay in 2004 to determine if disease suppression against rhizoctonia is achievable in an upper EP environment on a grey highly calcareous soil. It also assessed whether soil microbial populations can be influenced by rotation and fertiliser inputs in this environment.

How was it done?

This trial was established in 2004 (see previous EPFS Summaries for treatments and rotations). The DNA based testing service PreDicta® B was used to monitor disease inoculum levels in autumn (March-May) annually.

What happened?

Rhizoctonia inoculum level was strongly influenced by crop type (Figure 1) with both canola and medic (both grass free) having reduced Rhizoctonia inoculum levels but inoculum levels increased again following one wheat crop. Barley did not increase Rhizoctonia inoculum levels as much as wheat. However, Rhizoctonia infection on barley roots 6 to 8 weeks after seeding was similar or greater than wheat with the same inoculum level (Figure 2).

Fertiliser management did not affect inoculum levels or root infection (Figures 1 and 2). However, fluid fertiliser applications showed greater early dry matter (data in previous EPFS Summary articles) and increased grain yield, especially in higher rainfall seasons.

In 2009, surface soils were assessed for potential disease suppression to Rhizoctonia using a pot bioassay and disease suppression was similar in all rotations (EPFS Summary 2009, p 79). In spring of 2011, all cereals were severely affected by Take-all disease (EPFS Summary 2011, p 76). If biological disease suppression had developed, it should have controlled both Rhizoctonia and Take-all. This indicates that disease suppression had not been achieved in this soil type even after eight years of management styles which have created suppression in other environments (Avon) within this timeframe.

What does this mean?

After eight years of several rotations and fertiliser management combinations, it has been shown that canola and grass-free medic have the ability to lower Rhizoctonia inoculum levels for one season compared to a wheat crop, but the inoculum will increase again following one wheat crop.

In good seasons, the district practice treatment has shown that the yield is limited by nutrition, mainly phosphorus. Changing rotation and nutrition have changed the microbial population and diversity after eight years but disease suppression has not developed in this soil type and environment.

Acknowledgements

We would like to sincerely thank the Williams family for supporting MAC and research by having the trial on their property, and the Streaky Bay Ag Bureau for taking a very active interest in this research.

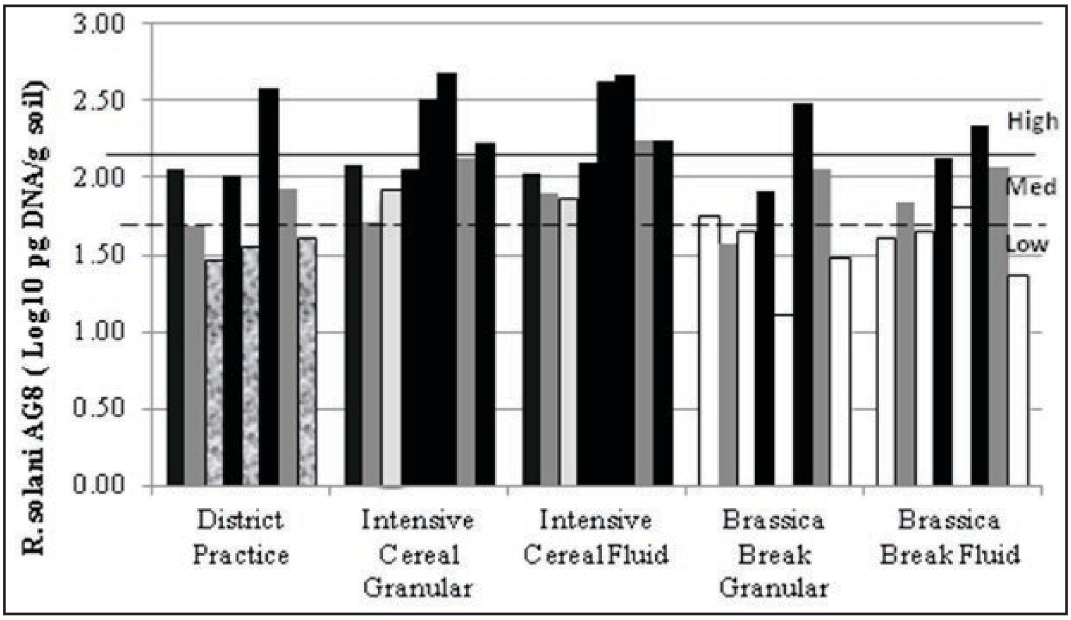

Figure 1 Rhizoctonia inoculum in the top 10 cm of soil at the beginning of each season (2005-2012) for each treatment of the field trial at Streaky Bay

Black bars – following wheat, dark grey - following barley, light grey - following triticale, grey pattern - following medic, white – following canola.

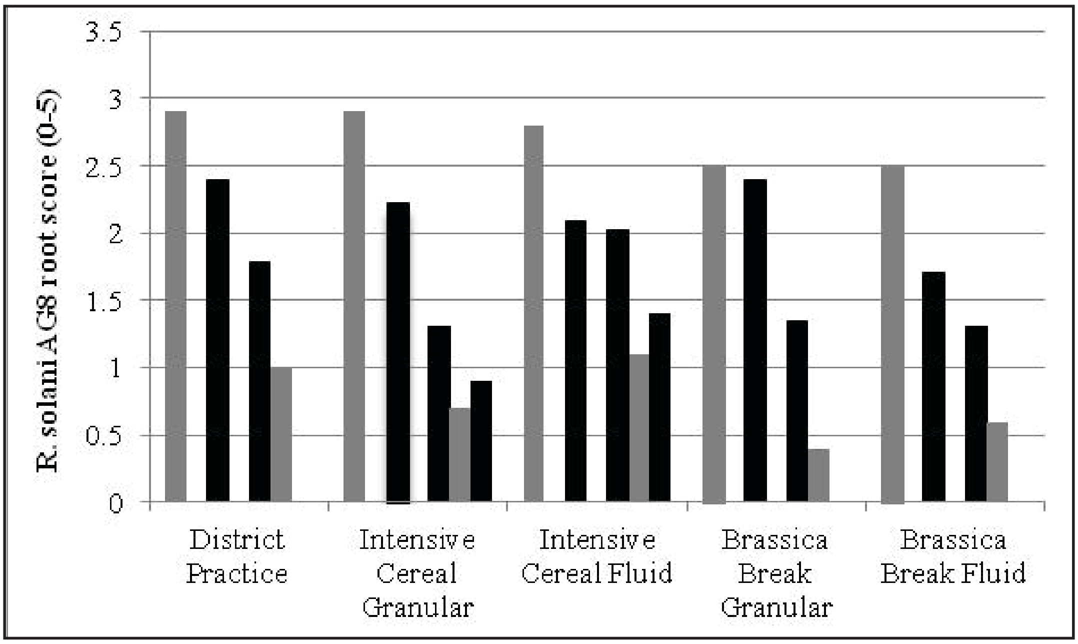

Figure 2 Rhizoctonia root score of cereal plants at 6-8 weeks post seeding (rating 0-5 where 0=no damage, 5=severe root damage) from 2005-2010 at Streaky Bay

Black bars - wheat, dark grey – barley.

Disease

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

Summer rain reduces Rhizoctonia inoculum

Amanda Cook[1], Nigel Wilhelm[1], Gupta Vadakutta[2], Wade Shepperd[1] and Ian Richter[1]

[1]SARDI, Minnipa Agricultural Centre, [2]CSIRO Waite

Searching for answers

Location: Streaky Bay
Phil Wheaton
Streaky Bay Ag Bureau
Rainfall
Av. Annual: 298 mm
Av. GSR: 243 mm
2012 Total: 265 mm
2012 GSR: 222 mm
Yield
Potential: 3.0 t/ha (B)
Actual: 0.63 - 0.78 t/ha (B)
Paddock History
2012: Commander barley
2011: Hindmarsh barley
2010: Pasture (80% medic)
2009: Pasture (60% medic)
Soil Type
High calcareous grey loamy sand
Plot Size
40 m x 6 m x 4 reps
Other factors
Rhizoctonia, later sown, cold winter

Location: Minnipa Ag Centre, N4
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2012 Total: 249 mm
2012 GSR: 185 mm
Yield
Potential: 2.0 t/ha (B)
Actual: 0.74 - 0.87 t/ha
Paddock History
2012: Hindmarsh barley
2011: Mace wheat
2010: Mace wheat
2009: Pasture
Soil Type
Red sandy loam
Plot Size
40 m x 6 m x 4 reps
Other factors
Rhizoctonia, double sown, cold winter

Key messages

- **In the absence of any summer weeds, major rainfall events at both sites generally resulted in a decline in Rhizoctonia inoculum.**
- **There was an increase in soil moisture conservation in the treatments which controlled summer weeds.**

Why do the trial?

Previous studies have shown that substantial rainfall events over summer can reduce rhizoctonia inoculum. This work has been conducted in trials where summer weeds were completely controlled. This project investigated the impact of not controlling summer weeds on Rhizoctonia inoculum levels over the summer of 2011/12.

How was it done?

Two trials were established at the end of the 2011 harvest, one located at the Minnipa Agricultural Centre, N4, and the other at Phil Wheaton's, Streaky Bay. The Minnipa site was chosen due to a high density of fleabane *(Conyza bonariensis)* and potato weed (*Heliotropium europaeum*). The Streaky Bay site targeted Lincoln weed *(Diplotaxis tenuifolia*).

Treatments for the trials were; Complete summer weed control, No summer weed control, Broad-leaved weed control early - 1st half of the summer (Harvest 2011 to Feb 2012), Broad-leaved weed control late - 2nd half of the summer (March 2012 to sowing 2012). There was no germination of grass weeds from harvest until late April/May 2012 which was only a few weeks before seeding, therefore the Grass weed control treatments were not applied and were the same as No weed control treatments. Also at Streaky Bay, no further control was required in the Complete weed control treatment after the first application so this treatment became the same as broad-leaved weed control early (Table 1).

Soil samples collected during the summer months were analysed for soil moisture and *R. solani AG8* DNA.

These treatments were designed to test not only the impact of types of summer weeds on Rhizoctonia inoculum over summer but also the timing of their control.

Treatments and operations were imposed as listed in Table 1. At the Streaky Bay site the weeds recorded in the No summer weed control in early May 2012 were Lincoln weed (large and also recently emerged ones), soursob, medic, and recently emerged self sown cereal, ryegrass and barley grass. At Minnipa in the No summer weed control the weeds recorded in late April 2012 were fleabane, potato weed, melon, milk thistle, buck bush, Lincoln weed, marshmallow, prickly lettuce, turnip and recently emerged self sown cereal and medic.

In the 2012 season barley was sown by the farmers using a one pass narrow point seeder (details in Table 1). Barley was chosen to follow the summer weed control trials because it displays Rhizoctonia patches more readily than wheat.

Barley at both sites was monitored for Rhizoctonia disease incidence and growth (Table 2).

What happened?

The chemical spray treatments imposed resulted in differences in weed populations with the complete weed control treatment being weed free, the early broad-leaved weed control being relatively weed free until late April and the late broad-leaved control had some larger weeds until controlled in early March (Figure 1). Significant rainfall events occurred over summer (Figures 3 & 4) with the largest being 21 mm of rainfall on 8 January 2012 at Minnipa. 15 mm of rainfall occurred at Streaky Bay also on 8 January 2012. Both sites had decile 3 rainfall in 2012.

Table 1 Weed control treatments imposed at Streaky Bay and Minnipa sites

Streaky Bay	Complete weed control	Broad-leaved control Early	Broad-leaved control Late
21 Dec 2011	1.2 L/ha Roundup Powermax, 850 ml/ha LVE Ester680, 300 ml/ha LI 700		
7 March 2012			1.2 L/ha Roundup Powermax, 850 ml/ha LVE Ester 680, 300 ml/ha LI 700
9 May 2012	Whole site sprayed with 1.5 L/ha Sprayseed		
13 June 2012	Whole site sprayed with 800 ml/ha Credit bonus + 800 ml/ha Trifluralin. Paddock sown with 70 kg/ha Commander barley with 40 kg/ha 18:20:0:0 (DAP). Paddock was baited for snails twice.		
Minnipa Ag Centre	**Complete weed control**	**Broad-leaved control Early**	**Broad-leaved control Late**
21 Dec 2011	1.2 L/ha Roundup Powermax, 850 ml/ha LVE Ester680, 300 ml/ha LI 700		
1 Feb 2012	1.5 L/ha Gramoxone		
15 March 2012	1.2 L/ha Roundup Powermax, 850 ml/ha LVE Ester 680, 300 ml/ha LI 700		1.2 L/ha Roundup Powermax, 850 ml/ha LVE Ester 680, 300 ml/ha LI 700
14 May 2012	Whole site sprayed with 500 ml/ha LVE Ester 680, 200 ml/ha LI 700 and 100 ml/ha Striker. Paddock sown with 60 kg/ha Hindmarsh barley with 60 kg/ha 18:20:0:0 (DAP).		
6 June 2012	There was a late germination of barley grass so farm management decided to inter-row sow part of paddock with 35 kg/ha Hindmarsh barley with 60 kg/ha 18:20:0:0 (DAP) to improve competition. Unfortunately, this second seeding pass went through the trial area and buried some of the initial crop, resulting in a second germination and complicated the identification of disease symptoms.		

Rhizoctonia disease inoculum

At Minnipa the Rhizoctonia inoculum levels in all treatments and at all times were within the high disease risk category for *Rhizoctonia solani AG8* (above 120 pg DNA/g soil).

The rainfall event at Minnipa on 8 January caused a germination of weeds (Figure 3). In the absence of any summer weeds (Complete weed control and Early broad-leaved weed control treatments) summer rainfall events generally were associated with a decline in Rhizoctonia inoculum (Figure 3). This trend supports previous GRDC research on EP and in the Mallee.

In the presence of high populations of broad-leaved weeds the Rhizoctonia inoculum levels were highly variable and no clear trends were present.

At Streaky Bay, Rhizoctonia disease inoculum levels of weed control treatments were all in the high Rhizoctonia disease risk category at all times. The highest rainfall event at Streaky Bay occurred on 8 January with 15 mm. In the absence of weeds (the Complete and Early broad-leaved weed control treatments) Rhizoctonia inoculum declined with the rainfall events, which supports previous research.

1a Complete weed control ***1b No weed control*** ***1c Broad-leaved weed control early***

Figure 1a, b & c. Weed control treatments at Streaky Bay site on 26 April 2012

2a Complete weed control 2b No weed control 2c Broad-leaved control early

Figure 2a, b & c. Rhizoctonia disease incidence in weed control treatments at Streaky Bay site on 28 August 2012

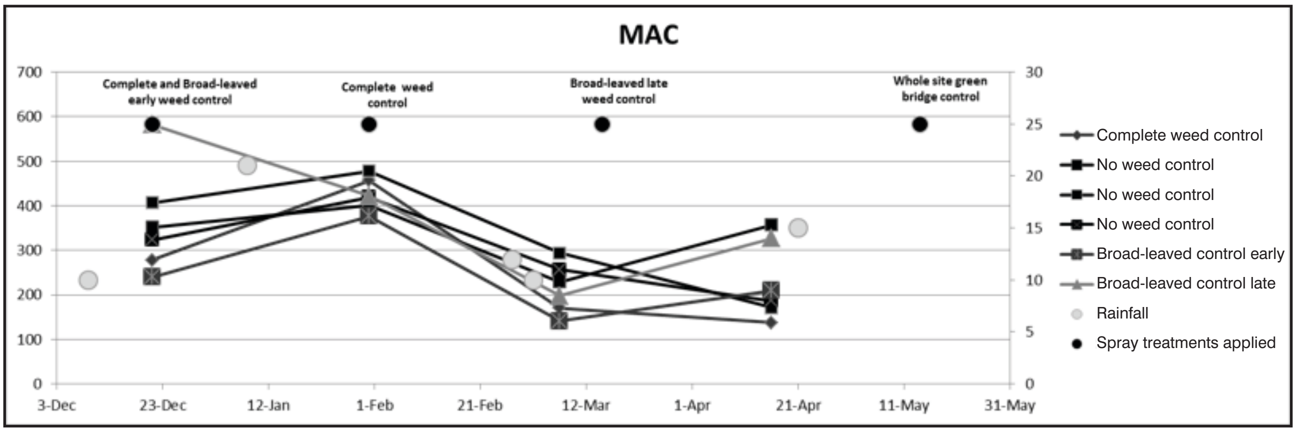

Figure 3 Rhizoctonia inoculum level (left hand axis, pg DNA/g soil) in weed control treatments and rainfall (right hand axis, mm) events at Minnipa, 2011/12

No clear trends were present in the No weed control and late broad-Leaved weed control treatments because of high variability in inoculum levels in the presence of broad-leaved summer weeds. Increased variation in Rhizoctonia inoculum levels may have been due to the wider plot size used in these trials to accommodate the patchy nature of summer weed populations.

A similar trial at Karoonda (conducted as part of the GRDC Rhizoctonia project by CSIRO) in the SA Mallee, showed that declines in inoculum level were greater with complete weed control and intermediate with incomplete weed control. The Mallee site had 2 m plots, grassy weed germinations over the summer period and the Rhizoctonia inoculum levels at this site were lower than the EP sites (90 to 200 pg DNA/g soil).

Rhizoctonia disease incidence in barley

The soil moisture measured in both trials before seeding showed similar results with the Complete weed control and Early broad-leaved weed control having greater stored soil moisture than the No weed control, an extra 14 and 10 mm respectively at Minnipa, 14 and 13 mm at Streaky Bay (Table 2). At Streaky Bay there was an increase in grain yield with the Complete and Early weed control compared to No weed control (Table 2).

Early barley growth in the later 13 June sown trial at Streaky Bay was similar in all treatments. The high Rhizoctonia inoculum levels resulted in severe disease symptoms in all treatments in this paddock due to the late break and very cold conditions after seeding (Figure 2). The Rhizoctonia root scores were similar in all treatments (Table 2).

At Minnipa the earlier 14 May sowing showed differences in dry matter with the Broad-leaved control plots having greater plant dry matter; however there were no differences in the second 6 June time of sowing (Table 2). The Rhizoctonia root scores showed no differences in either trial, however the second time of sowing at Minnipa in the same paddock showed greater disease symptoms than the earlier time of sowing.

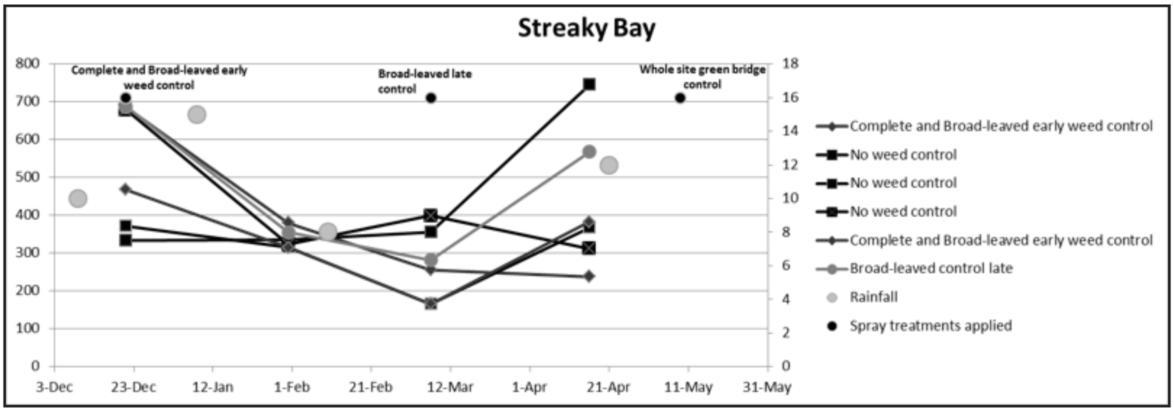

Figure 4 Rhizoctonia inoculum level (left hand axis, pg DNA/g soil) in weed control treatments and rainfall (right hand axis, mm) events at Streaky Bay, 2011/12

Table 2 Soil moisture, dry matter and Rhizoctonia root score and incidence at Streaky Bay and Minnipa, 2012

Streaky Bay	**Complete & Broad-leaved early weed control**		**Broad-leaved control Late**	**No weed Control**	***LSD (P=0.05)***
Vol. Soil Moisture (mm, 0-50 cm, April 2012)	58		44	44	*9*
Dry Matter (g/plant)	0.11		1.11	0.10	*ns*
Rhizoctonia root score	2.1		2.2	2.4	*ns*
Area of disease patches (% of crop)	57		58	51	*ns*
Rhizoctonia average plot patch score (0-3)	2.2		2.2	2.2	*ns*
Yield (t/ha)	0.78		0.70	0.63	*0.12*
Screenings (%)	9.5		9.3	11	*ns*
Minnipa Ag Centre	**Complete & Broad-leaved early weed control**		**Broad-leaved control Late**	**No weed control**	***LSD (P=0.05)***
Vol. Soil Moisture (mm, 0-50 cm, 10 May 2012)	64	60	54	50	*7*
Dry Matter (g/plant) early sown	0.25	0.34	0.31	0.24	*0.05*
Rhizoctonia root score early sown	1.7	1.3	1.6	1.6	*ns*
Rhizoctonia root score late sown	2.4	2.7	2.0	2.5	*ns*
Dry Matter (g/plant) late sown	0.10	0.14	0.12	0.11	*ns*
Yield (t/ha)	0.87	0.84	0.80	0.74	*ns*
Screenings (%)	4.8	5.7	5.7	5.6	*ns*

Rhizoctonia root disease rating (0-5 scale where 0=nil, 5=severe), plant dry matter at 8 weeks after seeding at Streaky Bay and MAC.

Area of disease patches (% of crop) were not taken at Minnipa due to the inability to differentiate visually between Rhizoctonia disease symptoms (less growth) and the second time of sowing (younger, smaller plants).

What does this mean?

This research at Streaky Bay and Minnipa has shown that complete weed control coupled with summer rainfall events resulted in declining Rhizoctonia disease inoculum levels, which supports previous Eyre Peninsula and Mallee research. However in the presence of high populations of broad-leaved summer weeds there was larger variation and no consistent trends could be identified.

Both the Streaky Bay and Minnipa trials had high levels of Rhizoctonia disease inoculum even at the end of the summer period. There were no differences in disease incidence between summer weed control treatments in the following barley crop.

There was an increase in soil moisture conservation when summer weeds were completely controlled, and a yield benefit at Streaky Bay.

Previous research with canola and fallow treatments have shown lowering Rhizoctonia inoculum levels (to low Rhizoctonia disease risk level) has resulted in yield benefits in the following cereal. In this research the high disease inoculum level and seasonal conditions (late sowing and cold temperatures in 2012) resulted in high Rhizoctonia disease incidence in crop.

Acknowledgements

SAGIT for funding this research.

White grain in wheat

Margaret Evans and Hugh Wallwork
SARDI, Waite

Searching for answers

Location:
Buckleboo: Graeme & Heather Baldock
Cleve: Rodney Quinn
Warrow: Matt Micken

Key messages

- **Despite high inoculum levels in paddocks, white grain affected very few crops on EP in 2012 due to dry conditions during flowering and grain fill. White grain trials did not express any white grain symptoms.**
- **Continue to consider white grain as a potential issue in any year where there is a wet spring. This disease is likely to be a continuing problem as the fungi causing white grain can survive on infected cereal residues for at least 24 months and spore production from infected residues occurs over an extended period in the growing season.**
- **Management options for white grain are limited, so it is important to check grain prior to harvest if there has been moisture during grainfill (at least 24 hours of high humidity is needed for infection). Where significant levels of white grain are found it may be possible to adjust harvester settings to reduce the affected grain (which will be lighter than normal grain) going into the bin. It may also be possible to separately harvest different areas of the paddock to maximise returns from wheat deliveries.**
- **There is no evidence to suggest that variety choice or fungicide application will provide a significant or consistent reduction in white grain expression. At least in part, this is because infection can occur over a range of temperatures (15-24°C) and crop growth stages (head emergence to soft dough).**
- **Check cereal residues to assess the risk. Residues from cereals infected with white grain in 2012 will show visual symptoms by the beginning of the 2013 cropping season. This will include slightly raised black fruiting bodies, producing a "scabby" look on nodes. Identification should be confirmed by microscopic examination.**
- **Future research areas suggested by 2012 data include management of infected residues during a break from cereal. Spore development and release was found to be faster in residues which were lying on the ground than in residues which were upright.**
- **Research will continue (2 variety screening trials, 1 fungicide trial) on upper EP in 2013.**
- **An information sheet "White grain in cereals" is available on request from Margaret Evans (marg.evans@sa.gov.au or mob 0427 604 168).**

Why do the trials?

White grain was first observed in bread wheat in South Australia (SA) during the 2010 season harvest and caused rejection and downgrading of deliveries in that year and also in 2011. Although detected across much of South Australia, north eastern Eyre Peninsula (EP) and the Far North were most severely affected by this problem.

White grains can be a symptom of infection by Fusarium head blight/ head scab (not found in SA) and with this disease it means that toxins are present in the affected grain. There is no evidence so far to suggest that white grain in SA is associated with toxins, however, it was this concern which led to rejection of deliveries at grain receival points in 2010 and 2011. Due to this perception that white grain is associated with toxins, it is likely that deliveries with significant levels of white grain will be downgraded or rejected in the future.

The fungus *Botryosphaeria zeae* is the causal agent of white grain in a limited number of cases in SA, but white grain in most samples is due to an unidentified fungus which may belong to a different genus. There is limited information about the epidemiology (disease origin and spread) and management of the fungi causing white grain in wheat in SA, so this research program was designed to explore management options and to acquire the epidemiological data relevant to managing this disease.

How were they done?

Screening for resistance

Seventy bread wheat entries (commercial cultivars and breeders' lines) were acquired from across Australia. These entries represented a broad range of genetic backgrounds, including resistance to fusarium head blight. Trials were undertaken at Buckleboo (70 bread wheat entries), Cleve (69 bread wheat entries) and Coulta (51 bread wheat entries). Small numbers of commercial cultivars of barley, durum wheat, triticale, oat and cereal rye were also included.

The trial design (2 replicates) incorporated check plots (Yitpi and Axe, selected for different maturities) spaced through the area to assess spatial variability in white grain infection.

Fungicides

Two field trials were co-located with the variety screening trials at Cleve and Buckleboo. Axe (early maturity) and Yitpi (late maturity) were used in these trials to give the longest period of crop susceptibility to infection.

The trial, using 6 replicates and 2 times of spraying, was laid out for ease of fungicide application to achieve untreated, single spray and two spray combinations as follows:

- Untreated – Axe and Yitpi
- Single application (flowering) – Axe and Yitpi
- Single application (early grainfill) - Axe
- Single application (head emergence) - Yitpi
- Two applications (flowering + early grain fill) – Axe
- Two applications (heading + flowering) – Yitpi

Epidemiology

1. Aerial dispersal of spores. Two traps were used to collect spores on sticky tapes for assessing when spores of the white grain fungi were present in the air. Both traps were at Buckleboo, one trap in a paddock with infected cereal stubble and one in a paddock with legume residues. An automated weather station provided climatic data to assess the conditions under which spore release occurred.
2. Stubble studies. Stubble from the Buckleboo and Kimba sites were examined monthly from in situ collections and additional stubble was removed to the Plant Research Centre for fortnightly examination. This was done to determine what fruiting bodies look like on stubble and how quickly they produce mature spores and when those spores were released.

What happened?

Varietal screening and fungicide management trials

Trials were successfully sown and harvested but levels of white grain were too low to see treatment effects or to draw conclusions as the dry conditions during grainfill meant that conditions were not conducive to infection by the white grain fungi.

Epidemiological studies

1. Aerial dispersal of spores. Tapes were collected from May 2012 until January 2013. DNA assessment methods need to be developed before these tapes can be examined. It is anticipated results from visual and DNA assessments will be available before the end of June 2013.
2. Stubble studies. Symptoms of white grain infection in cereal residues were found to include "scabby nodes" which show black, slightly raised lesions. Two types of fruiting bodies were identified microscopically. One type, pycnidia, oozes spores which are likely to be dispersed by rain-splash, while the other, ascocarps, produces spores which are likely to be aerially dispersed. The ascocarp fruiting bodies were less common than the pycnidia.

Spore ooze from pycnidia was seen as early as September at both Cleve and Kimba, but happened as early as July in stubble kept at the Plant Research Centre. At Kimba, spores were not released by the ascocarp fruiting bodies until early October, but were released as early as August in stubble kept at the Plant Research Centre.

Stubble which was upright had slower development and release of spores than stubble lying on the ground. Stubble from Kimba had a higher incidence of infection with the white grain fungi and had more fruiting bodies on infected stems than did stubble from Cleve.

Infected cereal residues from the 2010 season produced spores during 2012, although in low numbers.

What does this mean?

Due to dry spring conditions, white grain expression did not occur in 2012, so there were no results from the three variety screening and two fungicide trials conducted on EP last season. This highlights the fact that white grain expression will be very dependent on wet spring conditions even where inoculum levels are high. As stubble studies show that infected cereal residues can produce spores for at least 2 years, it will be important to continue to examine crops for white grain prior to harvest in future years.

Observational information on stubble from the trial sites combined with findings from controlled environment studies conducted at the Plant Research Centre show that:

1. Inoculum of white grain is likely to survive, at least at low levels, in paddocks for extended periods. Infected residues produce spores for at least 2 years and most spores produced will be rain-splash dispersed and will be produced for many months starting any time from about July, depending on season/ site conditions.
2. Direct management using variety choice or fungicide application is unlikely to be effective with current varieties and fungicides. Controlled environment data show that infection occurs at a range of temperatures (15-24°C) and plant growth stages (heading to soft dough). No differences in susceptibility could be detected amongst Axe, Yitpi, CF Justica, CF Stiletto, Gladius, Mace, Scout and Wyalkatchem.

1. Stubble management combined with rotation may provide the most effective solution, but this requires further research. Spore development and release was found to be delayed in infected stems which are upright when compared with stems which are lying on the ground.

The studies on EP in 2012 have greatly increased our knowledge about the white grain fungi and the methods to use when undertaking research on these pathogens and on disease expression. Additionally, they have suggested stubble management under break crops as an area for further research.

In 2013, two variety screening trials and one fungicide efficacy trial will be conducted on upper EP. Complementing this, varieties will be screened in field trials or on the Terraces at the Plant Research Centre where spores can be applied to plants during grain fill. This will increase the probability of achieving high white grain expression even if there are dry conditions on upper EP in spring.

Acknowledgements
This work was funded by SAGIT and GRDC. Thanks to our farmer co-operators for providing us with areas to run our trials. Thanks to Hayden Whitwell (AgSave, Kimba) for collecting spore tapes and stubble packets and Cherylynn Dreckow (Elders, Cleve) for collecting stubble packets. Thanks to Leigh Davis and Andrew Ware for answering all my questions as well as for assistance in site selection and for sowing, managing and harvesting trials.

Cereal Variety Disease Guide 2013

Hugh Wallwork and Pamela Zwer
SARDI, Waite

Summary of 2012 season and implications for 2013

The cool winter and dry spring hindered the development of most foliar pathogens in South Australia in 2012. The dry spring also prevented the development of white grain in crops as only a very low level was recorded in harvest deliveries. The dry spring did however promote the development of more crown rot than usual and severe infections were recorded across the upper/ western Eyre Peninsula. Crown rot survives in wheat stubbles and so many crops in 2013 will be exposed to high levels of inoculum where they are sown into these stubbles.

Eyespot has been occurring in crops in the high rainfall regions of the lower Eyre Peninsula and Mid-North. On lower EP the short stature of Wyalkatchem has probably reduced lodging and therefore disguised the level of infection in crops in previous years. Mace which has largely replaced Wyalkatchem therefore appears more susceptible.

Rusts

Stem rust survived until winter on a few scattered volunteers in northern districts but failed to transfer to 2012 plantings and caused no concern to crops. Leaf rust in wheat was not recorded in crops and leaf rust in barley started late on the Yorke Peninsula and caused little damage especially compared to the 2011 season. Stripe rust arrived late in winter with recordings across a wide area from mid-August onwards. One crop of Mace near Port Germein was found with much more severe infection and may have been the source of the other outbreaks. Timely application of fungicide sprays along with widespread use of in-furrow treatments in some districts kept the stripe rust under good control.

Net form net blotch

Net blotch levels were low in most crops. Ongoing analysis of samples of net form net blotch used in controlled environment tests have revealed a great diversity in virulence amongst a range of isolates obtained from around the state. Virulence in the fungus was found on Oxford, Henley, Navigator and Wimmera at Conmurra in the South-East and this is reflected in changed ratings for these varieties in this Guide. Further cases of virulence have also been recorded on Fleet at Urania and South of Port Pirie. Similar to barley leaf rust and scald, this guide is now showing the resistance ratings of barleys to NFNB as a range rather than as a single rating. This reflects variation in the fungus around SA.

White grain

Only a minimal amount of white grain was recorded in any wheat deliveries in SA due to the dry spring conditions. However the fungus remains viable in crop stubbles and could cause problems in 2013 should persistent damp conditions occur after head emergence. There is no good evidence for variation in resistance amongst varieties at this stage.

Loose smut

Hindmarsh barley has been observed with higher levels of loose smut than is commonly observed in barley crops. Whilst testing of varieties for resistance to this disease is not carried out, it would appear that Hindmarsh is more susceptible than other varieties. Where barleys are treated for mildew control then loose smut should not be a problem.

Explanation for Resistance Classification

Previously a '/' has been used where a rating falls between two of the ratings given in the following tables. Now there will be no / and the two ratings will be run together as one score. For example MR/MS will now be presented as MRMS. Where a '-' is used then the rating is given as a range of scores that may be observed depending on which strain of the pathogen is present.

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 up to 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 yield losses are rarely severe.

Other information

This article supplements other information available including the SARDI Sowing Guide 2013 and Crop Watch email 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 Diagnostics
Plant Research Centre
Hartley Grove
Urrbrae SA 5064

Further information contact:
hugh.wallwork@sa.gov.au

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Wheat	Rust			CCN	Yellow leaf spot	Powdery mildew	*Septoria tritici* blotch	Root lesion nematodes		Crown rot	Common root rot	Flag smut	Black point ‡	Quality in SA
	Stem	Stripe #	Leaf	Resistance				*P. neglectus*	*P. thornei*					
AGT Katana	MSS	MRMS	MS	MS	MS	MRMS	MS	MS	MS	MS	MS	S	S	AH
Axe	MRMS	RMR	MR	S	S	MSS	SVS	MS	MS	S	MSS	S	S	AH
Barham	MR	#MSS	MRMS	MS	MSS	SVS	MSS	MR	MSS	S	MSS	MRMS	MRMS	Soft
Bolac	MRMS	RMR	MS	S	S	-	MS	S	MS	S	MS	RMR	MSS	AH
Brennan	MS	RMR	RMR	-	-	-	-	-	-	S	-	-	MRMS	Feed
Catalina	MR	MS	R	R	MSS	MSS	MRMS	S	MR	S	MRMS	RMR	S	AH
Cobra	RMR	MSS	MR	MRMS	MS	MSS	MSS	MS	MS	S	MSS	SVS	MSS	AH
Corack	MR	MS	MS	RMR	MR	VS	MSS	MSS	S	S	MS	S	MSS	APW
Correll	MR	MRMS	MSS	MR	SVS	MRMS	MRMS	MS	S	S	MS	R	MS	AH
Elmore CL Plus	MR	MRMS	R/MR	S	S	MR	MRMS	-	MSS	S	MS	SVS	MS	AH
Emu Rock	MRMS	MRMS	MSS	S	MS	MSS	MSS	MS	MSS	MSS	MSS	MS	MS	AH
Espada	MR	#MRMS	R	MS	MS	S	S	MS	MSS	S	MSS	MRMS	S	APW
Estoc	MR	MRMS	MRMS	MR	MSS	MSS	S	S	SVS	S	MRMS	MRMS	MS	APW
Forrest	RMR	RMR	MR	S	MRMS	MS	MRMS	S	S	SVS	MS	RMR	MR	APW
Gladius	MR ^	#MRMS	MS	MS	MS	S	MSS	MRMS	S	S	MS	RMR	MS	AH
Grenade CL Plus	MR	#MRMS	MS	MR	S	MSS	MS	MSS	S	S	MRMS	R	S	AH
Impala	RMR	MR	S	S	MSS	RMR	S	-	-	S	MSS	SVS	MRMS	Soft
Justica CL Plus	MR	#MRMS	MSS	MS	S	S	S	MSS	S	S	MS	R	S	APW
Kord CL Plus	MR	#MRMS	MS	MR	MSS	MSS	MS	MS	MS	S	MRMS	MR	MR	AH
Lincoln	MR	RMR	MR	S	MRMS	MR	MSS	MS	MS	VS	MS	RMR	MR	AH
Mace	MR ^	#SVS	MR	MRMS	MRMS	MSS	MRMS	MRMS	MRMS	S	MS	S	MS	AH
Peake	MR ^	MRMS ^	R ^	R	S	-	MS	MS	S	S	S	MRMS	MSS	AH
Phantom	MR	MR	MRMS	MRMS	SVS	MRMS	MRMS	S	S	MSS	MSS	MRMS	MR	AH
SQP Revenue	R	R	R	S	MS	R	MR	MS	MS	S	SVS	S	MSS	Feed
Shield	MR	#MR	R	MR	S	MR	S	S	MS	S	MRMS	MSS	-	AH
Scout	MRMS	MS	R	R	SVS	MRMS	MRMS	MSS	MS	S	S	MR	S	AH
Sentinel	RMR	RMR	R	S	MS	R	MRMS	S	MS	MSS	S	MSS	MSS	ASW
Wallup	RMR	MRMS	MS	MR	MSS	S	MSS	MRMS	MRMS	S	MS	SVS	MRMS	AH
Wyalkatchem	MRMS	S	MS	S	MRMS	SVS	MR	MRMS	S	S	MSS	SVS	MS	APW
Yitpi	S	MRMS	MS	MR	SVS	MRMS	MRMS	MS	MS	S	MS	MR	MS	AH

- These ratings are for the WA Yr17 strain. Varieties with a # have the Yr17 resistance and so will be resistant to the other strains
^ - Some susceptible plants in mix.

Durum	Rust			CCN Resistance	Yellow leaf spot	Powdery mildew	*Septoria tritici* blotch	Root lesion nematodes		Crown rot	Common root rot	Flag smut	Black point ‡	Quality in SA
	Stem	Strips #	Leaf					*P. neglectus*	*P. thornei*					
Caparoi	MR	MR	MRMS	-	MR	-	RMR	-	MR	VS	MS	R	MSS	Durum
Hyperno	R	MR	RMR	MS	MRMS	MR	RMR	MR	MRMS	VS	MS	R	MS	Durum
Kalka	MR	MR	RMR	MS	MRMS	SVS	MRMS	MR	MR	VS	MS	RMR	S	Durum
Saintly	MR	MR	MRMS	MS	MRMS	VS	MRMS	MR	-	VS	MS	R	MS	Durum
Tamaroi	MR	MR	MR	MS	MRMS	MSS	S	MRMS	MR	VS	MS	R	MS	Durum
Tjilkuri	MR	MR	MR	-	MRMS	S	MRMS	-	MRMS	VS	MS	R	MSS	Durum
WID802	RMR	MR	RMR	-	MRMS	-	MR	-	-	VS	MS	R	-	Durum
Yawa	RMR	RMR	MR	MS	MRMS	MS	MR	MR	MR	VS	MRMS	R	MR	Durum

Triticale	Rust			CCN Resistance	Yellow leaf spot	Powdery mildew	*Septoria tritici* blotch	Root lesion nematodes		Crown rot	Common root rot	Flag smut	Black point ‡	Quality in SA
	Stem	Strips #	Leaf					*P. neglectus*	*P. thornei*					
Bogong	MR	MS	R	-	MR	R	R	-	-	MSS	MSS	-	-	Triticale
Chopper	MR	MSS	R	R	MR	R	R	-	-	MSS	S	-	-	Triticale
Fusion	R	MR	R	R	MR	R	R	-	-	-	MSS	R	-	Triticale
Goanna	R	MR	MR	R	MR	R	R	-	-	-	-	-	-	Triticale
Hawkeye	RMR	MR ^	R	R	MRMS	R	R	-	-	MS	MSS	-	-	Triticale
Jaywick	MR	MR ^	R	R	MR	R	R	-	-	MS	MS	-	-	Triticale
Rufus	RMR	MS	R	R	MR	R	R	RMR	RMR	MS	MS	-	-	Triticale
Tahara	RMR	MS	R	R	MR	MR	R	R	MR	MS	MS	R	-	Triticale
Treat	R	MSS	MR	MS	MR	R	R	MRMS	-	-	MS	R	-	Triticale

The stripe rust ratings for the tritcales are for the WA Tobruk strain.

R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible, VS = very susceptible
T = tolerant, MT = moderately tolerant, MI = moderately intolerant, I = intolerant, VI = very intolerant, - = uncertain

Tolerance levels are lower for durum receivals.
‡ Black point is not a disease but a response to certain humid conditions.

Barley	Leaf rust*	Net form net blotch*	Spot form net blotch*	Scald*	CCN Resistance	Powdery mildew	Barley grass stripe rust	Covered smut	Common root rot	Root lesion nematodes		Black point
										P. neglectus	*P. thornei*	
Bass	R-MS	MSS	MSS	MR-S	S	MS	-	VS	MS	MRMS	MRMS	MR
Buloke	MS-SVS	MR	MS	MS	S	MR	R	MS	MS	MS	MRMS	MS
Commander	MS-S	MS-S	MS	S	R	MR	R	R	MSS	MRMS	MRMS	S
Fathom	MR-SVS	MS-SVS	MR	R	R	MR	-	RMR	S	MRMS	MRMS	S
Flagship	MRMS-S	MR	MRMS	MS	R	MRMS	MR	MRMS	S	MS	MRMS	MSS
Fleet	MRMS-S	MR-S	RMR	MRMS	R	MRMS	MR	MR	MSS	MRMS	MRMS	MS
Flinders	MRMS-S	MR-MS	MSS	S	S	MR	-	S	MS	-	-	-
Gairdner	MS-S	MRMS	S	R-S	S	MR	R	MSS	MSS	MRMS	MS	MR
Grange	MR	MR-MS	S	MSS	S	MR	-	S	S	MR	MRMS	MS
Henley	MR-MRMS	MR-S	S	R-SVS	S	R	-	MR	MS	MRMS	MRMS	MSS
Hindmarsh	MRMS-S	MR	S	R-S	R	MS	R	MS	S	MS	MRMS	S
Keel	VS	MR-S	MR	MS	R	MRMS	MS	R	S	MR	MR	SVS
Maritime	MS-S	MR-VS	MRMS	MSS	R	S	S	MS	S	MR	-	MSS
Navigator	VS	MR-SVS	MR	R	R	R	MR	MSS	MS	MRMS	MRMS	MSS
Oxford	R-MRMS	MR-SVS	MSS	MS-S	S	R	-	MRMS	MSS	MR	MR	MR
Schooner	SVS	MR	MS	MSS	VS	S	R	MR	S	S	R	MS
Skipper	MSS-SVS	MR	MRMS	S	R	MR	-	S	MSS	MRMS	MRMS	MS
Scope	MS-SVS	MR	MS	MSS	S	MR	R	MRMS	MS	MRMS	MRMS	MSS
Sloop SA	SVS	MR	SVS	S	R	S	R	R	S	MS	R	S
Westminster	RMR	MR-MS	S	MR	-	MR	-	R	MRMS	-	-	MRMS
Wimmera	R-MRMS	MR-S	MS	MSS	S	MR	-	MRMS	MS	MRMS	MRMS	MR

* Due to multiple strains of these pathogens, the table provides a range of reactions that may be observed. Different ratings are separated by a -

R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible, VS = very susceptible
T = tolerant, - = uncertain

Disease

Oats	Rust		CCN		Stem nematode		Bacterial blight	Red leather leaf	BYDV**	*Septoria avenae*	*P. neglectus* Nematodes
	Stem*	Leaf*	Resistance	Tolerance	Resistance	Tolerance					
Brusher	MS-S	MS-S	R	MI	MS	I	MR-MS	MS	MS	MS	MR-MS
Echidna	S	S	S	I	MS	MT	S	MS	MS	S	MR
Euro	VS	S	R	I	S	I	MS	MS	MS	MS	MR
Forester	R-S	MR-MS	MS	MI	S	I	MS-S	R-MR	MR-S	MR	-
Glider	MR-S	MS-S	MS	I	R	T	R	R	MR-S	MR	-
Kangaroo	MS-S	MS-S	R	MT	S	MI	MR-MS	MS	MR-S	MR-MS	-
Marloo	S	S	R	MT	MS	MI	S	VS	MR-MS	S	-
Mitika	MR-S	MS-S	VS	I	S	I	MR	S	MS-S	S	-
Mulgara	MS	MR-MS	R	MT	R	MT	MR	MS	MS	MS	-
Numbat	MS	S	S	I	S	I	S	MS	S	MR	MR
Potoroo	S	S	R	T	S	MI	S	VS	MS	S	MR
Possum	MS-S	S	VS	I	S	I	S	MS-S	S	MS	MR
Quoll	MS-S	MR-MS	S	I	R	MT	MS	MS	MS	MR	MR-MS
Swan	VS	S	MR	I	S	I	S	S	MS	MS	MR-MS
Tammar	MR-S	MR-MS	MR	MT	R	T	MR	R-MS	MS	MR	-
Tungoo	MS-S	MS	R	MT	R	T	MR	R	MR-MS	MR	-
Wallaroo	S	S	R	MT	MS	MI	S	MS	MS	S	MR
Wombat	MS-S	MS	R	T	MR	MT	MR-MS	MS	MR	MS	-
Wintaroo	S	S	R	MT	MR	MT	MR-MS	MS	MR-MS	MR-MS	MR-MS
Yallara	S	MS	R	I	S	I	MR-MS	MS	MS	MS	-

* Due to multiple strains of these pathogens, the table provides a range of reactions that may be observed. Different ratings are separated by a -
** BYDV - Barley yellow dwarf virus
R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible, VS = very susceptible
T = tolerant, I - intolerant, MI - moderately intolerant, - = uncertain

Section Editor:
Nigel Wilhelm
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Farming Systems

Eyre Peninsula Farming Systems 3 Project – Responsive Farming Systems

Now in its final year, the five year (2008-2013) GRDC funded project 'Eyre Peninsula Farming Systems 3 – Responsive Farming Systems' continued to study the opportunities to tailor inputs to get the most profitable outcomes under a range of conditions. There has been a key research site at the Minnipa Agricultural Centre supported by regional sites at Mudamuckla and Wharminda on red sandy loam, grey calcareous loamy sand and siliceous sand over sodic clay respectively.

We combined the latest soil and plant science with new machinery technology. The sites have been EM38 mapped, yield mapped and variable rate technology is used for sowing and fertiliser applications. We ground-truthed the modelling tool Yield Prophet® to see if this program will be a benefit in making better farming decisions in the future on upper EP.

At the Minnipa Agricultural Centre, the key research site, the 5 years of the project has seen a wide range of growing season rainfall conditions. Very low, high, above average and average and finally, in 2012 a pasture phase, an above average winter but very low spring rainfall. After 4 years the major outcome was the level of residual phosphorus and total soil N available to maintain crop and pasture production. In studying the opportunities to tailor inputs to maximise profits, at the completion of the 4 year wheat-wheat-wheat-barley-rotation, there were examples of no yield difference, on heavier clay based soils, in the 2011 barley, and 3 previous wheat crops, between no applied and applied P and N over that period. This outcome was been repeated at regional focus sites over 3 years. However there are examples of responses to increased fertiliser on specific zones at the regional sites in 2012. The header yield monitor at Minnipa has also measured a yield benefit from targeting in-crop fertilisers to the more productive zones in the average and above average rainfall seasons over the term of the study. These outcomes continue to support tailoring inputs to specific needs, not a historical recipe.

The following series of articles are from trials undertaken in 2012 on the three focus sites or funded via the EPFS 3 project:

- Zone responses to four years of repeated low, medium and high input treatments at Minnipa
- Can we predict the rundown and long term value of P?
- Replacement P in cropping systems on upper EP
- Measuring the effect of residual P
- Time of sowing impacts at Mudamuckla
- Responsive farming for soil type at Mudamuckla
- Trace elements in a fluid fertiliser system at Mudamuckla
- Manganese response in barley at Wharminda
- Phosphorus rate trials at Wharminda
- Managing inputs to soil type in EP farming systems at Minnipa
- Liquid fertiliser evaluation trial

THE UNIVERSITY OF ADELAIDE AUSTRALIA
CSIRO
EPARF Eyre Peninsula Agricultural Research Foundation Inc.
SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE
GRDC Grains Research & Development Corporation

An 'exit survey' will be conducted with farmers in early 2013 to determine whether we have met the GRDC target of increasing water use efficiency by 10% on upper Eyre Peninsula.

Zone responses to four years of repeated low, medium and high input treatments at Minnipa

Ben Jones[1], Cathy Paterson[2] and Roy Latta[2] and Therese McBeath[3]

[1]Mallee Focus, [2]SARDI Minnipa Agricultural Centre, [3]CSIRO Ecosystem Sciences

RESEARCH

Almost ready

Location:
Minnipa Ag Centre paddock North 1
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2012 Total: 253 mm
2012 GSR: 185 mm
Paddock History
2012: Medic
2011: Barley
2010: Wheat
2009: Wheat
2008: Wheat
2007: Wheat
Soil Type
Sandy loam to sandy clay loam
Diseases
Rhizoctonia
Plot Size
Paddock trial, sowing widths 9 m
Yield Limiting Factors
Rhizoctonia
Dry spell in spring
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: Standard
Labour requirements: Standard
Economic
Infrastructure/operating inputs: VRT technology
Cost of adoption risk: Low if improving returns

Key messages

- **There are identifiable production zones in Paddock N1.**
- **Production zones are useful for designing sowing input strategies for 'typical' yields.**
- **In wet years, zones still indicate the risk and size of a return to in-season inputs but there will be increased input demand (e.g. N) and the response probably won't follow the exact pattern of response for an average year.**

Why do the trial?

Variable rate technology (VRT) allows farmers to easily adjust sowing and fertiliser rates during the seeding process, providing the opportunity to change inputs according to the production capability of different paddock zones or soil types. While this system has been steadily adopted in other regions it is not yet apparent whether the VRT approach will markedly shift yields and profitability from the levels achieved using blanket inputs across the whole paddock in the Minnipa region.

How was it done?

In 2008 a variable rate experiment commenced in N1 paddock at Minnipa Agriculture Centre with the paddock cropped to continuous cereals until 2012 when it was sown to medic (EPFS Summary 2012). Three treatment levels were set; the middle treatment was "district practice" as if it were a blanket application for the whole paddock and then low and high treatments were selected either side of district practice (treatment details given in the 2008-2011 EPFS summaries). The treatments were applied across the paddock in single 9 m seeder widths, sown with 2 cm GPS-guided auto steer. Treatments alternated in a repeated pattern across the paddock (low, medium and high) and the same treatments were applied in the same seeder run each year. Crops were harvested with a harvester of the same width as the seeder and using the same 2 cm guidance system. Yield data was recorded with a Microtrak yield monitor and logging system, using GPS with 2 cm correction.

In 2012 this data was analysed using spatial techniques to address the following questions:

1. In which parts of the paddock was there a difference in crop response to input level?
2. Are the zones of crop response to input level stable or do they change with season type?

What happened?

2008 was a dry season and we see this in the lack of response to varying input levels from low to medium (Figure 1a) except a small response in the Northern part of the paddock. In 2009, GSR was above average and the better production areas in the North East of the paddock showed responses to the medium input treatment (Figure 1b) with some differences between the medium and high input treatments in the North East (not shown). The GSR in 2010 was even better than 2009 and most of the paddock showed responses to medium inputs (Figure 1c) with further responses between medium and high levels of inputs in the North and South East (not shown).

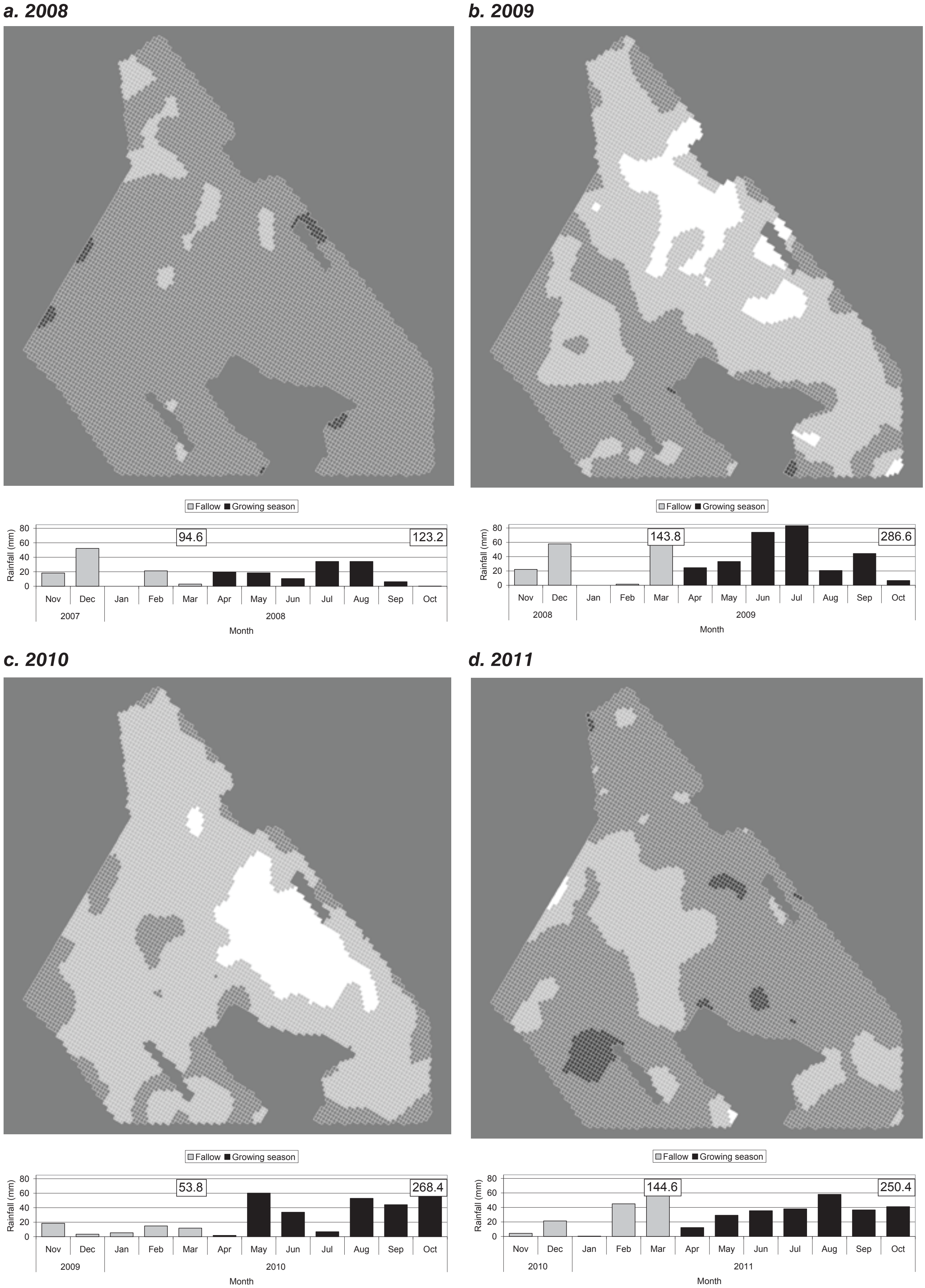
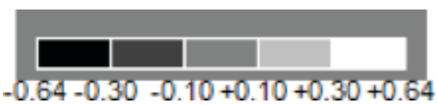


Figure 1. Visual representation of response to medium inputs compared to low inputs in a) 2008, b) 2009, c) 2010 and d) 2011.

Differences between treatments (t/ha):



Farming Systems

2011 was an average GSR and the better producing areas did not show responses to increasing inputs above the low input treatment (Figure 1d), however we did observe a response to inputs in the poor producing central parts of the paddock. These treatments will show cumulative effects because the same input level was applied to the same seeder run in each season. The response in the poor producing central part of the paddock is driven by a demand for P input following two high yielding seasons with low P inputs. This is supported by the observation of P responses in 2011 in the P replacement trial located in the same part of the paddock (EPFS Summary 2011, pp 119-122).

What does this mean?

There were responses to differing levels of inputs in different parts of the paddock. The paddock area that responded to inputs depended on both season type and treatment history (eg. poor part of paddock responded to inputs only after 2 above average GSR seasons). The pattern of response to inputs in the landscape may be correlated with soil type after a period of dry years, but will be affected by nutrient removal and paddock history after wetter years.

Zone-based upfront input strategies should focus on ensuring nutrition is adequate for the minimum likely yield. In wetter years, input requirements may not follow zone boundaries, but yield potential will. The status of the crop should be used as a guide to where to place in-season inputs, but zones will indicate the likely risk and size of the response.

Acknowledgements

We acknowledge the funding from GRDC project UA00107 for this work. Special thanks to Brett McEvoy, Mark Klante and Trent Brace for their assistance sowing and managing the trial.

GRDC Grains Research & Development Corporation

CSIRO

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Time of sowing impacts at Mudamuckla

Peter Kuhlmann
Farmer, Mudamuckla

INFORMATION

Searching for answers

Location: Mudamuckla

Rainfall
Av. Annual: 291 mm
Av. GSR: 216 mm
Average Yield
Wheat 0.99 t/ha
Soil Type
Calcareous sandy loam
Yield Limiting Factors
Unreliable spring rain, high phosphorus fixing soil, limestone, boron toxicity, rhizoctonia
Water Use
40%

Key messages

- **Strategic dry or early sowing is a good option for a portion of the cropping program.**
- **At Mudamuckla an average yield loss of 10.2 kg/ha/day occurs between the first wheat crop sown and subsequent crops in the program. This represents 71 kg/ha per week or a yield penalty of 11% per week in an environment with 1 t/ha average yields.**

Why write the article?

Early sown/early emerging crops are often the best yielding crops on upper Eyre Peninsula (EP) and early/dry sowing is now considered for an increasing area on my farm annually. Analysis of actual 2006 – 2012 time of sowing data from my program at Mudamuckla shows that sowing early can create a better balance between soil water content available to crops and pastures, and the peak water demand of the crop.

The soil type used to generate the information is typical of the calcareous soils of low rainfall areas of western EP with high boron, high pH, high evaporation, and only rare years where subsoil moisture can be conserved in summer and autumn in sufficient quantity for crop use the following spring.

The Yield Prophet® Sowing Opportunity Report from the Mudamuckla Focus Paddock (Figure 1) shows the peak potential yield for Mace wheat should result from sowing around the end of April. The frost risk increases as you sow earlier (minimal risk at Mudamuckla compared to that of a dry spring or hot conditions at anthesis or during grain fill) and the risk of heat shock increases sharply after sowing in June.

In this environment rainfall is typically received in small amounts throughout the year with falls over 20 mm rare in one event. Small amounts of rainfall are prone to rapid evaporation in the September to April period. The monthly rainfall peaks in July, but the peak demand from the crop is in August and September. The evaporation is large because of the low latitude of my district, and is at its lowest in June.

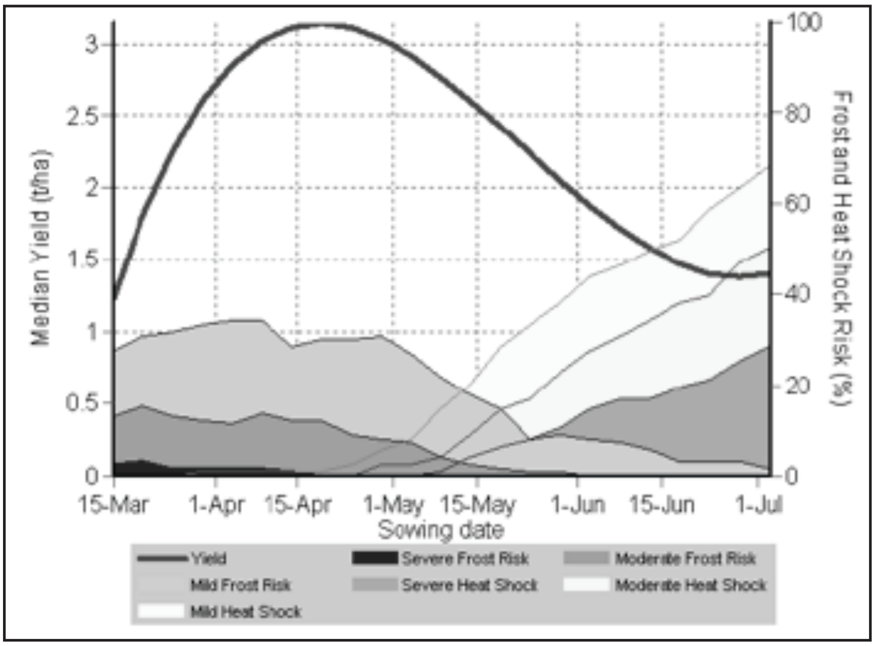


Figure 1 Sowing date impact on yield of Mace wheat and associated frost and heat shock risk taken from a Sowing Opportunity Report generated in Yield Prophet for the Mudamuckla Focus Paddock, 2012
The graph takes into account the variety, the specific soil type, pre-season soil moisture, the weather conditions and unlimited nitrogen.

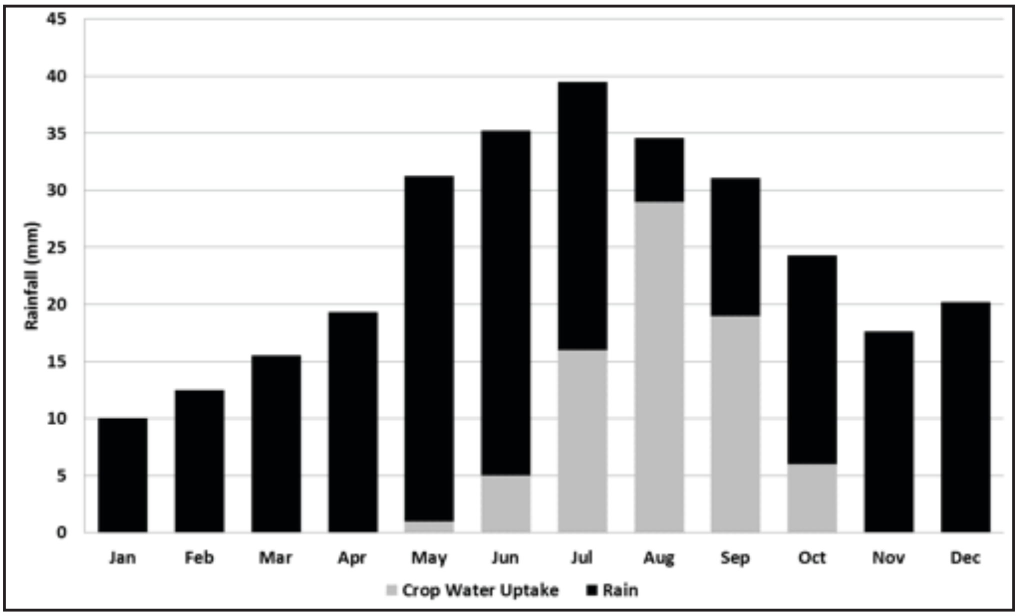


Figure 2 Mudamuckla average monthly rainfall (mm) and modelled crop water uptake

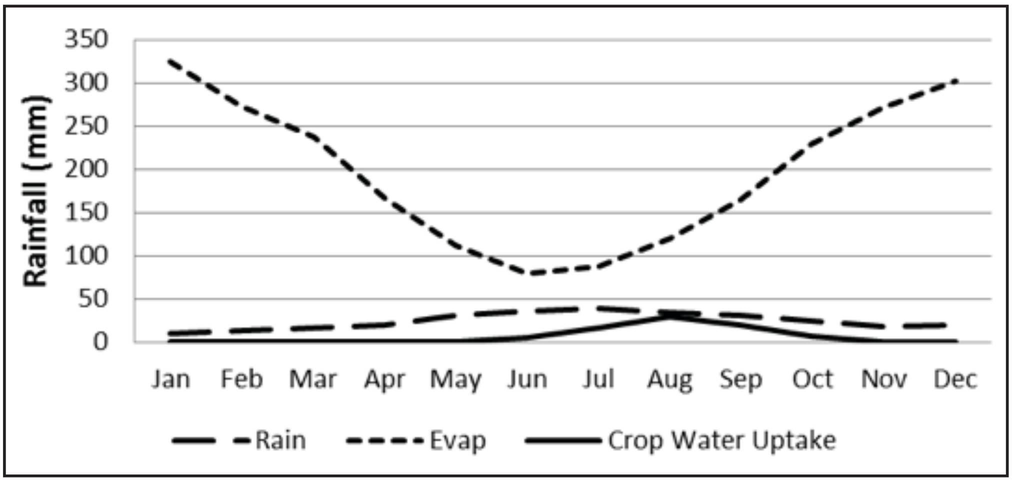


Figure 3 Mudamuckla average monthly evaporation, rainfall (mm) and modelled crop water uptake

In an average year scenario (seeding in early May) the crop has sufficient moisture to grow a reasonable amount of biomass up until August when the crop runs up into head (Figure 2). The daily requirements for both transpiration and evaporation are then rising rapidly, as is the risk of yield limiting heat stress (Figure 3). Water to satisfy grain fill to achieve the potential set earlier in the year needs to come from timely spring rains or stored soil moisture, neither of which are reliable at Mudamuckla.

Important practices and considerations for early sowing at Mudamuckla

Sowing later maturing varieties first is a way of matching the season length with the attributes of the variety. In seeking an early, competitive crop, water is often used up too early leaving little for flowering and grain fill. "Managing canopies" of early sown crops may assist the partitioning of soil moisture for later in the season when crop demand outstrips rainfall.

Observations of practices that can increase water stress in dry springs are high nitrogen status soils, high fluid phosphorus and nitrogen rates, high seeding rates, grazing crops (delays maturity) and cultivation. These practices all work well in years with adequate spring rainfall.

Cereals have great plasticity in their growth and can compensate for variations in plant density in the absence of constraints such as weeds or diseases. However, they are less able to compete with weeds if sowing rates are reduced, so paddock selection is critical.

Early sowing a paddock repeatedly is likely to select for a grass population that consists mostly of later germinating plant types. It is important to mix up the sowing order of paddocks over the life of a rotation. Dry sowing can produce good yields as early emerging crops compete well with low grass numbers. Later maturing grasses and resistance to many chemicals means we will need more than one year to manage the grass seed bank if we compromise our knockdown and pre-emergent weed control by dry sowing.

Table 1 Actual paddock yields at Mudabie, 2006-2012 and lost production with later sowing compared to earlier sown crops

Mudabie time of sowing and yield loss			
	Yield t/ha	kg loss/ha/day	loss/week %
2006	0.51	6.5	8.9
2007	0.51	29.0	39.8
2008	0.55	11.0	14.0
2009	1.35	5.8	3.0
2010	1.44	12.2	5.9
2011	1.64	3.3	1.4
2012	0.60	3.3	3.9
	Average	**10.2**	**11.0**

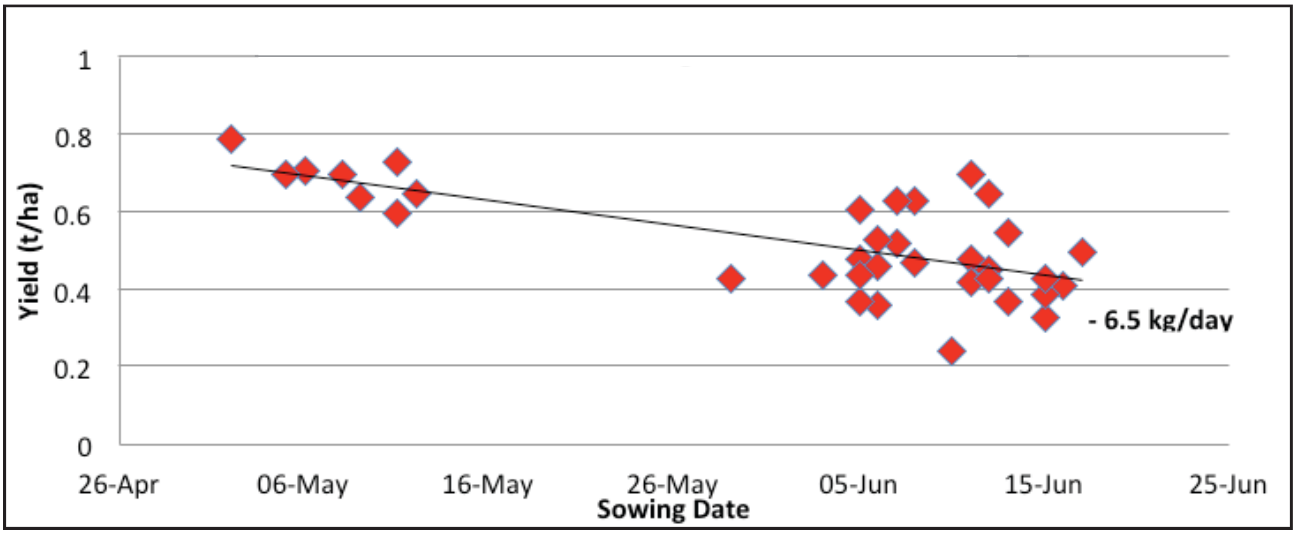


Figure 4 Paddock yields (t/ha) plotted against sowing dates from Mudabie, 2006

Mudabie analysis

Table 1 shows that as the crop is sown later, the likely yields are lower. In the last 7 years this loss has averaged 10.2 kg/ha per day which is 71 kg/ha or 11 % per week. This is based on actual paddock yields at Mudabie, not model simulations. The penalty is significantly higher in years of low spring rainfall (2006, 2007 and 2008) when there is no subsoil moisture. 2012 had a dry spring but the crop yields were assisted by the mild spring weather.

Figure 4 is typical of the yield losses over time. 2006 was a year where some crops were sown early onto stored moisture and the balance was sown after a break in the season in June. The trend downwards suggests you should not have stopped seeding. The need for a germinating rain and improved weed control were the dominant factors in delaying seeding.

What does this mean?

Early sowing or dry sowing is important in a large cropping program and has yield and operational advantages. Careful paddock selection and prioritisation is required to ensure this strategy does not have long term impact on weed populations.

Time of seeding, varietal mix, seed and fertiliser rates combined with weed control and rotations are all management strategies we need to utilise. A best bet option is required as the variation between season and soil can change the outcomes and still cannot be predicted reliably prior to the season starting.

Acknowledgements

Therese McBeath – CSIRO; Andy Bates - Bates Agricultural Consulting.

Yield Prophet® is an on-line modelling service based on APSIM that provides simulated crop growth based on individual paddock information and rainfall, and is registered to BCG.

The impact of livestock on paddock health

Roy Latta and Jessica Crettenden
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location: Minnipa Ag Centre, paddock South 7
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2012 Total: 237 mm
2012 GSR: 180 mm
Yield
Potential: 5.5 t DM/ha (pasture)
Actual: 2.4 t DM/ha (pasture)
Paddock History
2011: Wheat
2010: Medic pasture
2009: Wheat
2008: Wheat
2007: Wheat
Soil Type
Red sandy loam
Soil Test
Organic C%: 1.2
Phosphorus: 23-34 mg/kg
Plot Size
3.5 ha
Yield Limiting Factors
Nil
Livestock
Enterprise type: Self replacing merinos
Stocking rate: Rotational grazing and district practice
Environmental Impacts
Soil Health
Soil structure: Stable
Compaction risk: Plus and minus grazing treatments
Ground cover or plants/m^2: Grazed to 1 t/ha pasture residue
Grazing Pressure: High (1.5 DSE/ winter grazed ha) and medium (0.75 DSE/winter grazed ha)
Water Use
Runoff potential: Low

Key messages

- **As a result of higher regenerating plant numbers the improved annual medic pasture carried double the livestock numbers compared to an unimproved pasture.**
- **There has been no measured change in soil organic carbon over the 5 year project as a result of varying crop and pasture inputs, and grazing or not grazing crop stubbles and pastures.**

Why do the trial?

A trial was established on Minnipa Agricultural Centre in 2008 to test whether soil fertility and health could be improved under a higher input system compared to a lower input and more traditional system. The five year (2008-2012) wheat, wheat, pasture (annual medic), wheat, pasture (annual medic) rotation was also split for plus and minus grazing in both the high and low input systems to establish the impact of grazing between the two treatments.

How was it done?

In 2008 a 14 ha, red sandy loam (pH 7.7, CaCl) portion of a paddock on Minnipa Agricultural Centre was divided into 4 x 3.5 ha sections. Each section represented a system treatment: Traditional - grazed, Traditional – ungrazed, High input – ungrazed and High input - grazed. Four sampling points were selected and marked as permanent sampling points in each section. Data presented for each treatment are a mean of the four selected permanent points in each section. Weed control was imposed on all treatments as required in both summer and during the growing season.

In 2012 the trial was retained as a self regenerating annual medic pasture with no seed or fertiliser inputs. Selective chemical grass control was applied to the medic pasture. See EP Farming Systems Summary 2011 p 113 for 2008 - 2011 crop and pasture inputs.

What happened?

Soil fertility was estimated prior to seeding at five sites surrounding the four selected permanent points in each section. Table 1 presents the 2010, 2011and 2012 phosphorous, total nitrogen and soil organic carbon results.

Colwell P trends show an increase following medic in 2010 across all treatments when 7 kg/ha of P was applied only to the high input treatments, in 2012 levels are similar across treatments following 15 and 8 kg/ha of P applied to the high and low input treatments respectively. 2012 soil analysis figures indicate there was a decline in residual N over the 2011 wheat season following the increased total N contents in response to the 2010 medic pasture. Soil organic carbon levels have been steady to trending higher with no evidence of a separation as a result of grazing or not grazing.

Pasture biomass was collected in 2012 from 5 x 0.1 m^2 quadrats sited at each of the 4 permanent points in each section. Table 2 presents the annual pasture establishment, biomass and seed yield in 2012.

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 may require supplementary feeding and regular checking
Economic
Infrastructure/operating inputs: High input system has higher input costs
Cost of adoption risk: Low

There was less grass, increased biomass production and seed yield in response to the high input treatments with higher annual medic plant numbers. Grazing the medic pastures reduced seed yield and pasture residue that was measured on 7 December as opposed to their comparative ungrazed treatments. Both grazed treatments were stocked between 16 and 20 April, 10 July and 14 August, and 17 September and 5 October, 38 days at 11.25 and 22.5 DSE/ha growing season stocking rates for low and high input treatments respectively. 178 mm of growing season rainfall produced 2.7 t DM/ha in the 2012 improved pasture, which has an estimated water use efficiency (WUE) of 75% of potential, the unimproved pasture produced 1.6 t DM/ha, with 45% WUE.

What does this mean?

In 2012 an improved self-regenerating medic pasture reduced competing annual grass, increased biomass production and carried double the stocking rate, compared to a volunteer self-regenerating medic pasture. Although the stocking rate was quite low there was 1 to 1.5 t DM/ha retained on the grazed plots in early December which suggests there was opportunity for an increased stocking rate over the growing season while retaining adequate groundcover and with no expected loss in soil fertility or condition. The estimated livestock gross margins of $100/ha (2.5 DSE/ha @ $40/DSE) for the high input compares to $50/ha for the low input treatment. Although the high input medic has a 2010 $60/ha establishment cost it is spread over at least 6 pasture seasons, $10/ha/pasture year. The higher $ benefits derived from increased crop yields in response to more nitrogen fixed, better weed competition and root disease control, are forthcoming in 2013 and beyond.

Acknowledgements

We gratefully acknowledge the help of Mark Klante, Brett McEvoy and Trent Brace for their site management.

Farming Systems

Table 1 Colwell P (mg/kg 0-10 cm), total mineral nitrogen (kg N/ha 0-60 cm) and soil organic carbon (SOC%, 0-10 cm) in April 2010, 2011and 2012 following wheat, annual medic and wheat respectively

System	Cowell P (mg/kg)			Total mineral nitrogen (kg/ha)			Soil organic carbon (%)		
	2010	2011	2012	2010	2011	2012	2010	2011	2012
Traditional - grazed	25	41	34	93	134	64	1.1	1.2	1.3
Traditional - ungrazed	25	29	30	51	99	59	1.0	1.1	1.0
High input - grazed	17	23	23	54	119	72	1.2	1.1	1.2
High input - ungrazed	25	34	30	50	84	60	1.0	1.1	1.2

Table 2 Annual medic establishment (plants/m²) total biomass (t DM/ha) measured in July, August, September and December with and without grazing, and medic seed production (t/ha) in 2012

System	Establishment (plants/m²)	Biomass (t DM/ha)				Seed yield (t/ha)
	Medic (grass)	10 July	14 August	17 Sept	7 Dec	7 Dec
Traditional - grazed	233 (138)	0.2	0.3	1.3	1.0	0.11
Traditional - ungrazed	284 (109)	0.2	0.8	1.6	1.4	0.22
High input - grazed	554 (39)	0.6	0.8	2.3	1.5	0.29
High input - ungrazed	652 (30)	0.5	1.5	2.7	2.4	0.36

Crop sequences

Suzanne Holbery, Roy Latta & Ian Richter
SARDI, Minnipa Agricultural Centre

Searching for answers

Location: Minnipa Ag Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2012 Total: 253 mm
2012 GSR: 186 mm

Yield
Potential: 1.7 t/ha (W)
Actual: 1.7 t/ha (W)

Paddock History
2011: Various
2010: Wheat
2009: Wheat
2008: Wheat

Soil Type
Red sandy loam over light clay

Soil Test
Total N (0-60cm) 47 kg/ha
Colwell P 20mg/kg

Pests and diseases
Project key outcome: control grass weeds and cereal borne root diseases

Plot Size
40 m x 1.5 m x 3 reps

Yield Limiting Factors
Poor soil health
Grass weed competition

Environmental Impacts
Soil Health
Project aims to recommend options to improve;
- soil nutrients and groundcover
- reduce disease levels and chemical use

Key messages

- **Wheat yields increased by 0.4 t/ha following a single legume break in 2011 compared to continuous wheat, which yielded 1.7 t/ha, held back by grassy weeds and depleted soil nutrients.**
- **Sulla was the most financially viable as a grazing option or hay crop.**
- **Oats as a break crop provided little opportunity to control grass weeds and this had a negative impact on the following wheat yield.**

Why do the trial?

To determine the comparative performance of alternative crops and pastures as pest and disease breaks in an intensive cereal phase.

In low rainfall regions of south-eastern Australia broad-leaved crops make up only a very small proportion of the total area of sown crops. Farmers have adopted continuous cereal cropping strategies as non-cereal crops are perceived as riskier than cereals due to greater yield and price fluctuations. There is a need for non-cereal options to provide profitable rotational crops, disease breaks and weed control opportunities to sustain cereal production. A current ‘break crop’ may be a poorly performing volunteer annual grass dominant pasture. They are often havens for cereal pests and disease and are seen as having negative impacts on subsequent cereal grain yield and quality. However, breaks such as canola and peas are often perceived as too risky or too expensive to grow routinely.

How was it done?

The second year (2012) of the trial had 7 of the 20 treatments sown to Mace wheat @ 55 kg/ha, on 30 May. Five demonstrated the impact of a one year break in 2011 and two were continuous wheat. For the second year of the two year break treatments; Stingray canola (2 kg/ha), Twilight peas (80 kg/ha) and Winteroo oats (40 kg/ha) were sown on 2 May 2012. Regenerating Angel medic, early sown Angel medic and Sulla *(Hedysarum coronarium)* were also two year break treatments. Wheat, oat and canola treatments received 65 kg/ha DAP (18:20) and 50 kg/ha urea at time of sowing. An additional 50 kg/ha of urea was applied to canola on 25 July due to slow development of the plants.

All treatments excluding the continuous wheat and fallow plots were split into two sub-plots to demonstrate alternative enterprise options of grain, hay or grazing. In 2012 the sub plots demonstrated different enterprise options to 2011 where possible. Hay crops were cut prior to weed seed maturity on 18 September. Grazing was simulated by mowing the sub plots on 10 July, 17 August and 18 September. An additional mowing of oat treatments was measured on 17 October.

Weeds and pests were controlled in all treatments as required but with low cost options where-ever possible and only in those treatments which required it at the time.

Due to heavy grassy weed pressure, the continuous wheat and wheat following vetch/oats were sprayed with Monza @ 30 g/ha mid season, other wheat treatments received only Hoegrass500 @ 1.1 L/ha. Due to late germinating grasses an application of Atlantis @ 0.33 L/ha was also applied on 8 August to the continuous wheat treatments. After simulated grazing through mowing the fallow plots were controlled with glyphosate applications.

Table 1 2012 and 2011 treatments, grain yield t/ha in 2012, grain receival classification, water use efficiency kg/ha/mm and gross margin ($/ha)

	2012	2011	YIELD t/ha	CLASS-IFICATION[2]	WUE[1] kg/ha/mm	AUS $ / ha		
						INCOME[3]	COSTS	GROSS MARGIN
2012 GRAIN	Canola	Twil.Pea - Grain	0.9^{a}	42.1 % Oil	3.8	487	234	253
	Canola	Oats - Hay	0.8^{ab}	43.3 % Oil	3.6	410	227	183
	Canola	ESMed - Hay	0.6^{b}	41.6 % Oil	2.7	306	216	90
	LSD (P = 0.05)		*0.238*					
	Pea	Oats - Hay	1	Peak	4.6	275	243	32
	Pea	Canola - Grain	0.7	Peak	3.3	201	231	-30
	LSD (P = 0.05)		*ns*					
	Wheat	JagMed - Hay	2.1^{a}	APW	9.4	654	252	402
	Wheat	JagMed - Seed	2.1^{a}	APW		629	249	380
	Wheat	Vet/Oat - Hay	1.8^{b}	APW	9.4	620	225	395
	Wheat	AngMed - Hay	2.1^{a}	APW	9.3	632	249	383
	Wheat	AngMed - Seed	2.0^{a}	APW		599	245	354
	Wheat	MorPea - Hay	2.2^{a}	APW	9.0	675	254	421
	Wheat	MorPea - Grain	2.0^{a}	APW		620	248	372
	Wheat	Pea/Can - Graze	2.1^{a}	ASW	9.3	625	253	372
	Wheat	Pea/Can - Hay	2.0^{a}	APW		617	247	370
	Wheat	Wheat - Grain	1.7^{b}	ASW	8.0	499	282	217
	LSD (P = 0.05)		*0.174*					

1. WUE calculated using Hunt, J & Kirkegaard, J (2012) A guide to consistent and meaningful benchmarking of yield and reporting or water-use. CSIRO-Australia 2. Grain classification from Viterra receival standards South Australia 2012/2013 3. Gross margins are calculated from grain prices quoted from Viterra Port Lincoln on the December 1 Cash Wheat APW $307, ASW $292, Canola $547, Peas $283

What happened?

Root disease inoculum levels were monitored prior to sowing after each of the different types of break crops from year one. Pea treatments had levels of the Blackspot causing fungi in the high risk categories. The surrounding paddock had been sown with peas in 2011 and this may have influenced the result. *Pratylencus neglectus* levels were highest in continuous wheat but still at a low level. Medic treatments harboured highest levels of Pythium followed by peas but still at what appeared to be low levels. All other disease inoculum levels were low regardless of crop or pasture type in 2011.

Soil fertility early in 2012, except for total mineral N in the top 90 cm, was the same for all crop or pasture choices from 2011. Mineral N was lowest following wheat or canola (52-59 kg N/ha) and highest following peas (97 kg N/ha). All other treatments were intermediate between these extremes.

Crop establishment in 2012 averaged 131 for wheat, canola 40, oats 76 and peas 45 plants/m^2. The yield of continuous wheat and the wheat following vetch/oats averaged 1.7 t/ha (Table 1). The other four wheat treatments (following a legume or canola/pea mix) averaged 2.1 t/ha. There was no difference in 2012 yields when comparing hay, grazing or grain options in 2011. Pea yields may have been negatively impacted due to a lack of moisture early in the season and cloddy soil that resulted in uneven germination. Peas and canola struggled in 2012, yielding less than half of wheat.

Table 2 2012 and 2011 treatments, grazing biomass t DM/ha, dry sheep equivalents, gross margin (AUS $/ha)

	2012	2011	YIELD[1] t/ha	DSE[2]/year/ha[4]	AUS $ / ha		
					$48[3]/DSE	COSTS	GROSS MARGIN
2012 GRAZE	ESMedic	Oats - Hay	3.2^{bc}	8.8	421	58	363
	Med/Can	AngMed - Hay	3.4^{abc}	9.2	447	43	404
	ESMedic	Canola - Grain	2.0^{cd}	5.4	263	79	184
	Fallow	Fallow	0.4^{d}	1	47	35	11
	Oats	ESMed - Hay	3.1^{bc}	8.5	408	132	276
	Oats	Canola - Grain	3.0^{bc}	8.2	395	132	262
	Oats	Twil Pea - Grain	4.5^{ab}	12.4	592	132	460
	Sulla	Sulla	4.8^{a}	13.2	631	17	615
	LSD (P = 0.05)		*1.62*				

1.15% of total biomass was removed to allow for wastage 2. DSE = Dry Sheep Equivalent 3. $48 comes from the Gross Margins Guide 2012 4. Calculated on 1kg/DSE/day average consumption on green pasture

Table 3 2012 and 2011 treatments, hay yield (t/ha), gross margin (AUS $/ha)

	2012	2011	YIELD[1,2] t/ha	AUS $ / ha		
				INCOME[3]	COSTS	GROSS MARGIN
2012 HAY	Canola	Oats - Graze	3.7^{ab}	592	417	175
	Canola	ESMed - Graze	4.7^{a}	752	464	288
	Canola	Twil.Pea - Grain	4.6^{a}	736	459	277
	Pea	Oats - Graze	2.2^{b}	220	339	-119
	Pea	Canola - Graze	3.2^{ab}	512	385	127
	ESMedic	Oats - Graze	3.6^{ab}	576	305	271
	Med/Can	AngMed - Graze	4.8^{a}	768	346	422
	ESMed	Canola - Graze	2.7^{b}	432	284	148
	Sulla	Sulla - Graze	6.5^{a}	1170	399	771
	Oats	ESMed - Graze	5.6^{a}	896	473	423
	Oats	Canola - Graze	5.2^{a}	832	454	378
	Oats	Twil.Pea - Hay	4.7^{a}	752	431	321
	Wheat	Vet/Oat - Graze	4.9^{a}	784	467	317
	LSD (P = 0.05)		*1.85*			

1.15% was removed from biomass to allow for wastage 2. 15% was added to biomass to allow for moisture content of baled hay 3. Hay prices were estimated from The Stock Journal, 1 December 2012

Grassy weed biomass in the grazed treatments was highest in oats. The fallow treatment was mown once on 10 July and consisted of large broad-leaved weeds, total dry matter was 0.4 t/ha.

The proportion of medic was measured separately in crop mixes and revealed that regenerated medic with sown canola was lowest with 1.3 t/ha, despite plant emergence established on March rainfall being the highest with 168 plants/m2. Early sown medic following oats was highest with 3.3 t/ha, plant emergence 32 plants/m2. The Early sown medic following canola had 1.8 t/ha medic biomass but only 25 plants/m2.

The biennial legume Sulla produced the most biomass at 6.5 t/ha (Table 3). With hay prices estimated at $180/t Sulla as a hay crop was the most profitable over two years of all the treatments. Oats had high grass weed burden with an average of 1.2 t/ha grassy biomass compared to the other treatments which had less than 0.1 t/ha.

The Minnipa region experienced a decile 3 year for 2012, with a good start but subsequently the crops were moisture stressed through spring. Water use efficiency (WUE) figures were calculated using the Hunt, J & Kirkegaard, J (2012). *A guide to consistent and meaningful benchmarking of yield and reporting or water-use.* CSIRO-Australia. Continuous wheat had the lowest WUE figure with 8.0 kg/ha/mm, the five other wheat treatments averaged 9.3 kg/ha/mm. Peas following oats recorded 4.6 kg/ha/mm compared to 3.3 kg/ha/mm following canola, and this was consistent with the yields that were 1.0 t/ha and 0.7 t/ha respectively.

What does this mean?

In 2013 and 2014 the treatments will all return to wheat, and the effects of both a one and two year break on subsequent wheat yield and soil health will be better understood for the Minnipa environment.

The research so far has shown that:

- A one year break with a legume improved wheat yield the following year by 0.4 t/ha.
- Poor grass control in cereal treatments was an issue that impacted negatively on yield and reduced gross margins.
- Sulla may prove attractive for producers as a hay and/or a grazing option in its second year as costs are low once established.

Acknowledgements

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MONZA registered product of Nufarm, Hoegrass and Atlantis - registered products of Bayer crop science.

EPARF
Eyre Peninsula Agricultural Research Foundation Inc.

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GRDC
Grains Research & Development Corporation

Responsive farming for soil type at Wharminda

Cathy Paterson, Wade Shepperd and Ian Richter
SARDI, Minnipa Agricultural Centre

RESEARCH

Farming Systems

Almost ready

Location: Wharminda
Muddy/Nunji/Wirrulla Ag Bureau
Rainfall
Av. Annual: 291 mm
Av. GSR: 219 mm
2012 Total: 169 mm
2012 GSR: 128 mm
Yield
Potential: 0.8 t/ha (W)
Actual: 0.7 t/ha (16 kg P/ha - good zone)
Paddock History
2011: Wheat
2010: Canola
2009: Wheat
2008: Wheat
2006: Self sown barley
Soil test
Outlined in article
Diseases
Rhizoctonia
Yield Limiting Factors
Rhizoctonia, dry spell in spring
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: standard
Labour requirements: standard
Economic
Infrastructure/operating inputs: VRT technology
Cost of adoption risk: low if improving returns

Key messages

- **VRT- Go for gold! gave the same gross income as the standard input across the whole paddock.**
- **Applying VRT needs to balance business financial position, perception of the season and personal approach to risk.**

Why do the trial?

It is important that our low rainfall farming systems are low risk, flexible and responsive. Paddock inputs need to balance the best agronomic and economic advice with the need to ensure reliable outcomes at low cost. At Mudamuckla, one of three focus paddocks in the current GRDC funded Eyre Peninsula Farming Systems 3 project, the emphasis is on managing risk through tailoring inputs to different production zones by using variable rate technology.

Changing inputs according to the production capability of different paddock zones or soil types may provide an opportunity to improve gross margins for the whole paddock and improve water use efficiency.

How was it done?

Paddock 8 at Mudabie Farm was segregated into zones of good (grey calcareous sandy loam), medium (sandier hills) and poor (magnesia flats) production zones in 2009 using 5 years of yield maps and an elevation map (EPFS Summary 2009, pp 97-103). The areas in the paddock represented by these zones are 40% for the good, 45% for the medium and 15% for the poor.

The paddock was sown to Mace wheat on 29 May 2012 using variable rate technology (VRT) to apply 4 different rates of phosphorus (P) as phosphoric acid in seeder runs approximately 1.3 km long. Four permanent sampling points in each of the good, medium and poor zones were established in 2009 enabling soil chemical analysis, plant establishment, dry matter at anthesis, soil water measurements (sowing and harvest) and grain yield to be monitored separately for each zone. Due to the late, dry start to the growing season it was decided to apply nitrogen (N) as urea @ 9 kg N/ha in all zones to ensure plant growth after establishment was maximised.

A single demonstration strip of 16 kg P/ha, that has been applied every year since 2009 was harvested separately but no other measurements for this strip were taken during the year.

What happened?

Pre-seeding Colwell P levels tended to be lower in the good zone as compared to the other zones, while the DGT P levels were similar in all zones and below the critical level of 50 μg/L. There was more total mineral N measured in the poor zone than the good or medium zones (Table 2). The 2009 analysis of the depth to chemical plant root constraints is also shown in Table 2. The good and medium zones did not reach levels of boron (B) or chloride (Cl) that are hostile to root development within the sampling depth.

In the good and medium zone the plants/m^2 reflected the higher sowing rate for the 4 and 8 kg P/ha treatments, in the poor zone the number of plants established tended to be lower (Table 3). There was a response to P in dry matter production at anthesis in the good zone of the paddock but only to 8 kg P/ha. There was only a yield response to P when it was applied at 16 kg P/ha in the good zone, in the poor zone applying P at all rates increased yield. There was good grain quality in all 3 zones and there was no response in quality to applied P.

To compare the value of VRT for this soil type a basic economic analysis was carried out on the combinations outlined in Table 4.

Table 1 Soil chemical analysis for Mudamuckla in 2012

Zone	Colwell P 0-10cm (mg/kg)	DGT P 0-10 cm (µg/L)	Total Mineral N 0-60 cm (kg/ha)	*Depth to B >15 mg/kg (cm)	*Depth to Cl >1000 mg/kg (cm)
Good	40	15	65	n/a	n/a
Medium	45	15	80	n/a	n/a
Poor	44	17	192	60	40

**2009 data*

Table 2 Plants/m², dry matter production (DM t/ha), grain yield (t/ha) and grain quality, Mudamuckla 2012

Zones	Phos. Acid (kg P/ha)	Seeding Rate (kg/ha)	Establishment (plants/m²)	Anthesis DM (t/ha)	Grain Yield (t/ha)	Test wt (kg/hL)	Protein (%)	Screenings (%)
Good	0	45	131	1.9	0.45	84.0	11.6	3.6
	4	60	141	1.8	0.54	84.3	11.4	2.7
	8	60	195	2.5	0.59	84.5	11.6	3.0
	16	60	n/a	n/a	0.69	83.6	12.8	4.8
Medium	0	45	119	1.9	0.44	84.2	12.7	2.6
	4	60	145	2.0	0.57	84.4	12.8	2.4
	8	60	177	2.1	0.48	84.4	12.6	2.0
	16	60	n/a	n/a	0.51	84.2	12.4	1.9
Poor	0	45	100	1.3	0.29	83.7	12.7	3.5
	4	60	109	1.6	0.46	84.8	12.5	3.8
	8	60	121	1.1	0.45	84.8	12.6	3.5
	16	60	n/a	n/a	0.40	83.1	12.8	2.9
LSD (P=0.05)			*41*	*0.49*	*0.15*	*ns*	*ns*	*ns*

These VRT combinations were then compared to the potential gross margins if the different input rates had been applied to the whole paddock (Table 4) taking into account the percentage areas that the different production zones represent.

In 2012 the VRT – "Go for gold!" strategy resulted in a similar gross income than if the standard treatment had been applied across the whole paddock (Table 5). The more conservative VRT approach "Hold the gold!" gave a lower gross income than the standard input strategy.

What does this mean?

In 2012 the VRT – Go for gold! strategy resulted in a similar gross income to the standard blanket approach even after taking into account the higher input costs in the good zone of the Go for gold! strategy. The Go for gold! strategy matches the farmer's current VRT strategy (higher fertiliser inputs on the more reliable zones and a lower seeding rate and no fertiliser inputs on the poor zone) and covered costs, even in a dry year such as 2012. A more conservative approach such as the VRT – Hold the gold! strategy resulted in a lower gross income than the standard and Go for gold! treatments.

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 (eg. 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.

Acknowledgements

We acknowledge the funding from GRDC project UA00107 for this work. Thanks to Peter Kuhlmann for providing the land for this trial and to Andre Eylward and Paulus Viljoen for sowing the paddock and their help during the year.

Table 3 Treatments applied to VRT gross income analysis for Mudamuckla 2012

Paddock Zone	VRT - Go for gold!	Inputs		VRT - Hold the gold!	Inputs	
		kg P/ha	Seeding rate (kg/ha)		kg P/ha	Seeding rate (kg/ha)
Good	High	8	60	Standard	4	60
Medium	Standard	4	60	Low	0	45
Poor	Low	0	45	Low	0	45

Table 4 Comparison of the gross income of different sowing regimes vs. VRT combinations across the whole 200 ha paddock

Treatment	Gross income[1] ($/ha)	Gross income compared to standard input treatment ($/200 ha paddock)
VRT – Go for gold!	108	-153
VRT – Hold the gold!	82	-5430
High input across whole paddock	95	-2860
Standard input across whole paddock	109	0
Low input across whole paddock	91	-3650

[1] *Gross income is yield x price grain (H2 Wheat $270/t) less seed ($350/t) and fertiliser ($4.15/kg P) costs.*

Managing inputs to soil type in EP farming systems at Minnipa

Cathy Paterson, Roy Latta, Wade Shepperd and Ian Richter
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location: Minnipa Ag Centre, paddock North 1
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2012 Total: 253 mm
2012 GSR: 185 mm
Yield
Potential: 5.5 t DM/ha
Actual: 2.0 t/ha (Medium zone)
Paddock History
2011: Barley
2010: Wheat
2009: Wheat
2008: Wheat
Soil Type
Red sandy loam
Plot Size
Paddock trial, sowing widths 9 m
Yield Limiting Factors
Dry spring
Environmental Impacts
Water use
Runoff potential: low
Resource efficiency
Greenhouse gas emisions (CO_2, NO_2, methane): reduced fertiliser input

Key messages

- **In 2012 medic biomass production in paddock N1 was higher in the soil type with more plant available water in the root zone.**
- **There was no biomass increase as a result of higher residual P levels.**

Why do the trial?

Variability in soil and seasons are key drivers of crop productivity, and the use of soil and season specific inputs are becoming more common. In Minnipa Agricultural Centre North 1 paddock an EM38 survey, yield maps and soil testing have been used to create zones representing good, medium and poor performing areas (EPFS Summary 2008-11).

After 4 years of cereal rotation (wheat, wheat, wheat, barley) with low, standard and high inputs applied across the paddock zones, grass weeds had become a major issue and root disease inoculum levels were high. This resulted in the paddock being returned to a medic phase in 2012 with the opportunity to measure response in biomass to the 2008 to 2011 applied fertiliser rates.

How was it done?

Representative soils within these zones were characterised for plant available water capacity (PAWC) and chemical constraints such as pH, boron and chloride before seeding in 2008, as well as chemical analysis for plant available nutrients before seeding in 2012 (Table 1).

Annual medic was sown @ 10 kg/ha with unscarified seed harvested from paddock N5N plus 1 kg/ha Angel medic with no fertiliser on 26 April following 15 mm of rain on 21 April. The unscarified seed was tested at 50% viability, giving a total sowing rate of 6 kg/ha germinable seed. Measurements taken during the season included soil chemical analysis, soil water content, medic plant establishment, dry matter production and ground cover percentage.

The 61 ha paddock was stocked from 14 June until 9 July with 351 hoggets grazing on medic, self-sown barley and barley grass before a grass selective herbicide was applied. Grazing also occurred between 24 August and 20 September with 350 ewes and 420 lambs. The overall stocking rate was estimated as 2.5 DSE/winter grazed ha with a total gross margin of approximately $100/ha. Sheep exclusion cages were fixed in the 3 zones within the 3 input rate treatments prior to the 24 August grazing.

What happened?

Colwell P levels measured before seeding were positively correlated to historic levels of P inputs in the good and medium zones, with the highest levels measured in the 2008-11 high input treatment. This relationship was not as strong in the poor zone, although higher Colwell P levels were measured where-ever P had been applied, i.e. the high and standard input treatments.

In all zones where no P has been applied in the previous 4 years the Colwell P was below the critical level of 26 mg/kg (Holloway pers. comm.). However the correlation between Colwell P levels and medic biomass this season was not strong. While there was a high level of variation in the results there was no clear response to the previously applied fertiliser treatments whereas medic production response to each of the 3 zones was quite different.

The possible reasons are discussed below;

Approximately 5 plants/m^2 of medic germinated from paddock seed reserves after the initial 30 mm rain from 27 February to 7 March, these plants were sustained by a further 18 mm in April. The April rainfall event initiated medic seeding on the 26 April. There was no further rain until 24 May when 16 mm fell and although a total of more than 100 plants/m^2 established in all zones (Table 2) the biomass production was dominated by the early germinating plants throughout the season. Cold winter temperatures also reduced plant growth rates.

Table 1 Soil characteristics of the zones in paddock N1, Minnipa 2012

	Good (sandy loam)			Medium (constrained sandy loam)			Poor (constrained sandy loam/rock)		
	High	Standard	Low	High	Standard	Low	High	Standard	Low
Colwell P 0-10 cm (mg/kg)	29	23	16	31	27	20	36	42	22
Mineral N 0-60 cm (kg/ha)	48	47	45	128	105	63	55*	69*	47*
pH (0-10 cm)#		8.8			8.6			8.3	
Depth to soil $CaCO_3$ > 25% 9cm)#		60			40			20	
Depth to B > 15 mg/kg (cm)#		100			60			80	
Depth to Cl >1000 mg/kg (cm)#		80			60			40	
PAWC (mm)		108			74			57	

*#2008 soil characterisation, *measured 0-40 cm only due to rock*

Table 2 Medic establishment (plants/m2), biomass (t DM/ha), ground cover (%) and soil water content (mm/0-0.6 m good and medium zones, 0-0.4 m poor zone) in the three zones

Zone	Establishment (plants/m²) September	Biomass (t DM/ha)		Ground cover (%)	Soil water (mm)	
		August	September	September	April	September
Good	136	1.3	1.4	60	68	53
Medium	127	1.7	2.0	84	95	61
Poor	114	1.4	1.0	49	71	36

The paddock was grazed from June into July removing much of the early biomass production before any measurements were taken. The sown and established medics were allowed to regrow until sampling and subsequent grazing in August. This sampling found a difference in biomass production between zones (Table 2) but not between the different input levels within each zone. The zone biomass difference was considered to be due to the increased available soil water of the medium zone in the 0.6 m medic root zone compared to the good zone and the shallower 0.4 m rooting depth of the poor zone.

No further rain through to the September sampling ensured no further production was made with similar total biomass figures from the ungrazed caged areas as the August biomass figures (Table 2). The dry spring would also reduce the response to nutrients, plus a calculated average growth rate of 10 kg DM/ha/day from 9 July until 21 September would have resulted in little pressure on limited nutrient resources.

What does this mean?

The production response to zones was maintained where in a season with adequate soil water over winter the medium zone produced more biomass than the good or poor zones due to more plant available water in the medic rooting zone.

The decision to establish a pasture phase has provided valuable winter grazing along with the opportunity to economically control annual grasses with a selective Group A herbicide. Although it never reached 50% of potential, the biomass produced would add 30-60 kg/ha of N to the soil bank, plus it has provided a cereal root disease break. The total value of this medic phase including the subsequent cereal crop benefit may total $200/ha, dependent on the 2013 seasonal conditions. The cost of the purchased and on-farm seed, plus the selective herbicide totals around $20, a 1000% return on investment.

Acknowledgements

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Demonstrating variable rate technology at Wharminda in 2012

Linden Masters[1] and Ian Noble[2]

[1]SARDI Minnipa Agricultural Centre, [2]Farmer, Wharminda

DEMO

Farming Systems

Searching for answers

Location: Wharminda
Ian Noble
Rainfall:
Av. Annual: 320 mm
Av. GSR: 250 mm
2012 Total: 225 mm
2012 GSR: 211 mm
Yield
Justica wheat 1.4 t/ha. 11% protein, 2% sceenings
Paddock History
2011: Peas,wheat, pasture (fences removed before 2012 seeding)
2010: Barley, wheat
2009: Wheat
Soil Type
Sand over calcrete, sand over clay and deep sand
Soil Test
Table 1
Plot Size
200 ha, two x 2 km reps of 3 double air-seeder widths
Time of Sowing
28 April
Yield Limiting Factors
Poor germination due to seed used, and sowing into drying conditions.
Non-wetting soil hindered early plant emergence.
Ryegrass competition.
Early finish with no spring rain.

Key messages

- **Combining machinery capability with advances in soil testing enables easy demonstration of variable rate technology (VRT) practices across different soil types and production zones.**
- **EM38 mapping gave the same signal for limestone and deep sand making ground truthing even more important.**
- **There were no consistent yield differences between different rates of the same fertiliser at seeding so there is scope for fertiliser inputs to be adjusted.**
- **An initial zone map developed solely from EM38 mapping didn't fully capture soil variability so will need to be developed further.**
- **Targeted management could be improved by increasing variable seeding rates to achieve higher plant numbers and competition and adjust fertiliser rates using a revised zone map.**
- **The next step is to further refine the variable rate map and treatments using yield data and local agronomic knowledge, as an important component of variable rate is to constantly improve results and returns through on-farm trials and analysis.**

What did you do and why did you do it?

Ian wanted to gain experience with his Topcon X20 controller and the variable rate capacity fitted to his Simplicity air cart. The paddock under study was EM38 mapped with soil sampling and analysis conducted to ground truth EM38 zones and starting soil phosphorus (P) levels. This information was used to create a P fertiliser prescription map with the aim of improving or maintaining yields while reducing total input costs for the paddock. The system had to be reliable and sufficiently robust to be used by inexperienced operators.

For the GRDC funded EP Farming Systems 3 water use efficiency project, this demonstration gave an opportunity to apply the responsive farming systems approach at a farm level. Using EM38, soil testing and VRT, appropriate P fertiliser applications for managing input risks on three distinct soil types at Wharminda was determined.

How did you do it?

The paddock was EM38 mapped (Figure 1) by Peter Treloar and strategically soil tested to develop a VRT map comprising three major zones. Justica wheat was sown @ 50 kg/ha with 27:12 fertiliser on 5 March, using a Simplicity air cart and Morris bar, knife points and press wheels.

Treatments:

- Paddock mapped into 3 zones with 30, 60 or 80 kg/ha of 27:12 fertiliser applied in each zone. Three demonstration strips of 0, 50 and 80 kg/ha of 27:12 were replicated twice across all soil zones with the aim of ground truthing future paddock recommendations. Each strip was two air-seeder widths of 30.48 m (100 ft) x 2 km (Figure 1).
- Chemical applied 4 March 1.0 L/ha glyphosate, 70 ml/ha Striker®; 28 June 900 ml/ha Midas®.

Fertiliser rates
Paddock
Dark grey 80 kg/ha
Light grey 60 kg/ha
Medium grey 30 kg/ha
Trial strips
Dark grey 80 kg/ha
Light grey 50 kg/ha
White 0 kg/ha

Figure 1 EM38 VRT zones with demonstration strips

Table 1 Soil test results from Wharminda, 2012

EM Zones	Colwell P (mg/kg)	PBI	Critical Colwell P (mg/kg)	Colwell P minus Critical Colwell P (mg/kg)	cDGT (µg/L)
NE180	38	30	18	20	118
NW180	11	101	28	-18	31
S137 flat	44	10	11	33	217
S100	25	5	9	16	56
S74	29	10	11	18	87
S25 sand	7	5	9	-2	85
N74 flood	14	79	26	-12	25

What happened?

The soil test results showed a wide variation in Colwell P, PBI and DGT P across the paddock (Table 1).

The soil tests show that in N74 there is a need for extra P as this is part of an area scoured by floodwaters (Figure 1). S25 is a deep drifted sand hill lacking in P. S137 is a very productive area of the paddock.

Despite a good rain (24 mm) on 22 April, the crop was sown into a drying soil moisture profile and on sandier parts of the paddock failed to germinate until the next rain event of 48 mm (20 to 23 May). Better early crop growth was observed for several months after emergence in the higher fertiliser strips, however these strips were less noticeable as the crop matured.

A lack of spring rainfall resulted in the crop failing to reach potential yields. Grain yields varied from 0.5 to 2.5 t/ha across the paddock. There were no consistent differences between yield with the different rates of fertiliser applied in test strips.

What does this mean?

Fertiliser had little impact on yield with no consistent yield variation evident in treatments. This is supported by the soil testing showing excellent levels of P in most areas.

Visually better crop in the high fertiliser strips could have resulted from the extra N in 27:12,- but it did not increase grain yield even though strips were visible until Zadoks growth stage 41. Given the high P reserves across the paddock, an option we are considering for the 2013 crop is to use a replacement P strategy where fertiliser rates are determined from the header yield map of 2012, assuming the crop removed 3-4 kg of P per tonne of grain harvested.

Nitrogen testing of soil organic carbon, nitrate and ammonium levels throughout the root zone give a basis for N management. Seasonal conditions can dictate available N and further requirements.

The process of testing the soil and setting up the monitor has given Ian the confidence to continue using VR seeding in the future. Ian hopes to use VR technology to redistribute fertiliser inputs to increase profitability. He would also like to vary seeding rate to compete with weeds, improve germination and plant densities on lighter soils. He intends to increase the area that is sown to VR next year using more EM38 mapping and analysing yield maps.

The next step is to further refine the variable rate map and treatments using yield data and local agronomic knowledge, as the most important component of variable rate is to constantly improve results and returns through on-farm trials and analysis.

Acknowledgements

Brett Masters, Sean Mason, Kendall Curtis and Peter Treloar. GRDC Eyre Peninsula Farming Systems 3 project UA00107.

Section Editor:
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Nutrition

Can we predict the rundown and long term value of P?

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RESEARCH

Key messages

- **Using the residual P trial data from Minnipa we have developed a spreadsheet model to predict the rundown of soil P reserves under continuous cropping.**
- **With this prediction we can attempt to determine the long term value of investment in P fertiliser.**
- **As expected P applied becomes less valuable with time and is eventually unable to maintain crop productivity at optimal levels if there are no further applications of P. The uncertainty of the outcome also increases with increasing time since soil fertility was monitored.**
- **This is a work in progress!**

Why do the trial?

Phosphorus (P) fertiliser is the second largest nutrient input on Australian farms and prices are projected to increase as resources become more difficult to extract. Phosphorus is available to the crops as residual P (which includes native soil P and fertiliser P previously applied), and as P fertiliser freshly applied in the growing season. To maximise the economic benefit of soil P it is necessary to be able to predict the ability of soil and fertiliser to adequately supply crop demand for P over time.

Fertiliser price spikes and a series of droughts both tend to result in farmers reducing inputs of P fertiliser. This decision is an uncertain one as the value of previously applied fertiliser is difficult to predict.

We also observe the situation of soil P reserves increasing with time when P inputs exceed removal in grain or hay and soil fixation. While this may not be the most efficient use of P, it is a risk averse approach that maintains a high soil P supply, which allows more flexibility to lower P fertiliser rates in seasons where finance is constrained.

We wanted to know if we could manage the risk of over or undersupply of P to crops by developing a tool that would predict the change in P reserves with time.

How was it done?

- Data from the residual P trial at Minnipa was used to predict the soil test P response to P exported in grain crops (amount of soil P rundown with different grain yields).
- Laboratory trials were used to predict the amount of fertiliser P that is available to growing plants and not 'fixed' by soil when it is first added.
- A published value was used to predict the ageing of fertiliser in soil which reduces its availability with time.
- A 60 year APSIM simulation was used to generate the non-P limited yield potential over a range of season types.
- The calibration curves for the DGT-P soil test were used to estimate the yield penalty caused to the yield potential at different levels of soil test P.
- A bio-economic model (@ risk) was used to run 8 year sequences of yield potential in 50,000 different combinations to test the range of possible soil test P rundown possibilities.
- This distribution of possibilities was used to calculate the economic value of soil P with time.

What happened and what does this mean?

With a starting soil test P of 75 μg/L (as was the case for the Residual P trial), the spreadsheet model predicted that there would be a mean yield penalty of 44% due to soil P rundown after 6 years of cropping with no P addition (Figure 1).

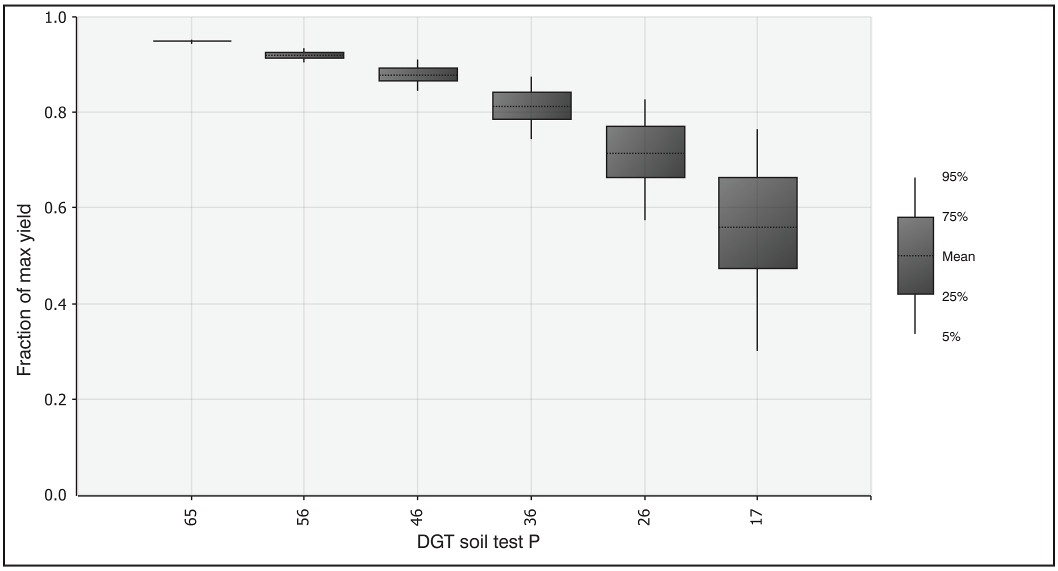

Figure 1 Fraction of potential wheat yield predicted 1-6 years after growing crops with no P fertiliser and a starting P level of 75 µg/L DGT-P. Each interval on the x-axis is one cropping year annotated by the resulting soil test level

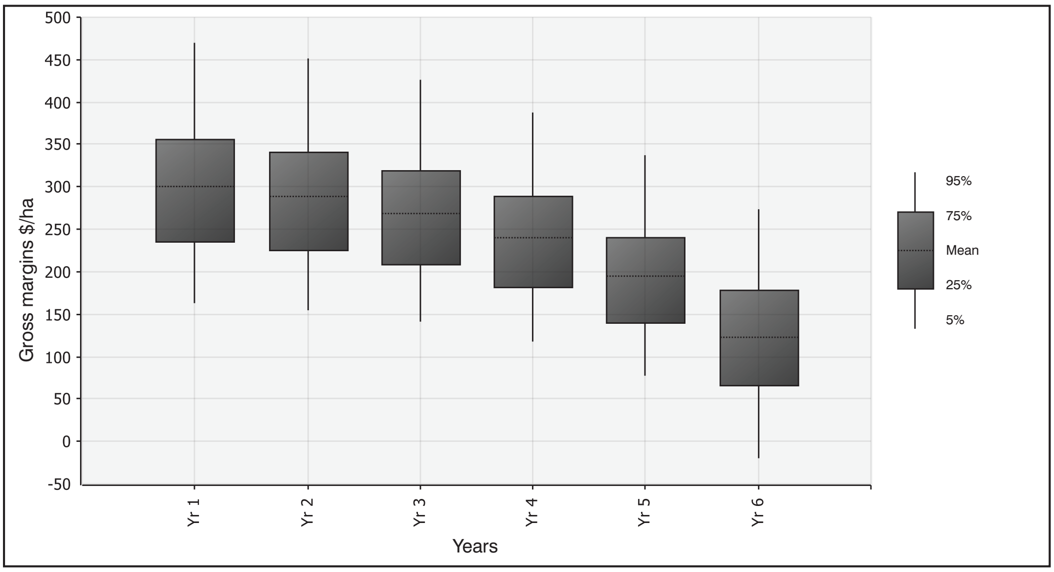

Figure 2 The gross margin ($/ha) predicted 1-6 years after growing crops with no P fertiliser and a starting P level of 75 µg/L DGT-P

We also estimated the effect of repeated cropping with no P input in a system that initially has sufficient P (Figure 2). As expected, allowing the system to rundown results in a reduction in the predicted gross margin with time, and these changes start in the third year of cropping. This result suggests that the model may be useful as a predictor of timing of P fertiliser requirement.

Where to next?

Our next step is to make some comparisons using scenarios that are relevant to common farm management practice. For example, what is the yield and economic outcome of repeated inputs of low levels of P (considered low risk management) vs. allowing the system to run down and adding intermittent large inputs of P in different soils, levels of starting P fertility and climates (crop yield potentials). We also plan to test whether the initial P fertility of soil causes soils to differ in their ability to replenish plant available P from the soil P bank at differing rates to improve our confidence in using this model for on-farm decisions.

Acknowledgements

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Nutrition

Measuring the effect of residual P

Cathy Paterson[1], Wade Shepperd[1], Ian Richter[1], Therese McBeath[2] and Sean Mason[3]

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Searching for answers

Location:
Minnipa Ag Centre, South 1

Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2012 Total: 253 mm
2012 GSR: 185 mm

Yield
Potential: 1.7 t/ha (W)
Actual: 1.6 t/ha (treatment 6)

Paddock History
2012: Wheat
2011: Barley
2010: Wheat
2009: Wheat
2008: Wheat

Soil Type
Red sandy loam

Plot Size
1.4 m x 12 m x 4 reps

Key messages

- **Treatments designed to test the residual benefit of previously applied P were again sown in 2012.**
- **No significant treatment effects were seen in 2012 due to the site having marginal but not deficient P levels.**
- **Soil test results indicate that P rundown has occurred from all treatments with the high P input (20 kg P/ha annually) treatment the least affected as expected.**

Why do the trial?

While we know soil reserves of phosphorus (P) are an important source of P for crops, we do not have a good understanding of how long soil P reserves last or how applied fertilisers contribute to soil reserves. In order to assess the value of current and residual fertiliser applications, a 4 year replicated trial was established at MAC measuring crop response to fresh and residual P additions, with soil P fertility measured annually as Colwell P and DGT-P.

How was it done?

A 4 year replicated trial was established in Paddock South 1, Minnipa Agricultural Centre in 2009 with an initial Colwell P level of 27 mg/kg (0-10 cm). The trial aims to measure wheat yields in response to different rates and strategies of P applications over time. Table 1 shows the P application rates on each of the 10 treatments over the 4 years of the study. Deep banded DAP is used as the P supply with the N balanced using urea to give a total of 18 kg N/ha. In 2012 the trial was sown on 25 May with Wyalkatchem wheat.

Soil samples were taken before sowing between the rows (0-10 cm) in a zigzag pattern from each plot to assess the effect of the treatments on soil P fertility. Grain yield and grain quality were measured at maturity. All plots were kept weed free.

What happened?

Colwell P measurements taken before sowing in 2012 ranged from 27-34 mg/kg and DGT-P measurements from 43-53 μg/L. All treatments had a Colwell P value greater than the critical value for this soil type (21 mg/kg) but treatments receiving lower rates of P were marginal for P according to the DGT-P test (44 -56 μg/L).

Using analysis of variance, there was no difference in wheat yield or quality in response to applications of different P levels in different seasons (Table 3).

Table 1 Phosphorus (kg/ha) applied over the 4 year duration of the project, 2009-12

4 YEAR PLAN	Year 1	Year 2	Year 3	Year 4
Treatment	**2009**	**2010**	**2011**	**2012**
1	20	20	20	20
2	0	0	0	0
3	10	0	0	0
4	5	10	0	0
5	5	5	10	0
6	5	5	5	10
7	5	0	0	0
8	5	5	0	0
9	5	5	5	0
10	5	5	5	5

Table 2 2012 pre-sowing soil test P in response to P fertiliser applied in 2009 - 2012

P applied (kg/ha)	Colwell P (mg/kg)	DGT-P (μg/L)
0+0+0+0	28	44
	2009 applied fertiliser (residual)	
5+0+0+0	27	47
10+0+0+0	28	51
	2010 applied fertiliser (residual)	
5+5+0+0	31	43
5+10+10+0	31	47
	2011 applied fertiliser (residual)	
5+5+5+0	33	43
5+5+10+0	30	50
20+20+20+20	34	53

Critical Colwell P = 21 mg/kg, critical DGT = 50μg/L (Confidence Interval 44-56 μg/L)

Table 3 2012 wheat grain yield and quality response to P fertiliser applied in 2009 - 2012

P applied (kg/ha) 2009+10+11+12	Grain Yield (t/ha)	Test Wt (kg/hL)	Screenings (%)	Protein (%)
0+0+0+0	1.39	84.2	3.7	10.4
		2009 applied fertiliser (residual)		
5+0+0+0	1.21	84.2	4.3	10.2
10+0+0+0	1.42	84.3	4.0	10.3
		2010 applied fertiliser (residual)		
5+5+0+0	1.48	84.4	4.0	10.0
5+10+10+0	1.51	84.5	4.2	10.0
		2011 applied fertiliser (residual)		
5+5+5+0	1.38	84.2	4.5	10.0
5+5+10+0	1.18	84.1	3.9	10.3
		2012 applied fertiliser (fresh)		
5+5+5+5	1.40	84.2	4.2	10.2
5+5+5+10	1.59	84.5	4.5	9.7
20+20+20+20	1.54	84.5	4.3	9.9
LSD (P=0.05)	*ns*	*ns*	*ns*	*ns*

Soil test values measured before the 2010 growing season were 37 mg/kg Colwell P and 75 μg/L DGT P and in 2012 Colwell P was 27-34 mg/kg and DGT-P was 43-53 μg/L (Table 2). The P levels are drawing down due to significant P removal from above average yields in 2010 and 2011. Continued monitoring of soil P levels through soil testing is especially important when using management techniques that are likely to draw down on soil P reserves (eg. nil and low P inputs).

What does this mean?

The value of soil testing showing adequate P levels was emphasised by the similar grain yields produced irrespective of 2012 P applications, 0 to 20 kg P/ha. This information provides the farmer with the opportunity to determine level of P input based on personal situation not through immediate agronomic necessity.

Acknowledgements

We acknowledge the funding from GRDC EP Farming Systems 3 project UA00107 for this work.

Replacement P in cropping systems on upper EP

RESEARCH

Cathy Paterson[1], Wade Shepperd[1], Ian Richter[1], Sean Mason[2] and Therese McBeath[3]

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Searching for answers

Location:
Minnipa Ag Centre, paddock North 1
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2012 Total: 253 mm
2012 GSR: 185 mm
Paddock History
2011: Barley
2010: Wheat
2009: Wheat
2008: Wheat
Soil Type
Red sandy loam
Plot Size
1.4 m x 9 m x 4 reps
Yield Limiting Factors
Dry spring
Environmental Impacts
Water use
Runoff potential: low
Resouce efficiency
Greenhouse gas emissions (CO_2, NO_2, methane): reduced fertiliser input
Social/Practice
Time (hrs): no extra
Clash with other farming operations: standard practice
Economic
Infrastructure/operating inputs: standard
Cost of adoption risk: medium

Key messages

In 2012 medic was sown without P fertiliser to plots receiving 0, 10, 20 and replacement P rates in 2009, 2010 and 2011, and;

- **Soil test P did not increase with increasing levels of P application in 2009-2011, and tended to be highest where 10 kg P/ha was applied in each of the 3 years.**
- **Pasture biomass production increased linearly with increasing soil test P.**

Why do the trial?

There was an accumulation of P reserves in many cropping soils as a result of application rates in excess of crop demand over a run of poor seasons prior to 2009. Replacement P application rates were tested for their ability to maintain production and soil P levels compared with 0, 10 and 20 kg P/ha applied annually. The replacement P rate was based on the estimated P exported from the paddock as a grain calculated as 3 kg P/ha/t of cereal grain harvested.

The aim of this study was to monitor crop production and economic outcomes from applying P at nil, replacement, 10 kg P/ha (district practice) and 20 kg P/ha (double district practice) on a deep sandy loam (good zone) and a shallow (poor zone) constrained soil at Minnipa. This work follows on from articles in the 2009 (pp 154-155), 2010 (pp 110-111) and 2011 (pp 119-122) EP Farming Systems summaries. In 2012 plots were sown to Angel medic with no additional P fertiliser to evaluate the residual effects of three years of different P application strategies.

How was it done?

Two replicated trials were established in Paddock North 1 (N1) on Minnipa Agricultural Centre (MAC) in 2009; one on a deep red sandy loam (good zone) that has been P responsive and a second trial on a shallow, heavy soil (poor zone) that has been non-responsive to added P prior to 2009. At the start of the trial in 2009, pre-sowing Colwell P levels were sufficient based on critical levels at 25 and 35 mg/kg on the good and poor soil respectively. There were four P treatments which have been tested for three consecutive years (2009, 2010 and 2011) on the same plot. P was applied as DAP banded at sowing, with N balanced with urea to give a total of 18 kg N/ha on all treatments. In 2012, both trials were sown with medic on 27 April (a seed mix of 10 kg/ha un-scarified medic seed harvested from paddock N5N mixed with 1 kg/ha Angel medic) and received no fertiliser application. Soil samples were taken before sowing between the rows (0-10 cm depth) in a zigzag pattern from each plot to assess the effect of previous applications on soil P levels.

What happened and what does it mean?

The P balance in Table 1 shows the amount of P applied and exported in the 3 seasons 2009 to 2011. The P balance for replacement P is negative because of low P applied (after a poor season in 2008), but high levels of P were subsequently exported in 2009. There is a substantial surplus of P where 20 kg P/ha has been applied annually and a deficit where 0 kg P/ha has been applied, while the application of 10 kg P/ha was the treatment closest to achieving a neutral balance (Table 1).

The pre-sowing soil P test values showed that there was not a relationship of increasing soil test P with increasing P applications from over the 3 seasons, 2009 to 2011 (Table 1). However, these samples were taken between crop rows in 2012 to avoid sampling fertiliser applied in 2011, which means that they are more likely to intercept the 2010 cropping row and the conditions at sowing for the 2012 cropping row. The 2012 pre-sowing soil test P tended to be highest where 10 kg P/ha has been applied annually (which yielded worse than both the replacement P and 20 kg P treatments in 2010).

Table 1 P added and P removed (kg/ha) in 2009, 2010 and 2011 and resulting soil test P and biomass (sum of the two cuts, 15 August and 27 September) in 2012

P treatment (kg/ha)	P applied 2009 - 2011 (kg/ha)	*P removed 2009 - 2011 (kg/ha)	2009-2011 P - balance (P added - P removed)	Pre-sowing soil P 2012 (DGT-P/ Colwell-P)	Medic** Biomass 2012 (t/ha)
Good zone, deep sandy loam					
0	0.0	30.6	-30.6	41/29	0.62
10	30.0	33.9	-3.9	44/27	0.90
20	60.0	35.7	24.3	40/25	0.72
Replacement P	28.2	34.5	-6.3	42/27	0.64
Poor zone, shallow constrained soil					
0	0.0	24.6	-24.6	32/41	0.54
10	30.0	25.8	4.2	34/48	0.71
20	60.0	27.0	33.0	32/47	0.66
Replacement P	21.3	26.1	-4.8	31/47	0.59

**P removed estimated as 3 kg P/t grain harvested.*
***Effect of P treatments on 2012 biomass was not significant (P>0.05)*

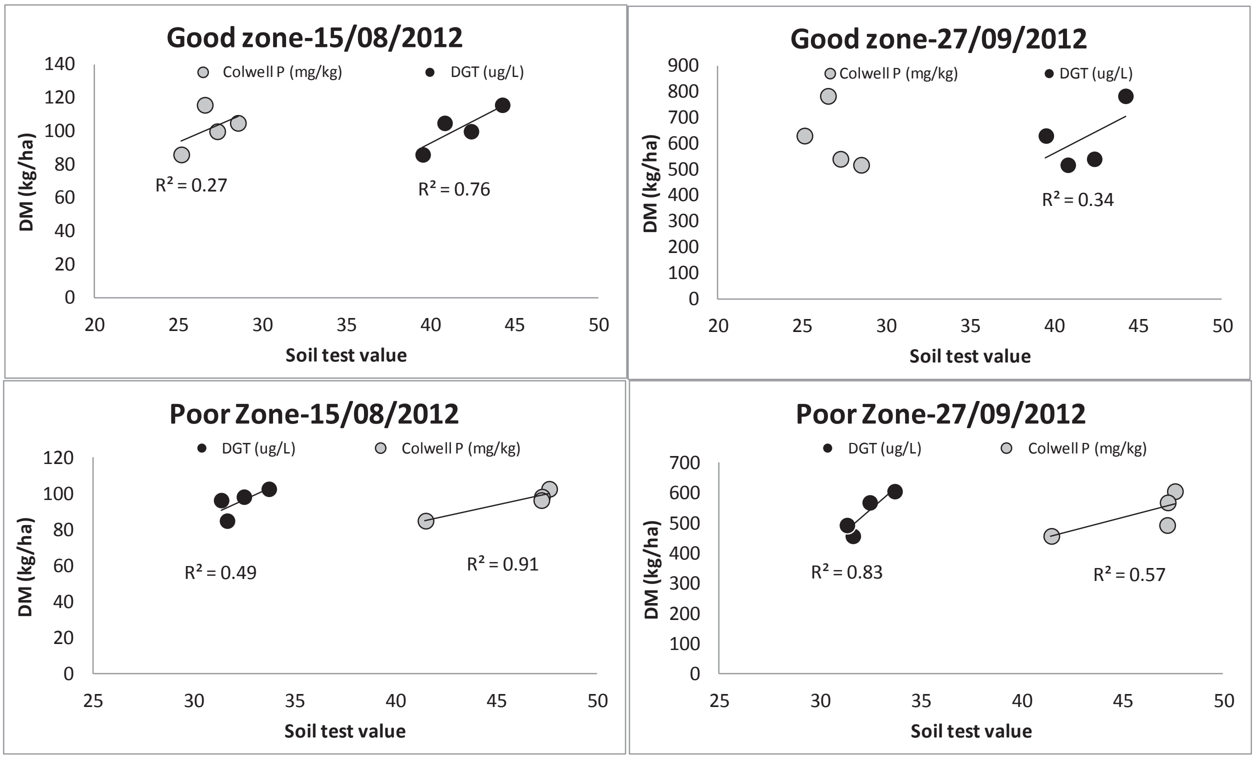

Figure 1 Relationship between soil test P and annual medic biomass production in 2012 measured on 15 August and 27 September

The production of pasture biomass was found to be directly related to the level of pre-sowing soil test P in 2012 at both times of measurement and on both soil types, with DGT-P a better predictor of the relationship in three of the four comparisons (Figure 1). The production of pasture biomass was not directly related to the level of previous P applications over the three seasons, 2009-2011 (Table 1).

In the 2012 season the medic sown without P fertiliser to plots which had previously received 0, 10, 20 and replacement P rates in seasons 2009-11 showed; soil test P did not increase with increasing levels of P application in 2009-2011 seasons, and tended to be highest where 10 kg P/ha was applied in each of the 3 years and the pasture biomass production increased linearly with increasing soil test P.

Acknowledgements

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Trace elements in a fluid fertiliser system at Mudamuckla

RESEARCH

Cathy Paterson, Wade Shepperd and Ian Richter

SARDI, Minnipa Agricultural Centre

Searching for Answers

Location: Mudamuckla
Peter Kuhlmann
Rainfall
Av. Annual: 291 mm
Av. GSR: 219 mm
2012 Total: 169 mm
2012 GSR: 128 mm
Yield
Potential: 0.8 t/ha (W)
Actual: 0.63 t/ha (treatment 6)
Paddock History
2012: Wheat
2011: Canola
2010: Wheat
2009: Wheat
2008: Wheat
Soil Type
Grey calcareous sandy loam
Soil Test
soil chemical analysis
Plot Size
1.4 m x 18 m x 4 reps
Yield Limiting Factors
Later sowing and dry spell

Key message

- **No further yield benefit was measured from applying other nutrients and trace elements over and above P and N in 2012.**

Why do the trial?

Phosphorus (P) has been a major limiting factor to crop growth on calcareous grey soils of the upper Eyre Peninsula. P deficiency causes plants to be low in vigour and fail to produce adequate tillers. Research with fluid fertilisers has not only confirmed P was the major limiting nutrient, but also that fluids increased the availability of P.

Research conducted by Holloway *et al* in the early-mid 2000's showed that the use of fluid P increased dry matter production by 20-30% compared to granular fertiliser at equivalent rates of P, but did not always result in a yield increase. This extra growth also increased the demand for other nutrients, which can cause other deficiencies and reduce the response to applied fertiliser (EPFS Summary 2004, pp 92-94).

During the 2012 farmer meetings concerns were raised about not getting the expected yield increases from using a fluid fertiliser system. This trial was designed to begin investigating what nutrients (macro and micro) are required to increase grain yield in a fluid fertiliser system.

How was it done?

The trial was sown on 19 June with Axe wheat @ 50 kg/ha with 8 treatments (Table 1), replicated 4 times. Measurements taken during the year included soil chemical analysis, plant establishment (not reported), dry matter at early tillering, anthesis and harvest, grain yield and grain quality.

What happened?

Soil chemical analysis performed before sowing measured the Colwell P level (0-10 cm) at 32 mg/kg, mineral nitrogen (N) (0-60 cm) 58 kg N/ha and trace element analysis (DTPA 0-10 cm) reported copper (Cu) 0.3 mg/kg, zinc (Zn) 0.8 mg/kg and manganese (Mn) 2.4 mg/kg. The iron (Fe) (0-10 cm) level was 1.7 mg/kg, sulphur (S) (0-10 cm) was 8.8 mg/kg, potassium (K) (0-10 cm) was 266 mg/kg and exchangeable magnesium (Mg) (0-10 cm) was 0.71 meg/100g. With the exception of copper all nutrient levels were above critical values.

Compared to the nil treatment there was more early dry matter production (Table 2) where P plus N was applied but no further increases in response to other nutrients applied. At anthesis there was a response to N+P+S but no further increases in response to other nutrients applied and at harvest all treatments had higher dry matter production where P was applied.

There was a grain yield benefit from applying P and N compared to applying no fertiliser, but no further increases in response to other nutrients applied. Grain test weight and protein levels were higher in response to P, and P and N respectively. Screenings were above 5% for all treatments with the lowest amount of screenings being achieved where P was applied.

Table 2 Plant dry matter production, grain yield and quality, Mudamuckla 2012

Treatment	Early DM (t/ha)	Anthesis DM (t/ha)	Harvest DM (t/ha)	Yield (t/ha)	Test Wt (kg/hL)	Protein (%)	Screenings (%)
Nil	0.12	1.01	1.65	0.42	82.9	12.5	8.5
N	0.14	0.89	1.67	0.59	83.1	12.6	8.7
P	0.21	1.08	1.80	0.58	84.2	12.9	6.2
N+P	0.35	1.33	2.02	0.61	83.7	13.5	5.8
N+P+S	0.37	1.42	1.83	0.56	83.7	13.4	5.8
N+P+S+K+MG	0.32	1.42	2.01	0.63	83.6	13.3	5.3
N+P+Zn+Mn+Cu	0.33	1.49	1.92	0.61	83.9	13.2	5.7
N+P+Zn+Mn+K+S+Mg+Cu	0.40	1.60	2.01	0.62	84.0	13.3	5.9
LSD (P=0.05)	*0.08*	*0.39*	*0.33*	*0.04*	*0.5*	*0.6*	*1.1*

What does this mean?

Grain yield increases were achieved with the application of P and N but there were no further benefits with applying other nutrients in 2012. The dry conditions experienced meant that these increases were small and the screenings of all treatments were over 5%, downgrading the grain from Hard to Feed 1. This site was only deficient in copper (The Wheat Book - Principles and Practice), although there was no benefit gained from applying this nutrient this season. The dry conditions and consequential low yields would have reduced the plants demand for all nutrients.

The results from this trial demonstrate that more work is required into the use of nutrients other than P in a fluid system across a range of seasonal conditions to investigate if these increases can be consistently achieved and what rate and form is most likely to provide an economic benefit.

Acknowledgements

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Nutrition

Liquid fertiliser evaluation trial

Tristan Baldock[1] and Cathy Paterson[2]

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RESEARCH

Searching for Answers

Location: Tuckey
Jason & Julie Burton
Rainfall
Av. Annual: 330 mm
Av. GSR: 235 mm
2012 Total: 169 mm
2012 GSR: 289 mm
Yield
Potential: 1.95 t/ha (W)
Actual: 0.63 t/ha
Paddock History
2011: Angel medic pasture
2010: Stiletto wheat
2009: Wheat
Soil Type
Grey brown loam
Soil Test
C_{DGT} 36: Predicted Response (DGT) 81%
Plot Size
50 m x 2 m x 3 reps
Yield Limiting Factors
Early finish
Social/Practice
Time (hrs): uses less labour
Clash with other farming operations: more timely sowing operations
Labour requirements: Savings in terms of logistics and associated labour costs

Key messages

- **Liquid N gave the most significant response of all liquid treatments in terms of mid-season biomass production and final yield.**
- **A full liquid system including N, P, trace elements and fungicides provided the greatest yield response, significantly better than district practice granular treatments.**
- **Full liquid and liquid N treatments provided similar returns to that of traditional treatments, and greater returns than liquid P only treatments.**

Why do the trial?

The necessity to evaluate a decision to convert a grower's system to full liquid technology in 2011 prompted the establishment of split paddock trials in that season, resulting in a $100/ha gross margin benefit in the Liquid system over the traditional granule MAP + urea system on a farm at Tuckey. This gross margin increase prompted investigation into what components of this liquid system were responsible for such a benefit, thus the establishment of this trial site in 2012.

How was it done?

The trial was established on a uniform grey brown loam top soil over soft limestone subsoil, with a Colwell P of 36 mg/kg (sufficient) and nitrate N of 36 mg/kg (sufficient) (Figure 1), and chemical fallowed over summer. Sown with certified Mace wheat on 28 May, the replicated trials consisted of a number of liquid, granular, and liquid/granule combination treatments of nitrogen (N), phosphorous (P), trace elements (TE) and in furrow fungicide (fung) designed to establish which component has the greater effect on final yields. The treatments are summarised in Table 1.

What happened?

Visual differences in treatments were observed from crop emergence through to grain fill, with treatments containing liquid nitrogen, as well as the complete liquid treatment establishing quicker, with increased early vigour and maintaining a growth stage and biomass advantage. Emergence counts were variable, however it was noted that most complete liquid and liquid N treatments had greater emergence than the control (nil fert), while all complete granule and granule N treatments had a lower emergence than the control. It was also observed that higher P rates, regardless of P form, increased crop emergence.

Tissue analysis showed that treatments with liquid trace elements had healthier plants and liquid treatments had more favourable levels of N and P, although this was not validated. Tiller counts showed that higher rates of P (12 units) in the granule form supported increased tillering, but this did not translate into a significant yield benefit. Similarly, liquid flutriafol showed a tillering advantage over granule, but no yield benefit in 2012.

Nutrient (Depth 0.00 - 10.00)	Result	Low	Marginal	Sufficient	High	Excess	Sufficiency Range
pH (1:5 CaCl2)	7.6						4.7 - 7.7
pH (1:5 H2O)	8.3						5.5 - 8.5
EC (1:5 H2O) dS/m	0.21						0.00 - 0.80
EC (se) (dS/m)	1.7						0.0 - 6.0
EC (se) (dS/m) (Cladj)	0.9						0.0 - 6.0
Chloride (1:5 H2O) mg/kg	21						0 - 250
Electrochemical Stability Index	0.277						0.050 - 10.000
Organic carbon (Walkley Black) %	1.43						1.00 - 2.00
Nitrate nitrogen (KCl) mg/kg	36						25 - 50
Ammonium nitrogen (KCl) mg/kg	4						0 - 5
Phosphorus (Colwell) mg/kg	36						20 - 100
Phosphorus Buffer Index (PBI)	103.9						15.0 - 280.0
Potassium (Colwell) mg/kg	629						120 - 200
Sulfur (KCl-40) (mg/kg)	12.6						8.0 - 50.0
Exch. Ca (BaCl2/NH4Cl) meq/100g	15.15						10.00 - 100.00
Calcium Carbonate %	4.9						0.0 - 5.0
Exch. Mg (BaCl2/NH4Cl) meq/100g	1.76						5.00 - 200.00
Exch. K (BaCl2/NH4Cl) meq/100g	1.49						0.30 - 10.00
Exch. Na (BaCl2/NH4Cl) meq/100g	0.14						0.00 - 1.00
Aluminium (KCl) meq/100g	0.00						0.00 - 0.50
eCEC meq/100g	18.5						5.0 - 15.0
Exch. magnesium %	9.5						0.0 - 25.0
Exch. sodium %	0.8						0.0 - 6.0
Dispersion Index (Loveday/Pyle)	0						0 - 6
Copper (DTPA) mg/kg	0.4						1.0 - 5.0
Zinc (DTPA) mg/kg	1.3						0.8 - 5.0
Manganese (DTPA) mg/kg	4.0						6.0 - 50.0

Figure 1 Soil test results for Rudall trial site, 2012

Yield data (Table 1) shows the full liquid treatment (treatment 8) yielded significantly more than the district practice of granule MAP + Urea (treatment 1). This is consistent with observations in the 2011 split paddock trial, however the liquid treatment assessed in 2011 (Burton Brew treatment 21), which has less liquid P and N than other liquid treatments, did not have a significant yield advantage over granules this season. Trace elements, or the addition of fungicide, had no impact on final yields, but rather differences were driven by N and P. Despite these trials being planted on medic pasture stubble, liquid N had a far greater impact on yield than P when fertiliser form was analysed as a factor (Figure 2). Treatments containing liquid N yielded significantly more than traditional granule treatments, as well as those containing granule N and liquid P.

Grain test weight was the only quality measure to show any significant difference between treatments, however not enough to affect the grain quality grade, therefore having no impact on gross margin return (data not shown). Improved yields did not translate into higher profits, with no difference in gross margin return between full liquid, liquid N and granule treatments (Figure 2). Liquid P had the poorest return, returning up to $70/ha less than Liquid N or granule treatments and $35/ha less than the higher costing complete liquid treatments.

Table 1 Wheat emergence, tiller count, grain yield (t/ha), test weight (kg/hL) and gross margins ($/ha) in response to fertiliser treatments. *Note all treatments contain 20 units of N and 8 units of P unless specified otherwise in the description. Trace elements (TE) consists of Zn and Mn @480 gms/ha and Cu @ 193 gms/ha as sulphate, except for treatment 13 which is EDTA chelate. Fungicide consists of flutriafol @ 100 gm/ha active ingredient as a liquid, except for treatment 18 which has a coating on granule fertiliser. Furthermore, the Burton Blend contains N-(6liquid+14granule), P-(6liquid+2 granule), Zn Mn 480 gms, Cu 193 gms, and Burton Double N-12liquid, 14granule, P-12liquid+2granule, Zn Mn 1000 gms, Cu 42 gms.*

Treatment	Treatment Description	Emergence (plants/m²)	Tiller Count (/m²)	Grain Yield (t/ha)	Test Wt (kg/hL)	Gross Margin ($/ha)
1	granN granP (T1)	144	172	2.38	84.8	666
2	ganN granP +fung -TE (T2)	146	226	2.37	84.6	660
3	granN granP -fung +TE (T3)	151	234	2.41	84.4	664
4	granN granP +fung +TE (T4)	133	232	2.40	84.8	658
5	liqN liqP -fung -TE (T5)	172	233	2.53	84.9	636
6	liqN liqP +fung -TE (T6)	175	235	2.49	84.8	619
7	liqN liqP -fung +TE (T7)	162	231	2.55	84.7	638
8	liqN liqP +fung +TE (T8)	181	232	2.64	84.6	658
9	liqN granP -fung -TE (T9)	178	245	2.55	85.0	675
10	granN liqP (T10)	134	231	2.38	84.4	593
11	liqN granP -fung +TE (T11)	160	242	2.56	84.6	673
12	ganN liqP -fung +TE (T12)	137	205	2.44	84.5	600
13	liqNliqP +fung +TE (T13)	160	221	2.51	84.9	598
14	granN (20) granP (12) -fung -TE (T14)	154	235	2.42	84.2	668
15	Burton Double (T15)	140	242	2.55	84.4	630
16	liqNliqP (6) +fung +TE (T16)	170	243	2.57	84.5	650
17	granNgranP (12) +fung +TE (T17)	149	258	2.46	84.6	671
18	granNgranP +granfung +H20 +TE (T18)	135	206	2.51	84.4	683
19	nil fert (T19)	160	219	2.43	84.7	728
20	nil fert +fung (T20)	165	228	2.44	84.9	729
21	Burton Brew (T21)	142	*	2.43	84.3	655
LSD (P=0.05)		*23*	*35*	*0.15*	*0.5*	*47*

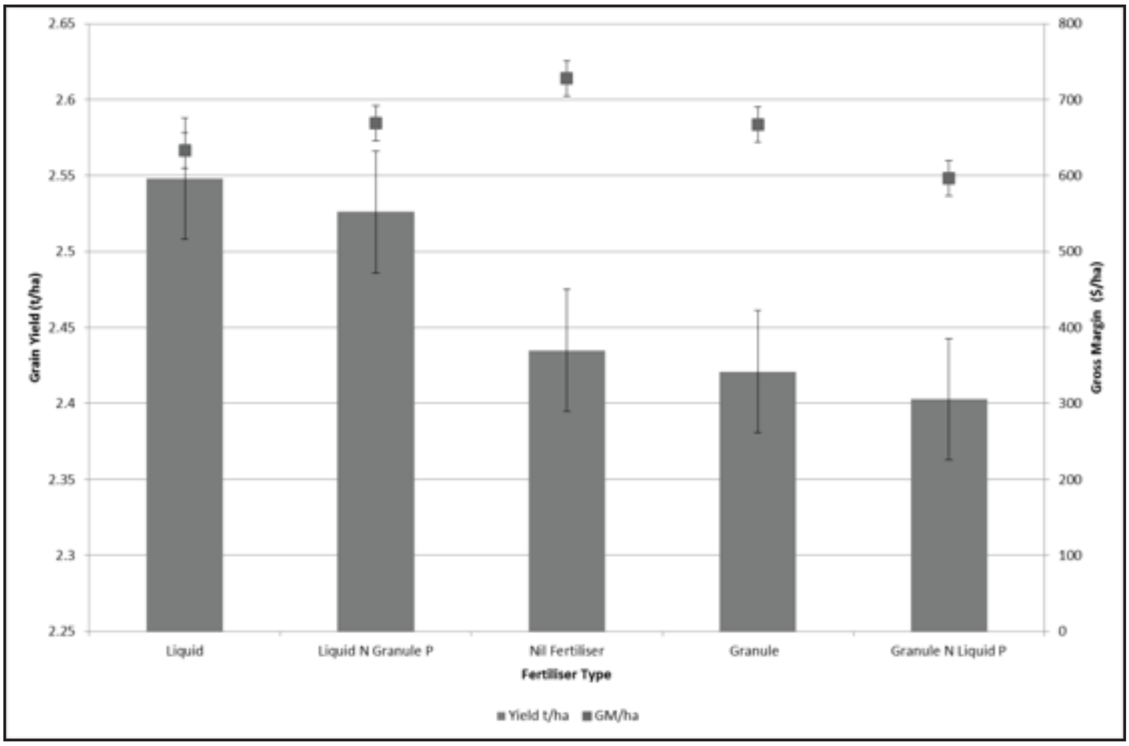

Figure 2 Wheat yield (t/ha) and gross margins ($/ha) of liquid treatments compared to nil fertiliser, granule treatments and granule N + liquid P

What does this mean?

Results from previous split paddock trials near this site suggest potential for large gross margin improvements in a full liquid system over a traditional granule fertiliser system at sowing. This study supports some of these observations, showing improvements in crop establishment and early vigour resulting in significant improvements in yield under a liquid system compared with granules, although there is no increase in profitability in this instance. This is however a significant outcome in a season where water was the limiting factor, not nutritional inputs.

This study also suggests that liquid N has had a greater impact on yields than P on this farm, which has given greater financial returns. Trace elements had no impact on final yield, although they did have an impact on crop establishment and tillering, indicating possible benefits in a more favourable spring. Likewise, the presence of flutriafol, whether as a liquid stream or as a coating on granule fertiliser, had no impact on final yield in a season where no disease pressure was observed.

This study has captured one year of split paddock trials and one year of replicated plot trials, which has encompassed two very different sets of seasonal conditions. While similar results and trends have been observed both years, further research is required to validate the results and learn more about the impacts of liquids under varying seasonal conditions. At this point there appears to be an advantage in liquid technology outside of P response with possible benefits in returns when liquid N is considered in the system.

Acknowledgments

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Nutrition

GRDC
Grains Research & Development Corporation

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

NRI
National Rural Independents Ltd

CLEVE RURAL TRADERS

SPRAY GRO LIQUID FERTILIZERS

Manganese response in barley at Wharminda

Cathy Paterson, Wade Shepperd and Ian Richter
SARDI, Minnipa Agricultural Centre

Searching for Answers

Location: Wharminda
Ed Hunt
Rainfall
Av. Annual: 322 mm
Av. GSR: 222 mm
2012 Total: 241 mm
2012 GSR: 209 mm
Yield
Potential: 2.5 t/ha (B)
Actual: 2.7-2.9 t/ha
Paddock History
2011: Pasture
2010: Barley
2009: Wheat
Disease
Nil
Yield Limiting Factors
Dry spring

Key message

- **In 2012 applying N at GS31 increased yields but no response to manganese was measured.**

Why do the trial?

During the 2010 growing season the Wharminda Ag Bureau questioned the value of applying manganese (Mn) with nitrogen (N) as this is a common practice for some farmers in the area. As a result in 2010 an unreplicated treatment strip of foliar Mn was applied to barley in a small area in the EP Farming Systems 3 Wharminda Focus Paddock, where there was a yield increase possibly in response to added Mn in combination with N in a decile 9 season.

In 2011 a trial was established to investigate Mn response in barley (EPFS Summary 2011 pp 133-134). This trial was repeated in 2012.

How it was done?

The trial was sown with Scope barley @ 55 kg/ha at Wharminda on 29 May with 9 treatments applied (Table 1). All treatments received DAP @ 50 kg/ha except treatment 9 which received triple super @ 48 kg/ha (equal to 10 kg P/ha). These treatments were established to investigate the benefit in applying Mn at different rates, different timings of application and method of application, as well as the interaction between N and Mn.

Due to a lack of spring rain in 2012 the late stage applications of Mn and N in treatments 6 and 7 were not applied.

Soil chemical analysis performed before sowing indicated that the Colwell P level (0-10 cm) was 18 mg/kg, mineral N (0-60 cm) was 34 kg/ha and DTPA Mn (0-10 cm) was 1.9 mg/kg. Measurements taken during the year included plant establishment (not reported), dry matter at early tillering and anthesis, grain yield and grain quality.

What happened?

There was no dry matter response to Mn or N at any stage during the growing season (Table 2), however there was a grain yield response to N when it was applied at GS 31, while the application of Mn did not result in a higher yield. In terms of grain quality all treatments were in the Barley Feed 1 parameters and there was no grain quality response to applied nutrients.

What does this mean?

Given that there was a grain yield increase only when N was applied at GS 31 it is doubtful that there is an agronomic advantage in applying these two nutrients together in the absence of severe Mn deficiency. The response at this site was most likely due to the lower mineral N status rather than Mn, as 1.9 mg/kg Mn is considered borderline for deficiency (The Wheat Book - Principles and Practice).

This trial needs to be repeated in different seasonal conditions and background soil nutrition levels to further explore any interaction between Mn and N.

Acknowledgements

We acknowledge the funding from GRDC for the EP Farming Systems 3 Project UA00107 which made this work possible and the Hunt family for providing the land for this trial.

Table 1 Mn treatments applied to Scope barley, Wharminda 2012

Treatment 1	Control
Treatment 2	Nil Mn + 12 units N @ GS 31
Treatment 3	1.1 kg/ha Mn sulphate banded with seed (fluid)
Treatment 4	0.55 kg/ha Mn sulphate 2-3 leaf stage + GS 31 1.1 kg/ha Mn sulphate + 12 units N
Treatment 5	0.55 kg/ha Mn sulphate 2-3 leaf stage + GS 31 1.1 kg/ha Mn sulphate
Treatment 6	0.55 kg/ha Mn sulphate 2-3 leaf stage + GS 31 1.1 kg/ha Mn sulphate + 12 units N + Late stage Mn application + N (Not applied)
Treatment 7	0.55 kg/ha Mn sulphate 2-3 leaf stage + GS 31 1.1 kg/ha Mn sulphate + 12 units N + Late stage Mn application – N (Not applied)
Treatment 8	Mn Seed dressing 6 L/t Seed
Treatment 9	Control minus N

GS = growth stage

Table 2 Barley dry matter, yield and grain quality response to Mn, Wharminda 2012

Treatment	Early DM (t/ha)	Harvest DM (t/ha)	Yield (t/ha)	Test Wt (kg/hL)	Protein (%)	Screenings (%)
Treatment 1	2.2	5.8	2.7	73.9	9.5	3.7
Treatment 2	2.2	6.4	2.8	73.4	9.8	4.7
Treatment 3	2.0	5.8	2.6	73.8	9.5	4.4
Treatment 4	2.3	5.9	2.9	73.9	9.4	3.5
Treatment 5	2.1	5.7	2.7	74.1	9.2	3.5
Treatment 6	2.1	5.5	2.9	74.0	9.3	5.6
Treatment 7	2.1	6.0	2.8	73.7	9.2	4.0
Treatment 8	2.0	5.8	2.7	73.8	9.4	4.6
Treatment 9	2.0	5.6	2.7	73.6	9.8	3.9
LSD (P=0.05)	*ns*	*ns*	*0.17*	*ns*	*ns*	*ns*

Phosphorus rate trials at Wharminda

Cathy Paterson, Wade Shepperd and Ian Richter
SARDI, Minnipa Agricultural Centre

Searching for Answers

Location: Wharminda
Ed Hunt
Rainfall
Av. Annual: 322 mm
Av. GSR: 222 mm
2012 Total: 241 mm
2012 GSR: 209 mm
Yield
Potential: 2.5 t/ha (B)
Actual: 2.7-2.9 t/ha
Paddock History
2011: Pasture
2010: Barley
2009: Wheat
Disease
Nil
Yield Limiting Factors
Dry spring

Key messages

- **No residual effects from varying fertiliser rates applied in 2010 were measured in 2012, following a 2011 pasture phase.**
- **Yield increased with P applied at sowing.**

Why do the trial?

It is important that our low rainfall farming systems are low risk, flexible and responsive. Paddock inputs need to balance the best agronomic and economic advice with the need to ensure reliable outcomes at low cost.

A paddock at Wharminda, one of three focus paddocks in the current GRDC funded EP Farming Systems 3 project, was chosen as representative of eastern Eyre Peninsula soils varying from deep sand to shallow clay loam. The emphasis in 2009 and 2010 was on managing risk through tailoring inputs to different production zone potential by using variable rate technology. In 2012 the Wharminda Focus Paddock was in the wheat phase of a pasture-wheat-barley-pasture rotation with the residual effects of the 2010 treatments to be assessed as well as the phosphorus (P) response of wheat yield on the three identified production zones.

How it was done?

A paddock at Wharminda was selected and zoned according to soil type; deep sand over clay representing 20% of the paddock, shallow sand over clay representing 50% of the paddock and loam representing 30% of the paddock, with four permanent sampling points per zone established. In 2010 the paddock was sown with Fleet barley with three fertiliser treatments of low, standard and high applied to the paddock in alternating strips across the paddock (EPFS Summary 2010, pp 93-94). In 2011 the paddock was in the pasture phase of the rotation, a self-regenerating pasture, established from the soil seed reserve, with no applied fertiliser (EPFS Summary 2011, pp 109-110).

In 2012 three trial sites were established on one of the four permanent sampling points in each zone, with treatments sown at 90 degrees to the treatment strips applied in 2010. The trials were sown on 29 May with Clearfield Stiletto @ 65 kg/ha. P was applied at 0, 3, 6, 9, 12, 15, 20, 40 kg P/ha as Triple Super and replicated 4 times. All treatments had N, Zn, Cu, Mn and S applied at seeding.

Measurements taken during the year included soil Colwell P levels, Phosphorus Buffering Index (PBI), deep N, root disease testing (RDTS), soil moisture at sowing and harvest, plant establishment, dry matter production (early and harvest), grain yield and quality.

What happened?

Soil chemical analysis prior to seeding showed that mineral N levels were low in all soil types (Table 1) and the loam and deep sand over clay zone had adequate P levels for this soil type for the high and standard input treatments (≥ 22 mg/kg). In all soil types the 2010 low input treatments were below the critical level for this soil type. All soil types had an extremely low PBI level.

Table 1 Soil chemical analysis for Wharminda Focus Paddock, 2012

Zone	Colwell P 0-10 cm (mg/kg)			PBI	Total Mineral N 0-60 cm (kg/ha)		
	High*	Standard#	Low ¥		High*	Standard#	Low ¥
Deep sand/clay	25	28	14	7	34	54	48
Shallow sand/clay	18	15	14	9	39	45	46
Loam	24	22	19	11	39	49	26

** 2010 P applied @ 16 kg P/ha, # 2010 P applied @ 8 kg P/ha, ¥ 2010 no P applied*

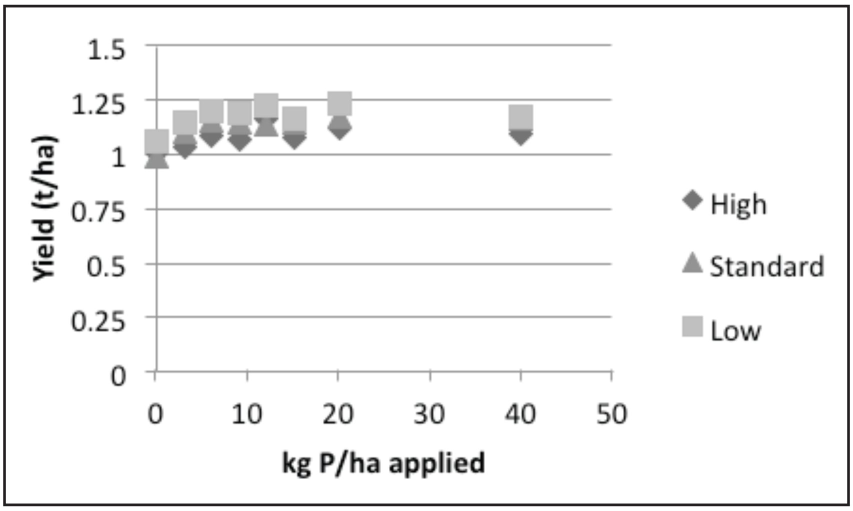

Figure 1 Yield (t/ha) in the deep sand over clay zone, Wharminda 2012

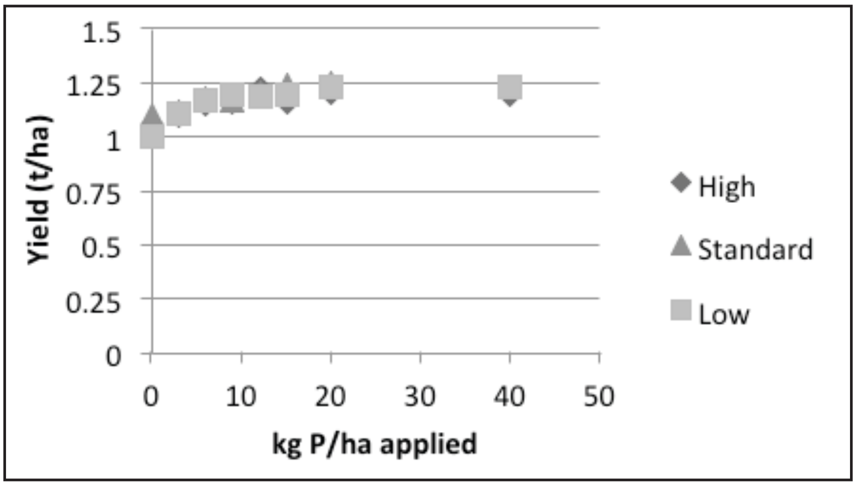

Figure 2 Yield (t/ha) in the shallow sand over clay zone, Wharminda 2012

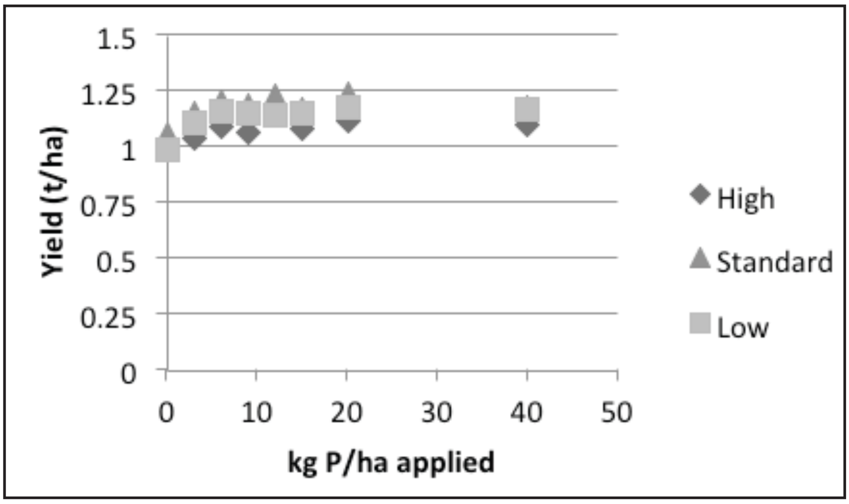

Figure 3 Yield (t/ha) in the loam zone, Wharminda 2012

There was no difference in plant establishment, dry matter production or grain quality (data not reported) in any zone. There was no response to the fertiliser treatments applied in 2010, however there was a grain yield increase to 6 kg P/ha applied at sowing in all zones (Figures 1, 2 and 3).

What does this mean?

The lack of a biomass or yield response to the treatments applied in 2010 was supported by the extremely low PBI in all soil types in this paddock. PBI is a measurement of a soil's ability to "hold onto P" and given the low values measured in this paddock it is likely that a majority of the P previously applied has been used by the 2010 barley and the 2011 medic pasture phase. As a result there was no response in the nil P to the 2010 treatments. There was no further yield benefit above 6 kg/ha of P applied at sowing.

The 1.2 t/ha yield was achieved with 6 kg of P/ha in 2012, however this was only approximately 50% of potential yield with other factors such as N supply, sowing date and 2012 spring conditions potentially limiting yield, and response to increased rates of P.

Acknowledgements

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GRDC Grains Research & Development Corporation

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Section 6

Section Editor:
Cathy Paterson
SARDI, Minnipa Agricultural Centre

Livestock

Identifying causes for lamb losses in low rainfall mixed farming regions

Jessica Crettenden and Suzanne Holbery
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for problems

Location: Minnipa Ag Centre
Rainfall
Av Annual: 325 mm
Av GSR: 241 mm
2012 Total: 253 mm
2012 GSR: 185 mm

Key messages

- **Ewes joined in late January 2012 scanned at 149% with 151% recorded at lambing and 118% at weaning.**
- **Autopsies found the majority of lamb deaths were due to the starvation, mismothering or exposure (SME) complex and premature or 'dead in utero' causes.**
- **Almost half of losses remained undiagnosed due to extensive predation prior to autopsy or disappearance of the lamb carcasses.**
- **Results suggest that managing ewe nutrition according to pregnancy scan results, controlling predator numbers and reducing mismothering issues through environmental factors are likely to increase lamb survival up until weaning.**

Why do the trial?

Survey data suggests that Merino weaning percentages in low rainfall regions vary from 80-90%. However pregnancy scanning indicates that percentages of around 130% are present in the uterus. This difference constitutes a loss of possibly 100,000 lambs annually on Eyre Peninsula (EP) alone. In most instances the failure is likely to be due to poor lamb survival which can occur due to a number of reasons involving the lamb itself, its genetics, the ewe and the environment.

Identifying the causes and timing of lamb losses may provide the opportunity to address these factors whereby a significant economic benefit accrues to the industry; however the first step is to establish where the issues are occurring in the reproductive cycle of the flock. The solutions to reduce lamb losses exist but there needs to be an accurate assessment of why the losses are occurring to implement the correct preventative strategies.

How was it done?

Research was carried out on Minnipa Agricultural Centre (MAC) through utilising the lambing program of an Australian Wool Innovation (AWI) and South Australian Research and Development Institute (SARDI) funded project 'Best Practice Wool Innovations on Eyre Peninsula'.

The 374 MAC flock ewes, ranging from 2006-2011 drop, were joined in 7 sire groups of approximately 50 ewes from 1 February until 12 March 2012. Sire group 7 consisted of 43 ewe lambs (2011 drop) that were 6-7 months old and heavier than 40 kg at joining.

The joined ewes were pregnancy scanned at 12 weeks on 27 April. Ewes were side-branded (for dam pedigree) and drafted into their sire groups for lambing on 8 June. Dry ewes were drafted from the flock and kept in a separate paddock over the lambing period. Seven sheltered paddocks ranging from 10-20 ha in size were chosen for lambing and ewes had a feed base including mallee scrub, saltbush, olive trees and wheat stubble with an understorey of medic, broadleaved weeds and annual grasses.

Lambing began on 28 June and finished on 9 August 2012. During this time daily observations were conducted and lambs were individually identified (for pedigree) at birth and tagged. To identify the cause of lamb losses from scanning until marking the following measurements were taken; birth weight (kg), birth type (single, twin, triplet or quadruplet), rectal temperature (°C), lamb vigour and dam maternal temperament (objective 1-5 score, with 1 being poor and 5 being excellent), and in the case of death prior to weaning, an autopsy to determine the cause (date of death and autopsy result).

This methodology provided the opportunity to identify the cause and timing of lamb deaths which were documented from the beginning of lambing on 28 June until weaning on 10 October 2012.

What happened?

The 2006-2010 (sire groups 1-6) drop ewes had a pregnancy scanning result of 162% equating to 538 lambs from 331 ewes with the ewe lambs (sire group 7) having a lower result of 48% equating to 21 lambs from 42 ewes.

Two ewes died of unknown causes in between scanning and lambing and 8 ewes died during lambing due to dystocia (abnormal or difficult birth) or other unknown causes. During lambing 563 lambs were tagged at birth (with a result of 151% for lambing) and 119 lambs died. One lamb died between marking and weaning, leaving 443 lambs surviving (with a result of 118% for weaning). The majority of lambs were born as twins (69%) and there were more ram lambs (53.2%) than ewe lambs (44.2%), with 2.2% of lambs born recorded as unknown sex due to predation and one lamb was born a hermaphrodite (0.2%).

Birth weight was measured from approximately 2-24 hours old and ranged from 2-8 kg, averaging 5 kg. The birth weights were also measured for lambs found deceased at the birth site. Rectal temperature was measured on living lambs only at the time of taking birth weight measurement and averaged 38.9°C (normal range 39-40°C, <37°C is critical, <35°C requires treatment). Maternal temperament averaged 3.6 for all ewes however was better in the 2006-2010 drop ewes compared to the 2011 drop dams and the average lamb vigour was 3.9.

The dams of the deceased lambs included 6 ewes that had died during the lambing period, 20 that had mastitis (which were hesitant to let their lambs feed) and 26 that were maidens. Due to predation, autopsies could not be conducted on 14% of lambs which were consequently recorded as 'undiagnosed' due to only finding parts of their bodies intact during daily observations (Figure 1). There were another 36% of lambs that existed and were tagged but were missing at marking time (the carcasses were most likely scavenged or predated before they could be recovered). These lamb deaths were recorded as 'not found' (Figure 1).

The lamb age at time of death ranged from less than 1 day to 47 days with an average age of 2.5 days, however the age at death of 43 deceased lambs was undermined due to predation. Of the deceased lambs there were 47 females, 60 males and 13 unknown (due to predation). Over two-thirds (82%) of deceased lambs were multiples. In the 'undiagnosed' and 'not found' categories, all lambs with a known birth type were multiples with the majority recorded as twins (63%).

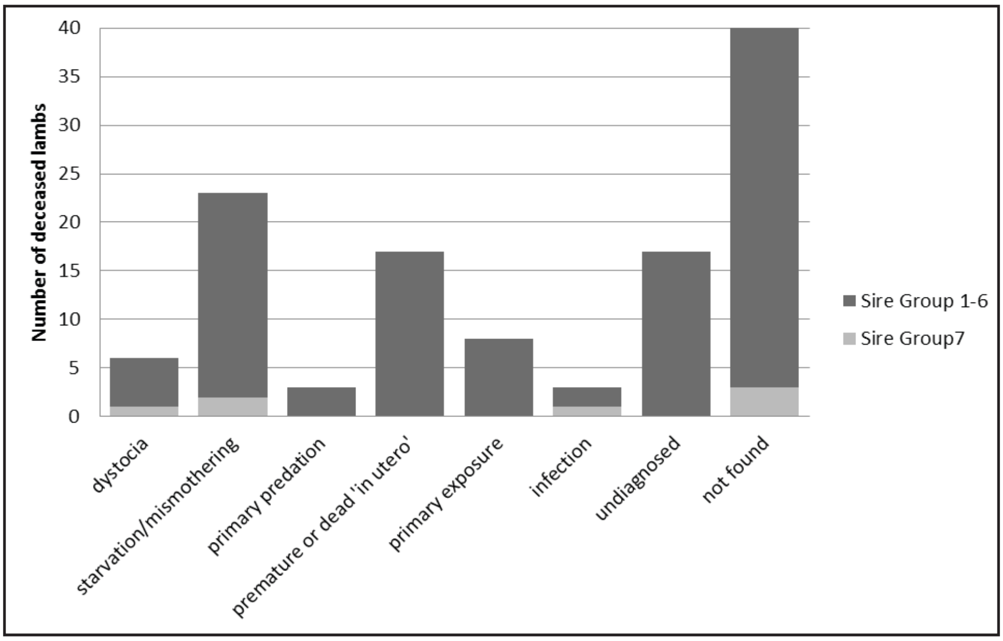

Figure 1 Autopsy results for the deceased lambs in the Minnipa Agricultural Centre flock 2012 drop from birth until weaning

Dystocia = abnormal or difficult birth

What does this mean?

The majority (72%) of known lamb deaths in the study were attributed to or associated with the complexity of issues involving starvation, mismothering and exposure (referred to as the SME complex), which is similar to industry records. It was suspected that the major cause of lamb deaths in the 'not found' and 'undiagnosed' categories could not be determined due to secondary rather than primary predation. These lambs were vulnerable and more likely to die in the absence of predation due to the relationship with multiple birth types and the SME complex, as well as other factors including maternal temperament, rectal temperature, birth weight and lamb vigour.

Nearly half of all pre-weaning deaths occur on the day of birth, therefore reducing the likelihood of lamb deaths within the first 24 hours will have a significant impact on lamb survival to weaning.

Recommendations to come out of the study include:

- Actively managing ewe nutrition during pregnancy according to scanning results, targeting a minimum body condition score of 3. Maintaining ewes in this condition will minimise the risk of dystocia and provide extra nutrition for multiple-bearing ewes, which will assist in increased lamb vigour and likelihood of survival past the 24 hour period.
- Using lick feeders for supplementary feed over the lambing period as opposed to trailing out feed will reduce the incidence of mismothering and will reduce flock stress during this time.
- Adequate paddock size for the number of lambs expected to be born and well planned placement of feed and watering points will also reduce mismothering issues, especially if interference during lambing time is a possibility (e.g. if mothering-up lambs). Suitable paddock shelter also plays a vital role in lamb survival (to reduce exposure risk).
- Managing future reproductive efficiency can be achieved by removing poor mothers from the flock as well as selecting ewes using Australian Sheep Breeding Vales (ASBVs) that are higher for number of lambs weaned. Traits can also be selected relating to birth weights if this is an issue and cannot be manipulated through ewe nutrition.
- Although predation is generally a secondary issue, predators and scavengers need to be controlled to avoid flock stress and predation on weak or abandoned lambs. A refined program needs to be in place at least a month before lambing to ensure pest numbers are controlled before lambing begins. Anecdotal evidence has indicated that alpacas and guardian dogs have an effect on reducing the losses caused by predators when placed within sheep flocks and could be used as part of the pest control program.

Opportunities arising from the results of this study are currently being assessed to minimise losses through management or genetic strategies. Identifying lamb losses will assist producers to recognise issues associated with lambing and subsequently improve sheep welfare conditions and enterprise profit.

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Roy Latta for project development and delivery. Emily Litzow for her technical expertise in lamb autopsy activities. MAC staff Mark Klante, Trent Brace, Brett McEvoy and Jake Pecina for their livestock management support and Ashlee McEvoy for support during the lambing period. SASAG for providing funding support.

EPARF
Eyre Peninsula Agricultural Research Foundation Inc.

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SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Using Breeding Values for genetic benchmarking in EP Merino sheep enterprises

RESEARCH

Jessica Crettenden, Roy Latta and Mark Klante
SARDI, Minnipa Agricultural Centre

Try this yourself now

Location: Minnipa Ag Centre

Rainfall
Av Annual: 325 mm
Av GSR: 241 mm
2012 Total: 253 mm
2012 GSR: 185 mm

Livestock
Enterprise type: Commercial sheep flocks

Social/Practice
Time (hrs): Additional time required for additional measurements and data entry
Clash with other farming operations: standard practice
Labour requirements: Some additional labour may be required depending on the type of measurements taken

Economic
Infrastructure/ operating inputs: Computer software and some data collection equipment is required
Cost of adoption risk: Low

Key messages

- **Merino sheep at Minnipa Agricultural Centre are being used as a practical demonstration and focus for discussion to assist ram breeders and buyers to gain an understanding of the Sheep Genetics system MERINOSELECT and Breeding Values.**
- **Breeding Values are used as a tool for benchmarking in a sheep enterprise and should be used in conjunction with visual selection.**
- **Minnipa flock breeding objectives have had measured success in most key traits.**
- **This technology has the potential to greatly increase production and profitability through long term improvement to genetics.**

Why do the trial?

Sheep Genetics Australia (SGA) is the Australian Wool Innovation (AWI) and Meat and Livestock Australia (MLA) genetic evaluation service, which calculates Breeding Values through MERINOSELECT and LAMBPLAN to assist with more accurate breeding and selection decisions. Using these tools in addition to visual selection has the potential to optimise genetic progress, which in turn will significantly improve livestock productivity and profitability. Breeding Values take into account all known environmental differences (e.g. age of dam, birth date and nutrition), all available pedigree information and any correlations between traits. The value of an animal's genes for most production traits cannot be visually measured, however Breeding Values provide livestock producers with a unique tool for the best estimate of genetic merit.

A well-defined breeding objective will assist sheep producers to set a clear direction for their breeding program and allow them the optimum use of the SGA system. This benchmarking tool uses a combination of pedigree, raw data collation from the animal and its relatives and environmental factors to generate Flock Breeding Values (FBVs) and Australian Sheep Breeding Values (ASBVs), which provide livestock producers with a description of the potential genetic value of a breeding animal for each trait (e.g. greasy fleece weight, eye muscle depth, body weights etc.). ASBVs are breeding values provided by SGA when there are genetic linkages between flocks, which allow these figures to be benchmarked across flocks Australia wide. The gains through genetic and production improvement and subsequent increase in profit margin are significant incentives for involvement in the SGA system.

There has been limited uptake of new and more efficient technology in the livestock component of mixed farming enterprises on Eyre Peninsula (EP) in recent decades. The aim of this project is to promote the recent advances in sheep genetic research and assist livestock producers improve their system. Breeding Values have the potential to increase productivity and profitability of a livestock business, and can also be used in conjunction with other associated technologies to increase labour efficiency.

The Minnipa Agricultural Centre flock breeding objectives aim to increase body weight, fleece weight, reduce breech wrinkle and maintain micron (fibre diameter).

Table 1 Average raw measurements and Australian Sheep Breeding Values (ASBVs) of the 2010 and 2011 hoggets (11-13 months old) in the Minnipa flock

Type of measurement	Year of drop	Fleece weight	Fibre diameter (µm)	Body weight (kg)	Eye muscle depth (mm)	Breech wrinkle (score 1-5)
Av. raw	2010	3.4 kg **	18.0	50	30.8	2.6
Av. ASBV	2010	+8.5%***	-0.8	+1.4	0	-0.1
Av. raw	2011	3.6kg**	18.6	47.1	34.6	2.1
Av. ASBV	2011	+11.0%***	-0.6	+2.5	-0.2	-0.1
Av. Australian ASBV*	2011	+9.8%***	-0.9	+2.9	+0.2	****

**Australian average for medium Merino flocks in the SGA system for the 2011 drop hoggets*
***Raw measurement of hogget greasy fleece weight (kg)*
****ASBV presented as a percentage of clean fleece weight*
*****Breech wrinkle is an objective score only and therefore has no national average*

How was it done?

The three-year project 'Best Practice Wool Innovations on Eyre Peninsula' began in 2011 using the Merino sheep flock at Minnipa to demonstrate the genetic benchmarking process that leads to the creation of MERINOSELECT Breeding Values by SGA. Measurements began on the flock in 2010 to register the sheep in MERINOSELECT and benchmark the original flock figures to track changes over the duration of the project, resulting in 4 years of genetic data.

Throughout the year a program of measurements are carried out on the Minnipa flock including sire and dam pedigrees, birth weight and date, sex and birth type (single or multiple), breech and body wrinkle scores, body weights over several age stages, fat and eye muscle scans, wool characteristics, wool weights, pregnancy scans, visual classing scores and physical abnormalities.

Measurements are taken from the ewes and wethers for each drop and submitted to SGA at hogget age (at approximately 12 months old). Wethers are sold off after their first shearing and breeding ewes are visually and objectively classed before being admitted into the breeding flock. If flock size needs to be reduced further, ewes are selected using their ASBVs.

To increase the accuracy (linkage) of the Breeding Values from the Minnipa flock, sires are selected based on ASBVs with emphasis on traits that correlate with the flock's breeding objectives, however sires are required to also be visually sound. Sires are sought locally from EP studs or from the Turretfield Research Centre for genetic linkage purposes.

Previous results for comparison are presented in EPFS Summary 2010, p 143 and EPFS Summary 2011, p 145.

What happened?

Measurements were submitted to SGA for the 2010 and 2011 drop hoggets and have been analysed through MERINOSELECT, generating ASBVs for these 2 years, which are presented with the average raw data figures in Table 1. Comparative results for the 2012 drop will be generated at yearling age. The ASBVs are expressed as the difference (+ or -) between an individual animal and the benchmark to which the animal is being compared. For some traits a positive ASBV is desirable (e.g. weight or eye muscle depth) and for other traits a negative is more desirable (e.g. fibre diameter). For example, an ASBV of +6 for hogget weight means that the animal is genetically better by 6 kg at this age than an animal with an ASBV of 0 (0 kg). As rams contribute half the genetics of their progeny (the ewe the other half), the resulting progeny will be on average 3 kg heavier than the animal with an ASBV at hogget age if a ram is mated to ewes of equal genetic merit.

Results have varied in the 2 years of hogget ASBVs due to lack of linkage in the Minnipa flock, however the average ASBVs of sires selected over the duration of the project shows improvements in most traits, which is presented in Table 2.

Table 2 Average Australian Sheep Breeding Values (ASBVs) of the sires used in the Minnipa flock

Year joined	Clean fleece weight (%)	Fibre diameter (μm)	Body weight (kg)	Eye muscle depth (mm)	Breech wrinkle (score-5)
2010	+12.7*	-0.5	+2.7	-0.3	-0.1
2011	+16.2*	-0.2	+3.9	-0.5	-0.2
2012	+16.0*	-0.2	+7.0	+0.4	-0.2
2013	+18.9*	-0.3	+7.4	+0.5	-0.2

**ASBV presented as a percentage of clean fleece weight*

What does this mean?

Minnipa flock breeding objectives aimed to increase body weight, fleece weight, reduce breech wrinkle and maintain micron. The project has had measured success with most of these objectives, however with increased data accuracy through better linkage and more measurements we hope to see improvement in all key traits. This technology has the potential to greatly increase production and profitability through long term improvement to genetics. However, there has been some hesitation from the industry in its uptake, with many breeders and buyers yet to see the benefits of the SGA system. For effective use of the new technology, it needs to be closely aligned with visual selection and breeding objectives in each individual flock in order to see significant outcomes. It also needs to be understood that improving genetics is a slow process and a long-term investment for the sheep enterprise rather than a method of increasing the businesses profit margin immediately.

Education about this genetic evaluation service and how it can be beneficial for sheep breeders and producers is the next step towards genetic improvement for the industry. The Minnipa project is assisting the sheep industry understand this new technology and helping to provide information and a demonstration of how to overcome the issues that come with uptake of the technology and involvement in the SGA system.

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MERINOSELECT ASBV

Grain and Graze – who, what, when, where, why, how?

Jessica Crettenden and Roy Latta
SARDI, Minnipa Agricultural Centre

EXTENSION

Try this yourself now

Location:
Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2012 Total: 253 mm
2012 GSR: 185 mm
Yield
Potential: 1.2 t/ha (W)
Paddock History
2011: Barley
2010: Canola
Pre - 2010: Varied
Soil Type
Red sandy loam
Plot Size
2.7 ha x 4
Environmental Impacts
Soil Health
Soil structure: Stable
Compaction risk: None
Perennial or annual plants: Annual
Water Use
Runoff potential: Low
Resource Efficency
Energy/fuel use: Standard
Greenhouse gas emmisions (CO_2, NO_2, methane): Cropping
Social/Practice
Time (hrs): No extra
Clash with other farming operations: Standard practice
Economic
Cost of adoption risk: Low

Key messages

- **The decision of whether or not to grain and graze ultimately is an evaluation of a range of factors including seasonal influence and an assessment of the potential crop penalty of grazing against the grazing value for livestock and overall system benefit.**
- **A late seasonal start with subsequent poor early growth supported the decision not to graze the canola crop in 2012.**

Why do the trial?

The concept of using cereal and oilseed crops for early season grazing and subsequent grain production, also known as growing dual purpose crops, has been demonstrated successfully throughout Southern Australia for a number of years. Dual purpose crops can increase total profitability on mixed farms by providing a source of high value feed during the autumn/winter feed gap, while giving pastures a chance to establish.

However, grazing crops has always been considered too great a risk by many farmers. One of the major issues is that grazing a crop requires a decision making process that can be clouded by too much, or not enough information, which leads the concept to be put in the 'too hard' basket. It is perceived that grazing crops for feed requires substantial technical knowledge, but once the interactions between the crop and livestock are taken into consideration, it is simply a process of understanding who, what, when, where, why and how.

How was it done?

The 4 x 2.7 ha Minnipa Agricultural Centre 'competition paddocks' (refer to EPFS Summary 2010, pg 103 and EPFS Summary 2011, pg 141 for previous records and trial design) were sown with canola @ 3 kg/ha and Angel medic @ 6 kg/ha on 2 May 2012. Four permanent sampling points were marked in each paddock (each paddock representing 1 of 4 replicates) with plans to split plots for plus and minus grazing. The aim of the trial was to provide a dual purpose crop with a grazing opportunity during the autumn/winter feed gap when the canola was well anchored and at approximately the 6-8 leaf stage (with biomass of 1.5 t/ha) and for livestock to be removed after buds had elongated no more than 10 cm. A grain yield was subsequently to be harvested.

Plant counts and biomass samples (dry matter (DM)) were taken for the canola and medic from 10 x 0.1 m^2 quadrats across each sampling point and dried at 70°C for 48 hours on 13 July (to assess biomass available for grazing), 30 August and on 5 October (to assess biomass available for a 'hay-cut'). A feed test was taken from the 13 July biomass samples to assist with calculating stocking rates for grazing. Canola grain harvest was undertaken on 31 October 2012.

What happened?

The 13 July feed test reported acceptable levels for grazing all sheep types at a production level (e.g. for young, quick growing lambs or lactating ewes) with 86.8% dry matter, 31.7% crude protein (target is 16% for production), 25.4% neutral detergent fibre (target over 30%, fibre would increase as plants matured and hay supplemented at grazing), 84.8% DOMD (digestibility) (75% required for production feeding) and 13 MJ /kg DM (11 MJ/kg DM required for production). Although canola and medic plant densities were acceptable, 34 and 100 plants/m^2 respectively, the amount of biomass in July was not adequate to support any useful grazing (Table 1). Data presented for each treatment are a mean of the four selected permanent points in each single treatment (paddock).

Table 1 Established canola and medic plant numbers (plants/m²) total canola, medic and weeds (tDM/ha) and canola grain yield (t/ha) in the competition paddocks for the 2012 season

Paddock	13 July (plants/m²)	13 July DM (t/ha)	30 August DM (t/ha)	5 October DM (t/ha)	Yield (t/ha)
A	40	0.15	1.6	2.3	0.23
B	40	0.12	1.0	2.5	0.16
C	34	0.08	1.2	2.7	0.25
D	32	0.16	1.9	1.7	0.18

Each of the four replicates had varied paddock history that impacted on the results shown in Table 1 and the lack of biomass was integral in the decision to not graze the crop early. The low canola yields measured suggested that the paddocks could have been used for sacrificial grazing (during the mid to late reproductive phase of the crop where there is a no likelihood of reaping a significant yield, to fill the feed gap or short supply over summer).

What does this mean?

The decision making process, which resulted in not grazing the trial in 2012, was a procedure that must take all factors of the system into account and can be broken up into the sections below:

Who

Livestock that have no previous grazing experience or are new to the particular paddock (e.g. weaners) are the best type of animal to use as they will graze the entire paddock more evenly and tend not to camp or rest in the same location. Another consideration is to avoid stock that may be vulnerable to stress or can be difficult to move to another paddock (e.g. ewes in late pregnancy or during lambing). Stocking rates can be calculated according to the Feed on Offer (FOO) by taking biomass samples and using a tool such as the MLA stocking rate calculator[1]. Alternatively, any number of livestock can simply be used until an even and sufficient grazing has been achieved, as long as the animals are not damaging the plant's structure. Higher stocking rates for a shorter amount of time will result in a more even grazing.

What

Most cereals and oilseeds can be grazed successfully if managed correctly (e.g. livestock may require supplements such as magnesium or sodium on certain crops). It does make sense to graze the crops with more biomass and vigour (e.g. barley) due to more feed being available at the early time of grazing and a faster recovery. A specific forage variety does not have to be chosen to grain and graze - crops that are chosen for grain quality are fine, though some varieties are superior in response and recovery from grazing and do have better grazing traits such as early vigour and more biomass (refer to EPFS Summary 2010, p 136). Early sowing of crops for the purpose of grain and graze and selecting longer season varieties are wise choices as it gives plants an extended recovery period.

When and How

Cereals: graze crops during early tillering at growth stage 18-22 (also known as jointing) when plants are well anchored, which can be measured using the pinch and twist test (pinch the top of the leaves upwards while twisting, if the leaves break and the plant does not pull out of the ground, the crop can be grazed). Take the livestock out when the crop is approaching growth stage 30 (stem elongation) and before boot formation to avoid compromising yield (use a stock exclusion area such as weldmesh to monitor crop stage).

Canola: grazing can commence at the 6-8 leaf stage when plants are well anchored. Livestock need to be removed from the paddock when buds have elongated no more than 10 cm. Grazing past this point can delay flowering and potentially reduce yield and oil content. Blackleg severity can be increased through grazing; therefore selecting a variety with a high resistance rating is necessary. Nitrate poisoning can occur if soil N levels are high and livestock are introduced to the paddock too quickly or when they are hungry. Therefore, avoid this situation by gradually introducing stock and providing roughage.

[1]MLA Stocking Rate Calculator can be found online at http://www.mla.com.au/Publications-tools-and-events/Tools-and-calculators/Stocking-rate-calculator

For both cereals and oilseeds ensure that sufficient biomass is available prior to grazing (seeding rates can be higher to increase plant density and early biomass), the timing of grazing allows for optimal crop recovery (choose to graze early-sown crops) and chemical withholding periods are adhered to. Consider applying more nitrogen at seeding and/or topdressing after stock removal to maximise plant regrowth and yield potential if conditions are suitable.

Where
The best paddocks to select are ones that are clean and do not have a grass weed issue (as livestock can exacerbate the problem due to reduced crop competition), although grazing canola crops may allow better exposure of target weeds for chemical control. Select paddocks that were sown early and with sufficient watering and/or feed points (such as lick feeders or hay racks) which are spread out to ensure an even grazing. Electric fences are worthwhile if available to force higher stocking rates and promote even grazing.

Why
Grain and graze is an opportunity to benefit both the livestock and cropping enterprises. Grazing crops helps fill the feed gap between the times of poor nutritive value of stubbles and while annual pastures are still establishing, and reducing supplementary feeding. Crops can also be used specifically to feed sheep in spring if adverse conditions prevent sufficient grain yield due to drought or frost. Grazing an early sown crop can also reduce the risk of frost damage by delaying flowering.

The decision of whether or not to grain and graze ultimately is an evaluation of the above factors, seasonal influence and an assessment of the potential crop penalty of grazing against the grazing value for livestock and overall system benefits.

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EYRE PENINSULA

Grazing canola: pure madness?

Alison Frischke and Dannielle McMillan

Birchip Cropping Group

RESEARCH

Location:
Town or District: Sea Lake, Victoria
Rainfall
Av. Annual: 318 mm
Av. GSR: 206 mm
2012 Total: 177 mm
2012 GSR: 103 mm
Paddock History
2011: Vetch
Soil Type
Red sandy loam over clay loam
Plot Size
12 m x 18 m x 4
Yield limiting factors
Well below average GSR
Environmental Impacts
Soil Health
Ground cover: enables annual pastures to establish
Perennial or annual plants: Annual
Grazing pressure: high
Resource Efficency
Energy/fuel use: Standard
Greenhouse gas emmisions (CO_2, NO_2, methane): Standard
Social/Practice
Time (hrs): Standard
Clash with other farming operations: Standard
Labour requirements: Standard
Economic
Cost of adoption risk: Potential grain yield loss vs. livestock income

Key messages

- **Subsoil moisture and an early sowing opportunity meant that grazing did not affect yield or the gross income return of canola at Sea Lake in 2012.**
- **Dry conditions increased canola tissue nitrate levels to toxic levels as plants matured.**
- **Canola has a shorter grazing window than cereals, and requires careful grazing management to avoid high tissue nitrate situations, and roughage to balance fibre.**

Why do the trial?

Canola crops are being successfully grazed in higher rainfall areas, but less is known about the ability of canola to recover from early grazing in a Mallee/Wimmera environment.

To successfully graze any dual purpose crop, it is desirable to minimise the effect on crop yield, although you may concede a small yield penalty through increased livestock returns. Research and grower experience in NSW (J. Kirkegaard, CSIRO, pers. comm.) has shown that for canola this means:

- Taking advantage of early sowing opportunities: 2-3 weeks earlier than usual. The first half of April is ideal. The later the crop is sown, the longer it takes to reach adequate biomass, and the less time it has to recover. Growing early means grazing early. Oil percentage of grain should not change with grazing, unless the flowering date is moved.
- Making the best variety choice: a variety with either a longer growing season or a dual purpose capability will recover better. However, any variety can be grazed. Choose suitable varieties for weed control; do not compromise on this. Hybrids (imi-tolerant and Roundup Ready) generally produce superior biomass, and are easier to manage weed control in relation to grazing than Triazine Tolerant varieties due to shorter chemical withholding periods.
- Increasing plant density: increase sowing rates and early seedling protection to ensure sufficient plant establishment.
- Increasing available nitrogen (N): apply more nitrogen than normal to stimulate biomass production. Top-dressing is best left until after grazing to avoid nitrate toxicity.
- Tackling blackleg: use blackleg resistant varieties. Grazing can open up the stem and allow infection. Avoid MS or S varieties.

The aim of this trial is to evaluate a vigorous hybrid canola variety in a low rainfall Mallee environment for its grazing value at different growth stages, and its ability to recover from grazing.

How was it done?

A replicated plot trial was established on vetch stubble at Sea Lake on 19 April, 43C80 hybrid canola was sown (targeted plant density 40 plants/m^2) with MAP @ 55 kg/ha. Plots were rolled post sowing to facilitate seed-to-soil contact. Urea was applied @ 90 kg/ha to the mid cabbage plus nitrogen at budding treatment only. Standard in-crop herbicides were used to control weeds. A small amount of damage was inflicted on some plots early in the season by rabbits, and later galahs; some plots suffered severe damage and were excluded from the analyses.

In the trial, dry matter production was measured, grazing simulated using mechanical removal and yield assessed for six grazing treatments:

- 6-8 leaf
- mid cabbage
- late cabbage
- 6-8 leaf and late cabbage
- mid cabbage plus nitrogen at budding
- ungrazed

Tissue samples were collected at the time of grazing and tested for nutritive value. Plots were terminated using Reglone (1.5 L/ha) on 20 November, and harvested on 30 November with a small plot harvester.

What happened?

The season at Sea Lake began with 58 mm in March, followed by only 102 mm of growing season rainfall and ended with a dry finish, resulting in a decile 1 rainfall season.

Forage value, or dry matter (DM) production, was greater for canola grazed at mid or late cabbage stage than at 6-8 leaf or if grazed twice at 6-8 leaf and late cabbage (Figure 1). At the time of the 6-8 leaf grazing, plants were small and moisture stressed due to the site receiving less than 10 mm of rain in the eight weeks post sowing. The twice grazed treatment (at 6-8 leaf and late cabbage) didn't recover well after the first graze and total DM suffered.

The mid cabbage grazed + N treatment did not respond to the extra nitrogen at bud formation. At this stage it is likely that plants already had adequate N because the season had been dry, soil N at sowing was 111 kg/ha and the crop had received a top-dress N application.

Grain yield was not affected by grazing (Table 1). Oil percentage of grain, however, was highest for the earliest grazing at 6-8 leaf, and was reduced by grazing at late cabbage. The reduction in oil in the late-grazed canola could have been due to a shift in flowering date further into the dry spring, but flowering date was not measured to confirm. All oil quality was lower than 42%, but this was not sufficient to affect the return for the canola.

Feed tests demonstrated that the forage value of grazing at all growth stages provided adequate protein and energy for lactating ewes and growing lambs. Crude protein ranged from 28-34% (require >16%) and metabolisable energy ranged from 13-14 MJ ME/kg (require >11%). While fibre increased as plants matured, fibre was low, ranging from 23-28% (require >30%) so provision of hay would be recommended. Nitrate levels in samples were generally high. At mid-cabbage, nitrate was 2600 ppm which is considered safe. All other samples were over 4000 ppm which has an impact on animal growth and can be toxic.

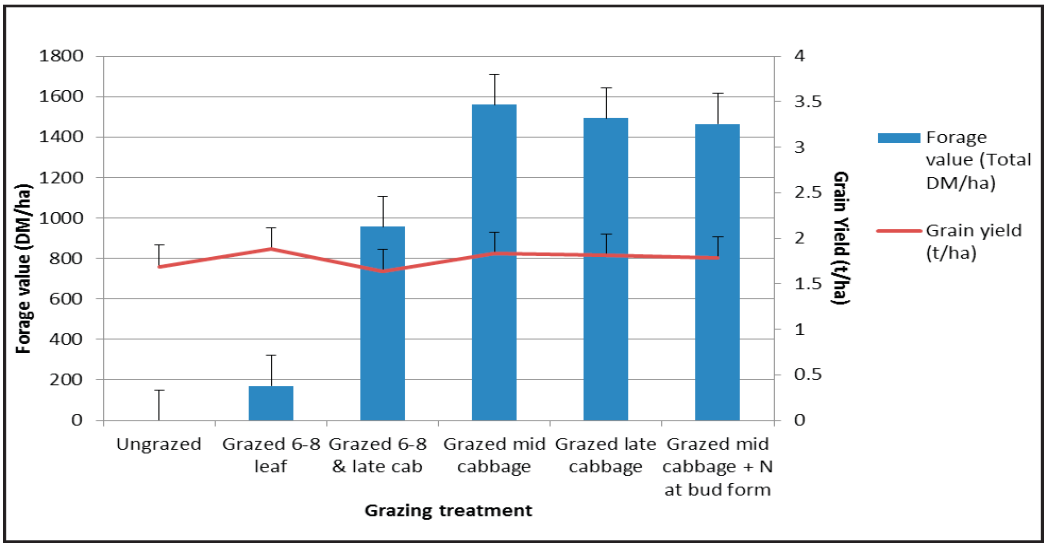

Figure 1 Forage value of canola at different growth stages and subsequent grain yields, Sea Lake 2012

Table 1 Dry matter production, grain yield and quality of canola grazed at Sea Lake, 2012

Treatment	Date grazed	Grain yield (t/ha)	Oil (%)	Grain gross income* (t/ha)
Ungrazed	-	1.69	40.4[ab]	867
Grazed 6-8 leaf	2 July	1.88	41.5[a]	965
Grazed mid cabbage	17 July	1.83	41.0[ab]	936
Grazed late cabbage	26 July	1.81	40.1[b]	898
Grazed 6-8 & late cabbage	2 July 26 July	1.64	38.3[c]	804
Grazed mid cabbage + N at bud form	17 July	1.78	40.6[ab]	917
LSD (P=0.05) CV%		*ns* -	*1.4* 2.2	*ns* -

**Cash price for canola at Sea Lake on 3 December 2012 was $517/t*

What does this mean?

The capacity for canola recovery depends strongly on seasonal conditions conducive to regrowth, and the time available for the crop to recover an adequate biomass to set yield. The later grazing occurs, and the longer it continues, the less time there is for this to occur.

Surprisingly, given the dry season in 2012, (simulated) grazing canola did not affect grain yield or quality. It is likely that success was due to the early sowing opportunity, and crop recovery was dependent on subsoil moisture and the ability of canola to extract moisture from depth.

When grazing canola, extra care is necessary, as it is likely that it will be a different feed source from the paddock the stock came from. If coming off grass onto canola, stock will eat out all the grass first. Introduce animals gradually for short periods at a time and observe them closely for any abnormal behaviour; ruminants will take a week or two to acclimatise to the brassica. After 2-4 weeks, weight gains will be achieved. This was seen at Birchip in the summer of 2011/12 when lambs grazing Winfred forage brassica grew at a rate of 110 g/day after 20 days and at 330 g/day after 40 days.

Nitrate poisoning can occur after a dry spell, when soil N levels (including sowing N) are higher and it is taken up by the plant after rain or irrigation. Animals begin to be affected (subclinical) at tissue nitrate levels over 2000 ppm, and toxicities occur above 4000-5000 ppm. Nitrates are also an issue in dark, overcast weather. To avoid nitrate poisoning introduce stock gradually, later in the day with full stomachs. Also provide roughage (which will also prevent scours), and observe animals closely. Wait for three weeks after top-dressing, or leave top-dressing until after grazing. Stock grazing canola doesn't have the same sodium and magnesium supplement requirements as those grazing wheat.

If contemplating grazing a failed canola crop to recover some of the growing costs via livestock, consider the possibility of nitrate poisoning, and be aware of chemical withholding periods for both pre and post-emergent herbicides.

Grazing had no significant economic consequences on the canola crop at Sea Lake in 2012. The main value of this practice is that it provides growers with a place to put their animals while other legume pastures are establishing or while grasses are being sprayed out of pasture crops. However, with necessary introductory periods for grazing, low fibre and nitrate poisoning risk, weed management and chemical withholding periods to consider, the window for grazing canola is short. Generally, the overall risk to crop and livestock production is higher than for cereals.

Further assessment of grazing canola in a low rainfall environment is needed to properly assess the feasibility and risk of the practice. This trial will be repeated in 2013.

Acknowledgments

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Livestock

Grain & Graze™ Profit through knowledge

CARING FOR OUR COUNTRY

GRDC Grains Research & Development Corporation

Benchmarking your sheep enterprise

Mary Crawford
Rural Solutions SA

EXTENSION

Best Practice

Location:
Eastern Eyre Peninsula
EP Sheep Group
Rainfall
Av. Annual: 300 mm
Av. GSR: 220 mm

Key messages

- **Profit drivers can be identified when benchmarking your sheep enterprise. Focusing on the profit drivers in your business can really make a difference, and producers paying attention to detail can be rewarded.**
- **Maximising stocking rates whilst ensuring adequate nutrition and good paddock management has the greatest effect on meat and wool produced per hectare and subsequently the gross margin and income of your business.**
- **Improving growth rates by producing more kg/ha/yr equates to the maximum amount of wool and meat produced in the shortest possible time.**
- **Improving reproduction percentages results in more lambs and improved weaning rates.**
- **Identifying causes of death and implementing measures to curb mortality rate reduces lost income.**
- **80% of the potential gains can be achieved by getting the system right then fine tuning that system rather than spending time trying to fine tune a system which is not working.**

Why do the work?

The sheep and wool industry has a poor reputation for productivity gains and has lost significant ground to competing industries such as broad acre cropping. Utilising tools such as benchmarking enables producers to properly evaluate the current state of the enterprise and identify profit drivers, which highlight any opportunities where changes can occur to the business. The aim of benchmarking is to examine the technical efficiencies of the enterprise, identify the range of possible outcomes in any one environment and the potential to change and identify the key performance indicators for that enterprise.

How was it done?

Three sheep groups, established with funding from the Eyre Peninsula Grain and Graze 2 Project and Sheep Connect SA have focused on benchmarking their sheep enterprises. Eighteen properties have completed benchmarking, with one group completing benchmarking for two years and two groups for one year. Benchmarking provided group discussion on the key performance indicators of the sheep enterprise and identified opportunities for change.

What happened?

Table 1 shows that the flock structure is dominated by ewes, representing 70% and hoggets 25%. The main two enterprise structures were self-replacing merino flocks and or terminal sire over merino ewes. Some farmers purchase lambs to utilise stubbles when the opportunity presents itself. The average winter grazed (WG) area is 800 ha with a stocking rate of 2.4 dry sheep equivalent (DSE) per ha and turning off 1.3 lambs per ha. High lambing percentage is important but is not the main driver of lambs produced per ha. The number of ewes per ha plus lambing percentage, drives the number of lambs produced per ha. The average lambing percentage was 94% so there is an opportunity for producers to focus on the ewe reproduction cycle and ewe nutrition to lift the average percentage.

The returns that sheep producers in the group achieved in 2010/11 and 2011/12 were exceptional due to a combination of good seasons and high commodity prices for meat and wool. Although the returns are good, the benchmarking has highlighted there is a large variation between producers within the same rainfall environment.

What does this mean?

Many producers in the groups commented that it was good to improve their understanding of their sheep enterprise and get a handle on what their sheep enterprise is returning on a $ per DSE and $ per winter grazed hectare ($/WG ha) basis.

The variation observed between producers within the same rainfall environment provides some opportunities for producers to be more productive and profitable. Producers can control the areas where the largest variations occurred including sheep losses and marking percentages. There were some small variations in sheep sale price, wool price and kg of wool/DSE. The big influence on gross margin per ha was the stocking rate, which influenced the number of lambs per ha and the wool production per ha. Therefore pastures, grazing management, animal health and genetics are the keys to optimising income from the sheep enterprise.

Table 1 Physical and production traits for participants surveyed in the 2010/11 and 2011/12 season

Sheep	Mean	Range Low-High	Mean	Range Low-High
	2010/11		2011/12	
Total dry sheep equivalent (DSE)	1780	1110 - 3940	1520	1300 - 5570
Ewes (%)	70	42 - 99	72	40 - 81
Ewe Hoggets (%)	24	0 - 46	27	9 - 37
Losses (%)	5	2 -13	3	1 - 6
Stocking Rate				
Winter Grazed (WG) hectares	810	240 - 2100	790	320 - 1550
DSE/WG ha	2.9	1.3 - 6.4	2.1	1.0 - 4.8
DSE/WG ha/100 mm rainfall	1.0	0.6 - 2.8	0.9	0.5 - 1.8
Sheep Trading				
Marking (%)	92	78 - 103	96	73 - 120
Lambs/ha (No/ha)	1.5	0.4- 2.3	1.1	0.3 - 2.0
Sale price (av $/hd)	122	101 - 155	112	92 - 165
Wool Production				
Wool price (av $/kg)	6.23	5.16 - 8.44	7.61	6.71 - 8.66
Total kg	9540	4020 - 26080	6,780	4900 - 23940
kg wool/DSE	5.1	3.6 - 6.6	4.5	3.2 - 5.5
kg wool/WG ha	14.8	5.7 - 32.1	9.4	5.1 - 26.7

Table 2 Financial results for participants surveyed for 2010/11 and 2011/12 seasons

%/DSE - Income	Mean	Range Low-High	Mean	Range Low-High
	2010/11		2011/12	
Wool Proceeds	32	18 - 48	34	28 - 42
Sheep Trading Profit	48	23 - 81	38	29 - 53
Total Sheep Income	80	42 - 109	72	54 - 89
$/*DSE* - Expenses				
Total Variable Costs	13.2	5.6 - 19.9	11.4	7.6 - 19.5
Gross margin/DSE	67	36 - 97	61	46 - 79
$/WGha - Income				
Wool Proceeds	92	29 - 199	71	34 - 207
Sheep Trading Profit	142	37 - 328	79	31 - 215
Total Sheep Income	234	66 - 527	150	66 - 410
$/WG ha - Expenses				
Total Variable Costs	37	9 - 66	22	8 - 82
Gross margin/WG ha	198	58 - 445	128	57 - 328

Risk management is also important and this will be determined by the management capabilities and the amount of risk that a producer is willing to take. The higher the stocking rate, the higher the risk and more management required. Some producers have low stocking rates as it makes it easier to get through the "poor season". Many producers have an idea in their minds of what they will do in the "poor season" but there is no written strategy to implement 'back door' or exit strategies.

Some producers have started to implement changes to their enterprise after the first year of benchmarking their sheep enterprise. These changes have resulted in an improvement in their second year figures. The changes included improving pastures, monitoring ewe condition score and focusing on genetic improvement. The local information from the group allowed these producers to focus on targets that are being achieved in their own district and give them confidence to implement the change as they have the support of the local group members and advisors.

Benchmarking has demonstrated that sheep systems should be treated more as a business opportunity with an associated profit focus rather than a historic production system.

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Livestock

Livestock options in dry times

Brian Ashton

Sheep Consultancy Service Pty Ltd, Port Lincoln

EXTENSION

Key messages

- **Prepare for the next feed shortage now.**
- **The condition score of your stock will tell you if you are under- or over-feeding.**
- **Have a plan and act early.**
- **A containment area is a farm "risk management" asset.**

What happened?

In 2011 medic pastures were hit by powdery mildew. Many sheep suffered by lack of feed over the following summer and this greatly affected staple strength, micron, wool cut and lambing percentage in 2012.

We often suffer from a feed shortage, although the reason varies. Poor spring rains have been common in recent years while late breaks, or droughts, have occurred in the past. We know that a huge range in pasture production is a feature of our climate – we have dealt with it for many years.

Management options

Farmers manage in different ways. Now that sheep are worth money it's time to review how you plan to manage.

- Some people stock very conservatively – but they have reduced income in all the average and above average years.
- Some sell immediately while the stock are still in good condition. This is OK if the price is reasonable.
- Some feed to maintain reasonable condition and production levels. This may involve a containment area if there is an erosion risk.
- The worst case is to feed less than they require, run out of feed, and then to sell when the sheep are poor and the prices are still depressed.

What does this mean?

Stock that you keep will need to be fed enough to maintain reasonable condition and production levels. The Lifetime Wool project gave us an excellent guide to help us determine this (visit www.lifetimewool.com.au for more information on ewe management and condition scoring). From mating until lambing, ewes should be maintained in condition score 3, or better.

The cost benefit ratio for this is clear. On average Merino ewes that are score 3 from mating to lambing will rear 15 percent more lambs than ewes at score 2. If they lose one condition score during pregnancy they will produce 0.8 kg less clean wool and their lambs will produce less wool for the rest of their lives.

These condition score losses were common on upper Eyre Peninsula in the summer of 2011/12. At current prices these losses equate to about $30 per ewe. You could have bought a lot of feed for that.

If ewes drop below score 2 the production losses are even greater. As well, there will be ewe deaths. With current prices, and animal welfare concerns, I believe it is unacceptable to let ewes drop below score 2.

What to do about it?

- Condition score a race full of your ewes 3 or 4 times every year - when they are in the yards. Do it more often in tough seasons.
- Draft off the ewes that may fall below score 2 and feed them more, either through supplementary feeding or access to better paddocks.
- Monitor pastures (bulk and quality) so you are not caught out.
- Have some feed reserve – or know where you can buy it. Cereal grain is the best value but some hay is really useful too.
- Keep some grain back after harvest until after the break and when the season is assured.
- In erosion prone districts set up a containment area so you are ready to go when needed.
- Keep a young flock because old sheep can become a liability.
- Improve your water supply, and fencing, so that you can utilise all your feed reserves.
- Pregnancy scan your ewes so that in tough years empty ewes can be shorn and sold early.
- Have a plan and act on it early.

Section Editor:
Cathy Paterson
SARDI, Minnipa Agricultural Centre

Pastures

Powdery mildew resistant medics for the EP and Mallee

Jake Howie, Ross Ballard and David Peck
SARDI, Waite Campus

Searching for answers

Location:
Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av GSR: 242 mm
2012 Total: 253 mm
2012 GSR: 185 mm
Yield
Potential: 5.5 tDM/ha
Actual: Est. 3-4.5 tDM/ha
Paddock History
2011: Canola
2010: Sown medic
Soil Type
Red sandy loam
Soil Test
pH CaCl 7.5, organic carbon 0.7%
Plot Size
5 m x 1.5 m x 3 reps
Yield Limiting Factors
Dry finish

Location:
Karoonda
Peter & Hannah Loller
Rainfall
Av. Annual: 312 mm
Av GSR: 215 mm
2012 Total: 317 mm
2012 GSR: 231 mm
Paddock History
2011: Sown medic
2010: Cereal
2009: Sloop barely
Soil Type
Non-wetting sand, pH 8.1

Key messages

- **We have short-listed a small group of strand medics with resistance to powdery mildew which exceed our benchmark strand medic cultivars, Herald and Angel, by up to 30% for dry matter production and seed yield.**
- **If the agronomic performance of non-segregating lines can be confirmed at new and regenerating sites, there are excellent prospects for a future cultivar release.**
- **The lines also have tolerance to SU herbicide residues, aphid resistance and a larger seed size.**
- **Regeneration and hardseed breakdown studies indicate they behave similarly to Angel.**
- **Unexpected responses to Rhizobium inoculation confirm some grower observations of poor medic nodulation in the Mallee, but the reasons for this remain unclear.**

Why do the trial?

The main aim of this SAGIT funded project was to assess the potential of a group of early generation “multi-trait” breeders' lines for future commercial development. More specifically the project has:

- Evaluated the agronomic performance of 27 early generation strand medic lines (and subsequent re-selections) possessing various combinations of important new traits;
- Made in-situ field re-selections from segregating medic lines under evaluation at the field sites and multiplied seed of these for further testing.

How was it done?

As part of this project, field selections and glasshouse screening for traits that are still segregating, have been regularly undertaken. Based on the excellent performance at multiple sites in 2010 and 2011 (EPFS Summary 2010, pp 61-62; EPFS Summary 2011, pp 68-70), a set of 17 non-segregating (stable) strand medic hybrids with various combinations of powdery mildew (PM) resistance, SU herbicide tolerance, aphid resistance and large seeds, was shortlisted for sowing in 2012. This included daughter lines for field testing to ensure they perform as well agronomically as the segregating PM parent lines from which they were selected. Also included were five benchmark cultivars and parents and, in response to farmer feedback at field days and measures of poor nodulation in 2010 and 2011 field trials, we also included some additional rhizobial treatments.

Soil Test
Colwell P, 28 ppm; potassium, 110 ppm; sulphur, 2.4 ppm
Plot Size
4m x 1.2 x 3 reps
Yield Limiting Factors
Poor establishment in 2011 due to non-wetting, soil, dry finish, frost, low soil K, S

Location:
Netherton
Lester & Kay Cattle
Rainfall
Av. Annual: 396 mm
Av GSR: 290 mm
2012 Total: 372 mm
2012 GSR: 232 mm
Yield
Actual: 3 t/ha (rising plate meter est. 16/10/10)
Paddock History
2011: Oaten hay
2010: Schooner barley
2009: Oaten hay
Soil Type
Loamy sand, pH 6.7
Soil Test
Olsen P, 14 ppm; NO_3-N, 12.3 ppm; sulphur, 4 ppm; organic matter, 1.4%; copper, 0.3 ppm; zinc, 0.3 ppm; manganese, 1.3 ppm
Plot Size
4 m x 1.2 m x 3 reps
Yield Limiting Factors
Lodging, dry finish, frost, low phosphorus, sulphur, trace elements (Cu, Zn)

Location:
Lameroo
Trevor & Cath Pocock
Rainfall
Av. Annual: 330 mm
Av GSR: 235 mm
2012 Total: 275 mm
2012 GSR: 197 mm
Paddock History
2011: Pasture
2010: Pasture
2009: Cereal rye
Soil Type
Loamy sand, pH 6.3
Soil Test
Colwell P, 20 ppm, potassium, 125 ppm; sulphur, 2.9 ppm; organic carbon, 0.89%
Plot Size
4 m x 1.2 m x 3 reps
Yield Limiting Factors
Difficult establishment due to clay spreading and rough terrain, dry finish, frost, low soil P, K, S

In addition to regenerating sites at Karoonda and Minnipa two experiments were established in the Murray Mallee at Lameroo and Netherton, enabling further evaluation of dry matter production, disease tolerance and seed yield.

What happened?

2012 sown trials – agronomic evaluation (Lameroo and Netherton)

Once again we were very encouraged with the agronomic performance of the PM lines with respect to dry matter (DM) production, seed yields are currently being processed and analysed. At Lameroo the top five PM lines (range: 84–95 of % maximum site yield (MSY); average 89% MSY) significantly out-yielded the benchmark strand medic cultivars, Herald, Angel and Jaguar (range: 55–71% MSY; avg. 66%). At Netherton the top five PM lines (88–95% MSY; avg. 91%) similarly out-yielded the strand medic cultivars (70-81% MSY; avg. 76%).

A feature of the new lines was increased early season vigour, possibly a benefit of the larger seed size inherited from the original PM resistant parent. Seed yields, which provide a critical measure of potential pasture persistence and future productivity, have been harvested and are currently being processed. The harsh spring finish should provide a good test of their ability to produce seed and persist under adverse conditions. In previous years they have been excellent; for example at Netherton 2011 the PM resistant lines averaged 1100 kg/ha, 30% greater than Herald and Angel (Figure 1).

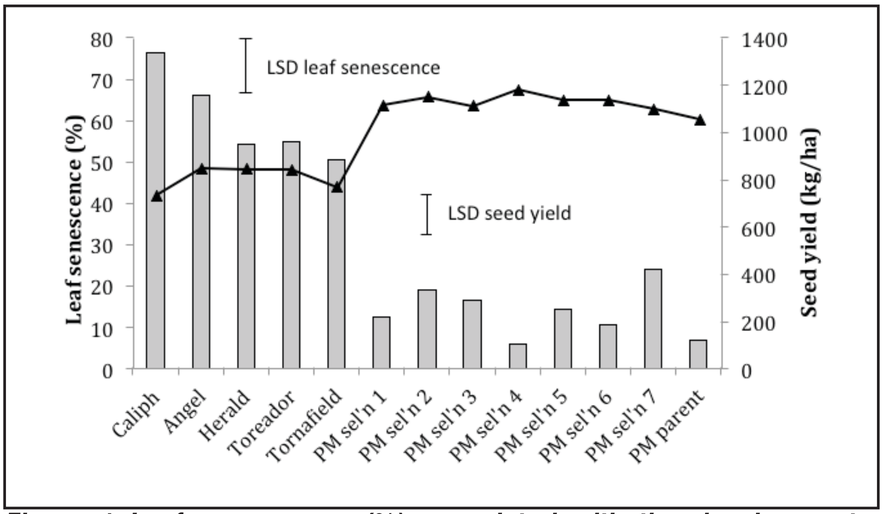

Figure 1 Leaf senescence (%) associated with the development of powdery mildew symptoms (bar), and kg/ha seed yield (line) of annual medic cultivars and PM-strand medic selections at Netherton, SA, 2011 (LSD P=0.05)

2012 regeneration of 2011 Karoonda site (powdery mildew resistance – field observations)

Despite the poor establishment at this site last year due to areas of non-wetting soil, there was enough seed-set to enable an adequate regeneration after early season rains in March. Although experimentally quite variable, this site as a whole responded very well to winter rains with the best plots producing an estimated 4 tDM/ha. At the time of the Karoonda MSF Field Day (GRDC GroundCover #102, p 14) the PM lines were still fresh and showing no signs of powdery mildew infection whereas Herald and Angel, although also growing well, were developing a heavy PM infection in the understory.

This is the second year we have been able to observe the impact of powdery mildew on the PM lines in the field (Netherton, 2011, Figure 1.) and we are very encouraged in that so far they support our results from greenhouse studies and field observations at the Waite Campus. However it is important to note that more fundamental research regarding the identification, pathogenicity and prevalence of different races of powdery mildew (if more than one) in SA is needed so that appropriate breeding strategies can be developed to ensure that the excellent levels of resistance in the current set of PM lines will be maintained.

2012 regeneration of 2010 Minnipa Agricultural Centre site

After growing very well in 2010, this site was sown to canola in 2011 and regenerated successfully in 2012, enabling two dry matter assessments to be made in August and September. As this was our first site regenerating after crop, it was pleasing to note the good performance (relative to the strand medic cultivars) of the parental PM lines which had subsequently been progressed (via their selected non-segregating progeny) into later trials.

Hardseed breakdown studies

Pods of short-listed PM lines and both parents (Angel and PM parent) were harvested from the Netherton 2011 site and taken back to the Waite Campus for hardseed breakdown studies conducted over 12 weeks from February to May 2012. At the end of the study Angel's hardseed content had declined from 99 to 88% and PM parent from 97 to 91%. The PM hybrid lines declined in hardseededness from 96-100% to 87-91% (i.e. very similar to both parents). This coupled with the Minnipa 2012 regeneration data, provides us with confidence that this material possesses an appropriate level of hardseededness for persistence in a ley farming system.

Nodulation responses in the field

Assessments of nodulation were made at Netherton, Lameroo and Karoonda where several additional rhizobia inoculation treatments were incorporated into the trial and demonstration plot designs in response to previous measures of inoculation response.

Large responses to inoculation in terms of nodule number were measured at Lameroo and Karoonda and improvements in legume vigour observed at the sites. The work again confirms that frequent grower reports of poor nodulation in the Mallee should be taken seriously and some work will continue to determine why this is occurring. Contrary to general practice, the findings show that medic should be inoculated to ensure good establishment and early vigour when sown on Mallee soils, even where there has been a recent history of medic in the paddock. Particular attention will be paid to ensuring PM medic lines are well inoculated in future trials to ensure their potential benefits are not limited by symbiotic constraints.

What does this mean?

The third year of field evaluation has so far confirmed our initial findings.

- We have identified a small group of material which exceed our benchmark strand medic cultivars, Herald and Angel, by up to 30% for dry matter and seed yield.
- The hybrid lines have powdery mildew resistance, SU herbicide tolerance, aphid resistance and larger seeds (cf Herald and Angel).
- Further selections have been made and there are excellent prospects for a future commercial release.
- Unexpected responses to inoculation confirm some grower observations of poor medic nodulation in the Mallee, but the reasons for this remain unclear.

Pending final harvest results from 2012 we will analyse all available data and further shortlist the PM daughter lines for final cultivar selection work in 2013-15, pending availability of future funding. These will be further seed increased at the Waite in 2013 to enable future cultivar developmental work.

Reference

RA Ballard, DM Peck, DL Lloyd, JH Howie, SJ Hughes, RE Hutton and BA Morgan (2012). Susceptibility of annual medics (Medicago spp.) to powdery mildew (Erysiphe trifolii). Proceedings of 16th Agronomy Conference 2012. University of New England, Armidale, NSW 14-18th October 2012. http://www.regional.org.au/au/asa/2012/pests

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Evaluation of perennial forage legumes on Eyre Peninsula

Roy Latta and Suzie Holbery
SARDI, Minnipa Agricultural Centre

Key messages

27 months after establishment the study has continued to show:

- **Lucerne to be well adapted to good Eyre Peninsula cropping soils.**
- **Cullen and Tedera to be more persistent and productive than lucerne on shallow calcareous and highly acidic soils respectively.**
- **Sulla to be highly productive on good EP cropping soils in the growing season following establishment.**

Why do the trial?

The use of perennial legumes on Eyre Peninsula has been largely restricted to lucerne, however it is not considered to be well adapted to shallow constrained soils common across much of the region. The benefits of a perennial legume phase within an intensive cropping system for soil rehabilitation and economic weed management is well documented.

As part of a national program to identify alternative perennial legumes to lucerne suitable for incorporation within cropping systems, there are at least 3 options potentially adapted to specific areas and systems within Eyre Peninsula.

Research in South Australia has shown Sulla *(Hedysarum coronarium)* to be a highly productive, perennial/biennial legume. The plants can survive for 2-3 years, but it will regenerate readily from seed. Sulla is used for grazing or hay production and contains condensed tannins that make it bloat-safe, increase protein digestion in livestock and make it less attractive to insects. These tannins also provide a reputed anthelmintic effect which may reduce worm and nematode burdens. Sheep grazing Sulla have been recorded to scour less, which is considered a result of the tannin content.

Western Australian research is suggesting that *Bituminaria bituminosa var albomarginata*, or Tedera, as it is more commonly known in its native Canary Islands, has the potential to offer a solution to the shortcomings of lucerne. It is shallow-rooted and very drought tolerant. Lucerne may only survive summer drought by its deep roots accessing a water supply. On many EP soils lucerne dies in the more constrained, shallow soils.

The third option *Cullen australasicum,* a native perennial legume, has been as persistent and productive as lucerne in previous South Australian studies. These results suggest that Cullen species will have adaptations to both survival and productivity traits that make them suitable for further development as perennial pastures in the low rainfall Mediterranean climate of upper Eyre Peninsula.

These three perennial species were considered worthy of continuing evaluation to compare to lucerne at a range of Eyre Peninsula sites. To review 2010 results see EPFS Summary 2010, p 141.

How was it done?

Six lines of forage perennials: Lucerne, Sulla, Cullen and three Tedera lines were established at four Eyre Peninsula sites in 2010 to represent four rainfall and soil type regions: Minnipa (325 mm), Rudall (350 mm), Edillilie (400 mm) and Greenpatch (450 mm). Soil types varied from red sandy loam (Minnipa, pH 7.7 -7.8 $CaCl_2$), calcareous sand (Rudall, pH 7.7-8.1 $CaCl_2$), slightly acidic, shallow duplex (Edillilie, pH 6.4-7.5 $CaCl_2$) and an acidic sand over clay (Greenpatch, pH 4-5.1 $CaCl_2$) in the 0-0.6 m soil profile.

Table 1 Plant establishment and persistence (plants/m²) from 2010 (Minnipa 2011) until 2012

	Minnipa		Rudall		Edillilie		Greenpatch	
	2011	2012	2010	2012	2010	2012	2010	2012
Tedera 27	17	16	5	5	9	6	9	7
Tedera 37	13	13	4	3	5	4	8	6
Tedera 42	11	12	4	8	6	6	7	8
Lucerne	17	17	3	2	8	5	6	3
Cullen	40	18	7	6	5	3	18	3
Sulla			4	1	21	2	17	4

Table 2 Total 2010 to 2012 (Minnipa 2011-2012) May to October and November to April biomass production (tDM/ha) at the 4 evaluation sites

	Minnipa		Rudall		Edillilie		Greenpatch	
	Nov - Apr	May - Oct	Nov - Apr	May - Oct	Nov - Apr	May - Oct	Nov - Apr	May - Oct
Tedera 27	0.7	2.4	0.31	0.25	1.7	3.2	0.63	1.42
Tedera 37	0.5	1.0	0.13	0.10	1.3	2.5	0.10	0.45
Tedera 42	0.6	2.2	0.29	0.24	1.5	3.4	0.49	0.86
Lucerne	1.4	4.9	0.44	0.10	3.9	2.4	0.33	0.27
Cullen	0.7	2.8	0.43	0.44	2.1	2.9	0.10	0.45
Sulla			0.27	0.10	1.7	5.5	0.10	0.39

Table 3 November 2011 and April and November 2012 volumetric soil water contents (mm) at Edillilie

	November 2011	April 2012	November 2012
	0-60 cm		
Tedera 27	131	186	118
Tedera 37	143	183	123
Tedera 42	143	167	122
Lucerene	126	188	125
Cullen	149	173	130
Sulla	141	175	113

In 2010 the trials were hand sown in 3 x 2 m plots replicated twice: Minnipa 2 June, Edillilie 22 July, Rudall 30 July, then re-sown on 18 September and Greenpatch 11 October. The Minnipa site was desiccated with an unplanned broad spectrum herbicide in March 2011. A replacement site was established at Minnipa on 2 May 2011, 5 x 1.5 m plots with 2 replicates were hand-sown into rows at 0.5 m row spacings.

What happened?

The trials were measured for biomass and plant numbers at each flowering time. 2012 rainfall and the months sampling was carried out in 2012 were; Minnipa (237 mm, January, May, July and October), Rudall (320 mm, January, April and May then site abandoned), Edillilie (385 mm, January, February, April, May, July, October, November and December) and Greenpatch (450 mm, January, April and May then site abandoned). Soil water measurements were collected in November 2012 at the Edillilie site to compare water use of species being evaluated.

The Sulla plant densities had declined after 2 summers at all 3 sites (Table 1). Cullen numbers declined at both the higher rainfall neutral to acidic Greenpatch and Edillilie sites, and reduced numbers at the Minnipa site in line with other entries. Lucerne plant numbers have trended lower at the 3 initial sites. The Tedera 27 and 37 have similar to lower numbers at all 4 sites while Tedera 42 has maintained or increased numbers over the 18 and 30 month period.

Over the study period the entries that produced more biomass than the site mean, the average of all entries, were lucerne at Minnipa, Cullen and Tedera lines 27 and 42 at Rudall, Lucerne and Sulla at Edillilie and Tedera lines 27 and 42 at Greenpatch (Table 2). Tedera line 37 produced less than the site mean at all 4 sites.

Soil water content at Edillilie declined over the 12 months under all the entries apart from lucerne (Table 3), which returned to the 2011 figure.

The abandonment of the Rudall and Greenpatch sites in May 2012 was in response to the Cullen (Rudall) and Tedera (Rudall and Greenpatch) having shown their improved adaptation in terms of productivity and persistence to these constrained sites compared to lucerne with low productivity and plant numbers supporting the decision. The continuation of the 2 sites on the "better" cropping soils until April 2013 will assess the drought tolerance of these lines over the third and to date driest summer period of the study.

What does it mean?

Both the Tedera and Cullen are only partially developed lines and will continue to be progressed through an intensive selection process in terms of establishment, management, persistence and animal production issues. However, these trials are giving an indication as to the potential role of "improved" lines of these perennial pasture species in the EP environment and farming systems.

Acknowledgements

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Grain & Graze

Profit through knowledge

EYRE PENINSULA

Government of South Australia

Eyre Peninsula Natural Resources Management Board

Establishing and managing perennial phase pastures

Roy Latta and Suzie Holbery
SARDI, Minnipa Agricultural Centre

Searching for answers

Location:
Edillilie, Peter Treloar
Minnipa, Minnipa Ag Centre
Rainfall
Edillilie
Av. Annual: 490 mm
Av. GSR: 397 mm
2012 Total: 381 mm
2012 GSR: 333 mm
Minnipa
Av. Annual: 325 mm
Av. GSR: 397 mm
2012 Total: 253 mm
2012 GSR: 185 mm
Soil Type
Edillilie: Duplex gravel sand over clay
MAC: Red calcareous sandy loam
Plot Size
Edillilie: 5m x 2m x 3 reps
MAC N4: 10 ha
MAC Argonomy: 20 m x 2 m x 2 reps
MAC Enrich: 185 m x 40 m

Key messages

- **Under-sowing perennial legumes to barley failed in 2012.**
- **Over-cropping established lucerne with a cereal produced a viable crop yield but suppressed lucerne to the extent the population declined.**

Why do the trial?

The introduction and use of perennial legume pastures on Eyre Peninsula is often restricted by shallow constrained soils, not suitable for deep rooted perennials. The project "Evaluation of perennial forage legumes on Eyre Peninsula" outlined in the 2012 EP Farming Systems Summary aimed at identifying and promoting perennial options for these constrained soils.

However there may also be a role for perennials as phase pastures in cropping systems to address weed, pest and disease issues that require an extended break. Phase pastures can be described as pastures that require establishment at the commencement of each phase, as opposed to a self-regenerating annual medic pasture.

The trials reported are based on evaluating opportunities to integrate well adapted perennial legumes into cropping rotations as breaks between extended periods of cropping. Lucerne due to its partial winter dormancy and summer activity is one option. Sulla as a second option has performed well in current trials (EPFS Summary 2012, Evaluation of perennial forage legumes on Eyre Peninsula), and differs from lucerne in that it is a biennial and summer dormant.

The time required for successful establishment of the perennial is an issue whereby a full season's production can be lost before any grazing can be undertaken. An option to address this is to under-sow the final year of the cropping phase with the perennial. An establishment trial was established at Edillilie and a commercial demonstration site on Minnipa Agricultural Centre (MAC) to assess under-sowing lucerne and other alternative perennials.

The other component evaluated was the over-cropping of established lucerne pastures with a cereal crop to assess the opportunity to produce an economic field crop while producing high quality stubbles and a summer forage supply. This addresses the ongoing cost and risk of failure when establishing a perennial. A trial and a demonstration site were established at Minnipa in 2012.

How was it done?

Under-sowing perennials

At Edillilie lucerne, Sulla, Cullen and Tedera were sown on 7 June 2012 both as monocultures and in alternate rows with Hindmarsh barley crop sown @ 60 kg/ha and 30 kg/ha in 6, 0.25 m and 3, 0.5 m spaced rows respectively by 5 m plots. All plants within plots were counted on 14 September and again on 5 December. Total plot biomass samples were collected on 19 October and 5 December. Grain yield comparisons between the 6 and 3 row barley plots were estimated from biomass collected at anthesis (19 October) and calculated from harvest indexes. Due to bird damage it was not possible to harvest complete plots. Comparative soil water contents in the 0-20, 20-40 and 40-60 cm profiles were collected on 20 November.

A demonstration site on MAC in paddock North 4 was sown on 6 June with Hindmarsh barley @ 35 kg/ha with 60 kg/ha of DAP at 30 cm row spacing. Lucerne (SARDI 10) was then sown @ 2.5 kg/ha in the inter-row, with no further fertiliser applied. Plant establishment counts were collected on 26 November, 8 December and 8 January from 100 1 m x 0.6 m quadrants.

Over-cropping established lucerne

At MAC in the agronomy paddock, lucerne was established in June 2011 in 20 m x 6 row plots, sown with GPS guided 2 cm auto steer. In 2012 sown rows of lucerne were removed with broad spectrum herbicides to allow for 5 sowing configurations (Table 1). On 24 May 2012 wheat was sown with 60 kg of DAP and at a sowing rate representative of the number of rows sown, 60 kg/ha 6 rows, 30 kg/ha 3 rows etc. On 9 July Bromoxyil and Hoegrass® was applied for broad-leaved weed and annual ryegrass control, it also suppressed lucerne production over winter. Measurements taken included soil water content pre-seeding, 19 April, and post harvest, 30 October, in 0.3 m soil profile sections down to 0.9 m, lucerne plant numbers on 4 June and again with biomass sampling on 29 October, from the complete plot. The wheat grain yield was calculated from plot weights collected with a Kingaroy harvester on 29 October.

An over-cropping demonstration site was established at MAC in the Enrich paddock on 24 May 2012 when a 1 ha paddock of lucerne sown in 2009 had wheat and DAP both @ 60 kg/ha sown into half the paddock. Comparative biomass and lucerne plant numbers between treatments were estimated.

What happened?

Winter rainfall at Edillilie in 2012 was average (150 mm) but below average in spring (50 mm). At Minnipa it was similar, average over winter (100 mm) and low in spring (24 mm).

Table 1 Lucerne (L) and 2012 wheat (W) sowing configurations at Minnipa, 2012

Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
LLLLLL	LWLWLW	LWWLWW	LWWWWL	WWWWWW

Table 2 Plant numbers (plants/m²), total biomass (tDM/ha), grain yield (t/ha) and soil water content (mm/0-0.6 m) at Edillilie in 2012

Treatment		Plant numbers (plants/m²)		Total biomass (tDM/ha)	Grain yield (t/ha)	Soil water content (mm/0.06 m)
Plant type	Sowing configuration	14 Sept	5 Dec	5 Dec	5 Dec	22 Nov
Cereal	Monoculture				1.3	101
Lucerne	Monoculture	16	12	0.48		108
Lucerne	Alternate rows	8	2	0.01	0.8	94
Tedera	Monoculture	15	9	0.17		96
Tedera	Alternate rows	6	2	0.01	0.9	95
Cullen	Monoculture	13	6	0.02		101
Cullen	Alternate rows	5	1	0.00	0.9	119
Sulla	Monoculture	11	7	0.45		99
Sulla	Alternate rows	6	1	0.01	0.9	88

Table 3 Lucerne (L) plant numbers (plants/m2), total biomass (tDM/ha), wheat (W) grain yield (t/ha) and soil water content (mm/0-0.09 m) in the over-cropping trial at Minnipa, 2012

Treatment	Plant numbers (plants/m²)		Total biomass (tDM/ha)	Grain yield (t/ha)	Soil water content (mm/0.06 m)
Row configuration	4 June	29 October	29 October		
WWWWWW				2.6	100
LWLWLW	3	0.5	0.02	1.9	98
LWWWWL	4	1.7	0.07	1.7	98
LWWLWW	4	0.8	0.04	2.0	98
LLLLLL	11	8.5	1.40		96

Established perennial legume numbers at the Edillilie site (Table 2) correlated with the 2 sowing densities; however number declined more in the alternate row sowing treatments than the monoculture. Biomass figures reflected the poor growth in the alternate row treatments plus the poor adaptation of the Cullen to the site. Estimated barley grain yields reflected the wide alternate row spacing. Soil water contents measured on the 22 November were variable, they trended higher under the monocultures but were much higher than prior to sowing when a site average of 62 mm was measured.

Lucerne densities in the North 4 demonstration site at Minnipa were counted 3 times to measure any decline. The barley yielded 1.4 t/ha. Counts on the 26 November, 20 December and 8 January 2013 totalled 9, 6 and 3 lucerne plants/m^2 respectively.

Over-cropping established lucerne with wheat in the agronomy paddock resulted in the loss of lucerne plant numbers and the suppression of lucerne biomass production (Table 3). The wheat yields reflected both the number of crop rows in each treatment plus the edge effect of the LWLWLW configuration compared to LWWWWL. Soil water content at the commencement of the study was 101 mm/0-0.9 m soil profile.

The over-cropping demonstration site in the Enrich paddock established 21 plants/m^2 in 2009 and produced 10 t DM/ha from November 2010 to January 2012. On 20 August 2012 the wheat lucerne mixture had produced a total of 2.1 t/ha dry matter (wheat 1.2 t/ha, lucerne 0.9 t/ha), the lucerne monoculture 1.9 t/ha (lucerne 1.3 t/ha, weeds 0.6 t/ha) from 16 and 13 plants/m^2 respectively.

What does it mean?

The dry spring conditions may have contributed to the failure to establish perennials under a barley crop at Edillilie due to an increased competition for soil water between an established annual crop and an establishing perennial; however the trial gave no such indication. There was a similar amount of water under the under-sown plots in the 0-0.6 m soil profile or within the 0.2 m profile subsections as the monocultures, plus the soil water contents were all much higher than the pre-seeding site average, thus there was no deficit. Crop nutrients were applied similarly to all treatments therefore the most likely conclusion is one of shading to explain the increased decline in plant numbers in the under-sown treatments. The under-sowing demonstration at Minnipa was considered a failure as a decline from 9 to 3 plants/m^2 by early January and an expected further decline prior to the seasonal break, is unlikely to constitute a productive pasture component.

The over-cropping trial showed the capacity of the wheat, with the addition of registered herbicide treatments, to suppress lucerne to the extent where the population declined. There was no major addition or decline in soil water contents measured at harvest between the wheat and lucerne monocultures in response to average winter rainfall. This suggests that the site provided no deeper access to the perennials over the course of the study than the cereal, which followed a lucerne stand that would have the soil water profile near to plant lower limits. Any further work should be undertaken on a deeper soil type. The demonstration showed some potential to increase production from a lucerne stand, plus compete with weeds volunteering into a monoculture, through sowing a cereal crop into the lucerne inter-row. It may also improve subsequent lucerne productivity by lightly cultivating the soil and applying fertiliser for both an immediate and long term production benefit.

Acknowledgements

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CARING FOR OUR COUNTRY

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Establishing perennial shrubs for mixed farming systems on Eyre Peninsula

Jessica Crettenden and Roy Latta
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location:
Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2012 Total: 253 mm
2012 GSR: 185 mm
Soil Type
Red sandy loam
Plot Size
46 m x 68 m with 1.5 m between rows
Environmental impacts
Soil health
Soil structure: Stable
Compaction risk: Nil
Ground cover or plants/m^2: Forage shrubs
Perennial or annual plants: Perennial
Water use
Runoff potential: Low
Resource efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, NO_2, methane): Nil
Social/Practice
Time (hrs): Site establishment time
Clash with other farming operations: Standard practice
Labour requirements: Nil
Economic
Infrastructure/operating inputs: Establishments costs
Cost of adoption risk: Low

Key messages

- **Difficulty in establishing perennial fodder shrubs, cost and labour are the major barriers to adoption.**
- **Direct seeding offers a method of overcoming these issues and provides a profitable and sustainable enterprise for future generations with added benefits of maintaining stocking rates and reducing supplementary feeding, capturing out-of-season rainfall, reducing soil erosion and salinity and providing shade, shelter and feed for livestock.**
- **A greater understanding of perennial shrub germination, establishment and productive qualities is required to increase survival percentage through the direct seeding method.**
- **Success rates need to be increased before this sowing technique can become profitable through improved shrub establishment and longevity.**

Why do the trial?

Current challenges facing farming systems in Australia, and on the Eyre Peninsula, including seasonal variability, alternative competing industries and technological advances, are the drivers for change from a reliance on annual legumes and grasses towards more sustainable perennial options. Out-of-season summer rainfall has also emphasised the need to utilise perennial plants that can better cope with an increasingly variable climate and provide green feed at the time of year when producers often have to supplement feed livestock.

Due to changing farming systems, some areas of land that were once productive have become or are becoming unsuitable for profitable grain production, consequently increasing the risk of soil degradation, erosion and salinity, which has supported the idea that perennials have the potential to be an essential component of modern mixed farming systems. Incorporating perennials, including perennial fodder shrubs, into farming systems across Eyre Peninsula opens up new opportunities to provide a profitable and sustainable enterprise for future generations.

For perennial species to be of commercial value, they need to persist and remain productive. Difficulty in establishing perennial shrubs has been a major barrier to adoption with the main hurdles of establishment being cost and labour for landholders. Direct seeding fodder shrubs offers a method of overcoming these issues and subsequently provides a productive and practical solution to the autumn feed gap in low to medium rainfall areas. Sowing marginal farming land to perennial shrubs also delivers a means of drought-proofing the farm and capturing out-of-season rainfall, with added benefits of maintaining stocking rates over summer with reduced cost and time spent supplementary feeding, reducing soil erosion and salinity and providing shade, shelter and feed to livestock.

How was it done?

A trial to explore the process of establishing a perennial shrub feed base using a direct seeding method was established on the Minnipa Agricultural Centre in 2011 with the shrub species selected as the best performed for survival, growth, biomass and palatability following grazing of the Enrich™ forage shrub trial in the same year (EPFS Summary 2010, pp 138-9 and EPFS Summary 2011, pp 135-8). The focus of the trial was to determine a more labour and cost efficient method to establish a perennial shrub feed base in order to make the system attractive to farmers.

The 46 m x 68 m site was established on 1 June 2011 with 4 replicates x 6 species, making a total 64 plots. Weeds were eradicated from the site after herbicide application in late July. Replicates 1, 2 and 3 were sown with a No-till plot seeder to have 3 rows x 9 m with a 1.5 m gap between rows using a mixture of treated purchased and collected seed. Seeding rate was determined by seed weight, viability and establishment percentage (Table 1). Replicate 4 was planted with 18 plants per plot on the site as tube stock (established in a greenhouse on 13 July using the same seed) on 22 August for comparison with the direct seeding method. These plants were watered with 200 ml/plant/day for 5 days after sowing due to dry conditions.

The success or failure of plant establishment and survival were observed and measured over 2011 and 2012 in anticipation that the site may be grazed once shrubs were established and biomass was sufficient for grazing in following years.

What happened?

Table 1 shows that all of the perennial shrubs established well after some good rain in August and September after sowing, however the germination of spring weeds over many of the plots caused issues as some shrubs were out-competed, reducing plant numbers towards the end of 2011. Shrubs emerged in high density in the direct seeding replicate, however not all survived which allowed improved growth and greater biomass in the living shrubs. The tube stock shrubs were more established than the direct seeded shrubs at time of sowing and had a greater growth before the end of 2011, however were less dense and therefore had similar biomass to the other plots. The successful species included *E. tomentosa, A. semibaccata* and *R. preissii* which established well and have grown significantly since sowing. *A. ligulata* also established well but was unsuccessful because of poor survival. Due to lack of shrubs emerging, it was determined that higher seeding rates were required for *A. nummularia* and *A. amnicola* to improve shrub numbers.

Plant size differed between shrub species at the end of 2012 with some species established well enough to graze in 2013; however grazing will have to be delayed until 2014 due to shrub variation over the site. After a particularly dry spring in 2012, *A. semibaccata* has browned off and has ceased growing, however other species are surviving well.

Table 1 Names, seed treatment, sowing rate and survival numbers of perennial shrub species at the Minnipa site

Perennial shrub species	Pre-sowing seed treatment	Sowing rate (grams)		Shrub count (number)*		
		Per placement	Per row	Oct 2011	Nov 2011	Oct 2012
Atriplex nummularia (old man saltbush)	Soak then leach	0.43	2.59	60 (15)	33 (13)	22 (11)
Atriplex amnicola (swamp saltbush)	Soak then leach	0.18	1.10	54 (17)	34 (15)	18 (9)
Enchylaena tomentosa (ruby saltbush)	Leach	0.48	2.88	377 (67)	228 (67)	119 (16)
Rhagodia preissii (mallee saltbush)	Soak then leach	0.27	1.65	662 (82)	352 (82)	71 (15)
Atriplex semibaccata (creeping saltbush)	Soak then leach	0.25	1.53	637 (142)	251 (18)	97 (18)
Atriplex ligulata (sandhill wattle)	Soak in boiling water	0.74	4.49	283 (96)	81 (60)	18 (12)

**figures in brackets for the shrub count describe the number of shrubs surviving out of the total number recorded in replicate 4 (established from tube stock)*

What does this mean?

Perennial shrubs are a valuable addition to the pasture system, giving farming systems a more predictable feed option during the autumn period, developing unproductive land and complementing rather than competing with the existing feedbase, as a result contributing to whole-farm profitability and sustainability. Establishing perennial shrubs can be quite challenging with many factors affecting success rates including incorrect sowing depth, poor seed quality, seed dormancy mechanisms, weed control and slow germination. Other elements that need to be taken into consideration include site selection (soil quality), seeding rates and timing of sowing, which are issues that need to be trialled before definite outcomes can be produced. Ongoing measurements in autumn and spring will monitor plant survival, growth, plant health, flowering/fruiting, recruitment, edible biomass, as well as defoliation (palatability) and recovery after the first grazing period.

A better understanding of perennial shrub germination, establishment and productive qualities is required to increase survival percentage through the direct seeding method. Cost and labour efficiency is increased through utilisation of direct seeding as opposed to planting seedlings or using other direct niche-seeding techniques, however success rates need to be increased before this practice can become profitable through improved shrub establishment and longevity.

Another trial site will be sown for the next stage of the Eyre Peninsula Grain and Graze 2 research into using direct seeding as a method of establishment in order to make forage shrub grazing systems more broad-acre friendly. Both sites will be evaluated to determine the success of direct seeding of selected native forage shrubs, including the ease of establishment of a cost and labour efficient shrub based grazing system on Eyre Peninsula.

Acknowledgements

We gratefully acknowledge the help of Ian Richter, Wade Shepperd, Trent Brace and Jake Pecina for their technical assistance and site management. The Enrich™ project is funded through Eyre Peninsula Grain and Graze 2 research by GRDC, Caring for Our Country and Future Farm Industries CRC. Project number UA00117.

Pastures

Cowell Enrich project: Perennial shrubs, options for soil constrained areas

RESEARCH

Neil Ackland

DEWNR – Sustainable Farming Systems, Natural Resources Centre, Eyre Peninsula

Searching for answers

Location: Elbow Hill
Scott Williams
Rainfall
Av. Annual: 280 mm
Av. GSR: 190 mm
2009 Total: 210 mm
2009 GSR: 163 mm
Soil Type
Strongly alkaline clay/loam and high in magnesia salt
Plot Size
1 ha (50 m x 50 m x 4 reps)
4 ha (200 m x 200 m x 2 reps)
Limiting Factors
Magnesia soil constraints and limited rainfall

Key messages

- **Non-productive land is being utilised by using perennial shrubs for erosion control and ground cover.**
- **Livestock can maintain condition in the short term on native perennial grazing systems during the summer feed gap.**
- **Magnesia affected areas can be reduced under a shrub-based system with increased ground cover.**

Why do the trial?

Ground cover has always been an issue on low rainfall areas of Eyre Peninsula. The aim of this project was to increase the productivity of areas that were continually suffering during the dry years and affecting the escalation of salt induced magnesia soils. Ground cover is vital to reduce the impact of magnesia soils caused through the evaporation of moisture from the soil, thus creating a wicking effect and bringing the salts to the surface. These areas become more noticeable and spread in the dryer years, however, these areas can be minimised through increasing ground cover and shading to keep the soil cooler during the summer period.

Farming properties in these cropping areas are in need of good quality stock fodder reserves that can sustain ground cover over the crucial summer period. Woody perennial grazing systems are an alternative option to fill the feed gap on these soil types. They also offer the potential to move sheep into these smaller areas of perennial shrub systems at high stocking rates, thus resting paddocks during times of low feed availability.

How was it done?

In 2008 Future Farm Industries CRC (FFICRC) and Eyre Peninsula Natural Resources Management Board (EPNRM) established a one hectare trial site using 15 mainly native shrubs selected from a potential 50 species of perennial shrubs, already trialled at Monarto, SA. These were divided into 4 replicated plots of 15 species x 36 plants each at Elbow Hill south of Cowell. Two other sites were established at Minnipa and Piednippie in 2009 (EPFS Summary 2011, pp135-138).

The shrub biomass, recovery and the sheep grazing preference have been monitored during autumn and spring each year since establishment. From the research and observations of the initial small plot trial, 4 varieties have since been selected and established in 2010 into a larger trial site of 4 ha at the same location.

What happened?

Although the Eastern EP has had significantly below average rainfall since establishment of the shrubs in 2008, there has been good survival (up to 80%) and significant ground cover establishment consiting of native grasses, rye and barley grasses, medics and blanket weed in the inter-row, due to the grazing pressure and timing. Shrub growth range has varied, with species ranging from over one metre in height to a stunted 20 mm as indicated by canopy volume (Figure 1).

Grazing of the shrubs has occurred in autumn since 2009 at high a stocking pressure of 80-120 DSE/ha until the majority of leaf material was consumed. Stock were moved from one replicate to the next when the majority of leaf matter was removed from most of the shrubs. Each year grazing preference was recorded to establish the palatability of the selected shrubs. Whilst some of the saltbush varieties were left until last in replicate 1, by the time the sheep entered replicate 4, the shrubs were grazed more evenly, therefore, indicating sheep become more accustomed to the varieties over time.

The larger trial site was split in two (2 ha each) and grazed over a 10 week period as per the small plots at a grazing pressure of 40 DSE/ha.

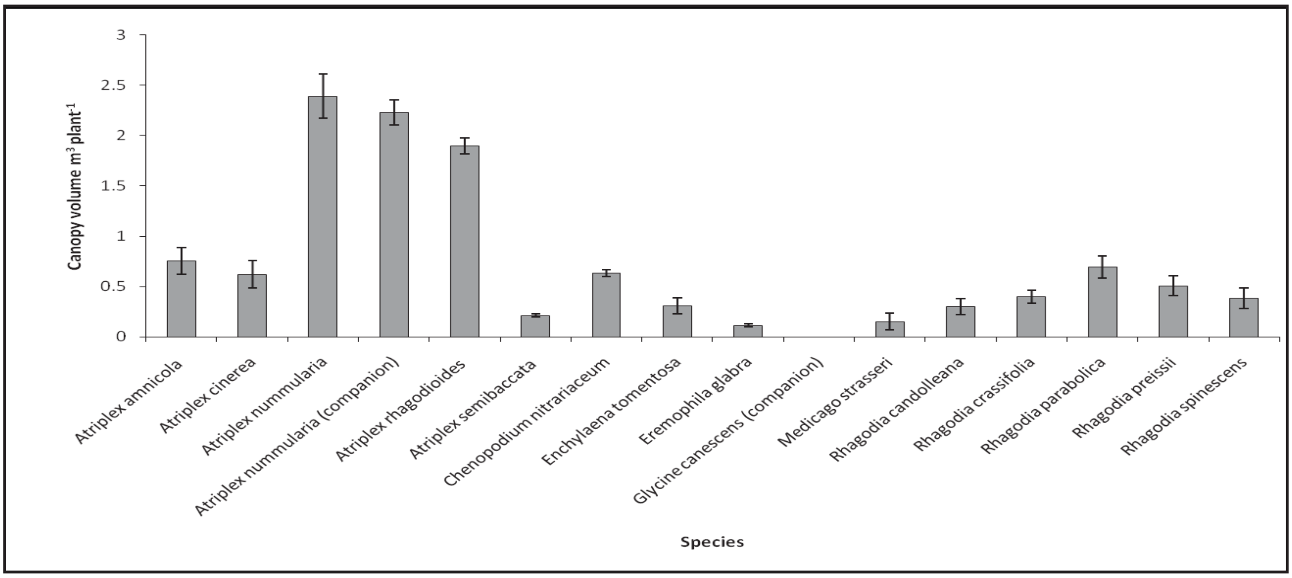


Figure 1 Average production (expressed as canopy volume) of the perennial forage species at Elbow Hill in April 2011

Table 2 Average weight of sheep during the grazing period in each of the trial sites, April to June 2012

Grazing Days	Large shrub site (stocking rate @ 40 DSE/ha)		Small shrub site (stocking rate @ 120 DSE /ha)		Paddock control	
	Entry weight (kg)	Average Weight (gain/loss kg)	Entry weight (kg)	Average weight (gain/loss kg)	Entry weight (kg)	Average weight (gain/loss kg)
	37.25		36.45		39.50	
14		+4.15		+2.15		
29		+4.60		-3.15		
37		+0.90		-0.35		
50		+3.85		+1.10		
65		+2.90		+3.40		
72		-0.40		+1.90		+6.80

In 2012 extra measurements of sheep condition/weight were monitored at intervals during the shrub trial grazing period and compared to a control paddock mob. Sheep initially gained weight in each of the 2 ha and small trial plots. The weight gain was mainly due to consumption of the inter-row plants (Barley grass and Blanket weed) before progressing onto the shrubs. Sheep in both shrub trials lost weight after long periods of grazing on shrubs only (Table 2).

What does this mean?

Forage shrubs do provide an option for the non-productive cropping soils in Eyre Peninsula's mixed farming systems. However, identifying the best mix of shrubs that suit differing soil types and rainfall zones along with inter-row species, is still work that needs to be continued. These trials at Elbow Hill have demonstrated that soil cover can be maintained on these magnesia areas under a shrub based system and through selected grazing. Also inter-row species such as native and annual grasses and medics increase to create a balanced system. This increased inter-row ground cover has meant that supplementary feeding of livestock has not been required during the last two years of these grazing trials.

With the development of these and further sites across EP and continued research into direct seeding (potentially a more cost effective option for establishment), inter-row species and shrub designs, some of the challenges may be overcome when establishing perennial shrub-based grazing systems. While shrubs are not the complete answer, this research in combination with "best practice" land management and farming practices, there is potential to increase productivity and soil cover on some of EP's more vulnerable soils.

Acknowledgements

Scott Williams, for the use of the land for these sites, local landholders for their input and support, FFICRC and Jason Emms (SARDI) for their technical advice and assistance and funding through the EPNRM Board & the Australian Government.

FUTURE FARM INDUSTRIES CRC

CARING FOR OUR COUNTRY

Government of South Australia
Eyre Peninsula Natural Resources Management Board

Section Editor:
Linden Masters
SARDI, Minnipa Agricultural Centre

Section 8

Soils & Tillage

Stubble and nutrient management trial to increase soil carbon

RESEARCH

Amanda Cook[1], Harm van Rees[2], Wade Shepperd[1] and Ian Richter[1]

[1]SARDI, Minnipa Agricultural Centre, [2]CropFacts Pty Ltd

Searching for answers

Location:
Minnipa Ag Centre, South 2/8
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2012 Total: 253 mm
2012 GSR: 185 mm
Yield
Potential: 1.44 t/ha (Yield prophet)
Actual: 1.14 - 1.37 t/ha
Paddock History
2012: Scout wheat
2011: Mace wheat
2010: Axe wheat
2009: Pasture
Soil Type
Red sandy loam
Plot Size
12 m x 3 m x 4 reps

Key messages

- **The extra nutrition treatment had no effect on yield or grain quality this season.**
- **In the 2012 season the stubble removed treatment had the highest yield.**

Why do the trial?

This DAFF funded national trial will examine existing, new and alternative strategies for farmers in the wheat/sheep zone to increase soil carbon. The trial will be used as base line data for carbon accumulation in soils and to;

- discuss the various forms of soil organic carbon (plant residues, particulate, humus and recalcitrant)
- investigate how management affects each of these pools and how humus can be increased over the medium to long term
- communicate how soil organic matter affects soil productivity (through nutrient and water supply, and improvements in soils structure).

How was it done?

Four wheat stubble samples from 2011 were collected in MAC S2/8 in May across the trial site and dried at 40°C for 24 hours to calculate the stubble load.

Soil samples were collected for soil carbon (0 to 10, 10 to 30 cm), air dried (40°C for 48 hrs) and stored for future processing, and soil samples were also taken for Yield Prophet (0-10, 10-40, 40-70, 70-100 cm) for soil available nitrogen and soil moisture.

In May the stubble management treatments of (i) Stubble left standing, (ii) Stubble worked in with single operation of the seeder using knife points before sowing (18 May), (iii) Stubble raked and burnt (21 May) were imposed.

Nutrient application treatments at seeding were: (i) normal practice for P at sowing and N in crop as per Yield Prophet recommendations; (ii) normal practice PLUS extra nutrients (N, P, S) required to break down the measured wheat stubble which is 5.8 kg N/t of wheat stubble, 2.2 kg P/t of stubble and 0.9 kg S/t of wheat stubble. The treatments were replicated 4 times.

The trial was sown on 30 May with Scout wheat @ 60 kg/ha and base fertiliser of DAP (18:20:0:0) @ 50 kg/ha. The extra nutrient requirement applied (N, P and S) at sowing to break down the stubble load was 19.5 units P, 33.9 units N and 3.8 units S, which was applied as DAP @ 97.5 kg/ha, ammonium sulphate (21:0:0:24) @ 16 kg/ha and urea (46:0:0:0) @ 28.5 kg/ha.

Emergence counts, flowering date and grain yield and grain quality were measured.

Table 1 Yield (t/ha) and grain quality measurements of stubble and nutrition treatments at MAC, 2012

Stubble treatment	Nutrition treatment	Yield (t/ha)	Protein (%)	Test weight (g/hL)	1000 Grain weight (gm)	Screenings (%)
Stubble removed	DAP @ 50kg/ha	1.34	11.65	84.32	30.66	4.8
Stubble removed	normal practice PLUS N, P & S	1.35	11.85	83.85	30.48	4.6
Stubble standing	DAP @ 50kg/ha	1.29	11.70	83.84	29.52	4.6
Stubble standing	normal practice PLUS N, P & S	1.24	11.75	83.84	29.28	5.1
Stubble worked	DAP @ 50kg/ha	1.25	11.65	84.15	30.26	5.6
Stubble worked	normal practice PLUS N, P & S	1.24	11.60	83.81	30.41	5.7
LSD (P=0.05)		*0.08*	*ns*	*ns*	*0.54*	*0.7*

What happened?

The mean stubble load calculated was 4.33 t/ha.

Emergence counts were taken on the 26 June with an average of 95 plants/m^2. There were no differences between treatments with plant emergence. Due to seasonal conditions, low rainfall and hot weather around 18 September, there were no differences in flowering date (GS 65 (when 50% of heads have anthers)) which occurred between the 18 and 21 September.

The trial was harvested on 6 November. The results are presented in Table 1.

Yield Prophet was used early in the season (30 July) to predict if extra nitrogen fertiliser was required to achieve potential yield. The report showed 200 kg/ha of soil nitrogen was available to the crop so extra nitrogen did not need to be applied to increase plant growth. The soil moisture profile at this stage of the season was almost at capacity.

What does this mean?

A decile 3 season, with little spring rainfall resulted in a very tight finish to the season. Flowering time was condensed due to higher temperatures between 18 and 21 September. Soil nitrogen was not a limiting factor in this paddock this season so no extra in-crop nitrogen was applied.

Soil moisture may have been a limiting factor as the treatment with stubble removed had increased yields. In this season the removal of stubble may have allowed better infiltration of rainfall and increased soil moisture available to the plant. The extra nutrient treatment had no effect on grain yield or quality this season.

It is expected that the imposed treatments to increase soil organic matter will take a few years to become noticeable. The trial will be repeated on the same site for at least the next two years.

Acknowledgements

Funding provided from DAFF, GRDC and CEF and project management through Ag Ex Alliance, BCG and EPARF.

Yield Prophet® is an on-line modeling service based on APSIM that provides simulated crop growth based on individual paddock information and rainfall, and is registered to BCG.

Managing problem sandhills for reduced erosion risk and improved productivity

Brett Masters[1] and Linden Masters[2]

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

EXTENSION

Key messages

- **Fill in blowholes using best practice techniques.**
- **Where suitable clay is present within operating depths, clay spread or delve the area to address such issues as water repellence and low inherent fertility.**
- **Ensure there is adequate moisture to quickly re-establish surface cover.**
- **Ensure that the site has adequate soil nutrition by applying fertilisers (including trace elements) where required.**
- **Remove stock from the area to enable surface cover to establish.**
- **To reduce erosion risk, surface cover should be well anchored and at least 2 cm in height with moderate bulk.**
- **Once cover has established grazing should be carefully monitored. Set stocking is not advised and electric fencing can be used to keep stock from the site.**
- **Build up soil organic carbon levels using stubble retention, and perennial pastures where applicable.**

Why do the demonstration?

Sandhills within cropping and grazing paddocks, though often productive, provide continual management challenges to maintaining adequate surface cover for wind erosion protection. Issues such as water repellence, low inherent fertility and low water holding capacity require careful and specialised management to reduce the risk of wind erosion on these sites.

Where deep sandy sites are exposed to continual wind erosion events blow-outs can form, which if not managed effectively can increase in size, becoming more difficult to rehabilitate and increasing impact on production.

The aim of the EPNRM Board's "Supporting Soil Protection and Health on Upper Eyre Peninsula" project is to work with landholders in western, central and eastern Eyre districts to help them address soil constraints and wind erosion risk on susceptible soils. Demonstration sites in five districts will showcase how landholders can re-establish problem areas of their properties and bring them back into profitable production.

How was it done?

Landholders within the target area were asked to submit an expression of interest. These properties were visited and a plan detailing appropriate management actions for the site was developed in consultation with the landholder.

Technical support to the management plan was provided. Management options considered included; levelling paddocks by filling in blow outs, fencing to land class, applying biosolids to increase organic carbon and moisture holding capacity, clay delving, establishing perennial pastures, revegetation and better managing stock movement by shifting water troughs and tanks and using electric fencing for better grazing management on susceptible areas. Photographs were taken pre and post treatment and surface cover is being monitored.

What happened?

Sandhill rehabilitation

A number of landholders chose to manage particularly susceptible areas of the paddock by filling in blow outs to level the paddock, then sowing the site to an annual cereal to rapidly establish surface cover for wind erosion protection.

Levelling the site

Using a scraper (contractor machine or modified cultivator/ dozer) sand was moved down from the tops of the hills toward the flats. This filled in the blow-outs but in some instances also brought the tops of the sandhills to a height that would allow clay to be reached with a delver. Conducting this operation whilst the soil was moist reduced the risk of erosion and made it easier to re-establish cover on the paddock. Where the operation was conducted on dry soil it was difficult to get re-establishment of surface cover and left the site prone to drift.

Establishing and maintaining cover

Sowing the site with cereal rye or triticale provided rapid crop establishment and quickly provided surface cover for wind erosion protection. These crops are recommended for wind erosion susceptible sites as they are tall growing and establish an extensive root system, helping to bind the soil together. They also seem to recover better from sandblasting than other crop types. Where wheat was sown the crop did not have the same early vigour as cereal rye, leaving the soil exposed for longer and plants susceptible to sandblasting.

A number of different sowing techniques were used on sites including sowing along or across slopes and "cross-hatching" (planting half of the seed in one direction and sowing the remaining seed at 90 degrees to the initial direction). The best success for establishing surface cover seemed to be where growers had sown in a cross hatch at a high rate (up to 180 kg/ha).

Well anchored cover will protect soil from wind erosion for a distance of up to 10 times its height. Where surface cover is well anchored and of moderate bulk above 2 cm in height the site is generally considered to have a low wind erosion risk.

Managing stock movement was critical to ensuring that adequate surface cover for wind erosion protection was maintained post establishment. The use of electric fencing allowed landholders to graze stubbles on the areas of the paddock with low erosion risk whilst excluding stock from high risk areas.

Other options for managing the sites

There were a number of other options employed by landholders under the project to effectively manage their high erosion risk sites. These options included;

- Clay spreading and delving sites where there is suitable clay within an appropriate depth.
- Establishing perennial pastures (including perennial veldt grass and lucerne).
- Establishing rows of perennial shrubs to act as a wind break.
- Spreading biosolids over the surface of the site to increase organic matter for improved root development.

Long term strategies for managing these areas include:

- Minimising soil disturbance by using no-till technologies for seeding.
- Using electric fencing to manage grazing for protecting at-risk soils.
- Building organic matter through retaining stubble.
- Fencing off at-risk areas and investigating alternative land use options to lower erosion risk including the establishment of perennial pastures such as lucerne and perennial veldt grass.

What does this mean?

Any cultivation on susceptible sites (including levelling out blow outs) should be done whilst the soil is moist and cover re-established on the site as quickly as possible. It is recommended that these sites be managed to maximise surface cover by growing appropriate plant species at a high density and adequately managing grazing using electric fencing and stock exclusion.

There are extensive areas of susceptible soil across the region and state which require specialised and careful management strategies in order to reduce the risk of erosion. It is expected that the twenty focus sites over five districts will allow these land managers to showcase better alternative strategies of managing these problem areas in the future.

Acknowledgements

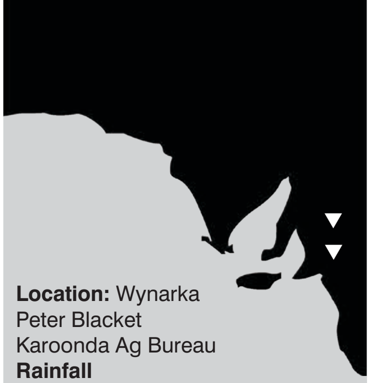
This project is supported by the Eyre Peninsula Natural Resources Management Board with funding from Caring for our Country. All landholders involved in the Supporting Soil Protection and Health project, EPNRM for the funding support, Regional Landcare Facilitators Linden Masters (SARDI), Neil Ackland and Corey Yeates (DEWNR) and Mary Crawford (Rural Solutions SA) for project delivery.

No-till into pasture, SA Mallee

Chris McDonough
Rural Solutions SA, Loxton

RESEARCH

Searching for answers



Location: Wynarka
Peter Blacket
Karoonda Ag Bureau
Rainfall
Av. Annual: 335 mm
Av GSR: 238 mm
2012 Total: 294 mm
2012 GSR: 221 mm
Yield
Potential: Wheat 2.5 t/ha
Actual: Highest yielding treatment 2.4 t/ha, site average 1.2 t/ha
Paddock History
2011: Volunteer pasture/sown Bevy rye for grazing
Soil Type
Calcareous shallow loamy sands
Soil Test
Sandy loam flats
Av. P: 30 ppm
Av. OC: 0.62%
Plot Size
0.4 ha x 2 reps
Yield Limiting Factors
Dry spring, Bipolaris (Common root rot)

Location: Wunkar
Daniel Evans
Wunkar Ag Bureau
Rainfall
Av. Annual: 285 mm
Av GSR: 190 mm
2012 Total: 263 mm
2012 GSR: 130 mm
Yield
Potential: Wheat 1.4 t/ha
Actual: Highest yielding treatment 1.26 t/ha, site average 0.72 t/ha
Paddock History
2011: Volunteer pasture/sown oats pasture
Soil Type
Dune swale, randy rises stony, sandy loam flats
Soil Test
Sandy loam flats
Av. P: 22 ppm
Av. OC: 1%
Plot Size
0.4 ha x 2 reps
Yield Limiting Factors
Very dry spring

Key messages

- **If using sown cereals for pasture, choose varieties carefully to avoid potential disease issues.**
- **The impact of various seasonal factors on N mineralisation can advantage farming systems differently between seasons.**
- **Grass control in pastures and summer weed control are vital for achieving No-till success.**

Why do the trial?

This paddock trial aims to better understand why many farmers with livestock find it difficult to No-till into pasture ground, and to give them practical management options for both the pasture and cropping phases that will help maximise outcomes, while reducing the risk of wind erosion.

How was it done?

Part A of this 3 year Grain and Graze 2 project compared 2011 wheat crops that followed 2010 grass free and spray topped pastures in 2010 (for full report go to https://msfp.org.au/docs/research_74.pdf).

Part B compared 2012 wheat crops following sown cereal pastures and volunteer pastures in both the southern (Wynarka) and northern (Wunkar) Mallee last season. The Wynarka paddock used cereal rye as the cereal pasture and was very clean of other grassy or broad-leaved weeds, while the Wunkar site had oats trashed in and had brome and barley grass, wild turnip and capeweed. In this dry season at both sites the volunteer pasture sections of capeweed, wild turnip and grass were poor leading to increased erosion risk from these sections. Observations suggested that the bulk of the paddock feed was obtained from the sown cereal sections (although areas were not separately fenced or measured).

In 2011 and 2012, 4 crop establishment treatments were used across the original pasture treatments:

1. early worked (EW) after rains in late February and worked again 1 week prior to seeding
2. late worked (LW) 1 week prior to sowing
3. No-till (NT)
4. No-till with higher inputs (NTH)

The trials were paddock scale using farmer equipment with all treatments replicated, and main soil types measured separately. The conclusions drawn reflect the clear and consistent results obtained irrespective of the variation across the paddock. This article mainly presents 2012 results (Part B) but will then also draw recommendations based on Part A and the overall project results and observations.

What happened?

Previously Part A of the project had clearly shown low rhizoctonia build up after grass free pasture, medium levels following spray topping and very high levels where autumn growth was not controlled. In last years' trial, however, the low/medium rhizoctonia level in December at Wynarka, and the medium/high levels at Wunkar had an over 80% reduction in rhizoctonia inoculum to low levels (Table 1). This was thought to be mainly due to significant summer rainfall events in both December and February. While seeding into these low levels, crop monitoring still showed an average of 30-35% root loss at both sites.

Table 1 Effects of 2011 pasture type on disease inoculum and 2012 wheat yield (t/ha)

Wynarka						Wunkar					
2011	Rhizoctonia pgDNA/g		Bipolaris* pgDNA/g		2012	2011	Rhizoctonia pgDNA/g		Bipolaris* pgDNA/g		
Pasture	Dec 2011	May 2012	Dec 2011	May 2012	Yld (t/ha)	Pasture	Dec 2011	May 2012	Dec 2011	May 2012	Yld (t/ha)
Pasture	60 (M)	3 (L)	18	35	1.5	Pasture	120 (M/H)	23 (L)	19	23	0.8
Rye	43 (M)	12 (L)	88	163	1	Oats	186 (H)	15 (L)	24	17	0.8

**Common root rot*

Table 2 Available nitrogen (kg/ha) at seeding time after different cultivation treatments

Wynarka	0-10 cm	10-30 cm	Total	Wunkar	0-10 cm	10-30 cm	Total
EW	21	34	55	EW	21	68	89
LW	21	26	47	LW	13	45	58
NT	18	24	42	NT	12	42	54

EW=early worked, LW=late worked, NT=No-till

Table 3 Yield, protein and nitrogen use results from 2012 Wunkar site

	Yield (t/ha)				Protein (%)				N use* (kg/ha)			
Tillage	SCP Flat	VP Flat	Ave Flat	SCP Sand	SCP Flat	VP Flat	Ave Flat	SCP Sand	SCP Flat	VP Flat	Ave Flat	SCP Sand
EW	0.93	1.00	0.96	0.62	10.5	11.3	10.9	9.0	43	50	46	25
LW	0.71	0.68	0.70	0.59	12.1	11.0	11.5	7.8	38	33	35	20
NT	0.72	0.66	0.69	0.53	10.8	11.1	10.9	7.9	34	32	33	18
NTH	0.77	0.80	0.79	0.56	10.5	10.9	10.7	7.8	36	38	37	19
Ave	**0.78**	**0.79**	**0.79**	**0.58**	**11.0**	**11.1**	**11.0**	**8.1**	**37**	**38**	**38**	**21**

SCP = Sown Cereal Pasture of Marion oats, VP = Volunteer Pasture
EW=early worked, LW=late worked, NT=No-till, NTH=No-till with higher inputs
**N use refers to Nitrogen extracted by crop based on Yield and Protein levels*

Bipolaris innoculum levels at the Wynarka site after Bevy rye averaged 88 pgDNA/g soil in December compared to 18 pgDNA/g soil following the volunteer pasture. By seeding time these levels had grown to an average 163 pgDNA/g soil after the Bevy rye, and only 35 pgDNA/g soil after volunteer pasture across 32 soil tests (Table 1). As the wheat crop ripened in mid-October white heads marked the cereal rye strips, resulting in a 33% yield loss compared to the volunteer pasture. It was also noted that the root loss measured from rhizoctonia averaged 39% from these Rye areas compared to 24% from the volunteer pastures, suggesting a link between the disease effects. Generally cereal rye is used as an important break crop in the Mallee to improve soil health, and bipolaris is generally not a strong consideration when planning rotations, so it was quite unexpected that this problem arose, and suggests that further work needs to be done in this area.

As in the previous years' trial (Part A), the early tillage treatments had little impact on the levels of rhizoctonia inoculum in the soil come seeding time, but did result in large differences in available nitrogen to 30 cm depth. Early worked areas last year had between 13-35 kg/ha higher N availability at seeding compared to the No-till areas (Table 2), and 23-27 kg/ha higher N at seeding in 2011.

Yield results from the Wynarka site last season were inconsistent between tillage treatments across replications, and there was no clear advantage to cultivation. However, in 2011 the Wynarka results consistently showed a yield benefit from No-till over early working across the site. In both years these sites were well set up for No-till with summer and autumn chemical weed control as required.

Results from Wunkar in 2012 (130 mm GSR) showed a consistent yield advantage for the early worked plots (Table 3). This may have been due to several reasons. The first is that this paddock did not have any chemical summer weed control, but rather just grazing of summer weeds. Last year many Mallee farmers commented on the large difference in crops between those paddocks having excellent summer weed control that conserved moisture, and those that didn't. Any No-till farmer knows that one of the keys to success is having good summer weed control. My feeling is that many livestock farmers tend to use grazing more for summer weed control, which is a logical compromise for getting some valuable feed as well as keeping summer growth down to a manageable size. However, if you are not killing the plants, roots and all, then you will be compromising the potential of your following crop and certainly diminishing your chances of success with No-till seeding into this ground.

The second is that while we are keen to promote No-till seeding over cultivation where it may lead to potential erosion issues (both sites, particularly Wynarka, suffered wind erosion from the worked areas), the reality is that there are some seasons and situations where cultivation may prove to be advantageous, particularly in relation to the availability and timing of N mineralisation.

In 2011(Part A) at the Wynarka site the No-till plots started with around 20-25 kg less N available at seeding time, but then appeared to mineralise far more N throughout the growing season, leading to higher yields and resulting in about 20 kg/ha more N being found and used at harvest. This extra N mineralisation (also measured in CSIRO trials) is attributed to the higher microbial activity that occurs in No-till systems throughout the growing season as the crops need it, predominantly when the soil is moist and the temperatures are warmer. In 2012, however, this extra N boost in No-till systems did not appear to kick in as well, possibly due to the cold winter and almost complete lack of rainfall after mid-August to the end of the season when increased microbial activity normally occurs. This appears consistent with the generally low proteins from continuous cropping systems across the region. More work needs to be done to better understand these microbial and nutritional relationships within various farming systems and seasons.

The No-till High (NTH Table 3) plots were designed to try and account for the extra nutrient mineralisation at seeding from cultivation. In 3 of the 4 trials over the 2 years, while the farmer applied an extra 25-50 kg/ha of fertiliser, this only equated to an extra 4.5-9 kg/ha N which generally showed no consistent advantage. However, at Wynarka in 2012 the No-till High received an extra 23 kg/ha N, which averaged a 0.4 t/ha yield increase over No-till and 0.8% higher protein across the loamy sand main trial area. These yield and protein benefits were higher in the plots suffering from bipolaris. While I would like to see more work done in this area, I feel that farmers starting No-till from a more traditional base with pastures may benefit from extra N, unless coming off a good legume pasture.

Differences in protein levels between the soil types in dune swale landscape at Wunkar were high (Table 3). If achieving APW was borderline then there may well have been a good case for harvesting and marketing the flats separate to the sand hills, to help maximise returns.

What does this mean?

To maximise potential success with No-till into pasture ground, based on results from these 2 years of trials, other mallee research and anecdotal observations, I recommend the following:

- Early grass removal from pasture phase is better than just spraytopping.
- If using sown cereal pastures, choose disease resistant varieties.
- Use chemical summer weed control that kills weeds and optimises moisture conservation, rather than just relying on grazing management.
- Keep autumn a weed free zone, not allowing for disease build up on volunteer growth.
- Use proven No-till seeding systems with good breakout pressure, deeper working narrow points, good seed and fertiliser placement and presswheels creating a water harvesting furrow.
- Sow early as practical before soil temperatures decline, with adequate N, P and Zn.
- Don't despair if No-till looks poor early, as generally nutrient mineralisation later in the season as the crops require it will be advantageous.

My observations are that farmers that have been successfully No-tilling in more intensive cropping systems with the right set ups and management generally have more success with No-till into pasture ground. Farmers that are generally coming from a more traditional crop pasture situation will have bigger challenges in trying to move toward best practice No-till management after pasture. Remember, No till systems will help protect your paddocks from potential erosion and will help increase biological activity in the soil that will improve crop nutrition in the long term.

Acknowledgements

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Soil quality website

Annie McNeill
The University of Adelaide, Waite

RESEARCH

Key messages

- **Soil quality is currently being measured in grain-producing areas across Australia.**
- **This monitoring program and associated website www.soilquality.org.au is providing the Australian grains industry with a unique resource on soil quality including soil biology, chemistry and physics.**
- **Each grower's soil quality information is housed on the soil quality website and workshops can provide training to access and interpret this information to support improved soil management.**
- **For more information contact the soil quality champion for South Australia ann.mcneill@adelaide.edu.au**

What is the Soil quality website?

The soil quality website (www.soilquality.org.au) provides a unique, interactive resource to the Australian grains industry on soil quality, including soil biology as well as soil chemistry and physics. The web site is designed to allow growers and advisers to benchmark paddocks against a range of values for the local catchment and region, as well as against expert opinion. This information will aid growers and advisers to determine if they are heading in the right direction with their systems and practices, and will support decisions to improve soil management practices.

The National Soil Quality Monitoring Program

The Soil Quality Monitoring Program initially provided Western Australian soils data for the website and is expanding to include grain-producing areas across Australia. This has been made possible by linking into the DAFF program to assess Soil Carbon Stocks in agricultural land and accessing soil samples for additional quality measurements. Soil quality 'champions' have been sourced in each state and are charged with co-ordinating activities to facilitate the collection of soils data, and to raise awareness of the soil quality website and what it offers. The champions to contact in South Australia are Lynne Macdonald and Annie McNeill.

The website will give growers and advisers across Australia access to regionally specific data on soil biological, chemical and physical constraints to production. The website currently has benchmark data from red-brown earths on Eyre Peninsula and the mid-north regions of South Australia. Some of the biological, chemical and physical indicators of soil quality measured as part of the Monitoring Program are shown in Table 1, which also lists how each indicator can be related to soil quality and production. Whilst some of these indicators may currently inform agronomic planning by growers and advisers, many are not used. Greater awareness of why they should be considered can be gained by engaging with the soil quality website.

Benchmarking soil quality

The information on the website is provided in a number of formats including a 'traffic light' snap shot where each measure of soil quality is partitioned into ranges that are assigned green, amber and red status. This makes it possible to highlight the main indicators of concern in relation to soil quality and grain production. The traffic light system is based on expert panel recommendations for critical values of each indicator housed in the website. Where there is sufficient data recorded on the website users can also benchmark their soil quality results against that of other producers on similar soil types in their catchment or region (as shown in the Western Australian example in Figure 1). More data is needed for South Australia to allow growers across the regions to do this.

A screen shot from the soil quality website (Figure 1) illustrates there is enough data for a grower from Young River, Western Australia to be able to benchmark their own level of the soil quality indicator 'Soil pH' with the range for all sites in their catchment (left) or region (right). The graph compares the grower's value (dot) with the range for all sites in the catchment or region (open rectangle) and with the range of the middle 50% of sites in the catchment or region (filled in box).

Workshops and demonstrations

Soil health workshops can be organised by liaising with your State soil quality champion. The goal is to enable groups of growers and advisers to understand and interpret the data being generated, so that they can use it to improve productivity on-farm. Computer and web training can show individuals how to access and examine their own data via the web site. This training will empower growers to make better-informed management decisions with respect to production and longer-term soil sustainability.

Fact sheets and calculators

The soil quality data on the web site is supported by a wide range of fact sheets and some simple calculators. Fact sheets generally relate the soil quality indicators to productivity and management options within certain environments or States.

Table 1 Effects of 2011 pasture type on disease inoculum and 2012 wheat yield (t/ha)

Type of soil property	Soil quality indicator	Relationship to soil quality and production
Biological	Total organic carbon	Plays a key role in nutrient cycling and can improve soil structure
	Microbial biomass	Closely related to nutrient release from crop residues
	Diseases & nematodes	Causes patches of poor growth in a range of crops
	Molecular fingerprinting	A measure of which organisms are present to help unravel the complexity of soil biology
	Potential soil nitrogen supply	Provides an index of the capacity for nitrogen release from soil
Chemical	pH	Affects nutrient availability, microbial activity, aluminium and manganese toxicity
	Cation exchange capacity	Influences soil structure stability, nutrient availability and soil pH
	Mineral nitrogen	Plants require larger amounts of nitrogen than any other nutrient
	Nutrients	Essential for plant growth; deficiencies limit yield
Physical	Bulk density	Affects root growth rate, water availability and susceptibility of crops to waterlogging. Required to convert soil quality indicators from "per kg" to "per ha"

**Common root rot*

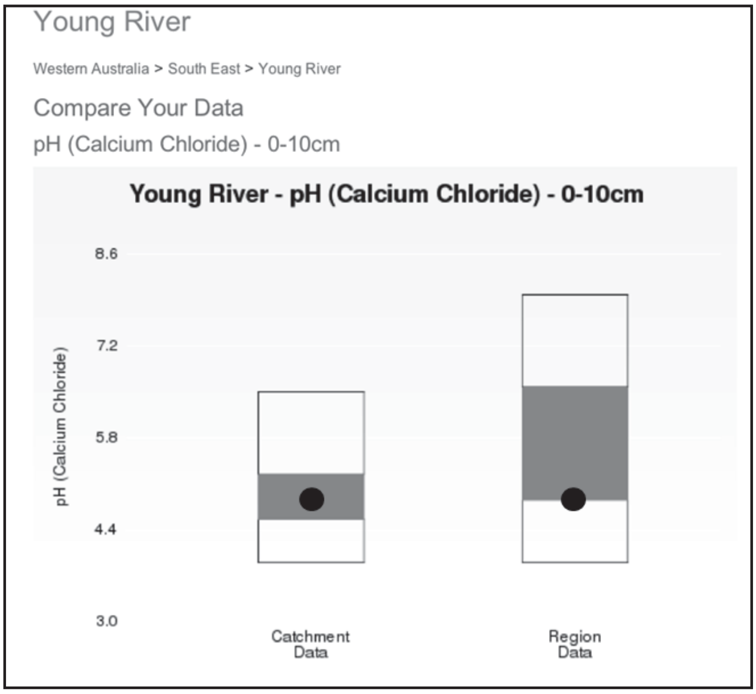

***Figure 1** A screen shot from the soil quality website illustrating a farmer's soil pH (dot) compared to local catchment and regional levels*

Some provide information on a specific soil quality indicator (e.g. microbial biomass), while others give instructions on how to measure and interpret some soil analysis results (e.g. bulk density). There are also a number of fact sheets introducing different farm management strategies for those farmers coming to terms with difficult soil properties, such as compaction or waterlogging. While these fact sheets give a concise introduction to each topic, more detailed information that advisers might require can be gained through the "Further Reading and References" section at the end of each fact sheet.

The simple calculators available on the website enable 'what if' scenarios to be tested to highlight management decisions that can improve soil quality. They are designed to give a basic understanding of different strategies that may present options for management change on the farm and are useful in determining the soil quality value, and sometimes the economic implications, of a change in paddock management (e.g. green/brown manuring, controlled traffic), effectiveness of liming products, potential wheat yield based on rainfall, or simply to determine the potential to alter soil carbon.

Where to next?

The website needs to continue to be populated with reliable data. This requires that stakeholders such as advisers and grower groups work together with the State soil quality champions and partners to ensure suitable projects for soil sampling and indicator analyses are funded. The website will then grow and provide an invaluable long term resource for Australian grain growers to monitor and benchmark their soil quality over time and to learn about options for ensuring quality is maintained and grain production is sustained.

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Effect of size and density of bait pellets on juvenile snail mortality

RESEARCH

Helen DeGraaf, Latif Salehi and Greg Baker
SARDI Entomology, Waite

Key messages

- **Juvenile snails can be killed with bait but efficacy is highly variable due to numerous factors.**
- **Preliminary studies indicate that bait density is more important than bait size (smaller pellets usually mean greater bait density and therefore more bait-snail encounters).**
- **GRDC is funding a new round of snail/slug research to expand on some aspects of snail management.**

Why do the trial?

Preliminary investigations will assess the effect of bait size and density on mortality of juvenile pest snail species.

In South-Eastern Australia, round and conical snails cause significant economic losses through yield loss from feeding damage, field control costs, additional harvest costs, grain value loss, receival rejection, and can threaten market access. Year round snail management should involve an integrated approach of various cultural, mechanical and chemical controls. Baiting is a major tool that when used at the right time can provide good control. However, the success of baiting programs is dependent on several factors, including timing, species and age of snails, environmental conditions, and properties of commercial baits. Juvenile snails (<7mm) are considered especially hard to control (SARDI 2003). Preliminary SARDI trials comparing efficacy of commercial bait products against juvenile snails have revealed that mortality can vary greatly (18-80%) between products and snail species. For more information contact the authors.

How was it done?

Location: Roseworthy Campus, SA

Replicates: 5

Plot size: Arena 0.2 m^2 (circular sheet metal enclosure (15 cm high) partly buried into soil with fly screen mesh fitted over top)

Treatments: Metaldehyde 15 g/kg bait applied as 2 pellet sizes (whole, half), at 3 rates (20, 40, 80 baits/m^2) to arenas containing 2 densities (150, 300 snails/m^2) of 2 species of juvenile snails, plus controls (nil).

Juvenile specimens of Italian white snail (*Theba pisana*) and pointed snail (*Cochlicella acuta*) were collected from Warooka (SA). Arenas were prepared in the field and each contained germinating canola seedlings and stinging nettle weed seedlings. On 19 September 2012, snails (30, 60) were placed in the centre of each arena and bait pellets distributed in an even circle around the snails. After 13 days, snails were retrieved and assessed for mortality. The average snail retrieval rate per cage was 94 ± 1%.

What happened?

Smaller bait pellets did not reduce the likelihood of Italian white snail juveniles encountering bait. Table 1 reveals no change in snail mortality with whole and half sized pellets at both 20 and 80 baits/m^2 rates for Italian white snails. This suggests that mortality rates equivalent to that achieved with large pellets can be achieved with less active ingredient by using smaller pellets. Juvenile pointed snails showed similar results at the 80 baits/m^2 rate, however there was a marginally significant difference in mortality between the pellet sizes when applied at the 20 baits/m^2 rate (lower mortality with half-size pellets).

Doubling the bait density is likely to significantly increase snail mortality. This is made clear in Figure 1, with an increase in Italian white snail mortality reflecting the increasing density of bait pellets. This trend occurred for both moderate and high snail densities and occurred similarly for the pointed snail (graph not shown). Therefore, the results in Table 1 along with Figure 1, together suggest bait effectiveness could be improved by deploying the active ingredient in smaller pellets which would result in a higher density of baits per area, increasing the likelihood of snails encountering baits.

Table 1 Percent mortality of juvenile snails (150/m²) contained in field arenas with Metaldehyde (15 g/kg) bait applied at different rates and pellet size along with alternative food

Species	Baits per m²	Whole	Half	Paired t-test
Italian white	20	43.3	35.8	*ns*
Italian white	80	70.4	65.2	*ns*
Pointed	20	47.0[a]	33.5[b]	$P<0.05$
Pointed	80	69.9	65.0	*ns*

**Mortality of Italian white and pointed snails in control groups was 3.4 and 3.6% respectively. Recommended bait rate is 16-24 baits/m² (5 - 7.5 kg/ha).*

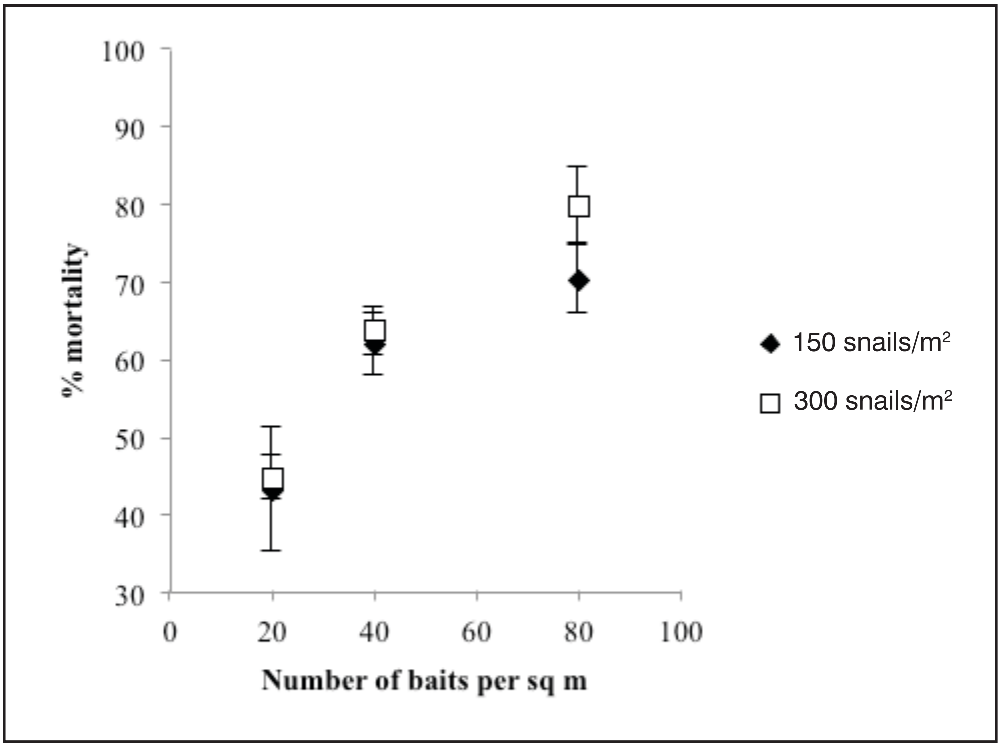

***Figure 1** Per cent mortality (± Standard Error) of juvenile Italian white snails showing increased mortality with increased number of baits per m² at two snail densities*

What does this mean?

Ideally, a snail baiting program should focus on the brief (~ 2 weeks) window of early season snail activity prior to the beginning of egg-laying and appearance of juveniles, and should be used as a mop up operation for those snails that survived summer burning/rolling/cabling management activities. Juveniles can be killed with bait, however snail species, bait product, and environmental factors will influence bait efficacy. This preliminary trial suggests that bait density is more important than bait size. Therefore, some products offering smaller bait sizes to achieve the same application rate as products with larger bait sizes may achieve greater frequency of bait-snail encounters.

This project is ongoing and extensive baiting trials are planned in order to validate some observations in relation to bait properties including the effects of environment (e.g. temperature, UV, etc) on bait persistence.

References

SARDI (2003) 'Bash'em, Burn'em, Bait'em: Integrated snail management in crops and pastures'.

Acknowledgements

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Management of herbicide resistant Barley grass in pulse crops

RESEARCH

Ben Fleet[1], Lovreet Shergill[1], Gurjeet Gill[1] and Barry Mudge[2]

[1]School of Agriculture, Food & Wine, University of Adelaide, [2]Upper North Farming Systems

Searching for answers

Location: Baroota
Rob Dennis
Nelshaby Ag Bureau, Upper North Framing Systems

Rainfall
Av. Annual: 330 mm
Av GSR: 230 mm
2012 Total: 390 mm
2012 GSR: 230 mm

Yield
Potential:1.5 t/ha
Actual: 0.8 to 2.3 t/ha

Paddock History
2011: Mace wheat
2010: Movava wheat
2009: Feed barley

Soil Type
Mallee loam

Plot Size
13.5 m x 5 m x 4 reps

Yield Limiting Factors
Barley grass very dense (why site selected) except plots with good control, and dry finish to season

Key messages

- **Increasing incidence of barley grass in cropping paddocks in southern Australia is likely to be associated with selection of more dormant biotypes by weed management practices used by growers.**
- **In some districts, barley grass management is now being complicated by the evolution of group A resistance. However, there appear to be several effective potential herbicide alternatives for barley grass control in broad-leaved crops.**
- **Integrated weed management strategies are critical to delay onset of herbicide resistant barley grass.**

Why do the trials?

Feedback from growers and consultants in southern Australia has clearly shown increasing spread of barley grass. In a survey by Fleet and Gill (2008), farmers in low rainfall districts in South Australia and Victoria reported increasing incidence of barley grass in their crops. Research undertaken at the University of Adelaide has shown that barley grass has developed increased seed dormancy in response to management practices used in cropping systems. Presence of increased seed dormancy in this grass weed species has enabled it to escape pre-sowing control tactics used by the growers. This explains why barley grass is a problematic weed in cereal crops. However, in some locations like Port Germein and Baroota districts, it has now become largely impossible to control in pulse crops. This is likely due to the presence of group A (fop & dim) herbicide resistance. Currently in these locations barley grass control is reliant on growing Clearfield wheat and the use of imidazolinone (group B) herbicides. This management strategy is at high risk of collapsing from the additional development of group B herbicide resistance. Previous studies have shown that resistance to group B herbicides can develop relatively quickly. Presence of large densities and repeated exposure to group B herbicides could rapidly lead to group B resistance in such barley grass populations. The extent of this resistance needs to be understood and effective management strategies to manage resistant barley grass in pulse crops developed.

How was it done?

In 2012 a field trial was conducted at Baroota to evaluate possible herbicide options for controlling herbicide resistant barley grass in pulse crops (Kaspa peas). At the trial site, there was a very high background population of barley grass that was suspected to be resistant to group A herbicides. Herbicide treatments were developed for experimental purposes only and many are not currently registered (Table 1). The trial was sown on 10 May 2012 with Kaspa field peas @ 90 kg/ha and DAP @ 60 kg/ha, using a seeder with knifepoints and press-wheels on 10 inch spacing. Assessments included control of barley grass, crop safety and yield. Herbicide resistance at the site was confirmed in a pot study at the University of Adelaide.

Two random surveys were conducted to evaluate the extent of herbicide resistant barley grass. The first focused on cropping paddocks between Port Pirie and Port Augusta, where most reports of resistance have been. The second survey focused on problem barley grass regions on Eyre Peninsula and included transects from Kimba to Wirrulla, Kimba to Buckleboo, Cowell to Smoky Bay via Elliston, and Darke Peak to Kopi via Port Neill and Tooligie. Samples from these surveys will be screened at the University of Adelaide for herbicide resistance during 2013.

What happened?

Barley grass collected from the trial site at Baroota was screened for resistance. It is clear that the repeated exposure of the Baroota population to group A herbicides has resulted in a high level of resistance (Figure 1). This population has confirmed resistance to quizalofop (Targa), haloxyfop (Verdict) and clethodim (Select).

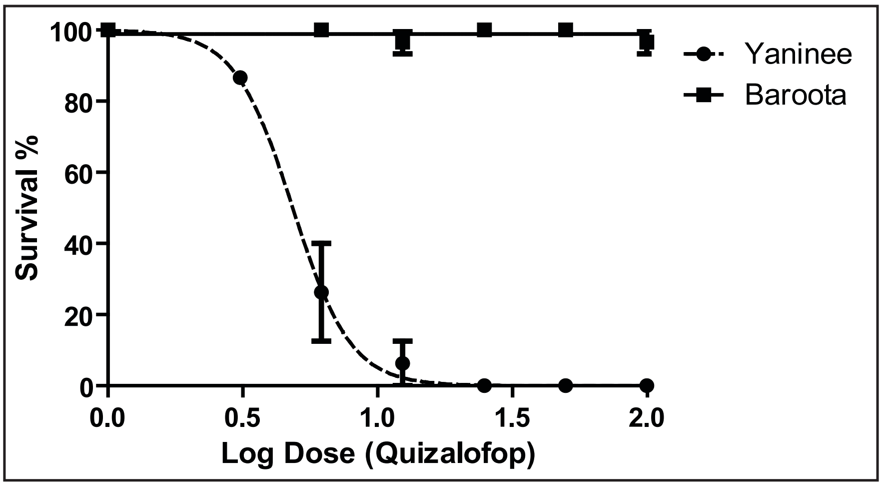

Figure 1 Effect of quizalofop (e.g. Targa) on the survival of barley grass field population from Baroota (Pt Germein) and the susceptible population from Yaninee. Herbicide rates are 0, 1/8, ¼, ½, 1, 2, & 4 x field rate (300 ml/ha of herbicide)

Table 1 Effect of different herbicide treatments on grain yield of field peas and reduction in group A resistant barley grass seed production at Baroota (SA) in 2012. Control treatment (knockdown alone) allowed seed set of potentially >65,000 seeds/m².

Treatments	Seed set reduction (%)	Pea yield (t/ha)
Sakura @ 118 g/ha IBS	99	2.29
Boxer Gold @ 2.5 L/ha IBS	74	1.41
Outlook @ 1 L/ha IBS	93	2.14
Raptor @ 45 g/ha + BS1000 0.2% PE	100	2.08
Trifluralin @ 2.0 L/ha + Avadex Xtra @ 2L/ha	71	1.32
Metribuzin @ 200 g/ha PSPE	46	0.82
Propyzamide 500 @ 1.5 L/ha	100	2.29
Diuron 900@ 1 kg/ha + Trifluralin @ 2.0 L/ha IBS	78	1.58
Trifluralin 2.0 L/ha IBS	68	1.19
Control	-	0.82
LSD (P=0.05)		*0.33*

The herbicide treatments trialled achieved various levels of barley grass control in field peas. Sakura, Raptor (imazamox) and Propyzamide provided excellent control of barley grass, which was reflected in significant increases in grain yield of field peas (Table 1). Outlook (dimethanamid) appeared to be relatively ineffective early in the season but its performance improved with time, so it may also have a useful role in field peas.

What does this mean?

Barley grass, like annual ryegrass, has the capacity to become highly resistant to group A herbicides (Figure 1). Even though resistance takes longer to develop in barley grass, its proactive resistance management is still vital. An integrated weed management strategy, combining multiple control tactics to reduce seed set, is required to delay the development of herbicide resistance. For example in a non-group A resistant population, pre-emergent herbicide + post-emergent group A herbicide + crop-topping could be used to reduce the risk of selection for resistance.

Sakura (pyroxasulfone), propyzamide, and Outlook (dimethanamid) showed much promise for controlling group A resistant barley grass, pending their possible registration. Raptor (imazamox) also provided highly effective control of this barley grass population. As some farmers are already using Clearfield wheat to manage barley grass, it would be inadvisable to use Raptor which is also an imidazolinone herbicide. Such heavy reliance on group B herbicides could render them ineffective in relatively short time and this would be particularly bad news under situations where group A resistance has already developed.

Acknowledgements

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Targa – registered trademark of Sipcam Pacific Australia Pty Ltd
Verdict – registered trademark of Dow AgroSciences
Select – trademark of Dow AgroSciences
Sakura – registered trademark of Bayer CropScience
Raptor – registered trademark of Crop Care Australasia Pty Ltd
Outlook – registered trademark of BASF Australia Ltd
Boxer Gold – registered trademark of Syngenta
Avadex Xtra – registered trademark of Nufarm Ltd

THE UNIVERSITY of ADELAIDE

GRDC Grains Research & Development Corporation

Brome grass management on northern Yorke Peninsula

RESEARCH

Chris Davey

Chairperson, Northern Sustainable Soils farmer group

NORTHERN SUSTAINABLE SOILS Inc.
Bringing New Ideas to Northern Soil Types

Government of South Australia
Northern and Yorke Natural Resources Management Board

Searching for answers

Location:
Port Broughton
a) Tony & Beaver Hewett
b) Peter & Michael Edwards
Rainfall
Av. Annual: 350 mm
Av GSR: 262 mm
2012 Total: 292 mm
2012 GSR: 185 mm
Paddock History
a)
2011: Lentils
2012: Barley
b)
2011: Barley
2012: Peas
Soil Type
Grey-brown calcareous
Plot Size
a) 1.5 m x 21 m x 4 reps
b) 9 m x 100 m x 2 reps
Yield Limiting Factors
Brome grass population

Key messages

- **Brome grass is resistant to Group A FOP's, Group A DIM's and Group D (Trifluralin) on Northern Yorke Peninsula, with the world's first case of Group M (Glyphosate) resistant brome grass being found further down the peninsula in 2011.**
- **Brome grass has a significant impact on crop yield, previous research indicates this is due to soil moisture and nutrient competition.**
- **Sakura showed the best results for brome grass suppression compared to other pre-plant herbicides.**
- **Chemically fallowing a crop in the year prior reduced grassy weed seed populations (up to 97%) compared to a conventional harvest with no weed seed control.**
- **Chaff carts, and narrow wind-row burning rely on catching the weed seeds with the header front at harvest. With a weed like brome grass, that matures early and shatters easily, only a 40-50% reduction in weed seeds was measured in this study.**

Why do the trial?

1. To assess both pre-emergent and post-emergent herbicides in controlling brome grass.
2. To assess brome grass populations in the year following different cultural practices.

How was it done?

a) Pre and Post-emergent control of brome grass trial

75 kg/ha Scope barley sown on 9 May with 90 kg/ha MAP. Measurements were taken on 7 June and 7 October for brome grass plant numbers and panicle counts. Grain yield was measured at harvest.

b) Harvest management of brome grass trial

100 kg/ha Gunyah peas was sown on 7 May with 40 kg/ha MicroEssentials Sulfur 10 lb S/ac (MES 10).

Treatments of 2011 barley crop:

1. Conventional – harvested normally with the chaff & straw spread out the back of the header
2. Chaff cart – the chaff component of the residue was collected in a chaff cart and later burnt
3. Narrow wind-row & burn – the chaff and straw out the back of the header was concentrated into narrow rows at harvest, and then these rows were burnt in April
4. Chemical fallow – in September 2011, the barley was sprayed out using paraquat
5. Hot burn – in April 2012, the whole plot was given a hot burn, removing all the stubble

Brome grass plant numbers were measured on 13 April (pre-sowing), 12 June (early post-emergent) and 27 August (late post-emergent). Peas were harvested and grain yield recorded.

What happened?

a) Pre and post-emergent control of brome grass trial

In 2012, Sakura performed well, controlling both brome grass and annual ryegrass. Sakura (and all other pre-plant herbicides used in this trial) can often struggle to control brome grass when it germinates and emerges from below the herbicide band. However, in this trial brome grass was controlled, which suggests germination did occur within the herbicide band.

The standout treatments in the barley were the use of Metribuzin and Intervix as a post-emergent treatment. Metribuzin (Group C) caused minimal damage to the barley seedlings with only slight tipping on the newest leaves following application. In the panicle count assessments done on 7 October, the Metribuzin applied @ 360 g/ha at early tillering (post-emergence) had equal best brome grass control and grain yield. Intervix (Group B) was applied when growing conditions were still relatively warm and at a crop stage where all target weeds were susceptible. Both brome and ryegrass were controlled well with Intervix.

Table 1 Pre and post-emergent control of brome grass in barley at Port Broughton in 2012

Treatment	Brome grass (plants/m²) 7 June	Panicle # 7 October	Yield (t/ha)	Yield (% of Standard treat.)
Untreated	22 [b]	6.8 [c]	1.74 [c]	108
2.5 L Boxer Gold	10 [ab]	1.8 [ab]	1.80 [c]	111
118 g Sakura*	4 [a]	1.5 [ab]	1.77 [c]	109
Sakura* + 1 L Trifluralin	12 [ab]	2.3 [ab]	2.05 [ab]	127
Sakura* + 1.6 L Avadex Xtra	13 [ab]	2.8 [b]	2.04 [ab]	126
Standard: 2 L Trifluralin + 2 L Avadex Xtra	16 [ab]	5.5 [c]	1.61 [c]	100
1.5 L Trifluralin + 200 g Metribuzin	13 [ab]	1.5 [ab]	1.83 [bc]	114
1.5 L Trifluralin followed by 750 ml Intervix (post)	19 [ab]	1.0 [a]	2.11 [a]	131
1.5 L Trifluralin followed by 360 g Metribuzin* (post)	16 [ab]	1.0 [a]	2.11 [a]	131
Co-efficient of variation (%)	85	52	11	
LSD (P=0.05)	*18*	*1.5*	*0.23*	

** denotes treatment is not registered for barley and is included for trial purposes only.*

Table 2 2012 grain yields of field pea (t/ha) in response to 2011 harvest management and herbicide treatments for the control of brome grass

Treatment	Timing	Brome grass (plants/m² total of 3 assessments)	Percentage Reduction (%)	Yield (t/ha)
Conventional	nil	2599	0	0.80
Chaff cart	December 2011	1243	52	1.07
Narrow wind-row followed by burn	December 2011 April 2012	1516	42	1.21
Chemical fallow	September 2011	155	97	1.43
Hot burn	April 2012	1840	29	1.20

b) Harvest management of brome grass trial

The chemical fallow of the barley crop in 2011 resulted in the highest pea yield in 2012. It could be concluded that this was due in part to extra moisture and nutrients available as a result of very low brome grass numbers. The conventional treatment had the lowest yield, as the brome grass population in these plots was extremely high and competitive. The yield from the hot burn plots exceeded that of the chaff cart treatments despite there being greater brome grass plants per square metre. However, a visual difference in early field pea vigour was observed. This resulted in a yield benefit and removing the stubble may have led to greater availability of nutrients and/or soil moisture during the season.

There was little difference between the chaff cart and narrow wind-row burning plots early in the season for brome grass populations. Both treatments rely on catching the brome grass with the header front, but then process it differently.

What does it mean?

a) Pre and post-emergent control of brome grass trial

- Pre-plant herbicides have some effect on suppressing brome grass. However, as brome grass germinates readily from depth, herbicides that rely on root uptake such as Sakura, Trifluralin and to a lesser extent Boxer Gold, have limited effect.
- In the absence of Group B resistant brome grass, Intervix worked well for controlling brome grass when used in accordance with the label recommendations.

b) Harvest management of brome grass trial

- Brome grass had an impact on pea yield, resulting in yield reductions of up to 45%, previous research has shown that this is due to depleted soil moisture and nutrient competition.
- A chemical fallow treatment resulted in a 0.63 t/ha increase in pea yield, and a 97% reduction in weed seed populations compared to the conventional harvest method.
- A compromise has to be met when hot burning. There is evidence to suggest an early burn results in the best weed seed kill, but will leave the soil exposed longer to erosion prior to seeding. A later burn performed just before seeding results in less weed seed kill, but a reduction in erosion risk of the fragile topsoil.

For more detail and discussion on this trial, refer to the article published in the Northern Sustainable Soils Trial Booklet.

Acknowledgements

Peter & Michael Edwards and Tony & Beaver Hewett (co-operators). BOXER GOLD is a registered trademark of Syngenta. Sakura is a registered trademark of Kumiai Chemical Industry Co. Ltd, marketed in Australia by Bayer CropScience. Avadex is a registered trademark of Nufarm Technologies USA Pty Ltd. Intervix is a registered trademark of BASF.

Buffel grass on EP: an invasive weed

Iggy Honan
Program Manager, Biosecurity, Natural Resources Eyre Peninsula

EXTENSION

Key messages

- **Buffel grass *Cenchrus cilliaris* is a pasture grass introduced throughout northern Australia to increase pasture fodder for cattle.**
- **When Buffel grass infiltrates an area it changes the fire regime, making it highly susceptible to extremely hot burns, and then completely takes over after the follow-up rains.**
- **Buffel grass is an extremely invasive perennial plant that can invade arid and semi-arid areas alike, completely overtaking an understory or pasture. While it does not appear to have infiltrated cropped areas, it has plenty of potential to do so.**
- **If you suspect you have found an outbreak contact the EP Natural Resources Centre at Port Lincoln on 8688 3111.**

What do the plants look like?

Buffel grass is an autumn to spring growing perennial grass that is supported by a deep root system and large amount of biomass or living material. Plants have green blades of grass, with fluffy seed heads that can range in colour from white to dark purple and can grow up to 15 cm long. The flower heads form from November to May then bloom after summer rains. Buffel grass reproduces from seed, germinating and setting seed within six weeks of rainfall, making it an extremely invasive plant. The seed is thought to remain viable in the soil for four or more years.

Prior to running up the seed head, Buffel grass is easily confused with grasses such as veldt, pigeon grass or even kikuyu. When the seed head first appears, it can also be confused with Rhodes grass.

Why should Buffel grass be controlled?

Buffel grass is regarded as one of Australia's worst environmental weeds due to its ability to grow rapidly and establish quickly, because of its high rate of seed production and dispersal. The plant is tolerant to drought, fire and heavy grazing, all traits that make it such a successful weed. It can invade native vegetation and completely dominate the understory. Because Buffel grass produces up to two to three times more flammable material than native grasses, it creates an increased fire risk. This means a hotter and more intense burn, which ultimately leads to a greater amount of fire damage, not only to native vegetation, but to any associated infrastructure.

What are the best ways to control Buffel grass?

Once Buffel grass is established, there is no single control method to successfully remove infestations. Manual removal of Buffel grass can be used for areas where the infestation is small. Hand pulling or digging out each clump of grass are the most common methods. Like many plants, any disturbance of the soil is likely to stimulate new seedling growth, so care should be taken when removing plants. Removed plants may be disposed of by burning or placing into garbage bags and placed into the household waste rubbish bin for deep burial at the dump, to avoid accidental spread of the seed.

Plants may be burned or slashed to reduce the biomass and encourage new growth. This should then be sprayed with a glyphosate-based herbicide. Local natural resources staff can advise you of the appropriate sprays to use. When using burning as your control method, contact the local council first to check on fire bans.

Herbicide is a good option for control as there is less disturbance of the soil, thereby reducing the risk of new seedlings. Always use herbicide on plants that are green and actively growing. Two to three weeks after rain is often an excellent opportunity to spray targeted plants. Make sure herbicides are always used according to the label directions. The control area should be monitored during the summer months, so any emerging seedlings can be controlled before they produce seed.

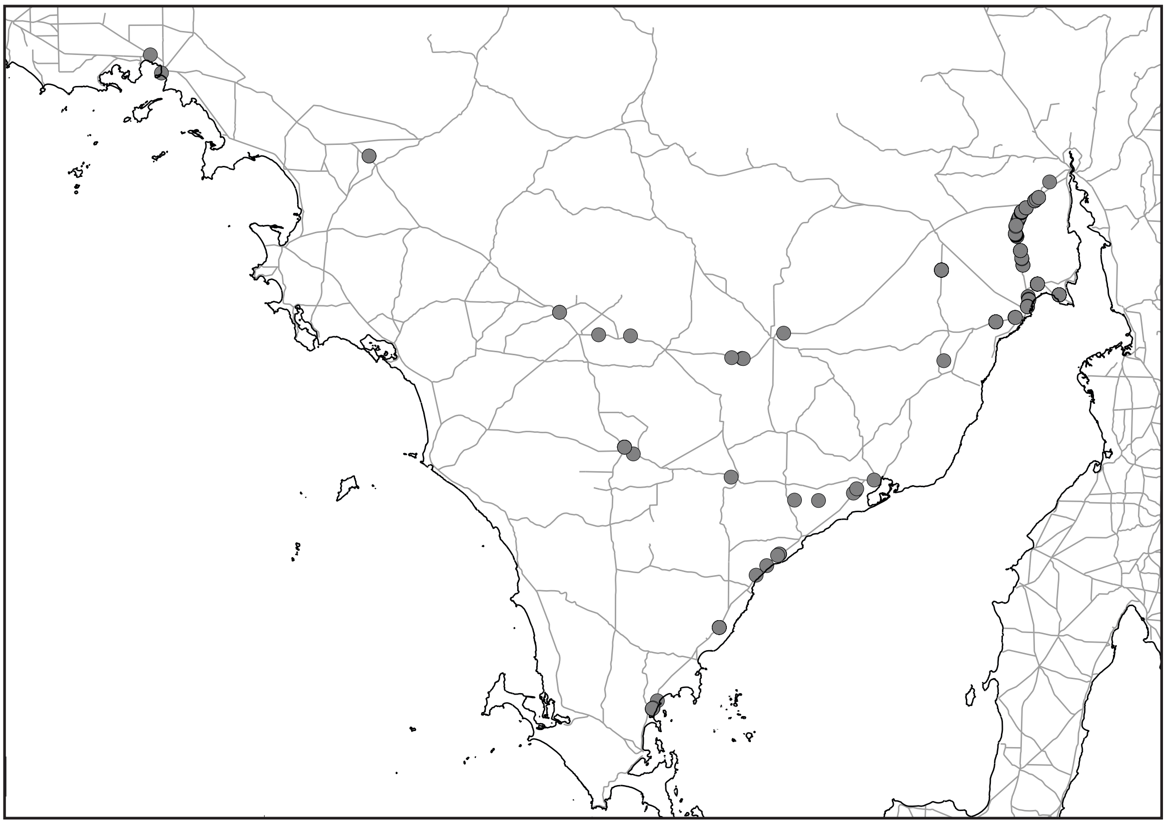

Figure 1 Destroyed Buffel grass locations on EP

Figure 2 Buffel grass in flower

Government of South Australia
Eyre Peninsula Natural Resources Management Board

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Acronyms and Abbreviations

ABA	Advisory Board of Agriculture
ABARES	Australian Bureau of Agricultural & Research Economics & Sciences
ABS	Australian Bureau of Statistics
AFPIP	Australian Field Pea Improvement Program
AGT	Australian Grain Technologies
AH	Australian Hard (Wheat)
AM fungi	Arbuscular Mycorrhizal Fungi
APSIM	Agricultural Production Simulator
APW	Australian Prime Wheat
AR	Annual Rainfall
ASW	Australian Soft Wheat
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
CfoC	Caring for our Country
CLL	Crop Lower Limit
DAFF	Department of Agriculture, Forestry and Fisheries
DAP	Di-ammonium Phosphate (18:20:00)
DCC	Department of Climate Change
DEWNR	Department of Environment, Water and Natural Resources
DGT	Diffusive Gradients in Thin Film
DM	Dry Matter
DMD	Dry Matter Digestibility
DOMD	Dry Organic Matter Digestibility
DPI	Department of Primary Industries
DSE	Dry Sheep Equivalent
EP	Eyre Peninsula
EPARF	Eyre Peninsula Agricultural Research Foundation
EPFS	Eyre Peninsula Farming Systems
EPNRM	Eyre Peninsula Natural Resources Management Board
EPR	End Point Royalty
FC	Field Capacity
GM	Gross Margin
GRDC	Grains Research and Development Corporation
GS	Growth Stage (Zadocks)
GSR	Growing Season Rainfall
HLW	Hectolitre Weight
IPM	Integrated Pest Management
LEADA	Lower Eyre Agricultural Development Association
LEP	Lower Eyre Peninsula
LRCP	Low Rainfall Collaboration Project
LSD	Least Significant Difference
MAC	Minnipa Agricultural Centre
MAP	Monoammonium Phosphate (10:22:00)
ME	Metabolisable Energy
MLA	Meat and Livestock Australia
MRI	Magnetic Resonance Imaging
NDF	Neutral Detergent Fibre
NDVI	Normalised Difference Vegetation Index
NLP	National Landcare Program
NRM	Natural Resource Management
NVT	National Variety Trials
PAWC	Plant Available Water Capacity
PBI	Phosphorus Buffering Index
PEM	*Pantoea agglomerans, Exiguobacterium acetylicum* and *Microbacteria*
pg	Picogram
PIRD	Producers Initiated Research Development
PIRSA	Primary Industries and Regions South Australia
RDE	Research, Development and Extension
RDTS	Root Disease Testing Service
SAFF	South Australian Farmers Federation
SAGIT	South Australian Grains Industry Trust
SANTFA	South Australian No Till Farmers Association
SARDI	South Australian Research and Development Institute
SASAG	South Australian Sheep Advisory Group
SBU	Seed Bed Utilisation
SED	Standard Error Deviation
SGA	Sheep Genetics Australia
SU	Sulfuronyl Ureas
TE	Trace Elements
TT	Triazine Tolerant
UNFS	Upper North Farming Systems
WP	Wilting Point
WUE	Water Use Efficiency
YEB	Youngest Emerged Blade
YP	Yield Prophet

NOTES:


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