Eyre Peninsula Farming Systems Summary 2013

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AgriFood Skills Australia

Agrifood is one of the lead industries underpinning the Australian economy, employing 825,000 Australian workers across 180,000 enterprises and representing 18 percent of Australia's GDP and collectively contributing $237 billion to the national economy.

AgriFood Skills Australia is the lead national, industry driven organisation that works with agriculture and food processing, government, education and training providers to meet the current and future skills and workforce needs of industry across Australia.

At the coalface of AgriFood Skills Australia on the Eyre Peninsula is AgriFood National Regional Initiatives, a national first in working collaboratively and cross-industry to share intelligence and develop solutions to the job retention, skills and workforce development issues confronting the region.

AgriFood National Regional Initiatives overarching principles are:

- Improving employers capabilities
- Building business capacity
- Enhancing job retention, through cross industry training
- Enhancing workers employability and job satisfaction through new training initiatives
- Sustaining regional communities

On the Eyre Peninsula, AgriFood National Regional Initiatives has already funded a number of important training and workforce development projects that are positively and permanently improving the skills and productivity of people and businesses.

AgriFood National Regional Initiatives has initiated a number of meaningful partnerships between industry sectors and service providers that will positively impact on job retention and business capability within the region.

Arthur Blewitt

Arthur Blewitt
CEO - AgriFood Skills Australia

GRDC Foreword

Co-operation, collaboration, commitment and determination are the hallmarks of Eyre Peninsula's grain-growing, research, extension, advisory and agribusiness community.

Without such a dedicated and optimistic band of industry stakeholders, I am certain the region's grains industry would be a considerably less vibrant and dynamic entity than is currently the case.

The region's quest for more efficient and cost-effective farming systems and improved productivity and profitability continues to underpin the research effort on behalf of EP growers whose enterprises are subject to unique constraints and limitations.

Ongoing and new challenges were front and centre for the Grains Research and Development Corporation's Southern Regional Panel when in September 2013 members travelled across EP during their annual spring tour, meeting with growers, farming systems groups, researchers, consultants and agribusiness representatives.

Frost, nitrogen management, herbicide resistance, non-wetting sands, stubble management, Rhizoctonia, white grain disorder, snails and mice were among the agronomic issues that were brought to the Panel's attention during the tour of EP.

When combined with difficulties associated with shortages in farm labour and industry professionals, rising input and freight costs and dwindling domestic markets for hay and grain, it is fair to say that regional grain growers are certainly challenged in many ways.

So it is heartening and encouraging to see such considerable emphasis being placed on advancing farming systems in the region.

SARDI, the University of Adelaide, SAGIT, CSIRO, EPARF, EP Natural Resources Management Board, local agribusinesses and growers are to be commended for their contribution to ensuring the local industry remains relevant.

The GRDC – through issues identification channels such as the Panel tour and having Panel members and Regional Cropping Solutions Network members on the ground representing the interests of growers – continues to listen and respond to the challenges that come with farming on EP.

And while research and development remains a fundamental requirement, extension and communication of results and outputs is just as critical, otherwise practice change and improvement will just not occur.

So it is with great pleasure that I welcome you to the 2013 Eyre Peninsula Farming Systems (EPFS) Summary, a much valued publication which details work undertaken on the upper EP and relevant activities in other low rainfall regions.

Andrew Rice

Manager – Regional Grower Services (South), GRDC

GRDC

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Eyre Peninsula Farming Systems Summary 2013

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All article submissions are reviewed by the Editorial Team prior to publication for scientific merit and to improve readability, if necessary, for a farmer audience.

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Contents

Minnipa Agricultural Centre Update

Welcome to the fifteenth Eyre Peninsula Farming Systems Summary. This summary of research results from 2013 is proudly sponsored by AgriFood Skills Australia, with support from the Grains Research & Development Corporation (GRDC) through the Eyre Peninsula Farming Systems project (EPFS 4), and the GRDC and Caring for our Country funded Eyre Peninsula Grain & Graze project (EP G&G 2). We also acknowledge the funding support from the Australian Government through the Carbon Farming Initiative project "Efficient grain production compared with N_2O emissions". 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

Two key research projects were completed in 2013, the GRDC funded EPFS 3, and the GRDC and Caring for our Country funded EP G&G 2. While both projects are to continue in an adapted form they have left positive extension messages for the industry. EPFS 3 has validated the opportunity and benefit there is to tailor agricultural chemical ingredients and inputs based on soil testing, seasonal and market issues and land capability. Be that through variable rate technology and site mapping or basic paddock history and personal local knowledge.

The EP G&G 2 project has concluded that livestock are not a negative influence on crop production when grazed on cereal crop residues and pastures grown in rotation with cereals. It has also provided the industry with increased confidence in the capacity to graze cereal crops with little or no loss in subsequent grain yield.

Initial studies with in-furrow fungicides have been shown to provide some improved control of Rhizoctonia with a resultant grain yield benefit. The ongoing rotation work with a range of alternative break crops is in its first wheat year following a two year break, second wheat year following a one year break and being compared to continuous wheat. The continuous wheat yield was reduced based on weed competition and some disease infestation.

Three research projects funded by the Australian Government as part of the Carbon Farming Initiative have been established over the past 12 – 18 months. A carbon accumulation on alkaline soils project has measured reduced pH in response to applied gypsum; high pH is considered a major constraint in achieving increased soil organic carbon content. A nitrous oxide project is assessing levels of greenhouse gas emissions as a result of in-crop nitrogen applications associated with canola-wheat rotations as opposed to legume-crop rotations. Initial results have given no indications of a significant increase as result of the extra N application in-crop at both a low and a high rainfall site. A methane study is measuring sheep methane production in response to alternative forages. The initial December 2013 comparison between weaners grazing a self-sown not harvested barley stubble and not harvested vetch stubble measured an increased growth rate from the vetch stubble. Methane production results await analysis.

Staff news

Cathy Paterson completed her 5 year Research Officer contract with the EP Farming Systems 3 project and Trent Brace completed his Agricultural Officer contract. We wish them both all the best for the future.

John Kelsh has commenced as an Agricultural Officer based on the farm and assisting with research and development activities when available. John has a background on the family farm with current and recent work experience in agricultural machinery and technology.

Projects

Projects completed in 2013:

- **Eyre Peninsula Farming Systems 3 – Responsive Farming Systems**
- **Eyre Peninsula Grain & Graze 2**
- **Introduce New Perennials and Systems Adapted to Semi-arable Farm Land on Eyre Peninsula**

New projects commenced in 2013:

- **Eyre Peninsula Farming Systems 4 – Maintaining profitable farming systems with retained stubble on upper Eyre,** GRDC funded, partnership with EPARF, researchers: Roy Latta/Nigel Wilhelm
- **Reducing methane emissions from improved forage quality on mixed farms,** funded by the Australian Government's Action on the Ground program, partnership with EPARF and WA CSIRO, researcher: Roy Latta

- **Developing future leaders for farming communities on the EP,** funded by the Australian Government's Community Landcare Grants, in partnership with EPARF, delivered by Linden Masters/Mark Stanley
- **Improving management practices of Rhizoctonia 'bare-patch' on upper EP soils,** funded by the Australian Government's Community Landcare Grants, partnership with EPARF, researcher: Amanda Cook
- **Regional Landcare Facilitator project,** funded by the Australian Government, partnership with EPNRM, delivery: Linden Masters

New projects to commence in 2014:

- **Eyre Peninsula Grain & Graze 3,** GRDC funded, partnership with Southern Farming Systems, researchers: Jessica Crettenden/ Roy Latta

Ongoing projects include:

- **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
- **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
- **Efficient grain production compared with N_2O emissions,** funded by the Australian Government's Action on the Ground Program, in partnership with BCG and EPARF, researcher: Roy Latta
- **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

2014 events

Major field day events at Minnipa Agricultural Centre in 2014:

- EPARF Day – Putting a lid on herbicide resistance (16 July)
- MAC Field Day (3 September)

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 2014, and all the best for a productive season!

Naomi Scholz/Roy Latta

MAC Staff and Roles

Nigel Wilhelm	Science Program Leader (visiting)
Roy Latta	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)
Cathy Paterson	Research Officer (EP Farming Systems 3)
Jessica Crettenden	Research Officer (EP Grain & Graze, Sheep Genetics)
Suzie Holbery	Research Officer (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 Member Day: Wednesday 16 July 2014

MAC Annual Field Day: Wednesday 3 September 2014

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

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Eyre Peninsula Agricultural Research Foundation Report 2013

Simon Guerin
Chairperson

Board members

Simon Guerin, Matt Dunn, Bryan Smith, Craig James, Mark Fitzgerald, Shannon Mayfield, Andy Bates, Mark Stanley, Alan Tilbrook (SARDI), Dr Glenn McDonald (University of Adelaide), Jordan Wilksch (LEADA), Neil Ackland (EPNRM), Roy Latta (Leader MAC), Dot Brace (Executive Officer).

This has again been a positive year with some new board members appointed helping to bring some new ideas and help move the board's agenda along.

Members

Current members: 287

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.

Role of EPARF

EPARF is a not for profit organisation made up of annually paid members. It gives independent advice and provides strategic support and planning for the Minnipa Agricultural Centre. It also aims to promote the advancement and practical application of scientific research through field days and seminars. More recently the EPARF board has increased its effort to secure additional funding for dry land farming through being actively involved in funding applications and looking to alternative funding streams. By attracting more funding through bigger projects the board has recognised the need to improve its corporate governance and currently two board members per year are funded to attend the not for profit directors training. All of the members that have completed the course so far recognise the value in having attended it.

Sponsors 2012/13

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	CBH Grain
	Agfarm
	EP Grain
	Letcher & Moroney
	EPIC
	GrainCorp

Always a special thank you to all sponsors for their generous support. It is a vital link in EPARF being able to provide the services to members that we hope to be able to continue.

2013 EPARF Member day

Managing nitrogen in EP farming systems (hit or miss) was held on 10 April at MAC and was well attended. Looking back it now seems a good choice as the year has saw more nitrogen fertiliser used on crops than ever before.

David Roget

The grains industry farewelled one of its brightest minds in December 2013, when former CSIRO researcher Dr David Roget passed away unexpectedly. Known as the ‘go-to’ person for delivering scientific outcomes that could be applied by growers, David will be remembered for taking research out of the laboratory and into the paddock. David contributed more than 30 years of service to agricultural research, initially in the field of soil-borne plant pathology and later on biological disease suppression and farming systems research.

David was instrumental in developing and promoting the concept of farming systems research by bringing together multiple disciplines and grower input. David played a significant role in the success of the SA Research and Development Institute (SARDI) Root Disease Testing Service. David’s research was pivotal in developing cropping practices that have removed take-all as a major disease constraint to cereal production in Australia.

David had a quiet, gentle manner and was well liked and respected by fellow researchers, farmers and funding bodies.

SOURCE: http://www.grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-108-Jan-Feb-2014/Farming-systems-pioneer-remembered#sthash.Lfi07sfV.dpuf

Appreciation and thanks

- As all farmers can appreciate the work involved in presenting the MAC farm is a credit to Roy and his staff. It is a real showcase for our region and it was a joy to show the visiting GRDC panel members around in September. It showed them the productive potential of the region and hopefully gives them the confidence to keep investing funding into research at MAC. All the trial sites were well presented and staff spoke well about what they were hoping to achieve with their work.
- A special mention to Jessica and Suzie for enthusiastically getting stuck into the sheep genetics and lamb survival project which has generated positive feedback from all those involved.
- Dot also has provided me with a great deal of help while I have been coming to terms with the role of chairman.
- To all of our members who have supported MAC and other field days.

Eyre Peninsula Agricultural Research Foundation Members 2013

Adams	Daniel	CUMMINS SA
Agars	Brad	LOCK SA
Agars	Michael	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
Baldock	Michael	STREAKY BAY SA
Baldock	Tristan	KIMBA SA
Bammann	Geoff	CLEVE SA
Bammann	Paul	CLEVE SA
Barns	Ashley	WUDINNA SA
Bates	Andy	STREAKY BAY SA
Beinke	Joshua	KYANCUTTA SA
Beinke	Lance	KIMBA SA
Beinke	Peter	KIMBA SA
Beinke	Xavier	KYANCUTTA SA
Berg	Ben	KYANCUTTA SA
Berg	Dean	KYANCUTTA SA
Bergmann	Brenton	CEDUNA SA
Blumson	Bill	SMOKY BAY SA
Blumson	Vinnie	SMOKY BAY SA
Bowey	Daniel	LOCK SA
Brace	Dion	POOCHERA SA
Brace	Jason	POOCHERA SA
Brace	Reg	POOCHERA SA
Brands	Bill	MINNIPA SA
Brands	Sharon	MINNIPA SA
Brown	Paul	CEDUNA SA
Bubner	Daryl	CEDUNA SA
Burton	Jason	RUDALL SA
Butterfield	Ashley	KIMBA SA
Cant	Alexander	CLEVE SA
Cant	Brian	CLEVE SA
Carey	Damian	STREAKY BAY SA
Carey	Matthew	STREAKY BAY SA
Carey	Paul	STREAKY BAY SA
Carey	Peter	MINNIPA SA
Carey	Shaun	STREAKY BAY 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
Cummins	Lyn	LOCK SA
Cummins	Richard	LOCK SA
Daniell	Wes	MINNIPA SA
Dart	Robert	KIMBA SA
Dodgson	Terry	MINNIPA SA
Dolling	Paul	CLEVE SA
DuBois	Ryan	WUDINNA SA
Dunn	Matthew	RUDALL SA
Dupree	Shaine	WUDINNA SA
Durdin	Barry J	PORT LINCOLN SA
Edmonds	Graeme	WUDINNA SA
Elleway	David	KIELPA SA
Elleway	Ray	KIELPA SA
Endean	Jim	MINNIPA SA
Fitzgerald	Clem	KIMBA SA
Fitzgerald	Leigh	KIMBA SA
Fitzgerald	Mark	TUMBY BAY SA
Forrest	Scott	MINNIPA SA
Foster	Daniel	WUDINNA SA
Foster	Matt	WUDINNA SA
Foxwell	David	CLEVE SA
Foxwell	Tony	CLEVE SA
Francis	Brett	KIMBA SA
Freeman	Shaun	CEDUNA SA
Freeth	John	KIMBA SA

Freeth	Thomas	KIMBA SA
Fromm	Jerel	MINNIPA SA
Fromm	Jon	MINNIPA SA
Gill	Isaac	MANGALO SA
Gillmore	Trevor	STREAKY BAY SA
Gosling	Trevor	POOCHERA SA
Guerin	Simon	PORT KENNY SA
Guest	Terry	SALMON GUMS WA
Gunn	Angus	PORT KENNY SA
Gunn	Ian	PORT KENNY SA
Hamence	Les	WIRRULLA SA
Heath	Andrew	PORT LINCOLN SA
Heddle	Bruce	MINNIPA SA
Hegarty	Kieran	WARRAMBOO SA
Henderson	Tom	ELLISTON SA
Hentschke	Andrew	LOCK SA
Hentcshke	Stuart	LOCK SA
Herde	Bill	RUDALL SA
Hitch	Max	PORT LINCOLN SA
Hitchock	Nathan	LOCK SA
Hitchcock	Peter	LOCK SA
Hollitt	Joshua	PORT LINCOLN SA
Hood	Ian	PORT KENNY SA
Hood	Mark	PORT KENNY SA
Horne	Jennifer	WHARMINDA SA
Howard	Tim	CEDUNA SA
Hull	Geoff	STREAKY BAY SA
Hull	Jake	STREAKY BAY SA
Hull	Jesse	PORT KENNY SA
Hull	Mark	PORT KENNY SA
Hunt	Ed	PORT NEILL SA
Hunt	Evan	PORT NEILL SA
Hurrell	Leon	LOCK SA
Hutchings	Warwick	MINNIPA SA
James	Craig	CLEVE SA
Jensen	Nik	KIMBA SA
Jericho	Janeen	POOCHERA SA
Jericho	Marcia	MINNIPA SA
Jericho	Neville	MINNIPA SA
Jolly	San	CLARE SA
Kaden	Paul	COWELL SA
Kaden	Tony	COWELL SA
Kaden	Ty	COWELL SA
Kammermann	Grant	LOCK SA
Kammermann	Mark	WUDINNA SA
Kay	Dylan	TOOLIGIE SA
Kelly	Damien	LOCK SA
Kelly	Genevieve	LOCK SA
Kelly	Ian	LOCK SA
Kelsh	Craig	PORT KENNY SA
Kenchington	Cassy	KIMBA SA
Kenny	Michael	CLEVE SA
Kenny	Tara	CLEVE SA
Kobelt	Myra	CLEVE SA
Kobelt	Rex	CLEVE SA
Koch	Daryl	KIMBA SA
Koch	Jeffrey	KIMBA SA
Kuhlmann	Peter	GLENELG STH SA
Kwaterski	Robert	MINNIPA SA
Lawrie	Andrew	TUMBY BAY SA
LeBrun	Dion	TUMBY BAY SA
LeBrun	Leonard	TUMBY BAY SA
LeBrun	Maria	TUMBY BAY SA
Lee	Howard	STREAKY BAY SA
Lienert	Bill	KIMBA SA
Lienert	Roger	ARNO BAY SA
Little	Ken	PORT KENNY SA
Little	Nathan	PORT KENNY SA
Longmire	Andrew	SALMON GUMS WA
Longmire	Ben	LOCK SA
Longmire	Jeffrey	LOCK SA
Lymn	Chris	WUDINNA SA
Lynch	Bradley	STREAKY BAY SA
Lynch	Christopher	STREAKY BAY SA
Lynch	Craig	POOCHERA SA
Lynch	Joel	POOCHERA SA
Mahar	Andrew	CEDUNA SA
Maitland	Stephen	KIMBA SA
Malcolm	Beth	ARNO BAY SA
Malcolm	Shane	ARNO BAY SA
Marshall	Jayne	WUDINNA SA
Masters	John	ARNO BAY SA
Matthews	John	KYANCUTTA SA
Matthews	Todd	KYANCUTTA SA
Matthews	Wes	KYANCUTTA SA
May	Ashley	KYANCUTTA SA
May	Nigel	ELLISTON SA

May	Paul	KYANCUTTA SA	Rayson	Peter	KIMBA SA
Mayfield	Shannon	KIMBA SA	Rehn	Gavin	ARNO BAY SA
Michael	Ashley	WUDINNA SA	Ryan	Martin	KIMBA SA
Michael	John	WUDINNA SA	Sampson	Allen	KAPUNDA SA
Millard	Darren	ARNO BAY SA	Sampson	Brett	WARRAMBOO SA
Mills	JK	COWELL SA	Sampson	Kane	WARRAMBOO SA
Mills	Leonie	COWELL SA	Sampson	Veronica	WARRAMBOO SA
Montgomerie	Ian	STREAKY BAY SA	Schmucker	Terry	KYANCUTTA SA
Montgomerie	John	STREAKY BAY SA	Schmucker	Thomas	KYANCUTTA SA
Mudge	Caroline	STREAKY BAY SA	Scholz	Gareth	MINNIPA SA
Mudge	Darren	STREAKY BAY SA	Scholz	Greg	WUDINNA SA
Mullan	Damien	WUDINNA SA	Scholz	Leigh	MINNIPA SA
Murray	Amy	KIMBA SA	Scholz	Lyle	YANINEE SA
Murray	Lynton	PENONG SA	Scholz	Michael	YANINEE SA
Newton	Len	ELLISTON SA	Scholz	Neville	WUDINNA SA
Nicholls	Anthony	CEDUNA SA	Scholz	Nigel	WUDINNA SA
Noble	Ian	WHARMINDA SA	Scholz	Stuart	WUNINNA SA
Norris	Daryl	RUDALL SA	Scholz	Yvonne	WUDINNA SA
O'Brien	Brett	KYANCUTTA SA	Scott	Nigel	CLEVE SA
O'Brien	Craig	KYANCUTTA SA	Seal	Brook	KIMBA SA
O'Brien	Darren	KYANCUTTA SA	Shipard	Bill	PENONG SA
Oswald	Clint	YANINEE SA	Simpson	John	WUDINNA SA
Oswald	John	YANINEE SA	Siviour	Mark	LOCK SA
Ottens	Tim	WHARMINDA SA	Smith	Bryan	COORABIE SA
Patterson	Simon	STREAKY BAY SA	Smith	Reid	MAITLAND SA
Phillips	Ashley	MINNIPA SA	Sparrow	Dustin	WUDINNA SA
Phillips	Darcy	MINNIPA SA	Stanley	Mark	PORT LINCOLN SA
Phillips	Glen	MINNIPA Sa	Story	Rodger	COWELL SA
Phillis	Jamie	UNGARRA SA	Story	Suzanne	COWELL SA
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Polkinghorne	Tim	LOCK SA	Swaffer	Michael	PORT LINCOLN SA
Pollock	James	MINNIPA SA	Taylor	Anton	CUMMINS SA
Pope	Ben	WARRAMBOO SA	Taylor	Kelly	CUMMINS SA
Pope	Lindsay	WARRAMBOO SA	Thomas	Geoff	BLACKWOOD SA
Powell	Clint	KIMBA SA	Tomney	Jarad	STREAKY BAY SA
Preiss	Kevin	ARNO BAY SA	Traeger	Sarah	CLEVE SA
Prime	Andrew	WHARMINDA SA	Trezona	Neville	PETINA SA
Prime	Caleb	WHARMINDA SA	Trowbridge	Shane	CEDUNA SA
Prime	Chris	WHARMINDA SA	Turnbull	John	CLEVE SA
Prime	Jarrod	WHARMINDA SA	Turnbull	Mark	CLEVE SA
Prime	Joel	PORT NEILL SA	Turner	Quentin	ARNO BAY SA
Prime	Peter	WHARMINDA SA	van Loon	Tim	WARRAMBOO SA
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Ramsey	Rowan	KIMBA SA	Veitch	Leon	WARRAMBOO SA
Ranford	Ben	CLEVE SA	Veitch	Sally	WUDINNA SA

Veitch	Simon	WUDINNA SA	Williams	Peter	WUDINNA SA
Vorstenbosch	Daniel	WARRAMBOO SA	Williams	Scott	WUDINNA SA
Wagner	Jeremy	WUDINNA SA	Williams	Susan	KIMBA SA
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Waters	Dallas	WUDINNA SA	Wiseman	Caroline	LOCK SA
Waters	Graham	WUDINNA SA	Wiseman	Lyall	LOCK SA
Watson	Peter	WIRRULLA SA	Woolford	Barb	KIMBA SA
Webb	Paul	COWELL SA	Woolford	David	KIMBA SA
Webber	Ken	PORT LINCOLN SA	Woolford	Dion	KIMBA SA
Wheare	Craig	LOCK SA	Woolford	Graham	KIMBA SA
Wheaton	Philip	STREAKY BAY SA	Woolford	James	KIMBA SA
Wibberley	Brian	PORT LINCOLN SA	Woolford	Michael	CLEVE SA
Wilkins	Gregor	YANINEE SA	Woolford	Nathan	KIMBA SA
Wilkins	Stefan	YANINEE SA	Woolford	Peter	KIMBA SA
Wilksch	Jordan	YEELANNA SA	Woolford	Simon	KIMBA SA
Williams	David	PORT NEILL SA	Zacher	Michael	LOCK SA
Williams	Dene	KIMBA SA	Zerk	Michael	LOCK SA
Williams	Gwenda	KIMBA SA	Zerna	Allan	COWELL SA
Williams	Jen	PORT NEILL SA	Zibbell	Lisa	KIMBA SA
Williams	Josie	WUDINNA SA			

MAC Events 2013

Naomi Scholz

SARDI, Minnipa Agricultural Centre

A “Sheep Genetics: Getting the best out of AI” workshop was held at the MAC shearing shed on 8 February. Dr Simon Walker (retired) SARDI, Geoff Lindon, Australian Wool Innovations, Brian Ashton, Sheep Consultancy Service Pty. Ltd. and Jessica Crettenden, SARDI, presented to both Merino stud and commercial Eyre Peninsula Breeders.

226 farmers and local agricultural re-sellers attended 12 upper Eyre Peninsula Harvest Report/ Farmer Meetings. Linden Masters, SARDI facilitated the meetings with local Agricultural Bureaus to discuss results of research and current future issues affecting agriculture locally.

Minnipa Agricultural Centre hosted a “Making more from Sheep” Workshop on 5 April 2013. Suzie Holbery, SARDI presented to 14 private consultant’s farmer clients.

EP Grain & Graze/SheepConnect SA Sheep Group benchmarking sessions were held at Buckleboo, Kimba, Poochera and Lock in April, and Cummins in July. Thirty eight farm businesses participated in the benchmarking. Mary Crawford, Rural Solutions SA facilitated the sessions and Daniel Schuppan, Landmark presented the benchmark information of each business and opportunities for potential improvement.

The 2013 Eyre Peninsula Agricultural Research Foundation Member Day ‘Managing nitrogen in EP cropping systems’ was held at MAC on 10 April, with 120 farmers, consultants, sponsors and organisers attending. The day focused on the relationship between plant nutrition, soil health, plant productivity and on-farm application of knowledge and technology. 77% of farmers said they would do something differently as a result of attending the event and 75% felt prepared to make good nitrogen decisions in 2013. 100% of attendees said they would recommend to friends and neighbours to attend EPARF Member Days in the future.

A Grazing Cereals Workshop was held at Lock on 4 July 2013, supported by Eyre Peninsula Grain & Graze 2 and Sheep-Connect SA projects. Seventeen farmers attended the workshop, which was a combination of in field demonstrations (cereal grazing, electric fencing) and in the shearing shed (animal nutrition, where grazing cereals fits in your farming system, crop growth stages). Daniel Schuppan (Landmark Livestock Consultant), Mary Crawford (Rural Solutions SA) and Matt McLaughlin (Gallagher) all presented information. Jessica presented the section on crop growth stages, with a hands-on session dissecting barley plants to determine growth stage.

A Ram Selection Workshop was held at MAC on 29 July 2013. Twelve farming businesses were represented at the workshop.

Thirty three young farmers in the Ceduna area attended sessions in June and August on ‘Introduction to Farm Finances’ presented by Phil Stevens and Andy Bates, as part of the Low Rainfall Collaboration Profitability and Risk project.

A workshop titled "Lamb V's Wild" was held at MAC on 9 August, which was funded via the Eyre Peninsula Agricultural Research Foundation (EPARF) by the South Australian Sheep Advisory Group (SASAG). 21 farmers attended the workshop, which was a combination of hands-on demonstrations (wet, dry and lambed and lost udders, autopsies) and in the shearing shed (ewe rearing ability, improving weaning percentages, ewe nutrition, technology hub, pest control, how to perform a basic autopsy, research results). Jessica Crettenden (SARDI), Suzy Holbery (SARDI), Gordon Refshauge (NSW DPI), Emily Litzow (PIRSA) and Luke Nettle (DEWNR) all presented information.

Linden Masters, SARDI and Brett Masters, Rural Solutions SA in conjunction with Stephen Davies, WA Department of Ag, ran a non-wetting sand 'mini workshop' at Warrachie/Murdinga for 13 farmers on 21 August.

Sticky beak days were held across upper Eyre Peninsula in August, September and October by 15 groups; 358 farmers and 116 agribusiness representatives attended the events.

The GRDC Southern Panel Spring Tour visited upper Eyre Peninsula on 3-5 September.

The Annual MAC Field Day was held on 11 September. 150 people attended. Alan Tilbrook, SARDI Director Livestock & Farming Systems, opened the event, and presentations were made by Roy Latta (nitrous oxide, methane), Mark Klante (farm overview), Leigh Davis (barley, peas, canola), Andrew Ware (wheat, peas, canola), Amanda Cook (Rhizoctonia), Suzie Holbery and Michael Moodie (crop sequencing, alkaline soils), Cathy Paterson (facilitated panel session discussing N deficiency, disease, frost and rust issues of the 2013 season with Andy Bates, Craig James, Andrew Polkinghorne and Amanda Cook), Jessica Crettenden (sheep genetics and lamb survival), Jake Howie (medics), Carolyn Dekoning (sulla) and Stuart Nagel (vetch). Trent Potter of Yeruga Crop Research spoke at the DAFF soil carbon site and Graydon Chong of Rabobank gave a global commodities outlook.

Linden Masters facilitated a Young Leaders workshop on 20-21 September. 16 young leaders from across upper Eyre Peninsula plus 4 speakers participated in sessions on expectations; our values, vision, goals; what is leadership; knowing our ourselves, our community, our region and communication and listening skills as part of a Community Landcare Grant project funded via the Eyre Peninsula Agricultural Research Foundation.

A Water Storage and Technology workshop was held in Ceduna on 13 December. 36 attended the event, with growers given the opportunity to map and plan their water infrastructure.

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

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

EPARF Eyre Peninsula Agricultural Research Foundation Inc.

Eyre Peninsula seasonal summary 2013

Linden Masters[1] and Brett Masters[2]

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

OVERVIEW

The 2013 season resulted in above average crop yields in all districts of Eyre Peninsula despite some challenges with areas of water logging on lower EP, dry conditions at grain fill in western districts, head and grain loss from strong damaging winds, and a severe frost affecting yields in the more northern areas. Many growers commented that crops looked to have better yield potential than what was harvested, and the lack of finishing rains certainly had a big impact on final crop performance. The majority of farms achieved cereal yields 20-40% above longer term averages. Farm gate prices held around average and overall it was considered a profitable season.

Extremely dry conditions over the 2012/13 summer resulted in no stored subsoil moisture prior to the opening rains, thus an early autumn break in most districts was appreciated. Warm soils at sowing saw crops germinate quickly with rapid early growth ensuring that crops were well advanced before growth was slowed by cold damp conditions in June and July. During this period mineralisation of nitrogen from soil organic matter was slower, with growers who applied additional nitrogen fertilisers reporting yield and quality improvements at harvest. Suppliers on eastern and upper Eyre Peninsula reported above average sales of nitrogen fertilisers in 2013.

A number of significant frosts were recorded in all districts during the week of 10 June. Cold overnight temperatures on 15 August resulted in stem frost damage to crops in northern districts. The cereal crops were at early head emergence with early-sown wheat crops in the far west starting to fill grain. Estimates of yield loss in frost affected areas are 10 to 20%, with isolated reports much higher. September and October rainfall in western and eastern Eyre Peninsula districts was below average (decile 2 to 3), however good growing conditions through winter allowed crops to fill grain from stored subsoil moisture.

A severe wind event on 9 October saw over 50% barley losses on early crops and losses on heavy wheat crops. Grain quality was generally good, with most barley meeting premium grades despite the dry finish to the season. However wheat protein levels were slightly lower than average. This may have been in part due to the poor conditions for mineralisation in the dry autumn. Nitrogen application had an unusually large, positive impact on paddock profitability in the lower rainfall areas this year.

Pest numbers were generally low, however Diamond back moth and aphids were observed in variable densities on canola and pulse crops in most areas and snails continue to be an emerging or ongoing issue. Rhizoctonia and staggered grass weed emergence continue to challenge farmers in many areas.

Above average biomass production in pastures enabled livestock to achieve excellent condition with excess pastures baled to replenish hay supplies.

DISTRICT REPORTS

Western Eyre Peninsula

In late April two 10 mm rainfall events enabled the majority of growers to have finished seeding by the end of May. The remaining crops were sown following good rainfall events on 14 and 21 June. Cold conditions set growth back on emerging crops with a number of light frosts being recorded around 10 June in the Central Eyre districts. By mid season crop yield potential was above average and most soils had some stored subsoil moisture. In the far west many commented that “you only see a year like this once in a lifetime”. A frost mid-October in central and western Eyre Peninsula resulted in some crops being affected by stem frost. Yield losses resulting from this frost are estimated to be 10 to 20% in these districts with isolated reports of much greater losses. Rhizoctonia bare patch symptoms were observed in a large number of crops and although leaf disease levels were generally low in 2013, there were some reports of low levels of stripe rust and powdery mildew in wheat crops in coastal districts.

Crop maturity varied greatly across the district due to variation in seeding time. This resulted in some variability in yield and quality across the district. Harvest began in late October with early sown barley being delivered to Wudinna around 24 October. Yields from early sown crops were 50% above average (2-3 t/ha) and of high quality. Peas yielded poorly and canola (0.6-1.0 t/ha) was below average.

Eastern Eyre Peninsula

Timing of seeding varied greatly across the district with growers in the coastal areas who received rains in early May finishing seeding by the first week of June. Inland cropping areas did not finish until the last week of June. Heavy rains in the Cleve Hills in late May/early June resulted in some areas becoming waterlogged, which delayed seeding. The crop yield potential midway during the season was well above average and soil profiles contained good levels of stored subsoil moisture. The good growing season conditions also saw an increase in the level of competition from grass weeds across the district.

Yield losses in frost affected crops north of Kimba were 10-25% with isolated reports even higher. Pea crops suffered higher losses than cereals, with pods freezing. There were some reports of stripe rust in susceptible crops, which saw many growers applying fungicide to protect yield potentials. Yields generally were 25% above average with good quality.

Lower Eyre Peninsula

Many growers began seeding following rains in late April. Dry conditions in mid-May caused many growers to halt seeding for more than a week until after rains in late May. Most growers in the district had finished seeding by early June. Early sown cereals germinated quickly with good early vigor. Cool conditions in early June meant that later sown crops were slow to germinate, with frosts in the second week of June significantly slowing crop and pasture growth. Above average rainfall and cool conditions resulted in some water logging on paddocks south of Cummins. Poor paddock trafficability and difficulties sourcing nitrogen fertilizer restricted the timing of nitrogen applications in some areas.

Whilst cereal crop yields were generally above average, they varied significantly between districts and soil type. Average to slightly above average yields were reported on lighter textured soils and red brown earths around Karkoo (3 t/ha), Yeelanna (2.8 t/ha), Cummins (3.5 t/ha) and Ungarra (2.8 t/ha). Yields were generally below average on the ironstone sand over clay soils at Koppio (1.2 t/ha) and Wanilla (1.8 t/ha) which suffered from some waterlogging early in the season. Canola yields in waterlogged areas south of Cummins were particularly disappointing with many reports of canola yields that were well below average.

MAC Farm Report 2013

Mark Klante
SARDI, Minnipa Agricultural Centre

INFORMATION

Try this yourself now

Location:
Minnipa Ag Centre
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm

Key outcomes

- **On average MAC wheat yielded 2.3 t/ha and barley yielded 2.2 t/ha.**
- **80% of total farm area was cropped.**
- **350 breeding ewes produced 128% lambs at marking.**
- **120 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.

2013 season

Sowing commenced with medic on 4 April 2013, followed by vetch on 19 April. We sowed 75 ha of Scope barley starting on 30 April, wheat beginning on 2 May and we finished sowing on 16 May. Including vetch and medic we sowed 16 varieties in 2013.

MAC had white peg trials in 8 paddocks and whole paddock demonstrations in N1, S7 and S3N (EPARF funded seed treatment demo for Rhizoctonia control).

Forty six percent or 511 ha of MAC farm was sown to wheat, barley 240 ha (20%), canola 50 ha (4%), medic 220 ha (20%) and peas 94 ha (8%).

What happened?

The average farm wheat yield of 2.3 t/ha was limited in some paddocks by annual grass competition. Barley yielded an average 2.2 t/ha. Canola yielded 0.88 t/ha. We received 237 mm of growing season rainfall (GSR), falling on 79 days, compared to 185 mm of GSR in 2012. The crops benefited from 158 mm of rainfall in June, July and August but suffered from 15 days above 30 degrees in August (max 34.7 °C) and September (max 39.8 °C) with only 21 mm of rain falling in this time. Harvest commenced on 11 October (peas) and finished on 14 November. Using the French and Schultz yield calculator, we could potentially have achieved yields of wheat 2.5 t/ha, barley 2.9 t/ha, peas 1.6 t/ha and canola 1.9 t/ha.

Livestock

350 ewes were joined on 7 February 2013, 62 of these were mated using artificial insemination. 304 ewes were scanned in lamb.

Scanning percentage 534 lambs = 152%

Lambing percentage 531 lambs = 152%

Marking percentage 449 lambs = 128%

Weaning percentage 448 lambs = 128%

For more in depth results see the lamb survival project results in the EPFS Summary 2013 article *'Identifying causes for lamb losses in low rainfall mixed farming regions'.*

Acknowledgements

MAC farm staff Brett McEvoy and Trent Brace.

Table 1 Harvest results, 2013 grain yields and protein aligned with paddock rotational histories

Paddock	Paddock History 09-12	Crop 2013	Sowing Date 2013	Yield (t/ha)	Protein (%)
North 1	W W W P	Mace (W)	7 May	2.5	10.4
North 2	B P W W	Scope (B)	30 April	2.4	14.0
North 3	W Pe P W	Wyalkatchem (W)	1 May	2.4	11.5
North 4	P W W B	Medic (P)	19 April		
North 5 N	W B P P	Grenade (W)	2 May	2.6	11.1
North 5 S	P P W W	Mace (W)	6 June	2.6	12.6
North 6 E	P W W W	Scope (B)	Self-sown	grazed	
North 6 W	W B Pe W	Mace (W)	5 May	2.6	11.4
North 7/8	W W W B	Pasture			
North 9	O P W W	Fathom (B)	14 June	2.8	11.2
North 10	B Pe W P	Kord/Grenade (W)	3 May	2.3	11.9
North 11	W W W P	Emu Rock (W)	14 May	2.3	10.2
North 12	W W C W	Kord CL Plus (W)	4 May	1.7	9.0
South 1	W W W B	44C79 (C)	26 April	0.8	
South 1 Scrub	W B B B	44C79 (C)	26 April	0.8	
South 2/8	W P W W	Twilight (Pe)	28 May	0.7	
South 2/8	P P W W	Twilight (Pe)	28 May	0.7	
South 3 S	P W W W	Medic (P)	4 April		
South 3 N	W W C W	Hindmarsh (B)	15 May	1.8	11.1
South 4	W W B P	Espada (W)	16 May	1.3	12.9
South 5	Pe W W C	Scope (B)	30 May	1.8	11.5
South 6 E	W B P M	Kord (W)	4 May	2.8	13.8
South 6 W	W B Pe W	Twilight (Pe)	28 May	0.9	
South 7	W P W P	Mace (W)	5 May	2.5	9.9
South 9	W W P W	Kord CL Plus (W)	3 May	1.7	10.7
South 10	W W P W	Cummins (V)	8 May		

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

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Lower Eyre Agricultural Development Association

"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 2013 achievements and 2014 focus

2013 saw the conclusion to two of LEADA's major projects.

June 2013 saw the completion of five years of GRDC funded research, development and extension conducted into improving water use efficiency on Lower Eyre Peninsula (LEP) by LEADA and its partners in SARDI and Rural Solutions SA, with assistance from Cummins Ag Supplies (Landmark Cummins).

This project had as its core objective to improve water use efficiency by 10% throughout the region. While many facets of management, beyond the scope of the work conducted on this project, can lead to improvements in water use efficiency, LEADA believes that this project has helped in successfully raising growers' awareness of some of the key production issues in the region and has assisted in developing methods to help remedy them. PIRSA crop estimates show the three year average water use on LEP has increased in wheat from 14.1 kg/mm in 2005-2007 to reach 18.4 kg/mm in 2009-2012, with similar increases in canola and barley production.

The Caring for our Country funded project looking at Hostile Soils was also completed in 2013. A major emphasis of the project was the extension of relevant information to LEADA members. The LEADA Expo was held on 21 March 2013 at Ungarra Sporting Complex with 80 participants attending. Subjects covered by the speakers included global markets, results of trials conducted in 2012, issues with micro nutrient management that are emerging with changing farmer practices and advances in soil amelioration techniques. The static display of soil conditioning machinery created much interest and stimulated animated discussions.

With the conclusion of the water use efficiency project GRDC has funded LEADA as part of a new initiative aimed at improving levels of stubble retention in the region. There may be some that believe that stubble retention was an issue dealt with years ago that has led to almost the complete uptake of No-till farming techniques in the region and to a large degree that is correct. However many of the key limiting factors in LEP farming systems are driven by a desire to keep higher levels of stubble residue, i.e. snails, weed control, and some diseases. This project will aim to address these issues, through investigating how improvements in weed control, pest management, disease management and nutrition management can be made while retaining stubble, and if this is not possible investigate when and how stubble reduction should occur.

2013 saw several changes to the management of the LEADA group. Jordan Wilksch continues as chair. A new Executive Officer, Helen Lamont, was appointed mid-year and has been working with the committee to finalise projects and improve the governance arrangements of the group. Helen's position is partially funded through the National Landcare Facilitators program, an initiative of the Australian Government Department of Agriculture.

Our links with GRDC, the Australian Government, State NRM, Rural Solutions SA, SARDI, EPARF and the Eyre Peninsula NRM Board have remained strong throughout the year. This positive collaboration is resulting in a greater research and extension effort on sustainable and profitable farming systems for LEP. The chair has also taken up a position as a member of the Regional Development Australia Agriculture Target Team, strengthening the group's relationship with the broader agricultural industries on EP.

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 865 055

Helen Lamont, EO 0428 761 502

Committee members:

Daniel Adams, Martin Burns, David Giddings, Mark Modra, George Pedler, Bruce Morgan, Dustin Parker, John Richardson, Pat Head, Jamie Phillis, Tim Richardson, Kieran Wauchope, Scott Siviour, Michael Treloar, Jordan Wilksch, Neil Ackland (EPNRM), Roy Latta and Andrew Ware (SARDI), David Davenport (RSSA) and Mark Stanley (Ag Ex Alliance).

GRDC Grains Research & Development Corporation — Your GRDC working with you

Government of South Australia — Eyre Peninsula Natural Resources Management Board

Australian Government — Landcare — Regional Landcare Facilitator — Hosted by Eyre Peninsula NRM Board for the Eyre Peninsula region

SARDI — South Australian Research and Development Institute

RURAL SOLUTIONS SA

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	$P \leq 0.05$
LSD (P=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 m² (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)

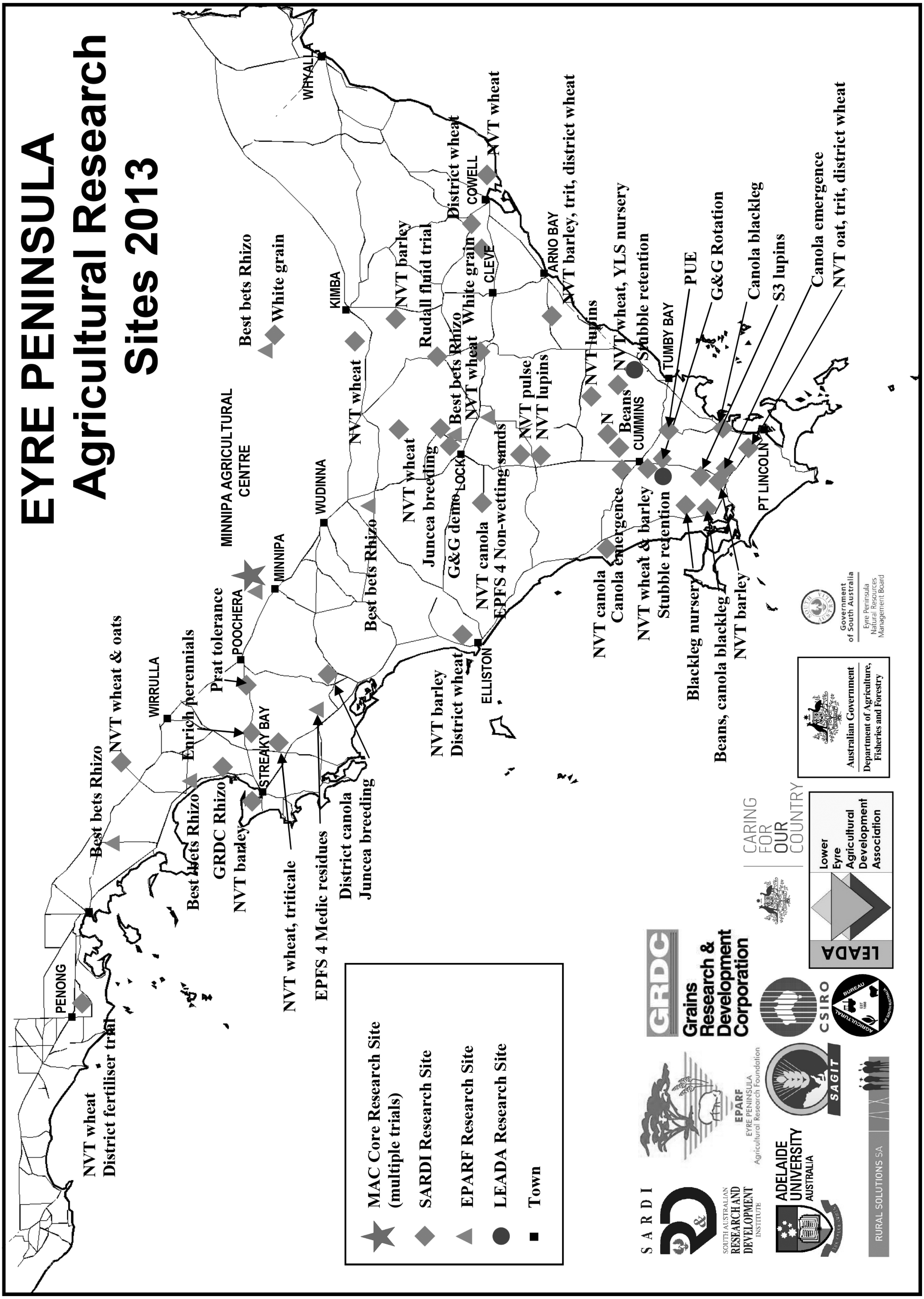
25 psi = 1.7 bar = 172 kPa

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 2013
MAC Core Research Site (multiple trials)
SARDI Research Site
EPARF Research Site
LEADA Research Site
Town
WHYALLA
COWELL
CLEVE
ARNO BAY
KIMBA
TUMBY BAY
CUMMINS
PT LINCOLN
LOCK
WUDINNA
MINNIPA
MINNIPA AGRICULTURAL CENTRE
POOCHERA
WIRRULLA
STREAKY BAY
PENONG
ELLISTON
NVT wheat
District fertiliser trial
Best bets Rhizo
NVT wheat & oats
Enrich perennials
Prat tolerance
Best bets Rhizo
GRDC Rhizo
NVT barley
NVT wheat, triticale
EPFS 4 Medic residues
District canola
Juncea breeding
Best bets Rhizo
White grain
NVT wheat
Best bets Rhizo
NVT wheat
Juncea breeding
G&G demo
NVT canola
EPFS 4 Non-wetting sands
NVT barley
District wheat
NVT barley
Rudall fluid trial
Best bets Rhizo
NVT wheat
White grain
District wheat
NVT wheat
NVT pulse
NVT lupins
NVT barley, trit, district wheat
NVT lupins
NVT lupins
N
Beans
NVT wheat, YLS nursery
Stubble retention
NVT canola
Canola emergence
NVT wheat & barley
Stubble retention
PUE
G&G Rotation
Canola blackleg
S3 lupins
Canola emergence
NVT oat, trit, district wheat
Blackleg nursery
Beans, canola blackleg
NVT barley
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Eyre Peninsula Natural Resources Management Board

Section

1

Section Editor:
Jessica Crettenden
SARDI
Minnipa Agricultural Centre

Cereals

Cereals

Crop estimates by district (tons produced) in 2013

	Wheat	Barley	Oats	Triticale
Western EP	780,000	120,000	19,500	2,100
Eastern EP	730,000	145,000	7,000	6,500
Lower EP	510,000	253,000	7,000	1,700

Source: PIRSA, January 2014, Crop and Pasture Report, South Australia.

SA Triticale variety yield performance

2013 and long term (2006-2013) expressed as % of site average yield and as t/ha

Variety	2013 (as % of site average)				Long term average across sites within region (2005-2013) as % site average			
	Greenpatch	Minnipa	Streaky Bay	Wharminda	Lower Eyre		Upper Eyre	
					% sites av.	# Trials	% sites av.	# Trials
Berkshire	99	105	100	Storm damage	110	9	106	10
Bogong	110	101	108		111	13	106	13
Canobolas	109	96	100		109	13	104	13
Chopper	98	109	84		107	11	105	12
Endeavour	85							
Fusion	111	108	104		120	7	111	8
Goanna	94	94	95		101	5	101	6
Hawkeye	106	100	91		109	15	105	15
Jaywick	98	84	89		104	15	102	15
Rufus	92	89	104		101	13	101	14
Tahara	94	94	102		98	15	100	15
Tuckerbox	76				85	9		
Yowie	94	87	102		97	7	98	8
Yukuri	83				79	9		
Site av. yield t/ha	**5.61**	**2.92**	**1.87**		**2.95**		**2.01**	
LSD % (P=0.05)	*10*	*4*	*10*					
Date sown	24 May	17 May	13 May	16 May				
Soil type	L	L	SL	NWS				
J-M/A-O rain (mm)	27/568	66/237	34/246	47/375				
pH (water)	6.1	8.4	8.7	7.0				
Previous crop	canola	pasture	pasture	pasture				
Stress factors		dl	dl,wg	st				

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

Site stress factors: d=post-flowering moisture stress, st=storm damage, wg=weeds

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 *2013 and long term (2009-2013) expressed as t/ha and % of site average yield*

Variety	Upper, Eastern and Western Eyre Peninsula										Mid and Lower Eyre Peninsula					
	2013 (as % site average)							Long term av. across sites (09-13)			2013 (as % site average)			Long term av across sites (09-13)		
	Kimba	Minnipa	Mitchelville	Nunjikompita	Penong	Piednippie	Warramboo	t/ha	as % site av.	# Trials	Cummins	Rudall	Ungarra	t/ha	% site av.	# Trials
AGT Katana	105	107		105	101	116	105	2.47	104	31	101	95	101	4.60	102	15
Axe	95	100		86	93	81	97	2.35	99	31	87	81	86	4.35	97	15
Catalina	93	94		77	85	83	102	2.30	97	31	93		96	4.31	96	14
Cobra	106	103		101	108	109	106	2.47	104	18	114	116	105	4.82	107	9
Corack	107	108		103	94	100	114	2.62	110	25	108	115	108	4.92	110	12
Correll	97	93		98	104	99	88	2.41	101	31	91	93	89	4.50	100	15
Dart	100	100		88	97	97	93	2.35	99	12	93	89	108	4.46	99	8
Derrimut								2.36	99	25				4.56	102	12
Emu Rock	101	108		105	114	108	110	2.54	107	25	97	96	109	4.66	104	12
Espada	100	107		110	92	107	98	2.52	106	31	92	101	98	4.59	102	15
Estoc	100	94		105	103	111	91	2.45	103	31	104	92	99	4.57	102	15
Gladius	95	98		100	105	92	94	2.43	102	31	95	90	94	4.51	100	15
Grenade CL Plus	93	101	Wind	101	111	90	90	2.36	99	18	91	96	94	4.33	96	9
Harper			Damage					2.46	103	7	102		96	4.57	102	5
Justica CL Plus	91	98		105	101	92	90	2.36	99	25	91	98	96	4.42	98	12
Kord CL Plus	90	95		104	100	99	92	2.43	102	19	88	91	92	4.42	98	9
Mace	102	110		119	108	105	108	2.61	110	31	107	111	102	4.80	107	15
Magenta								2.47	104	25				4.58	102	12
Peake								2.35	99	25				4.50	100	12
Phantom	93	90		88	93	103	81	2.36	99	25	96	89	85	4.62	103	12
Scout	98	93		94	95	99	94	2.47	104	31	110	100	102	4.87	108	15
Shield	95	96		90	102	104	107	2.45	103	18	99	103	99	4.53	101	9
Trojan	108	101		112	96	115	92	2.57	108	18	114	110	110	4.96	110	9
Wallup	97	96		95	89	103	102	2.38	100	12	98		102	4.62	103	10
Wyalkatchem	103	109		108	104	108	108	2.50	105	31	104	111	104	4.74	106	15
Yitpi	98	89		95	103	100	75	2.36	99	25	95		87	4.43	99	11
Site av. yield (t/ha)	**3.32**	**3.07**		**1.89**	**1.44**	**1.88**	**2.21**	**2.38**			**5.34**	**2.53**	**4.36**		**4.49**	
LSD % (P=0.05)	*6*	*4*		*7*	*7*	*12*	*7*				*4*	*7*	*5*			
Date sown	13 May	17 May	16 May	8 May	9 May	13 May	13 May				18 May	15 May	15 May			
Soil type	LS	L	LS	L	SCL	SL	SL				CL	SL	SL			
J-M / A-O rain (mm)	71/387	66/237	36/225	40/187	40/187	34/246	57/327				61/392	91/294	57/328			
pH (water)	8.3	8.4	8.0	8.7	9.0	8.7	8.6				8.1	8.5	8.2			
Previous crop	canola	pasture	pasture	pasture	pasture	pasture	pasture				canola	canola	canola			
Stress factors		dl	st	dl,wg		dl,wg						yls				

Soil type: S=sand, L=loam, C=clay
Site stress factors: dl=dry post anthesis, yls=yellow leaf spot, st=storm damage, wg=weeds
Data source: NVT & SARDI/GRDC (long term data based on weighted analysis of sites, 2009-2013) Data analysis by GRDC funded National Statistics Group

SA Barley variety yield performance *2013 and long term (2005-2013) expressed as t/ha and % of site average yield*

Variety	LOWER EYRE PENINSULA					UPPER EYRE PENINSULA							
	2013 (% site average)		Long term average across sites (2005-13)			2013 (as % site average)					Long term average across sites (2005-2013)		
	Cummins	Wanilla	t/ha	as % site av.	# Trials	Darke Peak	Elliston	Minnipa	Streaky Bay	Wharminda	t/ha	as % site av.	# Trials
Barque	96		3.54	99	23						2.51	107	29
Bass	110	110	3.79	106	18	107	90	105	101		2.54	109	20
Buloke	105	91	3.66	102	26	100	91	103	94		2.45	105	33
Charger	99	97											
Commander	110	96	3.77	106	26	101	91	106	98		2.54	109	33
Compass	113	114	4.15	116	5	119	105	114	112		2.91	124	8
Fathom	106	108	3.92	110	11	120	97	110	111		2.76	118	16
Flagship	92	88	3.49	98	26	103	97	92	95		2.43	104	33
Fleet	100	95	3.85	108	26	108	97	110	112		2.72	116	33
Flinders	102	109	3.66	103	11	101	99	95	96		2.36	101	16
Gairdner	88	96	3.47	97	23								
Granger	100	100	3.83	107	11	103	108	105	98		2.45	105	16
Henley	99	97	3.77	106	14	84	88	97	98	Storm	2.41	103	16
Hindmarsh	102	117	3.93	110	23	100	118	98	101	Damage	2.68	115	29
Keel	102	108	3.63	102	26	119	112	116	105		2.54	109	31
La Trobe	109	118	3.98	111	8	108	136	111	108		2.68	114	12
Maritime	100	91	3.53	99	26	105	89	89	105		2.38	102	33
Navigator	107		3.38	95	8								
Oxford	103	111	3.81	107	16	94	107	99	110		2.38	102	20
Schooner	88	98	3.28	92	26	78	98	82	89		2.23	95	33
Scope	102	89	3.63	102	14	93	83	93	94		2.40	102	20
Skipper	101	116	3.81	107	11	110	99	118	99		2.62	112	16
Sloop SA	85	88	3.40	95	26						2.30	98	29
SY Rattler			3.62	101	7								
Westminster	95	89	3.59	101	9								
Wimmera	100	103	3.75	105	12								
Site av. yield t/ha	**4.85**	**3.74**	**3.57**			**2.88**	**2.21**	**3.58**	**2.85**		**2.34**		
LSD % (P=0.05)	*6*	*10*				*5*	*9*	*10*	*9*				
Date sown	18 May	20 May				17 May	14 May	17 May	10 May	22 May			
Soil type	CL	S				SL	S	L	LS	NWS			
J-M/A-O rain (mm)	61/392	35/511				57/319	30/395	66/237	36/217	47/375			
pH(water)	8.1	6.4				8.1	8.3	8.4	8.7	7.0			
Previous crop	canola	canola				pasture	pasture	pasture	pasture	pasture			
Site stress factors							rh,sn	dl	dl,nn,sn,rh	nn,sn,st			

Soil type: S = sand, L = loam, C = clay, NW = non wetting. Site stress factors: dl=dry post anthesis, rh=rhizoctonia, nn=net form blotch, sn=spot form net blotch, st=storm damage

Data source: SARDI/GRDC & NVT (long term data based on weighted analysis of sites, 2005-2013).

Data analysis by GRDC funded National Statistics Group

SA Oat variety yield performance

2013 and long term (2007-2013) expressed as % of site average yield and as t/ha

	2013 (as % site average)		Long Term average across sites within region (2007 - 2013) 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	2.82	2.23	124	4	117	5
Dunnart	1.47	1.75	107	7	112	8
Echidna	2.32	2.02	116	4	109	4
Euro			93	6	104	7
Mitika	2.97	1.82	116	7	109	8
Numbat	1.80	1.26	85	3	69	4
Possum	3.15	1.90	115	7	109	8
Potoroo	2.74	1.69	115	7	114	8
Williams	3.37	1.99	129	4	112	5
Wombat	2.43	1.96	112	6	110	8
Yallara	1.65	1.50	94	7	103	8
Site av. yield (t/ha)	**2.55**	**1.67**	**3.39**		**1.71**	
LSD % (P=0.05)	*16*	*14*				
Date sown	24 May	8 May				
Soil type	L	L				
pH (water)	6.1	8.7				
J-M/A-O rain (mm)	27/568	40/187				
Previous crop	canola	pasture				

Soil types: L=loam

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

Port Kenny, Elliston, Wharminda and Franklin Harbour wheat and barley variety trials

RESEARCH

Cereals

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Try this yourself now

Location: Port Kenny
Jake Hull
Mt Cooper Ag Bureau

Rainfall
Av. Annual: 400 mm
Av. GSR: 300 mm
2013 Total: 380 mm
2013 GSR: 327 mm

Yield
Potential: 4.6 t/ha (W), 5.0 t/ha (B)
Actual: 3.5 t/ha (W), 4.2 t/ha (B)

Paddock History
2013: Wheat
2012: Canola
2011: Barley

Soil Type
Grey calcareous sandy loam

Plot Size
1.5 m x 10 m x 3 reps

Location: Elliston
Nigel and Debbie May
Elliston Ag Bureau

Rainfall
Av. Annual: 427 mm
Av. GSR: 353 mm
2013 Total: 486 mm
2013 GSR: 428 mm

Yield
Potential: 6.3 t/ha (W)
Actual: 1.5 t/ha

Paddock History
2012: Grass free topped pasture

Soil Type
Sand

Plot Size
1.5 m x 10 m x 3 reps

Yield Limiting Factors
Take-all

Key messages

- **Top five highest yielding varieties at Port Kenny in 2013 were Scout, Cobra, Corack, Mace and Wyalkatchem.**
- **Compass, Fathom and Skipper performed well at Port Kenny.**
- **There were no differences in yield between varieties in this trial however Cobra, CL Justica and Espada performed the best at Franklin Harbour in the 2013 season.**

Why do these trials?

These variety trials were identified as priorities by local Agricultural Bureaux to compare current varieties to ones which are not commonly grown in their respective districts, and to compare varieties in soil types and rainfall regions where wheat and barley National Variety Trials (NVT) are not conducted.

Port Kenny district wheat and barley trials

How was it done?

Fifteen wheat varieties and 12 barley varieties, replicated three times, were sown on 19 May with both trials receiving 71 kg/ha of 19:13:0:9.4S and 41 kg/ha of 46:0:0:0 (urea) fertiliser at sowing. On 26 June 50 kg/ha of urea was applied by the farmer. 1 L/ha Roundup PowerMax, 300 ml/ha Ester680, 100 ml/ha Goal, 100 ml/ha Dimethoate and 1.2 L/ha trifluralin were applied to both trials pre seeding, and 500 ml/ha Tigrex was applied for broad-leaved weed control on 31 July.

What happened?

Trials were sown into a canola stubble left from the previous year, providing a clean paddock with an insignificant amount of Rhizoctonia and minimal weed issues. The trial received an above average growing season rainfall of 327 mm, which gave the varieties excellent yield potential. Scout, Cobra, Corack, Mace and Wyalkatchem all took advantage of this rainfall, yielding above 3.65 t/ha (Table 1). Screenings and test weights were excellent in all varieties, however protein levels were down which was expected due to the good rainfall and the canola's nitrogen requirements in the previous year.

Elliston district wheat trial

How was it done?

Fifteen wheat varieties, replicated three times, were sown on 14 May with 100 kg/ha of DAP fertiliser and 400 ml/ha of flutriafol @ 250g/ha. The site received 1 L/ha glyphosate @ 570 g/L, 0.1 L/ha oxyfluorfen, 1 L/ha of trifluralin @ 480 g/L and 118 g/ha pyroxasulfone @ 850 g/kg prior to sowing. 1.4 L/ha MCPA @ 200 g/L, Bromoxynil @ 200 g/L, 0.25 L/ha cloquintocet-mexyl @ 25 g/L and 0.5 L/ha methyl esters of canola @ 440 g/L were applied mid-tillering in early July to control post emergent weeds. 3 L/ha of Zn, Mn & Cu foliar mix and 50 kg/ha of urea were also applied at the mid-tillering growth stage. Bait was spread to control snails in September.

The barley trial averaged 4.15 t/ha with Compass (4.46 t/ha), Fathom (4.45 t/ha) and Skipper (4.44 t/ha) producing the highest yields in the trial (Table 2). The potential malting varieties Compass and Skipper had positive results, competing and yielding as good as the feed variety lines.

Location: Wharminda
Tim Ottens
Wharminda Ag Bureau

Rainfall
Av. Annual: 338 mm
Av. GSR: 253 mm
2013 Total: 418 mm
2013 GSR: 328 mm

Yield
Potential: 5.3 t/ha (W)
Actual: 3.0 t/ha

Paddock History
2012: Grass free topped pasture

Soil Type
Sand

Plot Size
1.5 m x 10 m x 3 reps

Yield Limiting Factors
Storm damage

Location: Cowell
Tim Franklin
Franklin Harbour Ag Bureau

Rainfall
Av. Annual: 400 mm
Av. GSR: 256 mm
2013 Total: 280 mm
2013 GSR: 327 mm

Yield
Potential: 3.4 t/ha (W)
Actual: 3.7 t/ha (W average)

Paddock History
2013: Axe wheat
2012: Parabinga medic
2011: Axe wheat

Soil Type
Red clay loam

Plot Size
2 m x 20 m x 3 reps

Yield Limiting Factors
None

Table 1 Grain yield and quality of wheat varieties sown at Port Kenny in 2013

Variety	Yield (t/ha)	Protein (%)	Screenings (%)	Test Weight (kg/hL)
Scout	3.78	9.2	1.0	84.6
Cobra	3.73	10.0	1.3	83.0
Corack	3.68	9.3	0.9	83.8
Mace	3.66	9.8	1.0	83.2
Wyalkatchem	3.65	9.8	1.1	83.5
Espada	3.58	10.1	1.6	81.7
Kord	3.53	10.2	1.1	82.9
Gladius	3.47	10.5	0.8	82.8
Justica	3.45	10.2	1.4	81.3
Yitpi	3.42	10.5	1.6	81.9
Emu Rock	3.42	9.9	1.3	84.3
Phantom	3.40	9.4	1.6	84.0
Grenande	3.40	10.1	1.1	81.3
Shield	3.36	10.2	2.5	82.4
Axe	3.06	10.8	0.6	82.9
Mean	**3.51**	**10.0**	**1.3**	**82.9**
CV	*3%*			
LSD (P=0.05)	*0.18*			

Table 2 Grain yield and quality of barley varieties sown at Port Kenny in 2013

Variety	Yield (t/ha)	Protein (t/ha)	Screenings (%)	Test Weight (kg/hL)	Retention (% by weight)
Compass	4.46	10.0	1.2	68.8	92.8
Fathom	4.45	10.2	1.9	68.4	87.6
Skipper	4.44	9.7	1.3	72.6	94.4
Commander	4.37	10.0	2.3	69.7	87.7
Oxford	4.26	9.9	5.7	67.7	71.7
Fleet	4.20	10.2	1.9	67.8	85.9
IGB1101	4.19	10.0	1.7	70.6	90.1
Hindmarsh	4.14	9.7	1.7	72.1	91.4
Buloke	4.09	10.3	3.8	69.9	75.0
Scope	4.08	9.7	2.6	70.4	81.2
Flagship	3.70	10.6	1.8	72.0	88.7
Schooner	3.43	10.2	2.1	71.6	86.9
Mean	**4.15**	**10.0**	**2.3**	**70.1**	**86.1**
CV	*4.2%*				
LSD (P=0.05)	*0.30*				

What happened?

The Elliston trial showed symptoms of Take-all late in the growing season, which impacted on yield and caused some variability in the trial. The average yield from the trial was 1.45 t/ha with Emu Rock, Phantom and Mace all producing the highest yields (Table 3). Test weight was low at this site, which would have caused some down-grading at the silos.

The district wheat trial at Elliston has been conducted since 2006. Throughout that time the variety Yitpi has been a constant entry and provides a point of reference for long term comparisons. Table 4 shows grain yield as a percentage of the Yitpi yield over the past five years. The five year average shows an advantage for the longer season varieties at Elliston, with Scout and Estoc being the only two varieties with higher long term yields than Yitpi in that period.

Wharminda District Wheat Trial

How was it done?

Fifteen wheat varieties, replicated three times, were sown on 16 May with 80 kg/ha of DAP fertiliser and 400 ml/ha of flutriafol @ 250 g/ha. On 3 July 3 L/ha of Zn, Mn & Cu foliar mix was applied and urea @ 50 kg/ha was applied on 26 July. The trial chemical regime consisted of 1.0 L/ha glyphosate @ 570 g/L, 1.0 L/ha trifluralin @ 480 g/L, and 0.1 L/ha oxyfluorfen at seeding.1.4 L/ha MCPA @ 200 g/L and bromoxynil @ 200 g/L were applied for broad-leaved weed control.

What happened?

Mace, Emu Rock and Corack recorded the highest yields in the district trial at Wharminda with yields of 3.85 t/ha, 3.70 t/ha and 3.67 t/ha respectively (Table 5). Grain quality was quite good at the Wharminda trial in 2013, however the higher yielding varieties such Mace and Corack produced lower protein.

Table 3 Grain yield and quality of wheat varieties sown at Elliston, 2013

Variety	Yield (t/ha)	% of Site Mean	Protein (%)	Screenings (%)	Test Weight (kg/hL)
Emu Rock	1.85	127	11.7	3.0	77.4
Phantom	1.71	118	10.4	3.1	77.7
Mace	1.70	117	11.2	3.6	75.4
Shield	1.61	111	11.4	4.4	73.5
Wyalkatchem	1.60	110	11.3	3.3	74.1
Espada	1.55	106	12.3	3.6	72.6
Kord CL Plus	1.47	101	12.2	2.1	78.1
Yitpi	1.41	97	10.9	4.5	75.4
Scout	1.33	91	11.2	2.5	78.4
Grenade CL Plus	1.33	92	11.3	0.5	80.0
Corack	1.32	91	11.7	4.0	74.0
Justica CL Plus	1.25	86	11.7	1.8	75.9
Gladius	1.25	86	11.8	2.4	75.4
Axe	1.22	84	12.4	2.1	74.2
Cobra	1.21	83	11.6	4.4	72.6
Mean	**1.45**		**11.5**	**3.0**	**75.6**
CV	*13.8%*				
LSD (P=0.05)	*0.38*	*26*			

Table 4 Long term yield of wheat varieties in Elliston trials as a percentage of Yitpi, 2009-2013

Variety	2013	2012	2011	2010	2009	Average
Axe	87	92	83	82	58	80
Corack	93	94	85			91
Correll		96	84	95	85	90
Espada	110	92	104	101	76	97
Estoc		96	100	105		100
Frame				94	88	91
Gladius	89	86	90	91	83	88
Justica CL Plus	89	87	81			86
AGT Katana		92	100			96
Kord CL Plus	104	75	100			93
Lincoln		81	102	96	78	89
Mace	121	99	99	89	80	98
Scout	92	106	103	102		101
Wyalkatchem	113	97	85	87	78	92
Yitpi	100	100	100	100	100	100
Yitpi (t/ha)	**1.4**	**3.1**	**4.0**	**4.0**	**4.1**	**3.3**

Table 5 Grain yield and quality of wheat varieties sown at Wharminda, 2013

Variety	Yield (t/ha)	% of Site Mean	Protein (%)	Screenings (%)	Test Weight (kg/hL)
Mace	3.85	129	10.0	1.0	80.3
Emu Rock	3.70	124	11.2	1.3	81.8
Wyalkatchem	3.69	123	10.3	0.8	80.9
Corack	3.67	123	10.3	0.8	80.8
Cobra	3.51	117	10.5	1.3	79.7
Gladius	3.05	102	11.2	1.6	76.9
Grenade CL Plus	3.05	102	10.7	1.9	78.7
Shield	2.93	98	11.4	4.2	75.0
Espada	2.91	97	11.1	2.2	76.9
Justica CL Plus	2.72	91	11.2	2.5	76.6
Scout	2.52	84	10.6	5.9	77.3
Kord CL Plus	2.46	82	11.4	0.8	77.3
Axe	2.43	81	12.6	1.0	77.7
Yitpi	2.24	75	12.1	4.4	77.2
Phantom	2.13	71	12	5.9	73.2
Mean	**2.99**		**11.1**	**2.4**	**78.0**
CV	*7.8%*				
LSD (P=0.05)	*0.39*	*13*			

Franklin Harbour Wheat Trial

How was it done?

A 2012 Parabinga medic pasture was established with seed broadcast then sprayed with Broadstrike and Targa in July. 1.5 L/ha Roundup and 500 ml/ha LV Ester 680 were also applied to the trial site on 14 October 2012.

The replicated Franklin Harbour wheat variety trial was sown by the Agricultural Bureau on 15 May 2013 with the Minnipa plot seeder into the worked medic pasture paddock. Pre seeding on 6 May, the paddock received 1 L/ha glyphosate, 175 ml/ha Ester 680, 100 ml/ha oxyflouren, 35g/ha Logran and Wetter (0.1%). The trial plots were sown on 15 May with full cut shears, at a seeding rate of 60 kg seed and with 60 kg 18:20:0:0. On 18 June the paddock was sprayed with 1 L/ha Hoegrass and wetter (0.25%). On 8 July the paddock was sprayed with 125 ml/ha Zinc Max, 7 g/ha Ally, 80 ml/ha Lontrel and 500 ml/ha Amicide 625.

The trial was harvested 13 November with the small plot header and grain quality was assessed.

What happened?

The 2013 season at Franklin Harbour produced high yields, low grain protein levels, low screenings and high test weights in all varieties sown. The average yield from the trial was 3.67 t/ha with Cobra, CL Justica and Espada all producing the highest yields (Table 6). Axe produced the lowest yield but highest protein in the trial in the 2013 season.

What does this mean?

Variety selection should be made by yield performance over more than one year, however the disease resistance package (either root or leaf), sprouting tolerance, maturity, height, herbicide tolerance (Clearfield) and grain quality, are all important characteristics that should be considered when choosing a variety to fit your farming system.

For more extensive options and details on any variety visit the National Variety Trials (NVT) website at www.nvtonline.com.au, or refer to the articles in the EPFS Summary 2013 NVT Cereal Yield Performance Tables and the Cereal Variety Disease Guide.

Table 6 Grain yield and quality of wheat varieties sown at Franklin Harbour, 2013

Variety	Yield (t/ha)	% of Site Mean	Protein (%)	Screenings (%)	Test Weight (kg/hL)
Cobra	3.85	105	10.3	1.6	85.0
CL Justica	3.82	104	10.2	1.0	83.6
Espada	3.80	103	10.9	1.0	83.6
Yitpi	3.75	102	9.9	1.0	84.4
Scout	3.75	102	9.9	1.1	86.3
Gladius	3.75	102	10.6	1.1	83.9
Shield	3.75	102	9.9	2.3	84.3
Mace	3.74	102	10.3	0.9	84.9
Corack	3.73	102	10.2	1.1	86.8
Emu Rock	3.71	101	10.8	1.6	85.2
Wyalkatchem	3.66	100	10.5	0.6	85.0
CL Ford	3.57	97	10.5	2.0	83.8
Phantom	3.54	96	9.7	1.2	84.8
CL Grenade	3.51	96	10.4	0.8	84.5
Axe	3.16	86	11.4	0.7	84.9
Mean	**3.67**		**10.4**	**1.2**	**84.7**
CV	*9.5%*				
LSD (P=0.05)	*ns*		*0.5*	*0.6*	*1.1*

Acknowledgements

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Cereals

Government of South Australia
Eyre Peninsula Natural Resources Management Board

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Managing heat stress in wheat

Paul Telfer, James Edwards, Dion Bennett and Haydn Kuchel
Australian Grain Technologies (AGT), Roseworthy Campus

RESEARCH

Key messages

- **Heat stress is a key yield limiting factor in crop production.**
- **Heat stress has been shown to adversely affect yield as early as growth stage 45.**
- **Post flowering heat stress is most common in South Australia.**
- **Delayed sowing increases the chance of the crop being exposed to heat stress, particularly at the vulnerable pre-flowering growth stages.**

Why do the trial?

Wheat crops in most production zones of Australia, and more specifically southern Australia, frequently experience temperatures which inhibit optimal plant growth. Heat stress during flowering and grain filling has been shown to adversely affect grain yield, through both of its constituents, grain number and grain weight. Work is being undertaken to determine the effect of heat stress on wheat and its economic impacts, and to investigate different variety responses to heat stress. The purpose of this research is to develop a detailed understanding of the genetic basis of heat stress tolerance to help develop varieties that are better able to handle the harsh growing conditions encountered by wheat in SA. This study aims to build on work previously conducted by AGT (funded by SAGIT) at Roseworthy (EPFS Summary 2011, p 37), where varietal differences have been identified in controlled environment conditions. Although work is still being conducted to dissect and understand plant responses under these controlled conditions, preliminary field testing across southern Australia has started to validate these findings. This study presents an investigation into the effect of heat on wheat production in 2013.

How was it done?

Field experiments were conducted at six locations across SA for this project in 2013 and the grain yield, screenings and hectolitre weight (HLW) were recorded for each plot. These locations were Angas Valley, Booleroo, Minnipa, Pinnaroo, Roseworthy and Winulta, with sowing dates for each site shown in Table 1. Climatic data was collected using in-trial temperature loggers and rainfall from the nearest bureau of meteorology station. A set of 24 varieties, which consisted of locally grown varieties, a group of varieties that display contrasting performance to heat stress under controlled environment conditions, as well as a selection of exotic introductions that are of potential interest for heat stress tolerance.

Additional experiments, using the same set of varieties were conducted in the AGT-SAGIT heat chamber at Roseworthy, which generates a growing environment with temperatures of 36°C and 40 km/hr winds, while allowing us to remove confounding effects such as drought and maturity. Plants were placed in the chamber for three consecutive eight hour days, 10 days after the main tiller had finished flowering (GS72). Additional stresses were also tested at; booting (GS45), three quarters head emergence (GS57), start of flowering (GS62) and the end of flowering (GS69). Measurements were then taken to assess leaf damage, grain number, grain weight and harvest index.

What happened?

Field trials

The 2013 season started solidly, with sufficient rain through the growing season for most of SA. Unfortunately, by spring the situation changed quickly with stresses typical of our environment, such as frost, heat and drought coming to the fore. Although the dataset presented in this study is quite small, and is only from one year, it clearly demonstrates the negative impact of heat stress on production in 2013. Preliminary analysis of the average site grain yield for each of the six locations is shown in Table 1, along with growing season rainfall, the average maximum daily temperature experienced for the duration of both flowering and grain filling, and the number of days over 30°C experienced during both flowering and grain filling. Although these variables are used to explain the variation seen in the grain yield at each of the sites, they are not necessarily completely independent, so can only be used as an indicator of interaction with grain yield potential. Changes in average daily maximum temperature during flowering and grain filling had a negative effect on grain yield of 518 kg/ha and 1140 kg/ha (Figure 1) respectively for every one degree increase in average maximum temperature. During grain filling in particular, this accounted for a large component of the variation within the dataset (98%). Interestingly this is larger than the variation accounted for by growing season rainfall (84%).

Table 1 Summary of preliminary analysis of 2013 field trials across six locations in South Australia. For each climatic parameter, the significance of its correlation with site average yield is shown, along with the effect on grain yield for every one unit change in the parameter

Site	Grain yield (kg/ha)	Sowing date	Growing season rainfall (mm)	Average maximum tempera-ture °C during flowering	Number of days >30°C during flowering	Average maximum tempera-ture °C during grain fill	Number of days >30°C during grain fill
Angus Valley	1789	23 May	263	26.0	6	27.7	8
Booleroo	3119	17 May	291	24.7	2	26.3	7
Minnipa	2295	15 May	225	23.2	5	27.3	10
Pinnaroo	2318	28 May	204	24.1	3	27.4	10
Roseworthy	3489	17 May	286	21.9	2	26.3	9
Winulta	5222	10 May	444	20.2	1	24.8	5
LSD (P=0.05)			*0.01*	*0.022*	*0.022*	*<0.001*	*0.049*
% variation accounted for			84	77	77	98	66
Effect (kg/ha)			14	-518	-570	-1140	-603

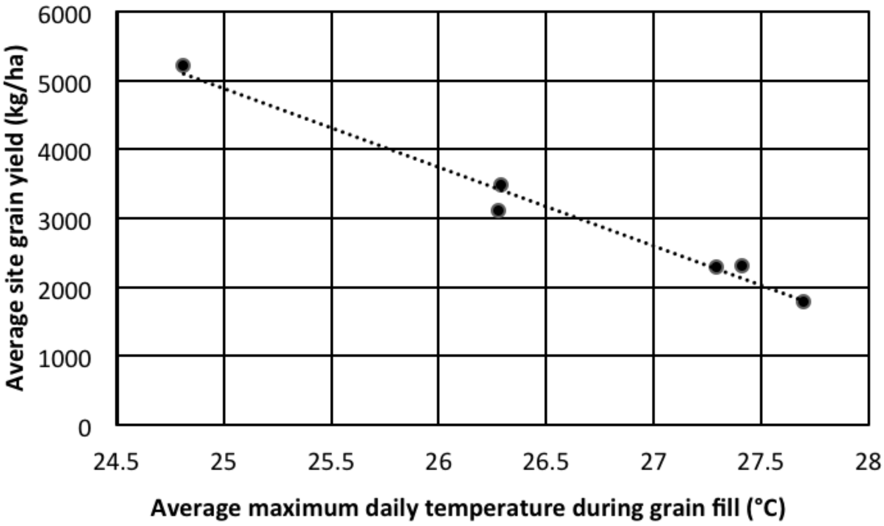

Figure 1 Average site grain yield plotted against the average maximum daily temperature (°C) during grain fill

This data set demonstrates the significant negative impact that heat stress can have in SA. The 2013 growing season generally set up a high yield potential, with limited stress conditions experienced until late in the season, when rainfall cut off. This left crops exposed to terminal drought stress and heat stress. Exacerbating the impact of heat stress, the 2013 season provided little opportunity for plants to acclimatise themselves (a factor which has been shown to be important for stress tolerance). The 2013 dataset also provided a good yield potential contrast; the average grain yield at Winulta was 5221 kg/ha, contrasting with Angas Valley which had an average grain yield of 1788 kg/ha. Associated with this was a good contrast in heat stress experienced, with Winulta being the coolest site (Table 1 and Figure 1).

Controlled experiments

The varieties included in the field experiments were also evaluated in controlled environment experiments that investigated the effect of heat stress at different growth stages. The role of abiotic stresses, such as excessive heat, at early growth stages has been proposed to be important in determining final grain yield. This study stressed wheat at five growth stages, ranging from booting through flowering to early grain fill. The impact of heat stress, conducted at each of these growth stages, on fertility and the change in leaf damage 3 and 10 days after stressing are shown in Figure 2. These results confirm that heat stress during early growth stages have large negative effects on the plant that result in corresponding yield penalties. Growth stage 45 or booting showed the greatest decline in fertility compared to the control.

Stress at this time corresponds to the formation of the pollen within the plant which is very sensitive to stress, with the size of the effects decreasing as stress occurs later in the plant's development. Flowering is also known to be sensitive to abiotic stress, with the pollen aborting or having reduced viability when subjected to stress. However, the opposite was observed for leaf damage, with less leaf damage observed at the earlier growth stages, while the rate of leaf senescence was increased if heat stress occurred post flowering and during early grain fill.

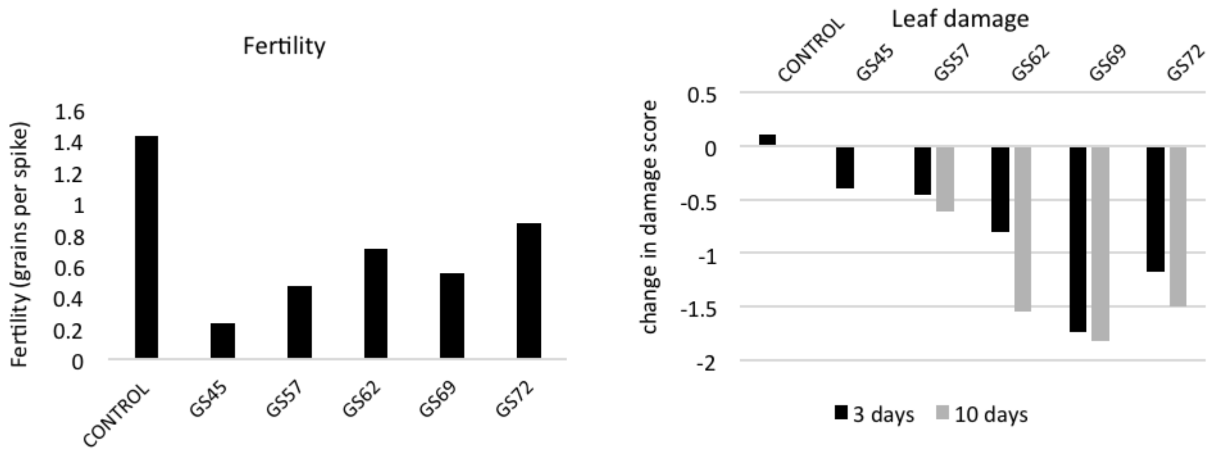

Figure 2 Treatment mean responses for fertility (grains set per spike), and change in leaf damage visual score 3 and 10 days after stressing (visual leaf score, based on the proportion of leaf area remaining viable)

Although the controlled environment experiment showed that there is greater potential for damage to occur to the plant's reproductive structures in earlier growth stages (Figure 2), from as early as GS45 through to grain filling, it should be noted that heat stress generally occurs during grain filling in SA. Due to the increased chance of heat stress occurring during grain filling, the effects on grain yield are generally of greater economic importance, as demonstrated by the 2013 field trials. The implication of this is to ensure appropriate sowing times are chosen for crops to minimise the risk of exposure. Although not presented here, analysis of other data sets from late sown trials has shown the considerable increase in exposure to heat stress with later sowing times.

What does this mean?

Heat stress had a significant impact on wheat production in SA in 2013. This study confirmed that variety selection and early sowing are still the most effective means to reduce the risk of a crop being damaged by excessive heat. A later sown crop will have an increased likelihood of being exposed to the heat stress at more sensitive growth stages, particularly pre-flowering, and will have greater consequences to the potential grain yield. Some of the effects on grain yield published in this study are higher than those previously seen, possibly due to the harsh conditions seen at times during the latter part of the growing season. Additional data will be required to improve this response calibration.

Further research is being carried out to dissect and understand the genetic basis to variation in heat stress tolerance exhibited by different varieties.

Acknowledgements

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AGT Australian Grain Technologies SEEDS FOR SUCCESS

SAGIT

Wheat seed source and seed size effects on grain yield

RESEARCH

Shafiya Hussein[1] and Glenn McDonald[2]

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

Searching for answers

Location:
Minnipa Agricultural Centre
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: (W) 2.73 t/ha
Actual: 2.89 t/ha (average)
Paddock History
2012: Medic pasture
2011: Medic pasture
2010: Barley
Soil Type
Brown loam
Plot Size
1.5 m x 5 m x 3 reps
Yield Limiting Factors
Early finish and Boron

Key messages

- **Large wheat seed (>2.8 mm) had a 6.6% plant density improvement over medium size seed (2.5 mm - 2.8 mm) but had no effect on yield in 2013.**
- **Seed source significantly affected grain yield with a 4-6% yield difference between the lowest and highest yields.**
- **Variation in yield due to seed source was associated with seed P and K concentrations.**
- **Mace out-yielded Scout, producing 3.2 t/ha and 2.7 t/ha respectively. Mace also had the highest plant establishment at 130 plants/m^2 and high vegetative growth.**

Why do the trial?

Good quality seed is necessary for improved crop establishment and yield. Larger seed provides more nutrients for early growth, leading to good establishment and vigorous growth, which is important for competitive ability against weeds and pests. The source of seed is also important since location can affect seed nutrient content as it is influenced by soil type, fertilizer applications and seasonal conditions. Larger seeds with high nutrient content, such as phosphorus (P), will produce better yield in a nutrient poor soil.

This trial was conducted to determine the influence of seed size and seed source on plant vigour and grain yield and quality in a low rainfall environment.

How was it done?

Four wheat varieties (Emu Rock, Estoc, Mace and Scout) were selected from five diverse 2012 NVT sites across South Australia (Nangari, Nunjikompita, Turretfield, Wanbi and Penong).

Seed to be sown was sieved into two grain size fractions, being either greater than 2.8 mm diameter or 2.5 to 2.8 mm diameter, and sown at the Minnipa Agricultural Centre. The trial was conducted as a split plot design with the wheat variety as main plots, seed source as sub plots and seed size as sub-sub plots. This trial was replicated at Karoonda and Turretfield.

The trial was sown on 24 May 2013 at a rate of 150 plants/m^2 in 5 m plots by 6 rows with 24 cm row spacing. Fertiliser (19:13:0 S9%) was applied @ 71 kg/ha. The trial received a chemical application on 15 May 2013 with Roundup Attack @ 1 L/ha, + LI700 @ 250 ml/ha, LV Ester 680 @ 300 ml/ha, Striker @ 100 ml/ha. On 11 July the trial received an application of Tigrex @ 300 ml/ha, Lontrel @ 50 ml/ha, zinc sulphate @ 2.5L/ha and on 20 August 2013 Prosaro @ 150 ml/ha and Astound @ 400 ml/ha was applied.

The trial was assessed for plant establishment, early vigour (Greenseeker hand held sensor used for normalized difference vegetation index - NDVI), grain yield and grain quality.

What happened?

Large seed improved germination consistently at three replicated sites by 6-9%. Vegetative growth (measured by the Greenseeker) at early stem elongation was higher with larger seed at Minnipa; however, large and medium sized seed had no effect on yield.

Seed source affected yield at Minnipa. Yields were highest when seed from Penong, Turretfield and Wanbi was used at this trial site. The difference in yield between the best (Turretfield) and worst (Nangari) seed sources was 120 kg/ha at Minnipa and 190 kg/ha at Turretfield, equivalent to 4-6% yield difference. Variation in yield was most strongly associated with variation in grain P concentration among the seed sources (Figure 1, Table 1) and with grain potassium (K) concentration. Differences in mean grain size (37-44 mg) and grain protein concentration (11.4-17.0%) did not influence yield. In 2012, seed from Nangari also produced low yields (EPFS Summary 2012, p 35).

Soil tests (Colwell P) prior to seeding indicate adequate availability of P (41 mg/kg) in the top soil (0-10 cm) and very low availability (8 mg/kg) in sub soil (10-60 cm).

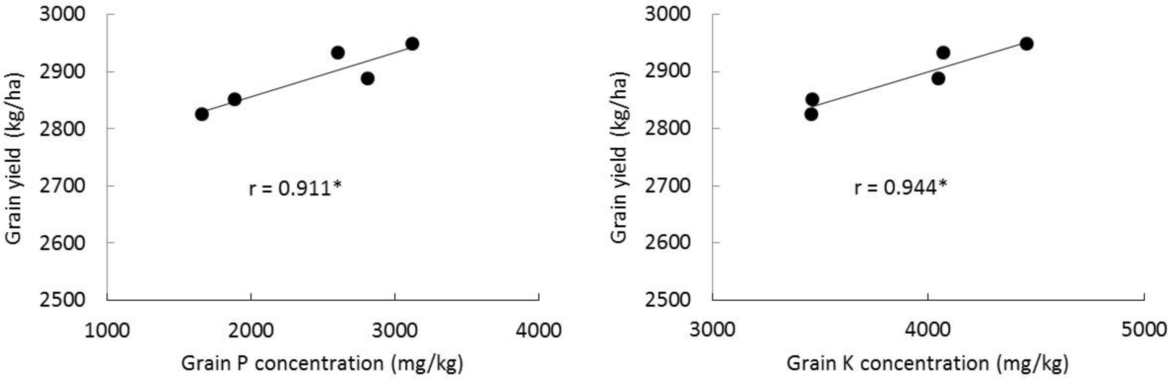

Figure 1 The relationships between the average P and K concentration of grain from different sources and the grain yield at Minnipa in 2013. Each point is the average of four varieties. * significance at P=0.05

Table 1 Mean nutrient concentration of seed from different NVT trials in 2012

Seed source	Thousand Grain wt (g)	GPC (%)	P	K	S	N:S ratio	Zn	Mn	Cu
			(mg/kg)				(mg/kg)		
Nangari	42.2	11.4	1668	3463	1389	14.4	8.9	29.3	4.5
Nunjikomita	37.6	14.7	1890	3467	1570	16.4	20.6	34.9	5.3
Penong	39.4	17.0	2613	4075	1810	16.5	19.7	55.2	3.4
Turretfield	43.6	11.9	3129	4457	1477	14.1	19.5	45.2	5.1
Wanbi	42.1	13.2	2817	4050	1612	14.4	21.1	28.2	3.2

Note: N:S ratio can be used to indicate sulphur (S) deficiency; if ratio >16 it suggests S is low (but not deficient)

Table 2 Mean yields (kg/ha) of varieties grown at three sites in 2013

Seed source	Site		
	Karoonda	Minnipa	Turretfield
Emu Rock	1923	3038	3608
Estoc	1673	2706	2927
Mace	1890	3151	3790
Scout	1758	2660	3394
	P<0.001	P<0.001	P<0.001
LSD (P=0.05)	*56.5*	*32.0*	*128.6*

Mace and Emu Rock yielded consistently more than Estoc and Scout across all the sites (Table 2). Grading seed did not alter the relative differences in yield significantly. The results are consistent with the results from 2012 when Emu Rock and Mace yielded well while Estoc and Scout produced lower yields.

Mace produced the highest yield at Minnipa when averaged across all treatments (3.15 t/ha) and Scout the lowest (2.66 t/ha). Seed size had no affect on yield: plump seeds (>2.8 mm) averaged 2.9 t/ha and medium sized seeds (2.5 -2.8 mm) averaged 2.9 t/ha also.

What does this mean?

Although larger sized seeds had a competitive edge over medium sized seeds in plant establishment and early plant vigour, any advantage was masked in yield. Early rain favoured varieties with larger seeds (Emu Rock and Mace) and these varieties continued to yield the highest in a dry seasonal finish. However, the seed size of each Emu Rock and Mace did not have any significant impact on yield at Minnipa in 2013.

Seed source can have a significant influence on yield and in this case low seed P and K were associated with lower yields. Ensuring that grain has high concentrations of nutrients will help ensure that a variety can express its potential yield.

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SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

THE UNIVERSITY OF ADELAIDE AUSTRALIA

Sowing in February: crazy or clever?

Dannielle McMillan[1], Alison Frischke[1] and James Hunt[2]
[1] Birchip Cropping Group; [2] CSIRO, Canberra

RESEARCH

Cereals

Almost ready

Location:
Curyo
Peter and Brenda Doran
BCG
Rainfall
Av. Annual: 370 mm
Av. GSR: 228 mm
2013 Total: 272 mm
2013 GSR: 218 mm
Yield
Potential:(W) 3 - 4 t/ha
Actual: Farmer paddock wheat 3.6 t/ha, highest yielding treatment Revenue at 3.4 t/ha
Paddock History
2012: Chickpeas
Soil Type
Sandy clay loam
Soil Test
PAW: 75 mm
Starting N: 83 kg/ha
Plot Size
1.8 m wide (6 rows on 30 cm row spacing) x 12 m long plots

Key messages

- **Winter wheat can be sown as early as February, flower at the optimum time and yield as well as spring wheat sown in May.**
- **Winter wheat provides lots of feed for livestock if used as a dual purpose crop.**
- **Future breeding efforts to improve adaptation of winter wheat to the Mallee environment are required.**

Why do the trial?

The amount of April to May rain the Mallee recieves has declined over the last decade, making it difficult to establish spring wheat crops at the traditional time. Winter wheat varieties (such as Wedgetail and Rosella) have a vernalisation requirement: they need to be exposed to low temperatures (4-18°C) for a certain period of time before spike development and stem elongation (GS30) can begin. This means that though winter wheat varieties can be sown much earlier than spring wheats (as early as late February), they do not flower too early and risk exposure to frost. Because of this, winter wheats have a more flexible sowing window (from March to early May) than spring wheats, which have an optimal window of about two weeks in the first half of May. Winter wheats also spend much longer in the tillering phase prior to GS30, and if used as a dual purpose crop can be safely grazed for longer than spring wheat.

Unfortunately, Australian breeding programs stopped selecting for milling quality winter wheats early last decade. There are very few cultivars available, particularly for medium-low rainfall zones with alkaline soils.

In mid February 2013, a storm delivered 54 mm of rain to the Curyo district north of Birchip. This turned out to be the only establishment opportunity until late May. The aim of this experiment was to discover how winter wheats performed when sown in response to late summer rain. Such a strategy may prove to be an adaption to reduced April to May rainfall, one which may improve grain yields by optimising flowering time, and also fill the feed-gap caused by dry autumns.

A similar experiment in 2012 (BCG 2012 Season Research Results, p 23-26) found that winter wheats were necessary to take advantage of such early sowing opportunities as even very slow maturing spring wheats (such as Bolac and Forrest) flowered too early. It also found that the best winter lines could yield as well as spring wheat varieties when dry-sown in May, and out-yield spring wheat sown after the break in June. However, the winter wheats used showed poor adaptation to alkaline soils, having no resistance to CCN, boron or salinity. This experiment aimed to evaluate a wider range of winter wheat lines to discover whether any were suitable for growing in the Mallee and to compare the early grazing and yield potential of winter wheat varieties sown very early in response to summer rain.

How was it done?

The trial was sown in the Curyo district north of Birchip on 26 February 2013 with four replicates of eight varieties of winter wheat, including; CSIROW7A, CSIROW8A, Revenue, Rosella, Wedgetail, Wylah, YW443 and Whistler. Table 1 shows the details and disease ratings of wheat varieties used. The trial was sown using the BCG parallelogram cone seeder (knife points, press wheels, 30 cm row spacing) and target plant density was 65 plants/m² for YW443 and 100 plants/m² for all other varieties.

Fertiliser was applied at sowing as MAP (Granulock supreme Z treated with Impact) @ 30 kg/ha, on 9 July as urea (45%N) @ 90 kg/ha and on 20 August as urea @ 180 kg/ha. The trial area received 118 g/ha of Sakura and 2 L/ha of Avadex Xtra herbicide and 400 ml/ha of Impact fungicide. Chemical control was applied on 1 July using herbicides Velocity @ 670 ml/ha, MCPA LVE @ 350 ml/ha and Hasten @ 1%. A fungicide was applied in-season on 28 August using Prosaro @ 150 ml/ha and Spreadwet @ 0.25%. An insecticide was used on 23 September with 200 ml/ha of Alpha Duo.

Table 1 Details and disease ratings of wheat varieties used in this trial

Variety	Maturity	Year of release	Quality	CCN	Stem rust	Stripe rust	YLS
CSIROW7A	Very fast winter	Experimental CSIRO near-isogenic line in a Sunstate background with no photoperiod sensitivity					
CSIROW8A	Mid winter	Experimental CSIRO near-isogenic line in a Sunstate background with moderate photoperiod sensitivity					
Revenue	Slow winter	2009	Feed (red grain)	-	R	R	MS-S
Rosella	Fast winter	1985	GP	S	MR-MS	MS	S
Wedgetail	Mid winter	2002	APW (APH in NWS)	S	MR-MS	MS	MS-S
Wylah	Mid winter	1998	APW (AH in NSW)	S	MR	MS	MS
Whistler	Fast winter	1999	ASW	S	MR	MS-S	-
YW443	Slow winter	N/A	-	-	-	-	-

This trial was sown on a chickpea stubble (starting nitrogen status 83 kg/ha) with starting sub-soil moisture of 75 mm plant available water (PAW), which included 54 mm of rain that fell on 14 February. Four replicates of each variety were mechanically defoliated on 8 July to simulate grazing at late tillering (pre-GS30). Dry matter production was measured at this time. Grain yield was measured using a small plot harvester, and all grain samples collected for further analysis. Grain yields were adjusted to 11.5 % moisture for the statistical analysis of results.

What happened?

Plants emerged evenly by early March and initially grew well on stored soil moisture present at the site. However, towards the end of March, the plants began to show signs of moisture stress which worsened until breaking rains fell in late May. With crops recovering and growth slow until a more significant rainfall in June (Figure 1), the first grazing was unable to be completed until 8 July.

Across the region, frosts (defined as air temperature below 2°C) were recorded up until late October, with a large amount of damage suffered by a number of crop types in the Wimmera and Mallee regions. At the Curyo site, 41 frosts and 18 heat stress days were recorded throughout the year, but this had no apparent effect on the winter wheat varieties.

All varieties matured differently, with YW443 and Revenue being the last two varieties to reach anthesis (Table 2). Varieties that had not been grazed were slightly more advanced than those that had, with the exception of Wylah and CSIRO W7A, where grazing seemed to accelerate development. Whistler, Wylah, Wedgetail and Rosella all flowered in mid-September, which is the time most optimal for yield potential in the southern Mallee (i.e. at the same time as spring wheat such as Scout sown in late April or early May).

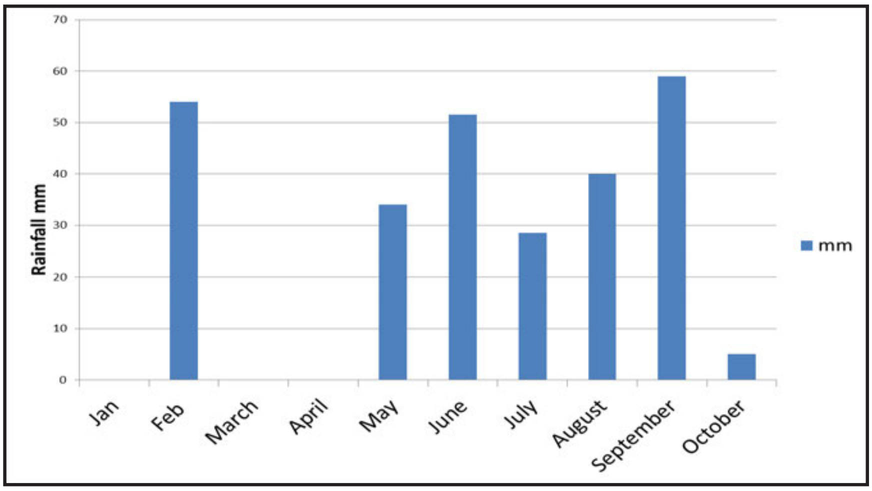

Figure 1 Monthly rainfall at the Curyo site in 2013

Revenue and Rosella achieved the highest yields, followed by Whistler, Wedgetail and Wylah (Table 3). There was no varietal interaction with grazing which, on average, reduced grain yields by 0.3 t/ha. The yield of Revenue was particularly impressive given its late flowering.

Kord wheat in the paddock surrounding the trial (sown on 18 May) averaged 3.6 t/ha (range: 3.0-4.4 t/ha). This further supports trial results from 2012 which showed that winter wheats sown on summer rain in the Mallee could achieve yields equivalent to those of spring wheats sown later. This is despite the fact that all available winter wheat varieties are ageing and/or poorly adapted.

All varieties achieved the protein, screenings and test weight specifications required to meet their maximum quality segregation; Wylah and Wedgetail could have been delivered into New South Wales as H1 and H2 respectively. Protein significantly increased when varieties were grazed (average 0.3 %) due to the linear relationship between protein and yield (as one decreases the other increases).

Table 2 Growth stage of different varieties on 12 September 2013

Variety	Ungrazed		Grazed	
	Zadoks code	Growth Stage	Zadocks code	Growth stage
YW443	46	Booting	39	Flag leaf emerged
Whistler	63	Early anthesis	51	Early heading
Wylah	61	Early anthesis	64	Mid anthesis
Wedgetail	66	Mid anthesis	61	Early anthesis
Rosella	60	Early anthesis	51	Early heading
Revenue	39	Flag leaf emerged	33	Three nodes on main stem
CSIROW8A	53	Early heading	51	Early heading
CSIROW7A	67	Late anthesis	63	Early anthesis

Table 3 Ungrazed grain yield and quality of the varieties in the experiment

Variety	Grain yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hL)
CSIROW7A	2.7	13.7	1.9	80
CSIROW8A	2.4	13.3	4.3	80
Revenue	3.4	11.5	4.6	76
Rosella	3.3	12.2	2.7	81
Wedgetail	2.8	12.4	2.5	77
Whistler	3.0	11.8	4.3	79
Wylah	2.8	13.1	2.6	76
YW443	1.7	15.4	3.7	74
P-value	<0.001	<0.001	<0.001	<0.001
LSD (P=0.05)	*0.3*	*0.9*	*1.2*	*3.0*
CV%	6.5	4.6	24.1	2.3

There was a significant difference between the dry matter produced by the varieties examined at all measurement stages (Table 4). At the time of grazing, Wylah, Rosella and Revenue recorded the highest dry matter available to be grazed (Table 4). In early October (when crops could have been cut for hay) Wylah, Rosella and Revenue again recorded significantly higher biomass than the other varieties.

YW443 measured a significantly lower harvest index than the other varieties. This is mainly due to it being the lowest yielding variety, as shown in Table 3. This variety is a Chinese winter wheat with clearly very poor adaption to the Mallee.

Tissue tests conducted on dry matter cuts taken on 8 July indicated that all varieties, with the exception of Rosella, had adequate nutrition to meet the minimum requirements for lactating ewes and lambs (Table 5). Revenue and Wylah would have been able to sustain the greatest number of grazing days.

Table 4 Dry matter production for winter wheat varieties, Curyo 2013

Variety	Dry matter 8 July (t/ha)	Dry matter 3 October (t/ha)	Dry matter at maturity (t/ha)	Harvest index	Seed weight (mg)
CSIROW7A	0.2	4.4	5.0	0.38	37
CSIROW8A	0.3	4.5	5.8	0.37	31
Revenue	0.5	5.2	6.5	0.40	39
Rosella	0.4	5.1	6.2	0.38	42
Wedgetail	0.3	4.9	6.0	0.40	40
Whistler	0.3	5.0	6.5	0.44	39
Wylah	0.4	5.5	6.8	0.38	38
YW443	0.4	4.1	5.2	0.31	44
P-value	<0.001	<0.001	<0.001	<0.001	<0.001
LSD (P=0.05)	*0.1*	*0.5*	*0.7*	*0.04*	*3*
CV%	24.6	11.1	12.2	11.1	6.8

Table 5 Nutritional value and dry sheep equivalent (DSE) grazing days from dry matter cuts on 8 July

Variety	Crude protein (% of DM)	Neutral detergent fibre (% of DM)	Digestibility DMD (% of DM)	Metabolisable energy (MJ/kg DM)	DSE grazing days
CSIROW7A	27	43	78	11.7	307
CSIROW8A	25	45	77	11.7	322
Revenue	24	40	83	12.6	740
Rosella	21	49	73	10.8	526
Wedgetail	26	44	80	12.1	424
Whistler	27	43	80	12.1	348
Wylah	24	44	78	11.8	605
YW443	24	41	81	12.2	549
Min. req. for lactating ewes and lambs	*>16%*	*>30%*	*>75%*	*>11 MJ kg/DM*	

What does this mean?

This experiment shows great potential for early sown winter wheats in the Mallee. Winter wheat varieties have the potential to reduce the impacts of dry autumns by ensuring more crop flowers on time, and stock can be adequately fed during the late-autumn early-winter feed gap.

Winter wheats can be sown from late February through to approximately 20 April, at which time our better adapted longer season spring wheats (Yitpi, Phantom, Harper, Magenta) will start to out-perform them. Yield of winter wheat is mostly maximised when sown in the first half of April, but sowing earlier is desirable if grazing of the crop is planned. If planning to graze, aim for optimum plant densities of between 100-150 plants/m^2; if not, plant densities of 60-80 plants/m^2 are adequate. The earlier crops are sown, the more soil water they require to keep them alive until winter. This experiment showed that approximately 70 mm was adequate in late February, and 25 mm was adequate in early April.

Although there is currently no perfectly Mallee-adapted winter wheat variety in existence, several of the varieties examined in this trial are suitable for growers wishing to try this practice commercially.

• Revenue has good resistance to foliar disease, provides the most autumn and winter grazing (can be grazed into August), and has shown that it is able to yield well even in a tough finish. Seed is readily available from south west Victoria, where it is a very popular variety. It is a red-grained feed wheat: grain needs to be either used on farm, or delivered directly to an end-user (dairy cows, chooks etc.) or to south west Victoria where red grained feed wheat trades at a $20-30 premium over white grained feed wheats as SFW1. It is an awnless variety; if cut for hay, it is more readily marketable.

• Wedgetail, Whistler and Wylah are all still commonly grown in southern NSW, and Wedgetail seed is readily available commercially. These three varieties need to be managed for stripe rust. Grazing can assist with early infection but a GS39 foliar spray is also required. Wedgetail and Wylah are classified APW in Victoria, but have good grain quality (APH and AH respectively in NSW) and they could potentially be marketed into higher grades.

• Rosella performed well in both 2012 and 2013 trials, but is also susceptible to stripe rust. It does not attract an end-point royalty, but is still grown in the Wimmera. However, it has lost its ASW-noodle segregation and can now be delivered only as GP.

All varieties tested are susceptible to CCN and sub-soil constraints; avoid sowing them in paddocks where these are likely to be an issue. Barley yellow dwarf virus can severely reduce yield of early sown crops, and it is recommended that seed be treated with imidicloprid (Gaucho) and crops monitored for aphids (a foliar spray is also sometimes required). If grazing, make sure that livestock are removed prior to GS30 to minimise the chances of a yield penalty. This occurs much later for winter wheats than for spring wheats.

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Wheat and barley variety tolerance to herbicide

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RESEARCH

Cereals

Wheat variety herbicide tolerance

Experiments investigating the tolerance of crop varieties to herbicides are conducted by State agencies throughout Australia, supported by funding from GRDC. Table 1 summarises this work in South Australia within trials conducted in the Hart/Kybunga area since 1993.

Within these experiments, a wide range of herbicides and tank mixes are applied pre and post sowing (crop dependent), at label recommended and twice recommended rates across each variety, under weed free conditions. The treatment rates provided an estimate of the varietal tolerance and safety margin likely through any differences in varietal response between the untreated control and the two rates applied. Comments and summary tables on varietal tolerance are generally based on data gained from two or more seasons experimental results, as year to year variation can be significant.

Preliminary results from evaluation of some newer chemistry (e.g. Boxer Gold and Sakura) against newer varieties can also be found on the NVT website. In early preliminary testing, Emu Rock has shown to be more sensitive to Sakura than other varieties when applied at above label rates.

Barley variety herbicide tolerance

Within herbicide by varietal tolerance trials conducted in the Kybunga district over many seasons, barley varieties have generally not shown herbicide intolerance (measured by yield loss) to the extent of that seen in wheat varieties. However the herbicides Cadence, Banvel, Tigrex and Bromoxynil/MCPA have commonly caused some yield loss and as Table 2 highlights, Cadence on Buloke, Tigrex on Fleet and Tigrex and Bromoxinyl/MCPA on Keel have been some of the more sensitive combinations over time.

Despite not being present in Table 2, recently released varieties such as Fathom, Flinders, Navigator, Skipper and Wimmera have undergone preliminary testing. Fathom has shown some increased level of sensitivity to Broadstrike and dicamba than other varieties when applied at rates exceeding label recommendations. Further information on these newer varieties can be accessed via the NVT website.

This data can be used to identify herbicide by variety combinations which minimise yield loss and best suit individual farming practices, primarily to obtain weed and herbicide resistance control. Information on varieties which have been tested in one year only should be treated with caution pending further trials. This research aims to evaluate all new varieties in the NVT program.

More information

For more extensive information please visit NVT Online www.nvtonline.com.au or contact project officer, Michael Zerner SARDI.

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Table 1 Long term summary of safety rating and potential % yield loss for selected bread wheat and durum varieties to various herbicides and tank mixes (Blyth district trials)

Variety	AGT Katana	Axe	Catalina	Correll	Espada	Estoc	Gladius	Hyperno	Mace	Saintly	Scout	Tjilkuri	Rates (product/ha)	Crop stage at spraying
Years Tested	**2009 - 2012**	**2008 - 2009**	**2007 - 2012**	**2006 - 2009**	**2009 - 2010**	**2009 - 2012**	**2006 - 2012**	**2009 - 2012**	**2009 - 2012**	**2009 - 2012**	**2009 - 2012**	**2009 - 2010**		
2,4D Amine 625	✓(2)	**6** (1/2)	**N** (1/3)	**14** (1/4)	**N** (1/2)	✓(2)	**6-11** (2/4)	✓(2)	✓(2)	✓(2)	✓(2)	✓(2)	1.4 L	2 node
Achieve®	✓(2)	**N** (1/2)	**N** (1/3)	**10** (1/4)	**7** (1/2)	✓(2)	**5** (1/4)	✓(2)	✓(2)	✓(2)	✓(2)	✓(2)	380 g	3 leaf
Affinity®	✓(2)	✓(2)	✓(3)	✓(4)	✓(2)	✓(2)	✓(4)	**N** (2/4)	✓(2)	✓(2)	✓(2)	✓(2)	60 g	3 leaf
Ally®	**6** (1/4)	**7** (1/2)	**N** (1/3)	**8-15** (3/4)	✓(2)	✓(2)	**9-18** (2/4)	✓(2)	✓(2)	✓(2)	✓(2)	✓(2)	7 g	3 leaf
Axial®	**N** (1/4)	**5** (1/2)	✓(3)	✓(4)	✓(2)	**N** (1/4)	✓(4)	✓(2)	✓(2)	✓(2)	✓(2)	✓(2)	250 ml	3 leaf
Banvel M®	-	**N** (2/2)	**N** (1/3)	**6** (1/4)	**7** (1/2)	-	**N** (2/4)	-	-	-	-	-	1.4 L	5 leaf
Boxer Gold®	✓(2)	✓(1)	✓(1)	✓(1)	✓(2)	✓(2)	**N** (1/1)	✓(2)	**N** (1/4)	✓(2)	✓(2)	✓(2)	2.5 L	IBS
Bromoxynil/ MCPA®	✓(2)	✓(2)	✓(3)	✓(4)	✓(2)	✓(2)	✓(4)	**5** (1/2)	**N** (1/4)	✓(2)	✓(2)	✓(2)	1.4 L	3 leaf
Cadence®	✓(2)	**10** (1/2)	**6-10** (2/3)	**N** (1/4)	✓(2)	✓(2)	**9** (1/4)	**9** (1/2)	**N** (1/4)	✓(2)	✓(2)	✓(2)	200 g	5 leaf
Conclude®	-	-	✓(3)	✓(2)	-	-	✓(3)	-	✓(1)	-	✓(3)	-	700 ml	5 leaf
Crusader®	-	-	-	✓(1)	-	-	✓(2)	✓(1)	✓(1)	-	✓(2)	-	500 ml	3 leaf
Diuron (500SC)/MCPA	✓(2)	**6** (1/1)	✓(2)	✓(3)	-	✓(2)	✓(3)	✓(2)	✓(2)	**6** (1/2)	✓(2)	✓(2)	500 ml/ 350 ml	3 leaf
Glean®	✓(2)	**9** (1/2)	✓(1)	**12** (1/2)	**6** (1/2)	**N** (2/4)	**7** (1/2)	**N** (1/4)	**N** (1/2)	**N** (1/3)	**N** (1/3)	✓(2)	20 g	3 leaf
Hussar®	✓(2)	**10** (1/2)	**9** (1/3)	**12** (1/4)	✓(2)	✓(2)	**17-19** (2/4)	**N** (1/4)	✓(2)	**N** (1/3)	✓(2)	✓(2)	200 g	3 leaf
Logran®	-	**N** (1/2)	✓(3)	✓(4)	**N** (1/2)	-	**5** (1/4)	-	-	-	-	-	35 g	PSPE
LVE MCPA	-	✓(1)	✓(2)	✓(3)	-	-	**N** (1/3)	-	-	-	-	-	1.2 L	5 leaf
Sakura®	-	-	✓(2)	✓(2)	-	-	✓(2)	-	-	-	✓(2)	-	118 g	IBS
Tigrex®	✓(2)	✓(2)	✓(2)	**7** (1/4)	**7** (1/2)	✓(2)	7 (1/4)	✓(2)	✓(2)	✓(2)	✓(2)	✓(2)	1 L	5 leaf

Table 2 Long term summary of safety rating and potential % yield loss for barley varieties to various herbicides and tank mixes (SA data from Kybunga district)

Variety	Buloke	Commander	Flagship	Fleet	Hindmarsh	Keel	Maritime	Oxford	Scope	Rates (product/ha)	Crop stage at spraying
Years Tested	2006 - 2009	2005 - 2007	2004 - 2009	2004 - 2006	2007 - 2009	1998 - 2001	2003 - 2005	2009 - 2012	2010 - 2012		
2,4D Amine 625	✓(4)	✓(3)	**10** (1/6)	✓(3)	✓(3)	✓(4)	✓(3)	✓(2)	✓(2)	1.4 L	2 node
Achieve®	**N** (1/4)	✓(3)	**5** (1/6)	**N** (1/3)	✓(3)	✓(4)	**N** (1/3)	✓(1)	-	380 g	4 leaf
Affinity®	**12** (1/4)	✓(2)	**N** (1/4)	✓(1)	**N** (1/3)	-	-	✓(2)	✓(2)	60 g	4 leaf
Ally®	**N** (1/4)	✓(3)	✓(6)	✓(3)	**N** (2/3)	✓(4)	**N** (1/3)	✓(2)	✓(2)	7 g	4 leaf
Axial®	✓(4)	✓(2)	**N** (1/4)	✓(1)	**11** (1/3)	-	-	✓(2)	**9** (1/4)	250 ml	4 leaf
Banvel M®	**N** (1/4)	**N** (2/3)	**16** (1/6)	**5** (1/3)	**8** (1/3)	**4** (1/4)	✓(3)	**N** (1/4)	✓(2)	1.4 L	6 leaf
Boxer Gold®	✓(1)	-	**6** (1/1)	-	✓(1)	-	-	✓(2)	✓(2)	2.5 L	IBS
Broadstrike®	✓(4)	✓(3)	✓(6)	✓(3)	**N** (1/3)	✓(4)	**5** (1/3)	✓(2)	✓(2)	25 g	6 leaf
Bromoxynil/ MCPA	**10** (1/4)	✓(3)	**12** (1/6)	**N** (1/3)	**6** (1/3)	**3-8** (2/4)	**N** (1/3)	✓(2)	✓(2)	1.4 L	4 leaf
Cadence®	**9-11** (2/4)	**12** (1/2)	**14** (1/4)	**N** (1/1)	✓(3)	-	-	✓(2)	✓(2)	200 g	6 leaf
Decision®	**12** (1/4)	✓(3)	✓(5)	**N** (1/2)	**7** (1/3)	-	✓(1)	✓(2)	✓(2)	1.0 L	4 leaf
Diuron/MCPA	**13** (1/4)	✓(3)	**N** (1/6)	**7** (1/3)	**10** (1/3)	✓(4)	**N** (2/3)	✓(2)	✓(2)	500 ml/ 350 ml	4 leaf
Glean®	✓(2)	✓(3)	✓(4)	✓(3)	✓(1)	**N** (1/3)	**N** (1/3)	✓(1)	-	20 g	4 leaf
LVE MCPA	✓(3)	✓(3)	✓(5)	✓(3)	✓(2)	**4** (1/4)	**4** (1/3)	-	-	1.2 L	6 leaf
Terbutryn	-	✓(1)	**N** (1/2)	**N** (1/2)	-	✓(4)	**4-7** (2/3)	-	-	850 ml	4 leaf
Tigrex®	✓(4)	✓(3)	**8** (1/6)	**7-8** (2/3)	**8** (1/3)	**4-6** (3/4)	**7** (1/3)	✓(2)	✓(2)	1 L	6 leaf

Key for shading and symbols in Tables 1 and 2

x-y% (w/z)	*Significant yield reductions at recommended rate in w years out of z years tested eg 6-10 (2/4) is yield losses of 6 to 10% in 2 out of 4 years tested.*
x% (w/z)	*Significant yield reduction at recommended rate in 1 trial only in z years of testing eg 8 (1/2) is 8% yield loss in 1 out of 2 years tested.*
N (w/z)	*Narrow safety margin – yield loss at higher than recommended herbicide rate only w years of z years tested.*
✓(z)	*No yield loss during z years of testing.*

Section 2

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Break Crops

Crop estimates by district (tons produced) in 2013

	Peas	Lupins	Beans	Vetch	Canola	Chickpeas
Western EP	4,750	1,000		100	5,400	
Eastern EP	5,500	5,500	200	300	9,000	100
Lower EP	8,000	44,000	12,000	1,400	82,000	280

Source: PIRSA, January 2014, Crop and Pasture Report, South Australia

Field pea variety trial yield performance 2013
(as a % of site mean) and long term (2007-2013) average across sites (as % of site mean)

Variety/Line	Lower Eyre Peninsula				Upper Eyre Peninsula		
	2013		2007-2013		2013	2007-2013	
	Lock	Yeelanna	% Site mean	Trial #	Minnipa	% Site Mean	Trial #
Kaspa	88	84	99	14	High variability in trials	101	6
Parafield	96	87	97	14		95	6
PBA Coogee**	79	86	91	4		97	3
PBA Gunyah	78	82	98	14		101	6
PBA Oura	97	108	108	14		102	6
PBA Pearl	125	139	121	10		109	5
PBA Percy	106	97	115	8		104	5
PBA Twilight	79	76	93	14		99	6
PBA Wharton	90	91	102	12		102	5
Sturt	-	-	120	4		106	6
Yarrum	-	-	101	10		100	5
Site mean yield (t/ha)	**1.57**	**2.39**	**1.74**		**0.86**	**1.74**	
LSD (P=0.05)	*17*	*15*			*30*		
Date sown	19 May	20 May			18 May		
Soil type	SL	CL			L		
Previous crop	Wheat	Wheat			Pasture		
Rainfall (mm) J-M/A-O	88/271	65/316			66/237		
pH (water)	6.3	8.2			8.4		
Site stress factors	dl				rh, dl		

** = Dual purpose type
Soil Types: S=sand, C=Clay, L=loam
Site stress factors: dl=post flowering moisture stress, rh=rhizoctonia

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 2013

2013 and predicted regional performance, expressed as % of site average yield

Variety	Lower Eyre Peninsula				Upper Eyre Peninsula			
	2013	**Long term average across sites**			**2013**	**Long term average across sites**		
	Cockaleechie	**t/ha**	**% Site Mean**	**# Trials**	**Lock**	**t/ha**	**% Site Mean**	**# Trials**
Farah	No valid result	2.13	100	11	92	1.55	101	4
Fiesta		2.13	100	11	91	1.56	101	4
Fiord		2.09	98	9				
Nura		2.09	98	11	85	1.45	94	4
PBA Rana		1.99	94	9	80	1.37	89	3
Site av. yield (t/ha)			**2.13**		**2.20**		**1.54**	
LSD (P=0.05) as %					*12*			
Date sown	9 May							
Soil type	SL				SL			
pH (water)	8.3				6.3			
Apr - Oct rain (mm)	316				271			
Site stress factors	cs							

Soil types: S=sand, L=loam
Site stress factors: cs=chocolate spot

Data source: SARDI/GRDC, NVT and PBA - Australian Faba Bean Breeding Program.
2007-2013 MET data analysis by National Statistics Program

EP Lupin variety trial yield performance 2013

2013 and predicted regional performance, expressed as % of site average yield

Variety	Lower Eyre Peninsula					Upper Eyre Peninsula			
	2013		**Long term average across sites**			**2013**	**Long term average across sites**		
	Wanilla	**Ungarra**	**t/ha**	**% of Site Mean**	**# Trials**	**Tooligie**	**t/ha**	**% of Site Mean**	**# Trials**
Jenabillup	105	97	2.53	102	20	88	2.02	100	14
Jindalee	81	78	2.02	82	20	55	1.64	81	14
Mandelup	83	111	2.40	97	20	120	2.00	99	14
PBA Gunyidi	102	98	2.63	106	14	92	2.14	106	10
PBA Barlock	113	109	2.62	106	16	112	2.11	105	12
Wonga	84	91	2.24	90	16	71	1.85	92	12
Site av. yield (t/ha)	**1.90**	**1.61**		**2.48**		**2.49**		**2.01**	
LSD % (P=0.05)	*12*	*9*				*12*			
Date sown	16 May	14 May				27 April			
Soil type	S	SL				SL			
pH (water)	6.8	5.7				6.2			
Apr - Oct rain (mm)	511	328				295			
Site stress factors									

Soil types: S=sand, L = Loam
Data source: SARDI/GRDC & NVT
2009 - 2013 MET data analysis by National Statistics Program

EP Desi & Kabuli chickpea variety trial yield performance 2013

(as a % of site mean) and long term (2007-2013) average across sites (as a % of site mean)

Variety	LOWER EYRE PENINSULA			UPPER EYRE PENINSULA		
	2013	2005-2012		2013	2005-2012	
	Yeelanna	% Site mean	Trial #	Lock	% Site mean	Trial #
Desi trials						
Ambar	100			129		
Genesis 079#	70	102	5	118	99	5
Genesis 090#	69	95	7	82	87	6
Neelam	102			104	106	3*
PBA Maiden	76			98		
PBA Slasher	100	103	7	100	104	6
PBA Striker	94	105	6	112	109	5
Site mean yield (t/ha)	**1.98**	**1.80**		**0.91**	**1.88**	
LSD % (P=0.05)	*8*			*8*		
Kabuli trials						
Almaz	82	88	4			
Genesis 079#	106	108	13			
Genesis 090#	100	103	13			
Genesis 114	97	87	4			
Genesis Kalkee	69	88	4			
PBA Monarch	79	99	4			
Site mean yield (t/ha)	**1.45**	**1.37**				
LSD % (P=0.05)	*10*					
Date sown	20 May			19 May		
Soil type	CL			SL		
Previous crop	Wheat			Wheat		
Rainfall (mm) J-M/A-O	65/316			88/271		
pH (water)	8.2			6.3		
Site stress factors						

 # Small kabuli type

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

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 2013

(as % of site mean yield) and long term (2007-2013) average across sites (as a % of site mean)

Variety	LOWER EYRE PENINSULA		
	2013	2007 - 2013	
	Yeelanna	% site mean	Trial #
Nipper	78	93	6
Nugget	79	93	6
PBA Ace (CIPAL803)	81	98	6
PBA Blitz	78	107	6
PBA Bolt (CIPAL801)	80	101	5
PBA Flash	97	106	6
PBA Herald XT	73	86	5
PBA Hurricane XT	98	-	-
PBA Jumbo	95	105	6
Site mean yield (t/ha)	**2.31**	**1.40**	
LSD % (P=0.05)	*6*		
Date sown	20 May		
Soil type	CL		
Rainfall (mm) J-M/A-O	65/316		
pH (water)	8.2		
Previous crop	Wheat		
Site stress factors			

Soil type: C=clay, L=loam

**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

(2013 performance expressed as % of site average yield)

Variety	Lower Eyre Peninsula		Upper Eyre Peninsula			Murray Mallee	
	2013		2013			2013	
	Mt Hope	Yeelanna	Lock	Minnipa	Mt Cooper	Lameroo	
AV Garnet	86	101	89			100	Conventional
AV Zircon	80	93	83			93	
CB Agamax	99	97	104	No	No	94	
CB Tango C	-	92	109			98	
Hyola 50	95	104	108	trial	trial	97	
Nuseeed Diamond	114	109	-			125	
Victory V3002	104	104	-			-	
Site Av. Yield (t/ha)	**1.55**	**2.03**	**1.22**			**1.17**	
LSD % (P=0.05)	*9*	*8*	*7*			*10*	
Archer	91	100	103	87	104	96	Clearfield
Carbine	98	92	119	-	-	110	
Hyola 474CL	107	107	122	112	107	102	
Hyola 575CL	110	109	-	111	107	93	
Hyola 577CL	92	93	-	96	112	-	
Pioneer 43C80 (CL)	-	-	-	119	89	-	
Pioneer 43Y85 (CL)	-	-	-	86	91	99	
Pioneer 44Y84 (CL)	95	90	98	85	92	114	
Pioneer 44Y87 (CL)	-	-	116	110	103	113	
Pioneer 45Y86 (CL)	103	104	-	116	102	-	
Pioneer 45Y88 (CL)	100	101	-	-	-	124	
VT X121CL	-	-	45	61	89	51	
Xceed Oasis CL	-	-	70	98	84	81	
Site Av. Yield (t/ha)	**1.65**	**1.94**	**1.09**	**0.78**	**1.47**	**1.00**	
LSD % (P=0.05)	*8*	*9*	*8*	*10*	*6*	*12*	
ATR Bonito	99	107		113	101	98	Triazine Tolerant
ATR Gem	97	103		103	108	105	
ATR Stingray	113	100		110	107	98	
ATR Wahoo	80	102		87	104	94	
CB Atomic HT	-	98		-	-	112	
CB Jardee HT	95	98		89	107	102	
CB Nitro HT	-	-	No	114	103	116	
CB Telfer	-	-		91	73	95	
Crusher TT	95	108		99	102	110	
Hyola 450TT	115	102	valid	104	106	107	
Hyola 555TT	108	111		116	115	-	
Hyola 559TT	114	110	result	111	119	125	
Hyola 650TT	114	-		-	-	-	
Hyola 656TT	113	118		112	122	-	
Monola 314TT	90	84		108	98	85	
Monola 413TT	90	84		81	86	104	
Monola 605TT	87	76		-	-	-	
Pioneer Sturt TT	-	-		109	106	89	
Thumper TT	99	104		-	-	-	
Site Av. Yield (t/ha)	**1.47**	**1.70**		**0.81**	**1.25**	**0.96**	
LSD % (P=0.05)	*9*	*10*		*10*	*12*	*0.15*	
Date sown	14 May	30 April	1 May	16 May	19 May	27 May	
Soil type	LS	CS	SL	L	SCL	L	
pH (water)	5.8	6.8	8.6	8.4	8.6		
Apr-Oct rain (mm)	406	316	271	237	341	222	
Site stress factors				dl	dl		

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

Site stress factors: dl=post flowering moisture stress

Data source: SARDI/GRDC, PBA & NVT

Field pea varieties and agronomy for low rainfall regions

Michael Lines[1], Larn McMurray[1] and Leigh Davis[2]
[1]SARDI, Clare; [2]SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location:
Minnipa Ag Centre, South 6 West
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential (Pulses): 1.75 t/ha
Actual: 1.6 t/ha
Paddock History
2013: Field peas
2012: Wheat
2011: Barley
2010: Barley
Soil Type
Brown Loam
Yield Limiting Factors
Low late season rainfall
Rhizoctonia
Ascochyta blight

Key messages

- **Field pea yields at Minnipa in 2013 were above the long term mean, averaging 1.63 t/ha.**
- **The relative yield loss from delayed sowing in 2013 was 19 kg/ha/day and lower than the long term average of 28 kg/ha/day, but continues to emphasise the importance of early sowing in these regions.**
- **PBA Oura showed higher yields than Kaspa and Parafield sown early, and will generally offer better long term yield stability.**
- **Inter-row sowing field peas into standing stubble has shown no yield benefit compared to slashed or removed stubbles in three seasons of trials.**
- **Significant lodging resistance and plant height improvements have been achieved through stubble management, which will benefit harvestability.**

Why do the trial?

The Southern Region Pulse Agronomy project is committed to developing agronomic management strategies that will maximise performance of new pulse varieties, particularly in the medium to low rainfall areas of Australia. Previous agronomic work conducted by this project has identified grain yield improvements of up to 30% in lentil by sowing inter-row into standing cereal stubble compared to where stubble was removed. These yield improvements have been achieved in the Pinery/Mallala region of the Mid North, which is characterised by medium rainfall and shallow soil depth. In a further trial in 2012, an 11% yield advantage was generated across multiple pulse crops (field pea, lentil and chickpea) by sowing into standing versus slashed stubble.

Recent seasons at Minnipa with above average rainfall and grain yield have produced thick, well anchored stubble ideal for conducting stubble research to identify whether yield improvements from varying stubble architecture are possible on upper Eyre Peninsula. Trials at Minnipa in 2011 and 2012 showed that substantial height and lodging resistance improvements can be generated by sowing field pea into standing versus slashed stubble, although no yield differences were recorded.

How was it done?

A multivariate agronomic field trial was set up at Minnipa in 2013. Treatments included two sowing times; early (2 May) and late (28 May), six varieties; Kaspa, Parafield, PBA Twilight, PBA Oura and OZP0804, and three stubble treatments; Standing (wheat stubble 27 cm high, ~1.5 t/ha), Slashed (pre sowing, ~ 1.5 t/ha) and Burnt (pre sowing) stubble. All plots were sown inter-row at 25 cm spacings. Scores for establishment, early vigour, disease, flowering, height, maturity and lodging were recorded during the year and grain yields were measured at harvest.

The trial was sown with 59 kg/ha of DAP (18:20:0:0). Metribuzin was applied post-sowing pre-emergent at 160 g/ha, and Select (300 ml/ha), Targa (150 ml/ha) and Astound (300 ml/ha) were applied for in-crop grass control. No broadleaved weed control was necessary. Insect sprays were applied as required.

What happened?

Annual rainfall (334 mm) and growing season rainfall (237 mm) was close to average at Minnipa in 2013. Grain yields were high (averaging 1.6 t/ha) due to the good winter rainfall, which buoyed crop yield despite low spring rainfall. Early season conditions were very favourable for plant growth, with warmer than average temperatures throughout winter, and yield potential was very high at the start of spring. However yields were limited by late season moisture stress. Low to moderate levels of blackspot were observed in trials in 2013. Some variation in growth was observed due to rhizoctonia infection, and may have suppressed growth and grain yield of field peas in these trials.

A significant sowing date by variety response was generated for grain yield (Figure 1). PBA Oura was the highest yielding variety when sown early, but yielded significantly lower than Kaspa and Parafield when sown late. Kaspa, Parafield and PBA Twilight performed similarly to each other at both sowing dates. OZP0804 (which was included in the trial for its improved boron tolerance) produced lower yields than PBA Oura when sown early, but similar yields to all other varieties. At the late sowing date it produced lower yields than all varieties except PBA Oura and PBA Twilight.

In 2013 delaying sowing by 26 days produced an average 27% yield loss across all varieties due to the dry and rapid finish to the season. This represents a 19 kg/ha/day yield loss, which is lower than the long term average yield loss of 28 kg/ha/day at this site.

Stubble management had no significant effect on grain yield in this trial in 2013, however differences in growth (height and lodging resistance) were measured. Vegetative standing height measurements (taken 5 August) showed that standing height of peas sown into standing stubbles was higher than those in slashed or burnt stubbles, which behaved similarly (Table 1). Visual observations showed the peas tendrils "netting" onto the standing stubble, which provided a trellis for the peas to grow up, leading to more erect plants.

Mature standing height (measured on 18 October) showed a similar trend to vegetative standing height in relation to stubble treatment. Peas sown into standing stubbles were 5 cm and 7 cm taller than those sown into burnt or slashed stubbles, respectively (Table 1). Peas sown into slashed stubble also showed increased standing height at maturity compared to those in burnt stubble.

Lodging scores showed a significant variety and stubble treatment response (Figure 2). Peas sown into standing stubble showed improved lodging resistance (i.e. were more erect) compared with those in burnt and slashed stubbles in all varieties except Kaspa, where standing stubble showed no improvement compared to slashed stubble. Kaspa was the only variety to show improvements in lodging resistance when sown into slashed compared to burnt stubble.

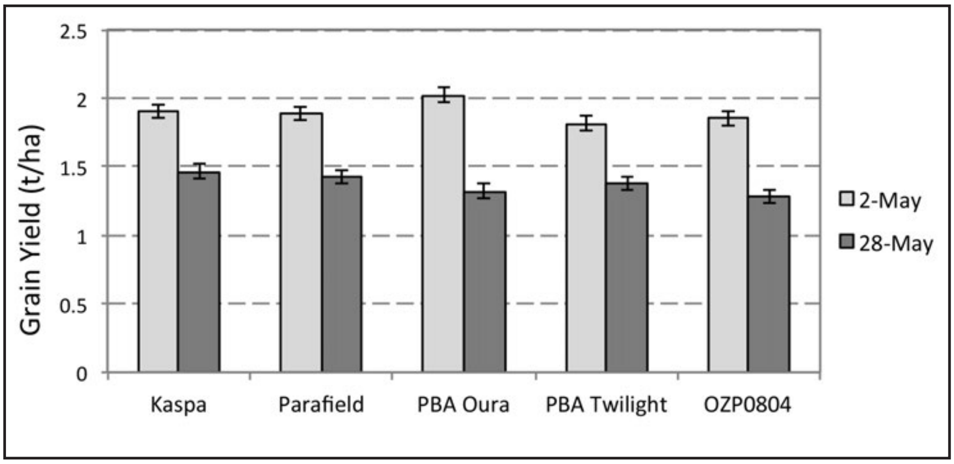

Figure 1 Effect of sowing date on grain yield of five field pea varieties, Minnipa 2013

Table 1 Effect of stubble treatment on vegetative standing height (cm) and mature standing height (cm) of field peas, Minnipa 2013

Measurement	Measurement Date	Burnt	Slashed	Standing	*LSD (P<0.05)*
Vegetative Standing Height (cm)	5 Aug	46.6	47.5	54.8	*3.5*
Mature Standing Height (cm)	18 Oct	34.8	36.7	41.8	*1.85*

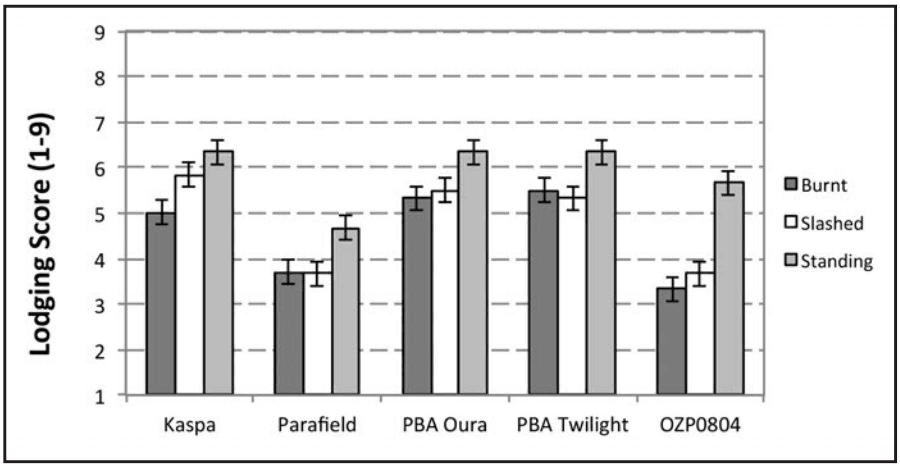

Figure 2 Effect of stubble management on lodging score (1-9*) of five field pea varieties, Minnipa 2013
**Lodging score: 1 = prostrate, 9 = erect*

What does this mean?

Good winter rainfall and mild spring temperatures enabled field peas to perform relatively well at Minnipa in 2013, despite the dry and rapid finish to the season. As in previous seasons, yield potential was maximised by early sowing. The relative yield loss in 2013 (19 kg/ha/day) was lower than the long term average (28 kg/ha/day), but emphasises the importance of early sowing in this area.

PBA Oura showed the highest grain yields when sown early, but was out-yielded by Kaspa and Parafield when sowing was delayed. Due to its later maturity, Kaspa has performed well in favourable seasons with above average rainfall, and can capitalise on late season rain events. However, earlier maturing varieties such as PBA Oura, PBA Twilight and PBA Gunyah will generally provide greater yield stability than Kaspa in the lower yielding short seasons or in years where early sowing cannot be achieved. PBA Twilight and PBA Gunyah have the same plant and seed type benefits of Kaspa, which are favoured for their milling quality and harvestability over wrinkled dun seed. PBA Oura produces seed that is suitable for marketing as Australian Dun type (similar to Parafield). PBA Oura has improved bacterial blight resistance compared to Kaspa, and although it does not have pod shatter resistance like the Kaspa types it is not prone to shattering (similar to Parafield). PBA Oura has improved downy mildew resistance (MR for Parafield strain, MS for Kaspa strain), and also shows improved metribuzin tolerance over other commercial varieties. This will be beneficial in regions with light or variable textured soils, or in high pH soils, where metribuzin damage is not uncommon.

Previous work conducted by the Southern Region Pulse Agronomy project in South Australia's Mid North has shown that sowing pulses, particularly lentil and field pea, into standing cereal stubble can benefit grain yield. However, no yield response has been generated at Minnipa from three years of trials investigating inter-row sowing of field pea into standing cereal stubble compared to slashed or removed stubble. Substantial differences in growth were achieved from this practice in trials at Minnipa in 2011 and 2013. This may aid harvestability, 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.

Acknowledgements

Select – registered trademark of Arysta Life Sciences and Sumitomo Chemical Co. Japan.

Targa - registered trademark of Nissan Chemical Industries, Co Japan.

Astound Duo - registered trademark of Nufarm Australia Limited.

Field pea and vetch forage options for low rainfall regions

Michael Lines[1], Larn McMurray[1] and Leigh Davis[2]
[1]SARDI, Clare; [2]SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location:
Minnipa Ag Centre, South 4
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential (Pulses): 1.75 t/ha
Actual: 1.6 t/ha
Paddock History
2013: Field peas
2012: Pasture
2011: Barley
Soil Type
Brown loam
Yield Limiting Factors
Low late season rainfall
Rhizoctonia
Ascochyta blight

Key messages

- **Vetches are a versatile break crop in low rainfall areas, offering both grain and 'forage' options.**
- **Dual purpose field pea varieties offer the flexibility of a forage option if grain yield is affected by seasonal stresses such as frost, and more established grain markets than vetch if taken through to harvest.**
- **The ideal timing of hay cutting is likely to be approximately 7-14 days after commencement of flowering (i.e. at early pod development, prior to grain fill).**
- **Biomass production averaged 2.8 t/ha at flowering and 3.8 t/ha at maturity across the trial.**
- **Kaspa, Morgan and PBA Coogee have generally shown similar but variable biomass levels at flowering in 2013, although Kaspa has generally shown higher grain yield.**
- **PBA Hayman generally shows higher biomass potential than other field pea varieties at flowering, comparison with vetch needs further evaluation.**
- **Biomass of field pea varieties at flowering was maximised at higher sowing densities, with no negative effect on grain yield.**
- **Further evaluation of these types is required across seasons varying in climatic conditions to assess their role, fit and management.**

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. Responding to industry feedback the PBA field pea program instigated a small but targeted program developing field peas for growing either as a forage or a dual purpose (grain or forage) crop. These lines have been characterised by high biomass production, improved bacterial blight resistance and (more recently) comparable grain yield with the straight grain varieties. Two varieties have recently been released: PBA Hayman and PBA Coogee (pronounced "Could-gee"). PBA Hayman was released as the first Australian forage field pea, while PBA Coogee has been released as a dual purpose field pea variety. Work funded by SAGIT has currently been assessing the biomass accumulation and grain yields in comparison with current field pea standards, Kaspa (the predominant grain yield variety in south eastern Australia) and Morgan (a dual purpose field pea variety) as well as several current vetch variety options. Minnipa Agricultural Centre is a key evaluation site of the project.

How was it done?

Two forage trials were set up; one to compare field pea and vetch varieties for biomass and grain yield potential, and the second to determine optimum sowing dates and sowing densities for maximising biomass production of field pea varieties. In the first trial, four field pea varieties (Kaspa, Morgan, PBA Coogee and PBA Hayman) and four vetch varieties (Morava, Rasina, Capello and the imminent new vetch release Volga) were sown on two sowing dates (5 May and 28 May). The second trial included four field pea varieties (Kaspa, Morgan, PBA Coogee and PBA Hayman) sown at four plant densities (25, 50, 75 and 100 plants/m^2) at two sowing dates (5 May and 28 May). In both forage trials, biomass measurements were taken during flowering and at maturity. Cuts during flowering were timed to correlate with early pod development (1-2 pods per plant, approximately 10-14 days after commencement of flowering). Final grain yield was also recorded.

All trials were sown with 59 kg/ha of DAP (18:20:0:0). Metribuzin was applied post-sowing pre-emergent at 160 g/ha, and Select @ 300 ml/ha, Targa @ 150 ml/ha and Astound @ 300 ml/ha applied for in-crop grass control. No broadleaf weed control was necessary. Insect sprays were applied as required.

What happened?

Annual rainfall (334 mm) and growing season rainfall (237 mm) was close to average at Minnipa in 2013. Grain yields averaged 1.0 t/ha across the trial, buoyed by good winter rainfall and mild spring temperatures despite the dry finish to the season. Early season conditions were very favourable for plant growth, with warmer than average temperatures throughout winter, and yield potential was very high at the start of spring. However yields were limited by late season moisture stress. Low to moderate levels of blackspot were observed in trials in 2013. Some variation in growth was observed due to rhizoctonia infection, and may have suppressed growth and grain yield of field peas in these trials.

Trial 1 Comparing performance of field pea and vetch cultivars

Flowering records showed that both Morgan and PBA Coogee commenced flowering at a similar date to Kaspa (Table 1), while PBA Hayman was 13 days later. All field pea varieties except PBA Hayman flowered earlier than all vetch varieties. The common vetch varieties Rasina and Volga were earlier flowering than Morava and the woolly pod vetch type, Capello.

Delayed sowing from early May to late May resulted in reduced biomass yield at flowering and at maturity. This was equal to a 27% reduction in biomass at flowering and a 29% reduction in biomass at maturity (Table 2).

Biomass cuts taken at flowering and at maturity showed significant variety responses (Figure 1). At flowering, Morava vetch had higher biomass than all field pea varieties and the earliest flowering vetch Rasina. The higher biomass at flowering in Morava compared to the earlier flowering vetch variety Rasina is likely due to its later flowering time, enabling more biomass accumulation prior to reproductive growth. The dual purpose field pea Morgan produced less biomass than all vetch varieties at flowering, and less than Kaspa but similar to the other two field pea varieties in this trial. PBA Hayman showed only similar biomass production at flowering compared to other field pea varieties at Minnipa in 2013. All previous and concurrent trials in the Mid North have shown that PBA Hayman produces significantly greater biomass than other field pea varieties at this timing. Further work is required to evaluate this result at this site.

At maturity the three common vetch varieties, Morava, Rasina and Volga showed significantly greater biomass (including grain yield) than the woolly pod vetch Capello and all four field pea varieties. Capello and the field pea varieties generally performed similarly, except that PBA Hayman produced less total biomass at maturity than Capello and PBA Coogee.

A significant grain yield response (Figure 1) showed that Volga produced more grain than all other vetch or field pea varieties. Kaspa was the highest yielding field pea, performing significantly better than PBA Coogee and PBA Hayman but only similarly to Morgan. The dual purpose field pea varieties Morgan and PBA Coogee showed similar grain yields. As expected, the forage field pea PBA Hayman produced the lowest grain yield of all field pea varieties, and also showed lower grain yield than all vetch varieties.

Table 1 Flowering dates of field pea and vetch varieties, Minnipa 2013

Field Pea	**Variety**	**Kaspa**	**Morgan**	**PBA Coogee**	**PBA Hayman**
	Flowering Date	11 Aug	12 Aug	9 Aug	24 Aug
	Flowering (days after sowing)	98	99	96	111
Vetch	**Variety**	**Morava**	**Rasina**	**Volga**	**Capello**
	Flowering Date	1 Sept	23 Sept	20 Aug	2 Sept
	Flowering (days after sowing)	119	110	107	120

Table 2 Effect of sowing date on biomass production (tDM/ha) of field pea and vetch at flowering and maturity, Minnipa 2013

Crop stage	Sowing Date	5 May	28 May	*LSD (P<0.05)*
Flowering Biomass (tDM/ha)		3.19[a]	2.35[b]	*0.83*
Maturity Biomass (tDM/ha)		4.45[a]	3.17[b]	*1.13*

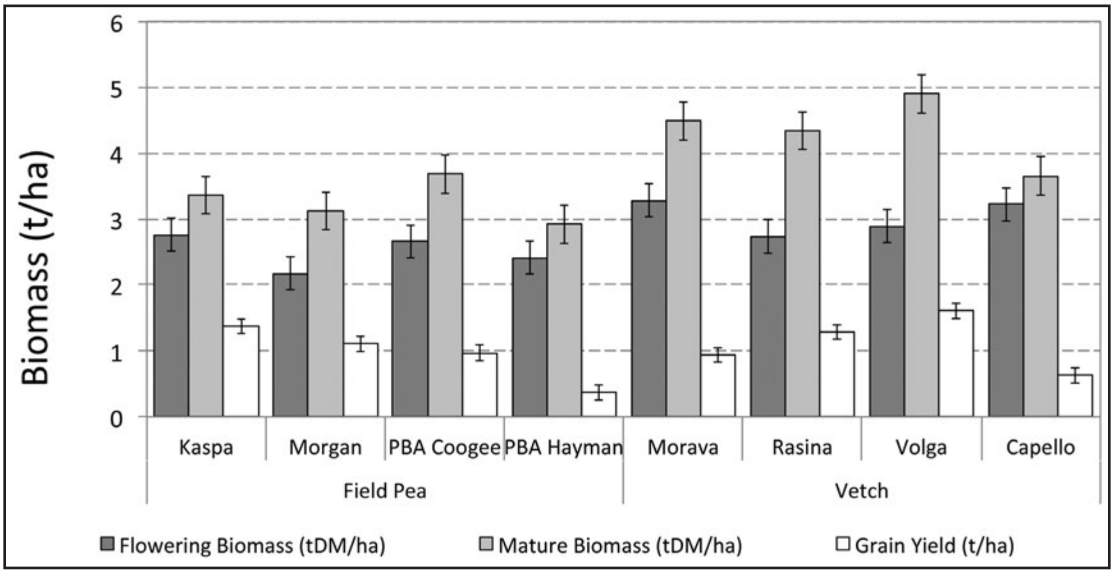

Figure 1 Biomass yield at flowering and at maturity (tDM/ha), and grain yield (t/ha) of field pea and vetch varieties, Minnipa 2013

Trial 2 Maximising biomass potential of field pea varieties through sowing date and plant density

A significant variety response for biomass production at flowering showed PBA Hayman to have higher biomass at flowering than the other three field pea varieties (Figure 2). The result from this trial reflects findings from other experiments in SA where PBA Hayman has shown consistently higher biomass yield than other varieties at flowering. Kaspa, Morgan and PBA Coogee all showed similar biomass at this timing. However, this is in contrast to the result from the previous trial, where PBA Hayman unexpectedly performed only similarly to other field pea varieties at this timing, and indicates variability in the previous trial possibly due to the presence of rhizoctonia.

A sowing date by sowing density interaction was identified for flowering biomass production (Figure 3). The lack of an interaction with variety means that all varieties behaved similarly for varying sowing date and densities. Both sowing dates showed an increase in biomass across all varieties as sowing density was increased, however this was more substantial at the later sowing date. Both sowing dates generally performed similarly at higher densities.

As for biomass production, a sowing date by sowing density interaction was identified for grain yield. The lowest density (25 plants/m^2) at the late sowing date yielded lower than all other treatments (Figure 4). All other treatments performed similarly.

What does this mean?

Break crop choice has typically considered more than just profitability, particularly in instances where the primary purpose of the break crop is to improve the performance of the following, more valuable crop. Additional considerations include agronomic (eg. weed or disease control objectives, reduced fertiliser (N) requirements, specific crop requirements) and marketing issues (eg. ease of marketing and access to established markets).

Some specific considerations when comparing vetch and field pea as break crop options include the end-use goal (i.e. grain yield, brown manure, hay), post-emergent weed control options, hard seededness and potential to carry through to the following crop, and ease of marketing. Vetches are a versatile break crop that can be used for forage (grazing, hay, silage and green/brown manure) or grain production. However they lack a well-established grain market, have generally low biomass production and weed competition through the winter months compared to other break crops, have few post-emergent in-crop weed control options, and have the potential to contribute to weed burdens in paddocks through the production of hard seeds. The development of dual purpose and forage field pea varieties give growers a competitive alternative to vetch and other current break crop options. Dual purpose field pea varieties also give growers the flexibility to react to seasonal conditions eg. frost, drought, or high grain prices for opportunistic grain production.

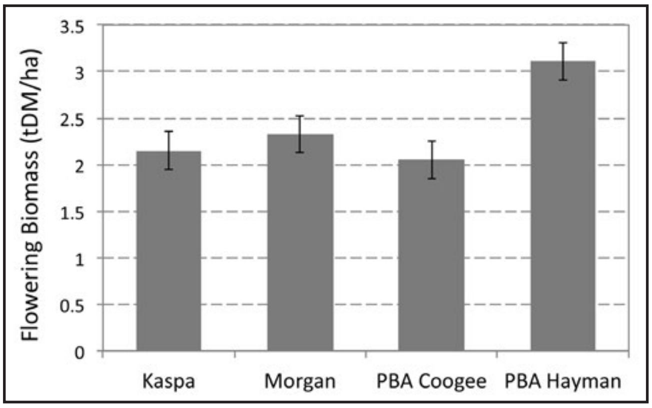

Figure 2 Biomass yield of field pea varieties at flowering (averaged across sowing dates and densities), Minnipa 2013

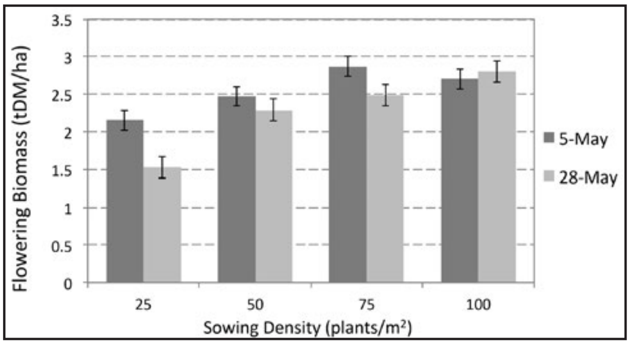

Figure 3 Effect of sowing date and sowing density on biomass yield of field pea at flowering, Minnipa 2013

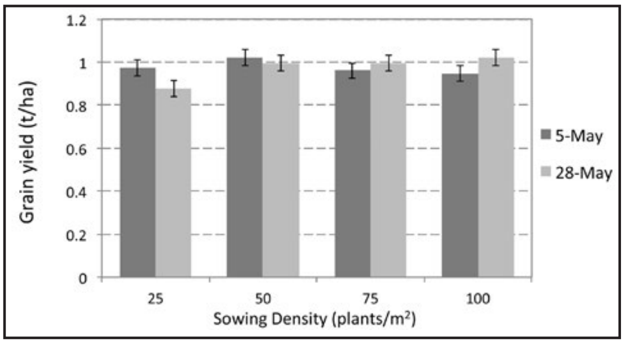

Figure 4 Effect of sowing date and sowing density on grain yield of field pea, Minnipa 2013

Vetch and field peas varieties performed relatively well at Minnipa in 2013, despite the dry and rapid finish to the season. This is likely due to high winter rainfall and warm winter temperatures throughout the growing season. The warm winter is likely to have been of particular benefit to vetch, which generally show restricted growth in cool winters. Vetch generally showed equal or greater performance to field pea cultivars at Minnipa in 2013 for the three parameters measured; grain yield and biomass production at flowering and at maturity. At other sites in the Mid North vetch showed equal or lower performance to field pea cultivars for these three parameters. Hence, further comparison is required in seasons with closer to average temperatures.

Cuts during flowering were timed to correlate with the development of 1-2 pods per plant (10-14 days after commencement of flowering). This timing is seen as the ideal time for hay cutting for optimising both biomass production and curing time (due to the difficulty of drying down pods). Later flowering varieties have generally shown higher biomass production at this timing than earlier flowering varieties (eg. PBA Hayman and Morava vetch). This characteristic will also promote hay quality by extending the timing of cutting into more favourable (warmer and quicker) curing conditions compared to earlier flowering varieties. This is a significant benefit of the forage field pea variety PBA Hayman, which often flowers 2 or more weeks later than other field pea varieties, and at a similar time to vetch.

PBA Hayman showed similar biomass at flowering to dual purpose (Morgan and PBA Coogee) and grain (Kaspa) field pea varieties in one trial at Minnipa in 2013. However this does not reflect results from the second trial at Minnipa, or trials at other sites in 2012 and 2013, where PBA Hayman showed significantly higher biomass at flowering than other field pea varieties. In trials at Hart and Tarlee in 2013, PBA Hayman showed 38-74% higher biomass than Kaspa at flowering when sown early, and 21-27% higher biomass when sown late. The presence of rhizoctonia in the trials at Minnipa suggest that biomass and grain yield of field pea may have been suppressed, and may be responsible for some unexpected results such as the lower biomass production from PBA Hayman in Trial 1.

At other sites in 2013, PBA Hayman produced significantly greater biomass than vetch varieties at flowering, but similar at later sowing dates. However, vetch varieties generally showed equal or greater biomass than the grain and dual purpose field pea varieties, Kaspa, Morgan and PBA Coogee across the three sites.

Kaspa has generally shown similar biomass production at flowering to the dual purpose field pea varieties (Morgan and PBA Coogee) across trials in 2012 and 2013, and has shown equal or greater grain yield. PBA Coogee has shown variable results across sites to date, ranging from lower grain yield than Morgan to equal grain yield to Kaspa. PBA Coogee showed lower relative grain yield at Tarlee in 2013, where it produced significantly greater biomass than Kaspa or Morgan. Consequently, the dry and rapid season finish in 2013 may have caused this variety to 'hay off' (where high biomass production leaves insufficient moisture for grain fill) at this site.

Biomass production of field peas at flowering time was maximised by sowing at higher sowing densities, particularly at later sowing dates. Late sown plots with high sowing densities were able to achieve biomass yields similar to early sown plots. This information is valuable in situations where sowing is delayed due to either a late season break or where blackspot risk is high due to low summer rainfall. Grain yield was generally not compromised by increasing sowing density, however further validation across seasons is required.

New varieties of field pea and vetch are now available which provide alternative forage opportunities. PBA Hayman is a forage field pea variety, which generally has lower grain yield than Morgan (which has been considered a dual purpose variety) but has higher biomass production. It also has improved bacterial blight resistance compared to most other varieties, but lower grain yield, indicating that grain retrieval may be difficult in low rainfall areas. However, due to its lower seed weight (averages 14 g/100 seeds compared with 20-25 g/100 seeds in other varieties) seed requirements for sowing are significantly lower.

PBA Coogee has been released as a dual purpose field pea variety that provides the flexibility of a forage option if frost or drought limits grain yield potential. PBA Coogee has a conventional plant type similar to the variety Parafield but with increased early season growth, more basal branching, longer vines and higher grain yield. It also shows improved tolerance to soil boron and salinity compared to all other field pea varieties, and is resistant to powdery mildew and moderately resistant to bacterial blight.

Volga is a highly rust resistant common vetch variety with good early establishment and early maturity (7-12 days earlier maturing than Rasina). Volga is early flowering, and will reach full flowering in 90-100 days from sowing. So far it is the best adapted vetch variety for grain and hay production in low/mid rainfall areas such as the SA Mallee, Mid North and Eyre Peninsula. Like other common vetch varieties, grain of Volga can be used to feed ruminant stock, whereas grain of woolly pod varieties such as Capello must not be used to feed livestock. Volga is currently undergoing seed bulk-up.

These SAGIT funded trials will continue in 2014, together with similar trials at Tarlee and Hart in the Mid North, and Lameroo in the Mallee. Additionally, nitrogen fixation and feed quality tests will be conducted on samples from the 2013 and 2014 trials. This will provide additional information to grain yield and biomass data, which will give growers with a holistic comparison of vetch and field pea break crops in South Australia.

Government of South Australia

SAGIT

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

New canola varieties for 2014

EXTENSION

Andrew Ware
SARDI, Port Lincoln

Break Crops

Key messages

- **Check NVT and local district trial results and the blackleg management guide to make the best decisions about new varieties.**
- **Select the most appropriate herbicide group based on your weed spectrum.**

Once again there is a large number of new canola varieties available for 2014. There are several new open pollinated triazine tolerant varieties being released, these will attract an end point royalty (EPR). However, the majority of new releases will be hybrids. These, together with a range of existing varieties will give growers and advisers a wide selection of varieties across all herbicide tolerance groups available for planting in 2014.

Blackleg and other diseases

Blackleg has the potential to be a very destructive disease when growing canola. Its management is critical in order to maximize yields. Growers and advisers are directed to the Blackleg Management Guide (at GRDC.com.au or australianoilseeds.com) as a point of reference to help manage the disease. This document is updated annually in March. It is important to review and monitor blackleg management strategies on a regular basis as the disease has a high capacity to breakdown varietal resistance.

Blackleg management involves assessing risk to the disease (based on rainfall and the intensity with which canola is grown on a regional level), having a good understanding of disease levels in existing and previous crops, and then planning to keep new canola crops at least 500 m from the previous year's canola stubble. Additional strategies include selecting varieties with a suitable blackleg resistance rating, assessing the need to use fungicides, and possibly changing varieties to a different blackleg resistance group after a number of years of growing one variety.

Since 2011, National Variety Trials (NVT) have been sown with the same fungicide treatment on all varieties, so the reaction to blackleg will be more difficult to assess from looking at the trials.

Much higher than normal occurrences of downy mildew and white leaf spot have been reported across Australia in 2013. Any varietal differences and effects these diseases are having on yield are not clear at this stage and will be the subject of ongoing research.

Speciality and Juncea types

In recent years a number of specialty canola varieties have been released. These include the Victory® varieties (marketed by Cargill) and Monola® varieties (marketed by Nuseed). These varieties have a different oil profile than commodity canola that is more suitable for use in the food industry. Agronomic speciality canola is the same as commodity canola. Speciality canola is being offered to growers in a closed loop marketing system, often attracting a premium price. Currently production contracts for these varieties are limited to particular regions close to crushing plants, but this may change into the future.

Juncea canola is being developed as a drought and heat tolerant alternative to canola for low rainfall environments. In 2014 there will be two juncea varieties available (XCEED™ X121 CL and XCEED™ VT Oasis CL) for sowing (both marketed by Seednet). Sales of Juncea canola must be segregated from regular canola.

Varietal selection

The selection of the most suitable canola variety for a particular situation needs consideration of maturity, herbicide tolerance, blackleg resistance, relative yield, oil content and early vigour.

The weed species expected may dictate the need for a herbicide tolerant production system (eg. triazine tolerant, or Clearfield). A triazine tolerant variety will incur a yield and oil penalty when grown in situations where they are not warranted.

When decisions are being made on canola varietal choice, the National Variety Trials provide an excellent, unbiased resource. Data from the NVT website (www.nvtonline.com.au) and any observations you might make from trials in 2013 will greatly add to the confidence you have on selecting a new variety.

Varietal characteristics for new varieties for 2014

Notes on new and recently released conventional varieties

Nuseed Diamond (tested as NHC1203C). Early-mid maturing hybrid. Current blackleg rating of R-MR (P). Medium plant height. Tested in NVT trials in 2012-13. Bred and marketed by Nuseed Pty Ltd.

AV-Garnet. Mid-early to mid to maturing. Medium height. High oil content. Rated MR for blackleg (resistance groups A, B and G). Tested in NVT trials 2006-2013. Bred by DPI Victoria. Marketed by Nuseed Pty Ltd.

AV-Zircon. Mid-early to mid to maturing. Medium height. Rated MR for blackleg (resistance group A). High-very high oil content. Tested in NVT trials 2010-2013. Bred by DPI Victoria and Nuseed Pty Ltd. Marketed by Nuseed Pty Ltd.

CB™ Agamax. Early-mid maturing hybrid. Suited to low to medium rainfall areas. Moderate-high oil content. Blackleg resistance rating MS. Tested in NVT trials in 2010-2013. Bred by Canola Breeders*.

CB™ Tango C. Early maturing conventional hybrid suited to low to medium rainfall regions. Blackleg resistance rating MS. Tested in NVT trials in 2011-2013. Bred by Canola Breeders*.

Hyola® 50. Mid to mid-early maturing hybrid. Blackleg resistance of R (resistance group D). Tested in NVT trials in 2005-2013. Bred by Canola Breeders International. Marketed by Pacific Seeds.

Hyola® 930. Winter hybrid canola with oil levels similar to Hyola® 50. Provisional Blackleg rating of MR. 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.

Victory V3002. Early–mid maturing conventional specialty (high stability oil) hybrid. Blackleg resistance of R-MR (resistance group C). Tested in NVT trials in 2011-2013. Bred by Cargill and DPI Victoria. Marketed by AWB in a closed loop program.

Withdrawn and no longer available: **Hyola® 433**

HERBICIDE TOLERANT

Notes on newly released Clearfield (imidazolinone tolerant) varieties

Hyola® 577CL. Mid maturing hybrid. Very high oil content. Very high yield, medium – tall plant height. Adapted to medium-high rainfall areas. Pacific Seeds suggest a blackleg resistance rating R-MR (P). Rotation Blackleg Group to be advised. Tested in NVT trials in 2013. Pacific seeds indicate excellent for standability and direct harvesting. Bred and marketed by Pacific Seeds.

Pioneer® 44Y87 (CL) (tested as Pioneer 09N121I). Early-mid maturing hybrid. Moderate-high oil content. Medium plant height. Suited to medium rainfall areas. Current blackleg resistance rating MR (P). Tested in NVT trials 2012-13.

Pioneer® 45Y88 (CL) (tested as Pioneer 09N146I). Mid maturing hybrid. Moderate-high oil content. Medium plant height. Suited to high rainfall and irrigated areas. Current blackleg resistance rating MR (P). Bred and marketed by DuPont Pioneer.

XCEED™ X121 CL. The first hybrid Clearfield® tolerant juncea canola. Four days later than Oasis CL. Excellent early vigour and branching ability and has high oil content. X121 CL has excellent pod shattering tolerance and is suitable for direct harvest. Provisional blackleg resistance of R-MR. Bred by Seednet in conjunction with GRDC.

Notes on recently released Clearfield (imidazolinone tolerant) varieties

Archer. Mid-late maturing hybrid. High oil content. Medium plant height. Blackleg rating of MR-MS. Tested in NVT trials 2011-13. Marketed by Heritage Seeds.

Carbine. Early-mid maturing hybrid. Moderate-high oil content. Medium plant height. MS (P) Blackleg rating. Tested in NVT trials 2011-13. Marketed by Heritage Seeds.

Hyola® 474CL. Mid-early maturing hybrid. High oil and protein content. Medium-tall plant height. Fits medium-low to high rainfall areas, and exhibits excellent hybrid vigour. Blackleg resistance rating R. Tested in NVT trials in 2011-13. Bred and marketed by Pacific Seeds.

Hyola® 575CL. Mid maturing hybrid. High oil content. Medium plant height. Blackleg resistance rating R. Tested in SA NVT trials in 2010-13. Bred and marketed by Pacific Seeds.

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

Pioneer® 43C80 (CL). Early maturing variety. Moderate oil content. Adapted to low rainfall areas. Medium plant height. Blackleg resistance rating of MR-MS. Tested in NVT trials 2008-2009, 2011-2012. Bred and marketed by DuPont Pioneer.

Pioneer® 43Y85 (CL). Early maturing hybrid. Moderate oil content. Medium plant height. Blackleg resistance rating of MR (rotation groups A, B). Suited to low rainfall areas and short season growing zones. Tested in NVT trials 2011-13. Bred and marketed by DuPont Pioneer.

Pioneer® 44Y84 (CL). Early/early-mid season hybrid. Widely adapted in low and medium rainfall areas. High oil content. Medium – tall plant height. Blackleg resistance rating of MS. Tested in NVT trials in 2010-13. Bred and marketed by DuPont Pioneer.

Pioneer® 45Y86 (CL). Mid maturing hybrid. High oil content. Replacement for 46Y83 (CL). Blackleg rating of MS (P). Tested in NVT trials in 2010-13. Bred and marketed by DuPont Pioneer.

XCEEDTM VT Oasis CL. First herbicide tolerant Clearfield tolerant Juncea canola released in Australia. Early maturing open pollinated variety. High oil content. Blackleg rating of R. Blackleg resistance group D, G. Tested in NVT trials 2008-13. An EPR applies. Bred by DPI Victoria/ Seednet. Marketed by Seednet.

Withdrawn and no longer available: **Pioneer® 45Y82 (CL)**

Notes on newly released Triazine tolerant (TT) varieties

ATR Bonito (tested as NT0183). Early-mid season maturing variety. Short-medium height. Current blackleg rating of MR (P). Tested in NVT trials 2012-13. Bred and marketed by Nuseed. An EPR of $5 per tonne (GST ex) applies to ATR Bonito.

ATR Wahoo (tested as NT0184). Mid maturity variety. Medium plant height. Current blackleg rating of MR (P). Tested in NVT trials 2012-13. Bred and marketed by Nuseed. An EPR of $5 per tonne (GST ex) applies to ATR Wahoo.

Hyola® 450TT. Early to mid-maturing hybrid. Medium plant height. Provisional blackleg resistance rating of R (P), blackleg rotation group D. Pacific seeds indicate excellent standability and shatter tolerance. Tested in NVT trials in 2013. Bred and marketed by Pacific Seeds.

Hyola® 650TT. Mid to mid-late maturing hybrid. Medium-tall plant height. Provisional Pacific Seeds blackleg resistance rating of R (P). Pacific seeds indicate excellent standability and shatter tolerance. Tested in NVT trials in 2013. Bred and marketed by Pacific Seeds.

Monola™ 314TT. Early-mid open pollinated specialty oil variety. Medium plant height. Nuseed indicate a blackleg rating of MR. Bred and marketed by Nuseed Pty Ltd.

Pioneer Sturt TT. Early-mid maturity open-pollinated variety. Moderate oil content. Short-medium plant height. Adapted to the low and medium rainfall areas. Blackleg rating of MS-S. Tested in NVT trials in 2011-13. An EPR applies. Bred by Canola Breeders but marketed by Dupont Pioneer.

Notes on recently released Triazine tolerant (TT) varieties

ATR Gem. Early-mid maturity triazine tolerant variety. High oil content. Medium plant height. Blackleg resistance rating of MR. Blackleg resistance groups A,B,D. Tested in NVT trials 2011-13.Bred and marketed by Nuseed Pty Ltd.

ATR-Stingray. Early maturing variety. Short height. Moderate-high oil content. Blackleg resistance rating MR. Tested in NVT trials 201-12. Bred by Nuseed Pty Ltd and DPI Victoria. Marketed by Nuseed Pty Ltd.

Bonanza TT. Early maturing doubled haploid OP TT variety. Moderate oil content. Short plant, suited to direct heading. Fits medium-low to medium rainfall areas. Blackleg resistance rating of R-MR. Blackleg rotation group C. Tested in NVT trials in 2011-12. Bred and marketed by Pacific Seeds. Bonanza TT has been outclassed, but seed is still available.

CB Atomic HT. Mid maturing hybrid. Medium height. Moderate-high oil content. Suited to medium to high rainfall zones. Provisional blackleg rating of MS (P). Tested in NVT trials in 2012-13. Bred by Canola Breeders*.

CB™ Henty HT. Mid-maturing TT hybrid. Moderate oil content. Suited to medium to high rainfall areas. Blackleg rating of MS. Tested in NVT trials in 2011, and at limited sites in 2012-13. Bred by Canola Breeders*.

CB™ Jardee HT. Mid maturing hybrid. Moderate oil content. Blackleg rating of MS-S. tested in NVT trials 2008-13. Bred by Canola Breeders*.

CB™ Junee HT. Early-mid maturing TT hybrid. Moderate oil content. Blackleg resistance rating MS-S. Tested in NVT trials in 2010-12. Bred by Canola Breeders*.

CB™ Nitro HT. Early-mid maturity hybrid. Moderate oil content. Medium plant height. Suited to medium to high rainfall areas. Provisional blackleg rating of S (P). Tested in NVT 2012-13. Bred by Canola Breeders*.

Crusher TT. Mid maturing OP TT variety. Moderate oil content. Medium-tall plant height. Suited to medium to very high rainfall areas including irrigation. Blackleg resistance rating MR-MS. Tested in NVT trials in 2010-13. Bred and marketed by Pacific Seeds.

Hyola® 444TT. Early maturing TT Hybrid. Medium-short plant height. Moderate-high oil content. Ideally fits low to medium-high rainfall areas and exhibits good TT hybrid vigour and good standability. Blackleg resistance rating R-MR. Tested in NVT trials in 2010-11. Bred and marketed by Pacific Seeds. Outclassed, but seed still available.

Hyola® 555TT. Mid-Early maturing TT Hybrid. Moderate-high oil content. Medium plant height. Ideally fits medium-low right through to high rainfall areas. Blackleg resistance rating R-MR, blackleg rotation group E. Tested in NVT trials in 2010-13. Bred and marketed by Pacific Seeds.

Hyola® 559TT. Mid-Early maturing TT Hybrid. High oil content. Medium plant height. Ideally fits medium-low right through to high rainfall areas. Blackleg resistance rating R-MR, blackleg rotation group D. Tested in NVT trials in 2012-13. Bred and marketed by Pacific Seeds.

Hyola® 656TT. Mid to mid-late maturing hybrid. High oil content. Medium-tall plant height. Suited to high to very high rainfall areas. Provisional blackleg rating of R (P). Tested in NVT trials in 2012 -13. Bred and marketed by Pacific Seeds.

Monola™ 413TT. Early-mid maturing open pollinated specialty oil variety. Medium plant height. High oil content. Provisional blackleg rating of R-MR (P). Blackleg resistance group D. Tested in NVT trials in 2012-13. Bred and marketed by Nuseed Pty Ltd.

Monola™ 605TT. Early-mid maturing open pollinated specialty oil variety. Medium plant height. Moderate oil content. Blackleg rating of R-MR. Blackleg resistance group D. Tested in NVT trials in 2011-13. Bred and marketed by Nuseed Pty Ltd.

Thumper TT. Mid to mid-late maturing doubled haploid OP TT variety. Moderate-high oil content. Medium plant height. Suited to high to very high rainfall areas. Ideally fits high to very high rainfall areas including irrigation, exhibits good early vigour and excellent standability. Blackleg resistance rating R. Blackleg rotation group E. Tested in NVT trials in 2010-13. Bred and marketed by Pacific Seeds.

Withdrawn and no longer available: **Fighter TT, Jackpot TT, and ATR Snapper**

*Canola Breeders ceased operating as a company in July 2013. The marketing for CB Sturt has been taken over by Dupont Pioneer. The future marketing arrangements of all other Canola Breeders released varieties is unclear at the time of writing this article.

Notes

(P) = provisional rating – the variety has only been in our blackleg nurseries for one year – it needs two years before it gets a full rating.

Ⓟ = plant breeders rights (PBR) varieties where an end point royalty is collected.

Acknowledgements

The SARDI New Variety Agronomy Group for conducting the NVT trials throughout South Australia.

Maximising canola yield by getting establishment right – upper EP experience in 2013

RESEARCH

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[1] SARDI, Port Lincoln; [2] SARDI, Minnipa Agriculture Centre

Almost ready

Location:
Minnipa Ag Centre, South 4
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: 1.4 t/ha Canola
Actual: 1.4 t/ha
Paddock History
2013: Canola and Field pea trials
2012: Wheat
2011: Barley
2010: Barley
Plot Size
1.5 m x 10 m x 4 reps
Yield Limiting Factors
Wind, Diamond back moth

Location:
Piednippie
Rainfall
Av. Annual: 324 mm
Av. GSR: 220 mm
2013 Total: 314 mm
2013 GSR: 246 mm
Yield
Potential: 2.0 t/ha Canola
Actual: 1.1 t/ha
Paddock History
2012: Wheat
2011: Barley
2010: Pasture
Plot Size
1.5 m x 10 m x 4 reps
Yield Limiting Factors
Low spring rainfall, Diamond back moth

Key messages

- **Early sowing had the largest positive impact on canola yield when comparing a range of treatments trialled in 2013.**
- **Good seeding depth and the correct seed rate were also important in maximising canola yields, but not to the same extent as time of sowing.**

Why do the trial?

This is part of a new South Australian Grains Industry Trust (SAGIT) funded project. It aims to maximise canola productivity through creating soil specific management strategies that improve canola yields, profitability and establishment in field trials on lower and upper Eyre Peninsula.

In 2013, seven separate trials were conducted at Minnipa Agricultural Centre (MAC), Poochera, and Piednippie on upper Eyre Peninsula. Five will be reported on here. Further trials were conducted on lower Eyre Peninsula and will be reported in the LEADA results booklet.

How was it done?

Trial 1 – Time of Sowing (Minnipa Agricultural Centre)

Aim: To evaluate the effect of four different sowing times, in combination with two different seeding depths and two different seeding rates has on canola emergence and yield of two Clearfield tolerant varieties on Minnipa Agricultural Centre.

Treatments:

- Sowing dates: Time of Sowing (TOS) 1: 23 April 2013, TOS2: 7 May 2013, TOS3: 17 May 2013, TOS4: 27 May 2013.
- Two varieties were sown each time: Pioneer 43C80 and Pioneer 43Y85.
- Sowing depths: 2 cm (shallow) and 4 cm (deep).
- Sowing Rates: 40 plants/m^2 (equivalent to 2.5 kg/ha 43C80 and 2.9 kg/ha 43Y85) and 60 plants/m^2 (equivalent to 3.7 kg/ha 43C80 and 4.3 kg/ha 43Y85).
- Seed size: 43C80 = 0.43 g/100 seeds and 43Y85 = 0.62 g/100 seeds.

Management: The trial received a total of 63 kg/ha 19:13:0 S9% + 64 kg/ha urea fertiliser, applied at seeding and 100 kg/ha sulphate of ammonia (SOA) broadcast during the season. 500 ml/ha Intervix, 300 ml/ha Select, 100 ml/ha Lontrel and 0.5% Supercharge was applied to control weeds. Multiple products were used during the season to control insects, but there was still some damage from Diamond back moth and aphids in all trials discussed in this article.

What does this mean?

- Time of sowing had a large impact on yield, where the earliest sowing time produced the highest yield with each subsequent time of sowing producing significantly lower yields.
- The time of sowing did have an effect on establishment, but this did not correlate to the differences in yield achieved.
- Other treatments such as sowing depth and seeding rate (results not shown), while significantly affecting establishment did not significantly affect grain yield within the same time of sowing (i.e. all treatments sown on the same day, regardless of sowing rate and sowing depth did not yield significantly different to each other.)
- A similar trial was established in the high rainfall zone of lower Eyre Peninsula, near Wanilla, and similar results were achieved.

Trial 2 & 3 – Triazine Tolerant Canola Emergence Trials

Aim: To evaluate the effect that one triazine tolerant variety, sown at three different seeding rates and three different depths has on emergence and yield at Minnipa Agricultural Centre and Piednippie.

Treatments: The trials were sown on the 14 May 2013 (Piednippie) and 16 May 2013 (Minnipa). The variety ATR Stingray (seed size 0.3 g/100 seeds) was used in all treatments. The trial was planted at three depths (1 cm, 2 cm, and 4 cm) and at three rates (1.5 kg/ha, 3 kg/ha and 4.5 kg/ha).

Management: The Piednippie trial received a total of 71 kg/ha 19:13:0 S9% + 41 kg/ha urea fertiliser, applied at seeding and 125 kg/ha SOA broadcast during the season. The MAC trial received a total of 63 kg/ha 19:13:0 S9% and 39 kg/ha urea fertiliser, applied at seeding and 100 kg/ha and 125 kg/ha SOA broadcast during the season. Both trials received a knockdown of Roundup, Carfentrazone-Ethyl and a bare earth insecticide of 1 L/ha Chlorpyrifos. At Minnipa 1.2 L/ha Gesaprim 600SC, 300 ml/ha Select, 200 ml/ha Targa, 1 L/100L Kwicken and 1 kg/100 L SOA was applied to control weeds. At Piednippie 1.2 L/ha Gesaprim600SC, 400 ml/ha Select, 30 ml/ha Karate Zeon, 1 L/100L Kwicken and 500 g SOA was applied to control weeds and insects.

Break Crops

Table 1 The effect of time of sowing (TOS), on grain yield and emergence of canola at Minnipa, 2013

Time of sowing	Yield (t/ha)	Emergence (plants/m^2)
TOS1	1.42	30
TOS2	1.13	41
TOS3	0.95	36
TOS4	0.69	38
LSD (P=0.05)	*0.07*	*4*

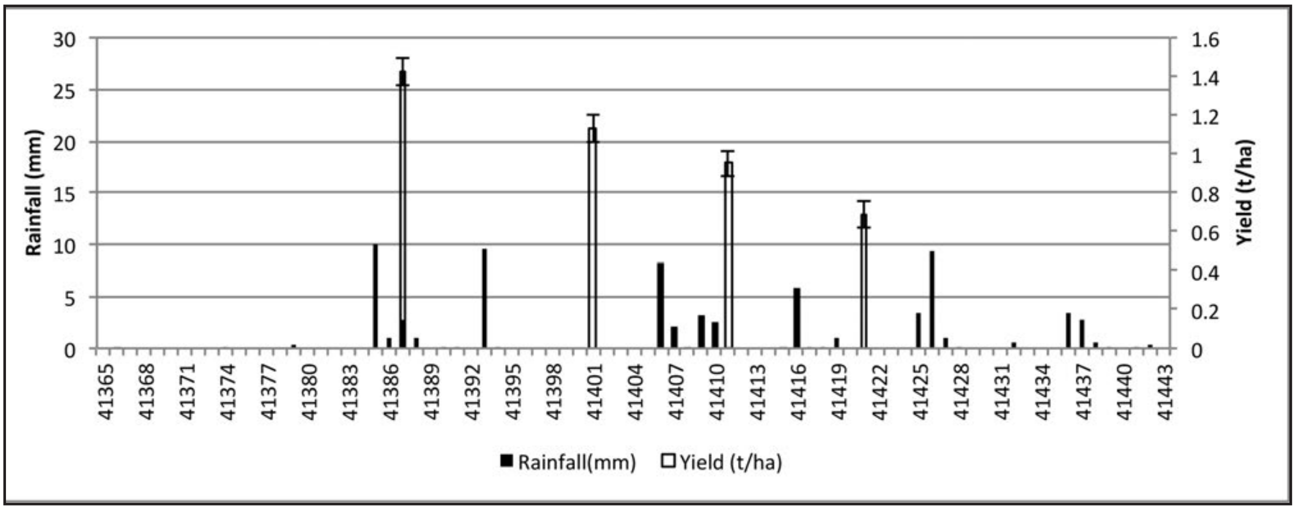

Figure 1 Daily rainfall (mm) at MAC (1 April – 18 June 2013) and canola yield (t/ha) of the four times of sowing (plotted on the day of sowing)

Table 2 The effect of sowing rate on grain yield and emergence of Stingray TT canola at Minnipa and Piednippie, 2013

	Minnipa		Piednippie	
Sowing Rate (kg/ha)	**Yield (t/ha)**	**Emergence (plants/m^2)**	**Yield (t/ha)**	**Emergence (plants/m^2)**
1.5	0.95	26	0.87	30
3	1.06	42	0.98	49
4.5	1.11	65	0.97	63
LSD (P=0.05)	*0.04*	*9*	*ns*	*8*

Table 3 The effect of sowing depth on grain yield and emergence of Stingray TT canola at Minnipa and Piednippie, 2013

	Minnipa		Piednippie	
Sowing Rate (kg/ha)	**Yield (t/ha)**	**Emergence (plants/m^2)**	**Yield (t/ha)**	**Emergence (plants/m^2)**
1	1.10	48	1.03	57
2	1.06	47	0.94	49
4	0.96	38	0.85	37
LSD (P=0.05)	*0.04*	*9*	*0.12*	*8*

What does this mean?

- At Minnipa the highest yielding treatments were sown at 4.5 kg/ha, this gave significantly better yields than treatments sown at 3.0 kg/ha and better again than treatments sown at 1.5 kg/ha. At Piednippie sowing rate did not significantly affect yield.
- Sowing depth had a significant effect on yield at both Minnipa and Piednippie, with yield decreasing the deeper the seed was placed.
- Results from both of these trials indicate that sowing canola too thin and too deep can have a significant detrimental effect on yield and also suggests that growers should target an establishment rate of at least 50 plants/m^2 to maximise yield.

Trial 4 & 5 – Clearfield Tolerant Canola Emergence Trials

Aim: To evaluate the effects of seed source, sowing depth and seeding rate on Clearfield canola emergence and yield at Minnipa Agricultural Centre and Piednippie.

Treatments: The trials were sown on the 14 May 2013 (Piednippie) and 16 May 2013 (Minnipa). The seed used in these trials consisted of: commercial seed (store purchased) of the varieties Pioneer 43C80 (seed size 0.43 g/100 seeds) and Pioneer 43Y85 (0.62 g/100 seeds) and farmer retained seed of Pioneer 43C80 graded into two sizes, larger than 2.0 mm (seed size 0.5 g/100 seeds) and smaller than 2.0 mm (seed size 0.31 g/100 seeds). The trial was planted at three depths (1 cm, 2 cm, and 4 cm) and at three rates (1.5 kg/ha, 3 kg/ha and 4.5 kg/ha).

Management: The Minnipa trial received a total of 63 kg/ha 19:13:0 S9% and 39 kg/ha urea fertiliser, applied at seeding and 100 kg/ha and 125 kg/ha SOA broadcast during the season. The Piednippie trial received 71 kg/ha 19:13:0 S9% and 41 kg/ha urea at seeding and 100 kg/ha SOA broadcast during the season. Both trials received a knockdown of Roundup, Carfentrazone-Ethyl and a bare earth insecticide of 1 L/ha Chlorpyrifos. The Minnipa trial had 500 ml/ha Intervix, 350 ml/ha Select, 60 ml/ha Lontrel and 0.5% Supercharge applied to control weeds. The Piednippie trial had 300 ml/ha Select, 150 ml/ha Targa, 300 ml/ha Astound Duo, 1 L/100 L Water Kwicken and 700 ml/ha Intervix, 30 ml/ha Lontrel, 15 ml/ha Karate Zeon and 500 ml/100 L SuperCharge applied to control weeds and insects.

Table 4 The effect of seeding rate on grain yield and emergence of Pioneer 43C80 and 43Y85 canola at Minnipa and Piednippie, 2013

	Minnipa		Piednippie	
Sowing Rate (kg/ha)	**Yield (t/ha)**	**Emergence (plants/m²)**	**Yield (t/ha)**	**Emergence (plants/m²)**
1.5	0.88	15	0.91	19
3	0.97	27	1.02	34
4.5	1.02	38	1.07	45
LSD (P=0.05)	*0.04*	*3*	*0.04*	*3*

Table 5 The effect of seed source on grain yield and emergence of Pioneer 43C80 and 43Y85 canola at Minnipa and Piednippie 2013

	Minnipa		Piednippie	
Seed Source	**Yield (t/ha)**	**Emergence (plants/m²)**	**Yield (t/ha)**	**Emergence (plants/m²)**
43C80 Large	0.98	24	0.96	31
43C80 Small	0.94	26	0.94	34
43C80 Store	1.04	32	1.04	37
43Y85 Store	0.86	23	1.05	28
LSD (P=0.05)	*0.05*	*5*	*0.05*	*6*

What does this mean?

- The trials at Minnipa and Piednippie both showed that using higher seeding rates improved establishment and yield.
- In both trials using commercial seed or store purchased seed of 43C80 produced a higher rate of establishment and a higher yield than the farmer retained seed. Grading the farmer retained seed to larger than 2.0 mm gave a higher but not significant yield to the seed that was smaller than 2.0 mm.
- Results from both of these trials indicate that sowing canola too thin and using retained seed can have a detrimental effect on yield.

Acknowledgements

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ATR Stingray - registered variety of Nuseed Pty Ltd. Pioneer 43C80. Pioneer 43Y85 - registered varieties of Dupont Pioneer. Intervix - registered trademark of BASF. Select – registered trademark of Arysta Life Sciences and Sumitomo Chemical Co. Japan. Lontrel – registered trademark of Dow AroSciences. Supercharge – registered trademark of Syngenta Group Company. Gesaprim 600Sc - registered trademark of Syngenta Group Company. Karate Zeon - registered trademark of Syngenta Group Company. Kwicken - registered trademark of Third Party SST Australia Pty Ltd. Targa - registered trademark of Nissan Chemical Industries Co Japan. Astound Duo - registered trademark of Nufarm Australia Limited.

Clethodim tolerance in canola

Michael Zerner and Rob Wheeler
SARDI, Waite

RESEARCH

Searching for answers

Location:
Yeelanna
Mark Modra
LEADA
Rainfall
Av. Annual: 422 mm
Av. GSR: 342 mm
2013 Total: 490 mm
2013 GSR: 403 mm
Yield
Potential: 4.6 t/ha
Actual: 1.9 t/ha (Control treatment average)
Plot Size
1.8 m x 10 m x 3 reps

Key messages

- **Grain yield losses of up to 50% can be caused by clethodim at particular rates and timings.**
- **Early application timings appear the best to avoid crop damage.**
- **Variation does exist between varieties across all herbicide tolerant crop types (conventional, Clearfield and TT) in their level of sensitivity to clethodim.**
- **Flower distortion was the major clethodim damage symptom observed, which led to poor pod development resulting in yield reductions.**

Why do the trial?

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

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

How it was done?

The trial was established as a split-plot design with three replicates. Three canola varieties were used; AV Garnet (conventional), ATR Gem (triazine tolerant) and Hyola 474 CL (Clearfield) to investigate the influence of clethodim rate and timing. Nine clethodim treatments were applied to each variety (Table 1). This trial was solely aimed at investigating the impact of clethodim on crop safety rather than weed control. The trial was sown on the 13 May with 2.5 L/ha trifluralin, 250 ml/ha Dual Gold and 1 L/ha Lorsban. At seeding 150 kg/ha of 19:13:0:9 blend fertilizer was applied with 400 ml/ha of Impact, followed by an additional 100 kg/ha of urea on the 13 June and again on 15 July.

Spray treatments for each growth stage were applied on the same day for each variety. As a result the exact growth stage at the time of application for each variety may have differed slightly, despite all varieties used in this trial being of very similar maturity. Following each spray application NDVI readings using a Greenseeker and visual damage scores were recorded.

What happened?

The trial results reflected the sensitivity of canola to high rates of clethodim. Of the varieties tested the conventional type variety Garnet appeared to show a greater level of tolerance to clethodim than the other varieties. Both Gem (TT) and Hyola 474 CL were more intolerant of clethodim, with Hyola 474 being the most sensitive, incurring up to 50% yield losses in the most damaging clethodim treatment.

Of the various clethodim timings, the later the application, the more damage to grain yields that occurred. Applications within current label recommendations of up to the 8-leaf growth stage appear relatively safe in this trial. As all treatments sprayed with a single label rate application of 0.5 L/ha up to and including this growth stage were not significantly different from the unsprayed control for any variety.

Early sprays (4 leaf growth stage) at rates up to 1 L/ha had no significant implications on grain yield for any variety. The next timing at 8-leaf was safe when applied at 0.5 L/ha, but when rates exceeded this, significant yield losses occurred of up to 25% in Hyola 474 and 10% yield losses in Garnet and Gem. The split application appeared to improve the safety of the 1 L/ha treatment when it is applied over two applications rather than in one application at the later, 8-leaf timing. Yield losses at this rate became insignificant for all varieties when split over two applications. Later timing treatments at bud initiation which are outside current label recommendations were found to be highly damaging causing significant yield reductions.

Table 1 Clethodim treatments applied at Yeelanna during 2013

CLETHODIM TREATMENTS
1. Untreated control
2. 0.5 L/ha applied at 4-leaf growth stage
3. 1 L/ha applied at 4-leaf growth stage
4. 0.5 L/ha applied at 8-leaf growth stage
5. 1 L/ha applied at 8-leaf growth stage
6. 0.25 L/ha applied at 4-leaf and 8-leaf growth stages (0.5 L/ha in total)
7. 0.5 L/ha applied at 4-leaf and 8-leaf growth stages (1 L/ha in total)
8. 0.5 L/ha applied at bud initiation
9. 1 L/ha applied at bud initiation
Application of clethodim at 1L/ha is not a registered rate and was undertaken for experimental purposes.

All varieties were significantly affected at both rates with yield losses ranging from 14-30% at 0.5 L/ha and 13-52% at 1 L/ha depending on the variety. Garnet showed improved tolerance levels at this timing where it was least affected at both rates, incurring 14% (0.5 L/ha) and 13% (1 L/ha) yield reductions.

These findings in grain yields closely matched visual scoring of damage symptoms during the season. A range of symptoms were observed, the first of which was a slight change in the colour of the crop canopy. The more damaged or sensitive plots become paler green in colour compared to the untreated control plots. There were no visual changes in overall crop biomass or any significant change in NDVI between treatments in this particular trial. As the crop further develops to reach flowering the damage symptoms become more pronounced. The flower buds become distorted and fail to open up fully leading to poor pod development, which in turn resulted in reduced grain yields. The grain yield losses were strongly correlated to the severity of the observed visual symptoms.

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

Application Timing	Clethodim Rate	ATR Gem 1.74 t/ha	AV Garnet 2.12 t/ha	Hyola 474 CL 1.75 t/ha
		******Grain yield % of control*******		
4 Leaf	0.5 L/ha	98	94	100
	1 L/ha	94	94	100
8 Leaf	0.5 L/ha	95	95	95
	1 L/ha	**90**	**90**	**75**
4 leaf and 8 leaf split	0.25 L/ha + 0.25 L/ha	90	96	99
	0.5 L/ha + 0.5 L/ha	97	92	98
Bud initiation	0.5 L/ha	**76**	**86**	**70**
	1 L/ha	**65**	**87**	**48**

What does this mean?

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

Acknowledgements

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Lorsban – registered trademark of Dow Agrowsciences. Impact – registered trademark of Cheminova A/S Denmark.
Dual Gold - registered trademark of a Syngenta Group Company.

Break Crops

Sulla - a new break crop for EP?

Roy Latta and Suzanne Holbery
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location:
Minnipa Ag Centre
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: (W) 2.5 t/ha
Actual: 2.4 t/ha
Paddock History
2012: Pasture
2011: Pasture
Soil Type
Red calcareous sandy loam

Location:
Edillilie
Shane Nelligan
Rainfall
Av. Annual: 420 mm
Av. GSR: 340 mm
2013 Total: 537 mm
2013 GSR: 463 mm
Yield
Potential: 7.0 t/ha Wheat
Actual: 3.9 t/ha
Paddock History
2012: Pasture
2011: Pasture
Soil Type
Acidic sandy gravel over clay
Environmental impacts
Soil Health
Soil structure: Stable
Compaction risk: Nil no livestock
Ground cover or plants/m²: standard crop establishment and management practice no grazing
Perennial or annual plants: Short lived perennial and annual
Water Use
Runoff potential: Low
Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, N_2O): Cropping
Social/Practice
Time (hrs): No extra
Clash with other farming operations: Phase rotations as opposed to ley systems
Economic
Infrastructure/operating inputs: Sulla has high seed costs
Cost of adoption risk: Medium

Key messages

- **Sulla produced more spring biomass and similar or higher subsequent grain production to an annual legume pasture over a 3 year pasture-pasture-wheat rotation.**
- **Sulla provides an option to consider for a 2 year break on the more reliable cropping soils of EP.**

Why do the trial?

A recent survey on Eyre Peninsula indicated that many mixed farms are extending the number of years of continuous cereal to 3, 4 or more years followed by a 2 year break, as opposed to a 1 or 2 year cereal followed by a regenerating legume pasture. This is called a phase rotation where the pasture phase requires re-establishment at the completion of the crop phase as opposed to the ley system where the legume pasture will regenerate from a seed bank after a 1 or 2 year crop phase. This rotation adaption has provided the opportunity to consider *Hedysarum coronarium* (sulla) as a species that may better fit a 2 year break. Sulla is a highly productive biennial or short lived perennial pasture legume. It is highly palatable with excellent forage and fodder qualities, which may result in increased animal performance.

How was it done?

In 2010 sulla was established at four Eyre Peninsula perennial pasture evaluation sites, Minnipa, Rudall, Edillilie and Greenpatch (EPFS Summary 2010, 2011 and 2012, p 141, 139 and 138 respectively).

In 2011 sulla was included in 2 rotation trials; one at Minnipa and the second at Edillilie. These rotation trials included a number of crop and pasture break crop treatments, however this article is comparing sulla with the currently recommended annual pasture species in each region, annual medic at Minnipa and sub-clover at Edillilie. The trials were comparing the biomass production and the subsequent wheat yield of the 2 species, over a 3 year pasture-pasture-wheat rotation. Each trial was replicated 3 times; plot sizes were 20 m by 1.5 m at Minnipa and 12 m by 1.5 m at Edillilie. Soil type at Minnipa is a sandy loam pH $CaCl_2$ 7.8 increasing with depth, Edillilie is gravelly sand over clay pH 5.5 $CaCl_2$ declining with depth. Sulla seed was inoculated with its specific rhizobia, the annual medic and sub-clover were not inoculated based on background rhizobia populations.

Plant establishment densities in 2011 and biomass production data, in 2011 and 2012, were collected from 4 by 0.5 m², plant establishment, 2 by 0.5 m², biomass production, quadrats at Minnipa and from 3 by 0.2 m² quadrats at Edillilie. In 2012 canola was dry sown into the Minnipa annual medic treatment on 24 April to increase the potential biomass of the second year pasture. There was no fertiliser applied in 2012 at either site.

In 2013 Mace wheat was sown at Minnipa at 55 kg/ha with 65 kg/ha DAP (18:20:0:0) on 14 May and at Edillilie at 85 kg/ha with 80 kg/ha of DAP (18:20:0:0) on 20 May. At Edillilie, based on visual observation the wheat following the sulla treatment received 100 kg/ha of urea (46 units of N), the wheat following sub-clover 50 kg/ha of N, both were manually top-dressed on the 15 August. There was no in-crop nitrogen applied at Minnipa. Selective grass control was applied in 2011 and 2012; selective broadleaved weed control was applied in 2013 at both sites.

Table 1 Pasture variety, sowing date, seeding rate and fertiliser applied to sites at Minnipa and Edillilie in 2011

Minnipa	Variety	Sowing Date	Seeding rate	Fertiliser
Sulla	Wilpena	2 May	5	12 N and 13 P
Annual medic	Angel	2 May	5	12 N and 13 P
Edillilie				
Sulla	Wilpena	26 May	5	18 N and 20 P
Sub-clover	Dalkeith	26 May	10	18 N and 20 P

Break Crops

Treatment means were not statistically significant due to only 2 treatments and 3 replicates being analysed (2 degrees of freedom), however the results are discussed in the context of data presented.

What happened?

The Eyre Peninsula perennial legume evaluation study 2010 to 2012 has shown sulla to be highly productive on EP cropping soils when rooting depth was not constrained, especially in the growing season following establishment.

Minnipa received average rain in 2011 and 2013 and below average in 2012. Rain at Edillilie was above average in 2011 and 2013 and slightly below in 2012.

Pasture plots were mown to simulate grazing immediately following each biomass sampling. Canola as part of the 2012 regenerated annual medic pasture at Minnipa was a declining proportion over the 3 samplings, 100% on 9 July, and 20% on 17 September.

The annual pastures produced similar or more biomass in the winter than sulla, apart from the Minnipa site in 2012 where an annual medic canola mix produced less. The sulla produced similar or increased spring biomass production at both sites in both years.

Table 2 Minnipa and Edillilie 2011, 2012 and 2013 growing season and total annual rainfall (mm)

	Minnipa		Edillilie	
	April - October	Annual	April - October	Annual
2011	252	404	422	500
2012	185	253	290	400
2013	237	334	463	537
Mean	242	325	340	420

Table 3 Minnipa and Edillilie sulla and annual medic/sub-clover plant establishment (plants/m²) in 2011 and biomass production (tDM/ha) in 2011 and 2012

	2011			2012		
	(plts/m²)	(tDM/ha)		(tDM/ha)		
Minnipa	**27 May**	**11 Aug**	**19 Sept**	**9 July**	**8 Aug**	**17 Sept**
Annual medic (& canola**)	123	2.1	*	0.5	1.7	1.3
Sulla	26	<0.1	3	1	3.3	1.9
Edillilie	**17 June**	**1 Sept**	**22 Oct**	**13 July**	**22 Aug**	**1 Oct**
Sub-clover	170	1.5	4.4	0.8	1.9	2.1
Sulla	49	0.1	6.7	0.5	1.1	2.4

**Annual medic did not recover following 11 August mowing (simulated grazing treatment) as a result of powdery mildew infestation.*
***In 2012 only.*

Table 4 Minnipa and Edillilie soil water content (mm) and nitrogen (mg/kg NH_4 and NO_3) in April, grass weed populations (plants/m²) in July and wheat grain yield (t/ha) and protein content (%) in 2013

	Soil water	Soil nitrogen	Grass weeds	Grain yield	Grain protein
Minnipa	**(0-1.2 m)**	**(0-0.3 m)**	**(plts/m²)**	**(t/ha)**	**(%)**
Annual medic	113	42	10	2.4	10.3
Sulla	111	50	20	2.2	11.4
Edillilie	**(0-0.6 m)**	**(0-0.1 m)**			
Sub-clover	91	29	16	3	9.6
Sulla	87	20	5	3.9	9.9

The soil water contents and residual soil nitrogen levels were similar in April between treatments at both sites, grass weed densities were variable. Grain yield at Minnipa following sulla was 10% less than following annual medic with a similar 10% increase in grain protein content. Grain yield at Edillilie was 30% higher with a similar grain protein content following sulla compared to sub-clover, however the sulla-wheat treatment received an extra 23 units of nitrogen in August 2013.

What does this mean?

In this study sulla has produced similar or increased biomass to the annual pastures in seasons of above and below annual average rainfall. However sulla shifted the pasture biomass production to later in the season, outside the normal period of winter forage deficit. The value of that spring flush may be in hay production or protecting annual pastures while awaiting the availability of crop stubbles. There is also the potential opportunity for increasing weight gains in prime lambs in preparation for an early turn-off.

The subsequent wheat production at Minnipa was similar between treatments in an average rainfall season, and there were no indications in soil water or residual N of a yield benefit resulting from either treatment. The higher protein content after sulla may have been a response to a lower yield trend.

At Edillilie the higher wheat grain yield with similar protein content after sulla compared to sub-clover has several possible explanations. An extra 23 kg/ha of N in August was a possible reason coupled with lower annual rye grass populations. This is supported with the results from not reported companion treatments which also received 23 kg/ha of N in August, canola-lupins-wheat and lupins-canola-wheat yielded 3.8 and 3.7 t/ha with a grain protein content of 9.9 and 10% respectively, a similar result to the sulla-sulla-wheat treatment. There was no suggestion of increased soil water use by the wheat after sulla with similar soil water contents between treatments on 29 November, however samples were physically unable to be removed below 0.3 m and therefore is not a conclusive outcome.

This study provides preliminary information relating to the potential of sulla as an inclusion in mixed farming systems where the farmer is addressing crop production constraints, including grass, pest and disease control, through implementing a 2 year non-cereal break. Economically the current cost of sulla seed may restrict its use to the more reliable rainfall regions of EP. Sulla will also need to demonstrate a wide range of agronomic and animal production benefits, such as effective alternative grass control options, and animal health and production advantages before it is widely introduced on Eyre Peninsula.

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Sulla *(Hedysarum coronarium)* broad acre demonstration at MAC

RESEARCH

Suzanne Holbery & Roy Latta

SARDI, Minnipa Agricultural Centre

Try this yourself now

Location:
Minnipa Ag Centre
Barn Paddock

Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm

Yield (Dry Matter)
Sulla 1.3 t/ha
Vetch 2.3 t/ha
Medic 2.3 t/ha

Paddock History
2012: Chemical fallow
2011: Durum wheat
2010: Hindmarsh barley
2009: Sloop SA barley

Soil Type
Red sandy loam over light clay

Soil Test
Total N (0-90 cm) 90 kg/ha
Colwell P (0-10 cm) 45 mg/kg
pH (H_2O) 8.5
Boron (0-10 cm) 2.4 mg/kg

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

Plot Size
9 m x 275 m x 5 reps

Key messages

- **Weed control prior to sowing is imperative for successful establishment of sulla.**
- **Regular monitoring in early spring will assist in managing pest outbreaks.**
- **There can be a grazing opportunity in the first year if sufficient biomass and flowers have been produced to ensure survival over summer and sufficient plant numbers in the second year.**

Why do the trial?

The legume pasture options capable of thriving in the low rainfall zone of Eyre Peninsula are currently limited. The success of sulla as a break crop treatment option in the GRDC funded Crop Sequencing project (EPFS Summary 2012, p 94) warranted further investigation into the productivity of the plant under upper Eyre Peninsula conditions on a broad acre scale. Research from south eastern South Australia suggested sulla requires a minimum 400 mm average annual rainfall to grow productively, precluding the upper Eyre Peninsula with only 320 mm. In the second year following establishment (under low rainfall conditions) it produced 6.5 t/ha dry matter, thus making it a viable option as a hay crop or pasture. The aims of the paddock demonstration are to measure the effects of sulla on soil health and weed burden, determine the financial viability of establishing a 2 year break phase within an existing cropping rotation and the feasibility of harvesting the seed for on-farm use.

How was it done?

The Barn paddock site was selected due to accessibility and paddock size. Pre-sowing preparation included cultivation with sweeps on the seeder bar, followed by prickle chaining. Herbicide application consisted of glyphosate @ 1 L/ha and carfentrazone-ethyl @ 50 ml/ha. The paddock was a grass free pasture the year prior to sowing.

Soil sampling across the site on the day of sowing measured root disease inoculum levels and soil fertility in the 0-10 cm profile. Soil moisture and total soil nitrogen was measured at 0-30, 30-60 and 60-90 cm increments down the profile.

The paddock was sown on the 2 May using a 9 m air seeder with knife points and 30 cm row spacing. The paddock was divided into 5 blocks with each block consisting of three sulla, one vetch and one medic in 9 m wide seeder widths. The sulla cultivar Wilpena seed was coated with Superstrike, containing a pesticide against red-legged earthmite, fungicide against pythium and fusarium and specific rhizobia inoculant. Specially formulated peat inoculum (strain wsm1592) specific to sulla was mixed through the seed the day of sowing. Seed was sown at 3 kg/ha at 2.5 cm depth. *Vicia sativa* cv. Cummins (vetch) was sown at 40 kg/ha and 2.5 cm depth, not inoculated. *Medicago* cv. Angel was sown in five strips at 3 kg/ha and 1 cm depth. Medic seed was coated with Agristrike containing AL rhizobia inoculum, additional nutrients and broad spectrum fungicide. All strips had 9 kg of N and 10 kg of P applied as 50 kg/ha of DAP 18:20:0:0.

For the post-emergence control of broadleaved weeds flumetsulam @ 25 g/ha on 4 June was applied. Grass selective, quizalifop-P-Ethyl @ 250 ml/ha was applied on 7 June. A second application of grass selective was required 26 June, clethodim @ 250 ml/ha was used. Alpha-cypermethrin pesticide was added to this application @ 200 ml/ha to control red-legged earth mite and native budworm. A second pesticide application on 23 September with dimethoate @ 300 ml/ha and emamectin @500 ml/ha was applied to control aphids and caterpillars.

Additional fertiliser with 10 kg of N and 12 kg of S as sulphate of ammonia was applied @ 50 kg/ha on 1 July.

On 2 October 340 ewes and 445 lambs grazed blocks 1, 2 and 3 with access to sulla, vetch and medic for 2 days until approximately 10 cm of biomass remained on the sulla plants. The decision to graze was based on better than expected dry matter yields. Blocks 4 and 5 remained un-grazed as a comparison of persistence into the second year.

What happened?

Results from DNA based PreDicta® B analysis prior to sowing provided no evidence of soil borne pathogens at levels likely to impact the crops.

There was 39.7 mm of water in the 0-30 cm profile at sowing. The sulla and medic emerged thirteen days after sowing whilst the vetch was a week earlier. It is possible that the seed coating on the medic and sulla delayed germination of the seed and in turn emergence.

To gauge the success of seeding and the viability of the seed it was calculated from seeding rate and plant establishment counts that 49% of the sown sulla seed germinated and made it through to seedling stage. Medic was 43% and vetch 77.4%. Plant establishment counts varied with 19, 38 and 65 plants/m^2 recorded for sulla, medic and vetch respectively.

The application of flumetsulam on 4 June negatively impacted vetch plant growth and development. The product was un-registered for vetch, however after this setback the plants did eventually recover and late dry matter figures suggest there was no long term effect.

Taking into account the different seeding rates and plant numbers, vetch proved to be the most productive at flowering on 26 August in terms of the average dry matter produced per plant. Medic was slightly less than the vetch however the sulla was 28% less productive. Four weeks later the medic production had increased whilst the vetch had begun to senesce. Sulla production was slow following establishment but rapidly increased with the onset of warmer spring temperatures. Dry matter results reflect this with 0.52 t/ha at flowering and 1.26 t/ha prior to grazing.

Moderate temperatures and 10 days of daily rainfall during September resulted in a major pest infestation of bluegreen and cowpea aphids and native budworm. Visual observation indicated that the vetch was targeted first and then the insect moved into the sulla. This outbreak may also explain the decreasing dry matter calculated pre-grazing in the vetch. The result of the outbreak required immediate pesticide application that postponed grazing until after the withholding period of the pesticide.

Research conducted by SARDI in south eastern South Australia indicated that sulla is preferentially grazed by livestock due to high palatability. To improve the chances of an even graze across the vetch, medic and sulla strips the stocking rate was approximately 250 DSE/ha and regular monitoring ensured over-grazing did not occur. Initially as the ewes and lambs were turned out into the paddock they targeted vetch but within a few hours there was a much more even spread across the paddock.

What does this mean?

The preliminary result from year one of the trial suggests that sulla can be a viable break crop alternative in the low rainfall region of Eyre Peninsula. However 2013 saw consistent rain throughout the growing season until it stopped in mid-September. The success of the plant during a below average rainfall year is still to be determined.

In good seasons it is likely that there would be an opportunity for either grazing or hay cut in the first year. The effects of doing so going into the second year will be measured in 2014.

There are presently no registered herbicides for use on sulla. The broadleaf herbicide used for this demonstration showed some yellowing of the leaves but was not detrimental to the survivability of the plant. Metribuzin has shown the most promising results in other trials.

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Nitrous oxide emission levels in response to alternative crop rotations

Roy Latta
SARDI, Minnipa Agricultural Centre

Searching for answers

Location:
Minnipa Ag Centre, Airport paddock
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Paddock History
2012: Wheat
Soil Type
Calcareous red sandy loam
Soil Test
Organic C%: 0.9
Plot Size
10 m x 3 m x 3 reps

Location:
Wanilla - David Giddings
Rainfall
Av. Annual: 550 mm
Av. GSR: 400 mm
2013 Total: 600 mm
2013 GSR: 480 mm
Paddock History
2012: Wheat
Soil Type
Duplex sand over loam
Soil Test
Organic C%: 1.2
Plot Size
10 m x 3 m x 3 reps
Yield Limiting Factors
November hailstorm
Environmental impacts
Soil Health
Soil structure: Stable
Compaction risk: Nil no livestock
Ground cover or plants/m^2: standard crop establishment and management practice no grazing
Perennial or annual plants: Annual
Water Use
Runoff potential: Low
Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, N_2O): Cropping
Social/Practice
Time (hrs): No extra
Clash with other farming operations: Standard practice
Economic
Infrastructure/operating inputs: Canola rotation has higher input costs
Cost of adoption risk: Low

Key message

- **Preliminary results showed the level of nitrous oxide emissions did not increase over the 2013 winter as a result of near capacity soil water contents coupled with increased nitrate nitrogen levels resulting from seeding and in-crop nitrogen applications on the canola compared with a pulse crop and legume pasture.**

Why do the trial?

Direct greenhouse gas emissions from agriculture currently accounts for approximately 15 per cent of Australia's total, of which nitrous oxide (N_2O) from agricultural soils contributes about 17% of total emissions from agriculture. A review by Grace (unpublished data) suggested Eyre Peninsula had low nitrous oxide emission potential. However the increasingly common wheat-canola rotation in the 400-500 mm rainfall zone of the lower EP, with 200-300 units of synthetic nitrogen (N), largely top dressed onto the canola phase, plus a further 100-150 units of N applied during the wheat phase may lead to higher emissions than previously estimated.

This project will measure N_2O at two sites, in key biophysical areas of the region, quantifying the relative amount of gas emitted from the use of synthetic N fertilizer while assessing the opportunity to provide alternative cost effective N sources (pulse and pasture legume N), which local farmers may adopt.

How was it done?

Rotation trials were sown at Minnipa Agricultural Centre on 30 April 2013 and at Wanilla on 17 May 2013. The treatments were replicated 3 times (Table 1).

Greenhouse gas measurements were taken at Minnipa and Wanilla on 2 and 17 May (post seeding), 24 and 26 June (post N application), 31 July and 1 August (post N application) respectively. Further sampling on the 30 August and 2 September, 1 and 5 October, and 9 November and 25 October at Minnipa and Wanilla respectively awaits analysis.

Measurements collected included;

- Gas samples from individual collection chambers were taken at 0, 20, 40 and 60 minutes from commencement and sent to the University of Melbourne for N_2O and carbon dioxide (CO_2) concentration analysis.
- soil water content (mm 0-10 cm, 10-30 cm),
- biomass (live crop and crop residues),
- soil temperature (5 cm) and
- NH_4 and NO_3 chemical analysis (0-10 cm, 10-30 cm).

Crop establishment counts were completed on 14 June (Minnipa) and 31 May 2013 (Wanilla). Pea and canola plots were harvested for grain yield at Minnipa on 8 October and at Wanilla on 27 November 2013. Pasture plots were mown on the October and November dates to simulate grazing.

What happened?

Annual rainfall at Minnipa totalled 334 mm, with 237 mm falling during the growing season (April to October). Wanilla received 600 mm over 2013, of which 480 mm fell over the growing season. Soil type is a calcareous sandy loam at Minnipa, pH $CaCl_2$ 8.1, with 70 kg N/ha and soil organic carbon content 0.9% (0-10 cm) and an acidic gravelly sand over clay pH $CaCl_2$ 5.5, with 73 kg N/ha and soil organic carbon content 1.2% (0-10 cm) at Wanilla in April 2013

Table 1 Crops, seeding rates and fertiliser applications applied at [1]Minnipa and [2]Wanilla in 2013

Crop Type	Variety	Seeding rates	Fertiliser rates	In crop nitrogen fertiliser (kg N/ha)		
		kg/ha	kg/ha (N + P)	June	July	August
Canola	[1]Stingray	3	23 N + 10 P	23	23	
	[2]Hyola 575CL	4	54 N + 16 P	46	46	30
[1]Ann. medic	Angel	10	10 P			
[2]Sub-clover	Dalkeith	16	8 N + 16 P			
[1]Field pea	Twilight	80	10 P			
[2]Lupin	Mandelup	80	8 N + 16 P			

Table 2 Crop biomass (tDM/ha), volumetric soil water (mm 0–30 cm), soil temperature (°C, 5 cm), nitrate and ammonium nitrogen (mg/kg 0–30 cm) and nitrous oxide emissions (g/ha/day) on the 24 June and 31 July at Minnipa

Crop Type	Date	Biomass	Soil water	Soil temp.	NH_4 NO_3	N_2O emissions
		(tDM/ha)	(mm)	(°C, 5 cm)	(mg/kg)	(g/ha/day)
Canola	24 June	0.2	59	13.3	68	1.6
Ann. medic	24 June	0.1	63	13.2	29	1.1
Field pea	24 June	0.3	59	12.8	28	2.6
Canola	31 July	1.6	51	14.4	36	6.3
Ann. medic	31 July	1.0	53	17.5	9	2.1
Field pea	31 July	1.5	55	17	20	5.1

Table 3 Crop biomass (tDM/ha) volumetric soil water (mm 0–30 cm) soil temperature (°C, 5 cm) nitrate and ammonium nitrogen (mg/kg 0–30 cm) and nitrous oxide emissions (g/ha/day) on 26 June and 1 August at Wanilla

Crop Type	Date	Biomass	Soil water	Soil temp.	NH_4 NO_3	N_2O emissions
		(tDM/ha)	(mm)	(°C, 5 cm)	(mg/kg)	(g/ha/day)
Canola	26 June	0.2	52	13.9	68	3.6
Sub-clover	26 June	0.1	60	15.1	20	1.8
Lupins	26 June	0.2	55	14.8	24	3.4
Canola	1 August	1.1	84	12.3	75	5.2
Sub-clover	1 August	1.1	86	13.4	29	4.4
Lupins	1 August	1.1	85	12.6	38	6.0

Table 4 Plant establishment (plants/m²) and crop grain (t/ha) and total biomass yields (tDM/ha) at Minnipa and Wanilla

Location	Crop Type	Establishment	Biomass	Grain yield
		(plants/m²)	(tDM/ha)	(t/ha)
Minnipa	Canola	62	4.0	0.6
	Ann. medic	129	2.8	
	Field pea	49	6.0	1.4
Wanilla	Canola	72	9.1	1.2*
	Sub-clover	94	6.5	
	Lupins	46	12.5	1.5*

**Grain yields were reduced at Wanilla as a result of a hailstorm.*

Nitrous oxide emission levels appeared more closely correlated with biomass production (regression analysis of 0.9 and $0.87r^2$) than with soil nitrogen content (-0.17 and $0.43r^2$) at Minnipa and Wanilla respectively. There was no difference in soil water content between treatments, however there was a trend towards lower soil temperatures under the canola. More nitrous oxide emission data taken over a longer time period is required before a statistical analysis can be undertaken, and more rigorous conclusions can be drawn.

What does this mean?

This work seeks to test the hypothesis that high levels of soil N created by high inputs of synthetic N in combination with waterlogged conditions will lead to higher N_2O emissions in the EP environment. The two sites represent the high and low rainfall zones of the region, and so the alternative cropping rotations effect on gas emissions can be assessed under these conditions.

The preliminary results show the level of nitrous oxide emissions did not increase as a result of higher soil nitrate nitrogen concentrations resulting from seeding and in-crop nitrogen applications to canola crops. The Wanilla site reached a 30% volumetric soil water content in August in conjunction with higher comparative measured levels of nitrate in the canola treatment compared to the legumes, but this did not translate into higher nitrous oxide emissions. The two sites had similar measured levels of nitrous oxide emissions over the winter growing season even though the Wanilla site had increased nitrate levels and similar or higher soil water contents. Any perceived increase in emission levels was seemingly associated with increased biomass.

Measurements will continue in response to any major summer rain events and the 2014 seeding and in-crop nitrogen applications to assess any response from increased levels of residual N resulting from the legumes.

Acknowledgements

Minnipa Agricultural Centre and David Giddings for the use of their land. Terry Blacker and Ian Richter for their technical support. This project is supported by funding from the Australian Government.

Australian Government

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Vetch breeding trials at MAC 2013

Stuart Nagel[1], Leigh Davis[2], Gregg Kirby[1], Rade Matic[1] and Brenton Spriggs[2]
[1]SARDI, Waite; [2]SARDI, Minnipa Agricultural Centre

RESEARCH

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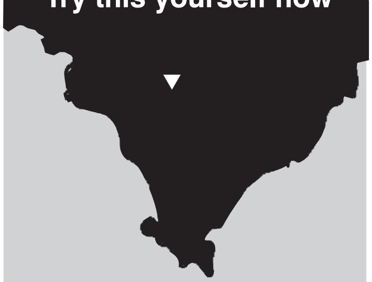

Location:
Minnipa Ag Centre (South 6 West)
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential (Pulses): Grain yield 1.75 t/ha
Actual: 6.0-7.0 t/ha of hay/dry fodder (from trial data)
Paddock History
2013: Canola and Legume trials
2012: Wheat
2011: Barley
2010: Barley
Soil Type
Brown sandy loam
Plot Size
12 m x 1.25 m x 3 reps
Yield Limiting Factors
Low late season rainfall
Rhizoctonia

Key messages

- **Vetch is a versatile crop that can be used for grain, pasture/grazing, hay/silage or green/brown manure.**
- **It provides an opportunity to attack problem/resistant weeds in rotation while still providing other benefits like high quality grazing or hay.**
- **Vetch offers oportunities for disease breaks in rotation and also returns significant amounts of nitrogen to the soil improving overall productivity.**
- **Advanced breeding lines were trialled and compared to existing varieties at Minnipa for fodder production.**
- **Several new vetch species were trialled on Eyre Peninsula in 2012 and 2013.**

Why do the trial?

In 2013 The National Vetch Breeding Program (NVBP) conducted two trials on Eyre Peninsula at Minnipa Agricultural Centre (MAC). A trial comparing hay production of advanced common vetch lines and existing varieties (S4 Trial) and another trial involving a range of new vetch species (New Species trial, funded by SAGIT) targeted 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.

How was it done?

Both trials were sown on 18 May 2013 with 57 kg/ha MAP fertiliser and no inoculum. Pre-sowing 900 ml/ha Roundup, 70 ml/ha Nail and 900 ml/ha Lorsban was applied. Pre-emergent herbicides Simazine @ 680 g/ha + Lexone @ 200 g/ha were used on the S4 trial and only Simazine @ 680 g/ha on the New Species trial. During the season 300 ml/ha Select, 150 ml/ha Targa and 1 L/100L Water Kwicken was used to control grasses.

The S4 trial was sown at 60 plants/m^2 which equates to approximately 45 kg/ha. The New Species trial was sown at 50 plants/m^2.

The S4 trial was cut for hay on 11 September 2013. The New Species trial was cut twice; one replicate was cut on 11 September 2013 and the remaining 2 replicates on 10 October 2013.

What happened?

The S4 trial emerged well and had good early vigour, looking particularly good at the time of the Minnipa Field Day in September when it was cut for hay (Table 1). The timing of cutting was not ideal for all lines, Volga and 34748 had finished flowering and Morava was only at 50% flowering, but it gives an indication of yield potential.

It was an excellent season and yields were above expectations, but this does demonstrate the potential of vetch to produce significant amounts of fodder in good years.

In 2012 the New Species trial was disappointing and again in 2013 it showed poor early vigour and very little winter growth. The trial was cut at two different times; one replicate on 11 September 2013 to assess regrowth potential and the remaining two on 10 October 2013, along with the regrowth from the first cut. Unfortunately regrowth was poor, averaging approximately 0.5 t/ha. There were also significant patches of Rhizoctonia apparent in the trial affecting the new species but not the common vetch. The fact that these new species could not out-yield Morava (Table 2) in this environment was disappointing. This combined with the poor early growth, lack of competitiveness and Rhizoctonia susceptibility has led to the conclusion that these new species are not suited to this environment.

Table 1 Hay yield of Minnipa S4 common vetch, 2013

Trial	Variety	Yield (t/ha)
13 MAC S4 vetch	34748	6.26
13 MAC S4 vetch	35036	6.96
13 MAC S4 vetch	35072	6.30
13 MAC S4 vetch	37107	6.98
13 MAC S4 vetch	34462-1	6.65
13 MAC S4 vetch	35418-2	6.09
13 MAC S4 vetch	35614-1	6.39
13 MAC S4 vetch	35675-1	7.18
13 MAC S4 vetch	Morava	6.57
13 MAC S4 vetch	Rasina	6.58
13 MAC S4 vetch	Timok**	7.18
13 MAC S4 vetch	Volga**	6.18

*** These lines are to be released as new varieties, previously trialled as 35103 (Timok) and 34823 (Volga), seed is not yet available for purchase.*

Table 2 Minnipa New Species Trial dry matter yields (t/ha), 2012 and 2013

Trial	Species	Line	2012 Dry Matter (t/ha)	2013 Dry Matter (t/ha)
New Species	*V. orbicularis*	33118	2.3	2.7
New Species	*V. palaestina*	37292	2.4	2.9
New Species	*V. palaestina*	37293	2.2	2.6
New Species	*V. palaestina*	37331	1.7	1.8
New Species	*V. palaestina*	37332	2.4	3.0
New Species	*V. palaestina*	37355	3.1	2.7
New Species	*V. palaestina*	37361	2.1	2.5
New Species	*V. sativa*	Morava	4.0	4.8

What does this mean?

The common vetch performed very well in 2013, providing excellent yields of high quality fodder. It was a very good season and shows the potential of vetch in this area to provide either excellent hay and/or grazing or significant biomass for green/brown manure.

The New Species trial was disappointing, with yields below expectations and several negative traits mentioned above combining to make these species unsuitable for further investigation or release.

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.

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Section Editor:
Roy Latta
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Section 3

Disease

Management of soilborne Rhizoctonia disease risk in cereal crops

RESEARCH

Vadakattu Gupta[1], Amanda Cook[2], Alan McKay[3], Wade Shepperd[2], Ian Richter[2], Jack Desbiolles[4], Kathy Ophel-Keller[3], Nigel Wilhelm[3] and David Roget[5]

[1]CSIRO, Waite; [2]SARDI, Minnipa Agricultural Centre; [3]SARDI, Waite; [4]University of SA; [5]Private Consultant, deceased December 2013.

Searching for answers

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

Rainfall
Av. Annual: 340 mm
Av. GSR: 274 mm
2013 Total: 261 mm
2013 GSR: 226 mm

Yield
Potential: 2.32 t/ha (W)
Actual: 1.33 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

- **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.**
- **The reduction in Rhizoctonia inoculum levels from non-cereal crops lasts for only one crop season.**
- **In cereals, Rhizoctonia inoculum builds-up from sowing to crop maturity (in all environments).**
- **Management practices which preserve 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 pathogen 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.**
- **SARDI and DAFWA field trial results showed that banding fungicides above and below seed, below seed only or below seed combined with a seed dressing treatment can improve control of Rhizoctonia compared to seed treatment alone, however, fungicide treatments need to be used as part of an integrated management strategy to effectively reduce Rhizoctonia impacts.**

Why do the trial?

Rhizoctonia continues to be an important but complex disease in the southern agricultural region, especially on upper Eyre Peninsula. This was the last season of a six year trial. 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. This season the Rhizoctonia disease and inoculum levels were compared between tillage systems and summer weed control on treatments which included a non-cereal break.

The cultivation treatments for weed control were conventional cultivation (23 January - wide sweeps; 4 March – wide sweeps), and no-till with narrow points were used for other treatments. Most trial plots were sprayed in the summer with 1 L/ha Roundup Attack, 1 L/ha LVE MCPA, 80 ml Hammer and 100 ml/ha BS100 to prevent a green bridge.

The trial was sown on 15 May 2013 into reasonable moisture with CL Kord wheat at 70 kg/ha with DAP @ 60 kg/ha, granular urea @ 35 kg/ha, and 1 kg/ha zinc sulphate applied as a solution in all plots. The trial area received 1.2 L/ha of Spray.Seed, 1 L/ha of trifluralin, 80 ml/ha Hammer and 100 ml/ha wetter pre seeding. Post sowing herbicides of Achieve @ 400 g/ha and Supercharge @ 500 ml/ha were applied on 13 June and on the 1 July after soil and root sampling 700 ml/ha Intervix, 80 ml/ha Lontrel and Supercharge @ 500 ml/ha were also applied on all plots. On 26 July all plots were sprayed for cut worm using 300 ml/ha of Astound. Sampling included Rhizoctonia pathogen DNA levels, root disease incidence, dry matter production, microbial activity, grain yield and quality.

What happened?

During 2013, moisture stress through the anthesis and grain filling periods resulted in grain yields similar to 2012 but lower than in 2009 and 2010. In the continuous wheat rotation, multiple cultivations resulted in significant yield benefits (Figure 1) but no such benefit was seen with single cultivation only. A lack of summer weed control ('no weed control' treatment (F-WWW no weed) caused a 21% yield reduction compared to chemical summer weed control (W-F-WW). In general, there were no benefits in grain yield from non-cereal breaks (before 2012) on grain yields.

Table 1 Details of treatments during the six years of the experiment

Treat No.	Treatment		2008	2009	2010	2011	2012	2013	
1	Continuous cereal	No-Till	Wheat	Wheat	Wheat	Wheat	Wheat	NT	W-W-W NT
2	Continuous cereal	Conv cult	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat Conv cult	W-W-W cult
3	Continuous cereal	Strategic cult	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat - Multiple cultivations	W-W-W multiple
4	Fallow - Wheat	No-Till	Fallow	Wheat	Fallow	Wheat	Wheat	Wheat - No weed control	F-W-W-W No weed
5	Wheat - Fallow	No-Till	Wheat	Fallow	Wheat	Fallow	Wheat	Wheat NT	W-F-W-W
6	Canola - Wheat	No-Till	Canola	Wheat	Canola	Wheat	Wheat	Wheat NT	C-W-W-W
7	Wheat - Canola	No-Till	Wheat	Canola	Wheat	Canola	Wheat	Wheat NT	W-C-W-W
8	Pasture - Wheat	No-Till	Pasture	Wheat	Pasture	Wheat	Wheat	Wheat - No weed control	P-W-W-W NT-No weed
9	Pasture - Wheat	Conv cult	Pasture	Wheat	Pasture	Wheat	Wheat	Wheat Conv cult	P-W-W-W cult
10	Wheat - Pasture	No-Till	Wheat	Pasture	Wheat	Pasture	Wheat	Wheat NT	W-P-W-W NT

Rhizoctonia inoculum levels at sowing were higher than observed in 2009, 2010 and 2012 similar to that in 2011 (Figure 2). There was no second year crop rotation effect on the pathogen inoculum levels i.e. the wheat crop in all plots in 2013 removed all previous crop rotation effects. This confirms previous observations that the reduction in the inoculum level lasts only for one year as inoculum builds up on the following cereal crop. Observations from other field 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 and crop rotation can be used as part of an effective management strategy against Rhizoctonia disease.

Rhizoctonia inoculum levels at sowing were significantly lower in treatments receiving summer cultivation (1-3 cultivations) in the continuous wheat rotation (Figure 2), however, inoculum levels were still in the medium risk category. Previous observations indicated that Rhizoctonia inoculum levels were generally higher in the surface 0-5 cm soil compared to that in 5-10 cm soil. Inoculum levels were significantly increased during the crop season and no treatment effects were found (average 1158 pg/g soil; high disease risk category). These results suggest that summer rainfall greater than 10 mm and weed control are necessary to reduce Rhizoctonia disease risk in the 2014 cereal crop.

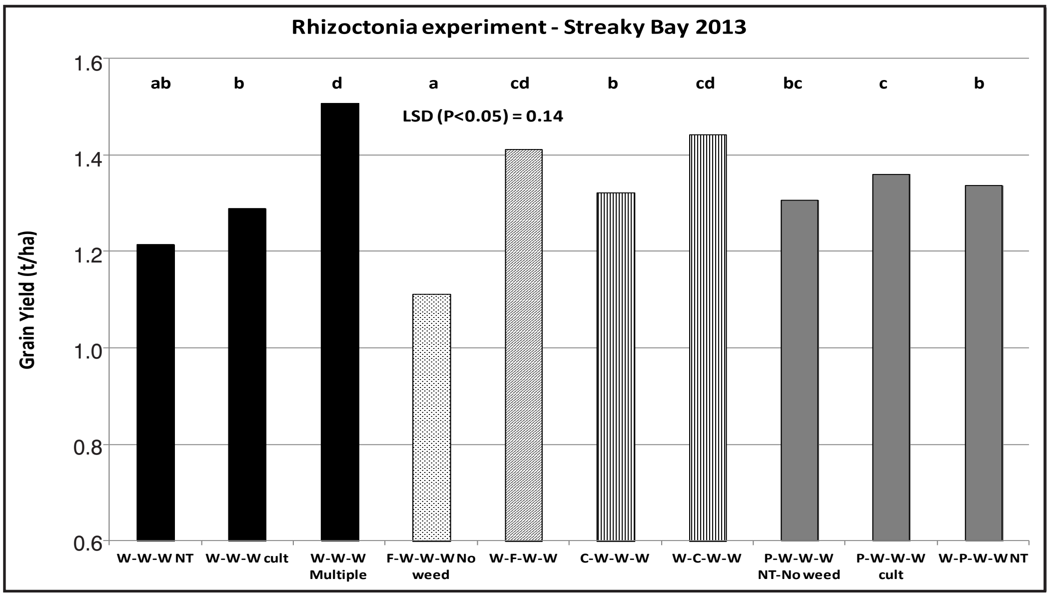

Figure 1 Crop rotation, cultivation and weed control effects on wheat grain yield (t/ha) at Streaky Bay during 2013 season. F=fallow, C=canola, P=pasture-grass free, NT=no-till and cult=cultivated, Multiple=3 cultivations. Treatment averages with different letters are significantly different from each other at P<0.05

Rhizoctonia disease incidence, measured at 7 weeks after sowing, was similar to that in 2009 and 2012, with an average disease incidence score of 2.874 ±0.04 and there was no significant treatment effect. 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 lower during 2013 compared to that in the 2010 and 2011 seasons resulting in higher disease incidence across treatments. Severe damage from Rhizoctonia infection during the seedling stage (up to 6-8 weeks after germination) generally results in characteristic patches. 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. There was no treatment effect on the seminal and crown root infection in 2013. The average infection was 61 and 47%, respectively across all treatments. Crown root infection was lower (39-57%) compared to that in 2012 (53-80%).

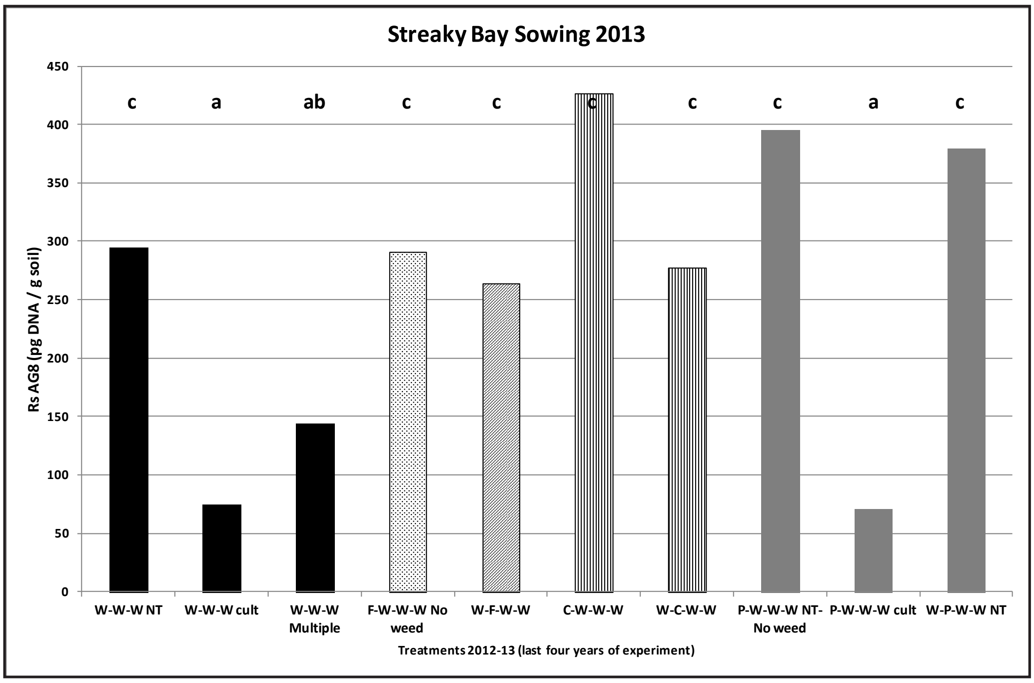

Figure 2 Crop rotation and cultivation effects on the* Rhizoctonia solani AG8 *inoculum levels in soil at sowing of wheat crops during 2013. Legend indicates crop type / treatment from 2008-12. Wheat was grown in all plots during 2012. F=fallow, C=canola, P=pasture, NT=no-till and cult=cultivated, Multiple=3 cultivations, No weed=no weed control during summer. Treatment averages with different letters are significantly different from each other at P<0.05

What does this mean?

Research during the last 5 years has clearly demonstrated that effective management of rhizoctonia disease in rainfed cropping systems requires both the management of inoculum levels and the infection process.

A. Management of inoculum: Rhizoctonia inoculum build-up in one year's crop is the major determinant of disease risk in the following year. Although non-cereal crops can be infected by Rhizoctonia, most either reduce or do not allow the build-up of inoculum.

1. Cereal crops (wheat and barley) increase Rhizoctonia inoculum from seedling stage to maturity in all seasons. This was observed at all sites on Eyre Peninsula and other regions in Southern and Western Australia.
2. Grass free canola and medic pastures reduce Rhizoctonia inoculum level resulting in significant increases in subsequent cereal yield. Other legumes such as field peas, chickpeas and vetch also showed (based on results from field experiments in the Mallee) limited or no inoculum build-up. The effect of rotation crops is similar to that after a weed free fallow.
3. Preliminary results from other cereal experiments on Eyre Peninsula indicated variation in inoculum development between cereals (wheat vs. barley) and between barley cultivars.
4. Crown root infection late into the crop season results in the build-up of *Rhizoctonia solani AG8* inoculum in cereal crops. Therefore, observation of infected crown roots late in the season could provide a visual indication of inoculum build-up that will impact the following crop.
5. Rhizoctonia inoculum levels generally peak at crop maturity and rain post maturity of a crop and over the summer fallow causes a decline in inoculum.
6. Major rainfall events (>10 mm) over summer that keep soil moist can reduce inoculum from a high to low risk situation, but prolonged dry periods that allow the soil to dry out would result in the recovery of inoculum levels.

B. Infection and disease impacts:

7. Plant-soil-microbe interactions can influence the effect of rhizoctonia disease on crop yield. The final impact of Rhizoctonia disease on yield is due to a combination of inoculum level, and many other factors including the level of soil microbial activity at seeding, the amount of soil disturbance below seeding depth, N levels at seeding and constraints to root growth (eg. compaction layers, low temperatures, soil moisture etc). For example, soils and cropping systems that maintain higher microbial activity at the start of the season would have lower disease incidence even in the presence of higher pathogen inoculum.
8. Assessment of yield loss from Rhizoctonia based on the area of distinct patches underestimates the true costs. Rhizoctonia damage to crown roots can result in significant loss (>10%) in wheat grain yield.
9. SARDI and DAFWA field trial results show banding fungicides above and below seed, below seed only or below seed combined with a seed dressing treatment can improve control of Rhizoctonia more consistently compared to seed treatment alone. However, fungicide responses may vary between sites (soil type) and seasons. Fungicide treatments alone will not eliminate patches and need to be used as part of an integrated management program (refer to EPARF Rhizoctonia fungicide trial article by Amanda Cook et al. in the EPFS Summary 2013).

Potential high soilborne disease risk in 2014:

- Conditions in 2013 crop season favoured increases in Rhizoctonia inoculum and inoculum levels were high at harvest.
- If summer rainfall continues to be low then inoculum reduction would not occur.
- Rhizoctonia disease risk will be further increased if there is a late break to the 2014 season and soils are cold at the time of sowing.

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. Technical support in the laboratory at CSIRO was provided by Stasia Kroker and Marcus Hicks.

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GRDC project codes: CSE00150, DAS00122, DAS00123

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SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

EPARF Rhizoctonia fungicide trial

Amanda Cook, Nigel Wilhelm, Wade Shepperd and Ian Richter
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location:
Minnipa Ag Centre South 3 North
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: 3 t/ha (Yield prophet MAC S2/8 Mace)
Actual: Wheat 1.3 - 2.1 t/ha, Barley 1.7 - 2.6 t/ha
Paddock History
2013: Hindmarsh barley
2012: Wheat
2011: Canola
Soil Type
Red sandy loam
Plot Size
20 m x 2 m 3 reps

Key messages

- **At Minnipa in 2013 there were cereal yield responses to fungicide treatments in both wheat (up to 14% better than no fungicide) and barley (up to 12 % better than no fungicide, but not all strategies were effective). However there were still visual Rhizoctonia patches present.**
- **In-furrow fungicide applications were more effective than seed treatments.**
- **Tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments.**
- **A three week delay in seeding reduced yield by nearly one third.**
- **Fungicide treatments did not prevent an increase in Rhizoctonia inoculum levels during a cereal phase.**

Why do the trial?

Several new fungicide products for Rhizoctonia suppression have been recently released onto the market. This trial was undertaken to assess the benefits of these products, and various application strategies, on wheat and barley performance in a typical upper Eyre Peninsula environment. Historically, fungicidal control of rhizoctonia which infects the major crops grown in southern Australia has generally been poor. However, these new products have shown greater promise in the development trials undertaken so far (McKay *et al,* 2013 GRDC Update) but our experience with them under commercial conditions is still limited. With the relatively recent development of processes to evenly coat fertiliser granules with fungicides and to deliver liquid products around the seed row during the seeding pass, there is now a range of application strategies available to growers to make use of these new products.

This trial assessed the new products with a range of application strategies and compared them to other management options (tillage, zinc, starter nitrogen, deep sowing, fluid fertiliser and late sowing) which can change the impact of rhizoctonia on crop production.

How was it done?

Two identical replicated trials were established in MAC paddock S3N which had a high level of Rhizoctonia inoculum. One trial was sown to CL Kord wheat, the other to CL Scope barley; Clearfield varieties were used due to the potential for grassy weeds to be a problem in the paddock in 2013. Paddock history, PreDictaB disease inoculum levels (RDTS), plant establishment, Rhizoctonia seminal root score, Rhizoctonia crown root score, green leaf area index, Rhizoctonia patch score, grain yield and quality were measured during the season.

The trial was sown with current best management options for Rhizoctonia control on the western end and fungicide products and rates on the eastern end. The control treatment was 60 kg/ha of wheat or barley with 50 kg/ha of 18:20:0:0. For treatments which required tillage prior to seeding plots were worked once on 11 April. Cultivation prior to seeding and seeding itself were conducted with a 6 row seeder at 27 cm spacing and with knife points. Starter N was an extra 20 kg/ha N applied as urea at seeding. A fluid fertiliser delivery system placed fluid fertiliser and banded fungicides approximately 3 cm below the seed at an output rate of 85 L/ha. Fungicides were applied as seed treatments according to label recommendations. The fluid fertiliser treatments were equivalent to 50 kg/ha of 18:20:0:0 as phosphoric acid and zinc sulphate but with N applied as granular urea below the seed.

Chemical control of weeds (eliminating a green bridge) occurred on 4 April with 0.8 L Roundup Attack, 350 ml Ester 680 LVE and 175 ml/ha LI 700. Trials were sown on 13 May @ 60 kg/ha of wheat or barley with 50 kg/ha of 18:20:0:0 (other than fluid fertiliser treatments) after receiving 1.5 L Spray.Seed. The late seeding treatment was sown three weeks later on 4 June. Further weed control was achieved with 700 ml Intervix and 500 ml/ha Supercharge on 27 June after early root sampling (25 June).

Rhizoctonia infection on seminal roots was assessed using the root scoring method described by McDonald and Rovira (1983) six weeks from seeding.

Paddock patch score for Rhizoctonia is a visual score of the number plants of 5 plants affected by Rhizoctonia (400 plants scored per treatment) across 4 transects. Crown roots were sampled on the 17 and 18 September after a rainfall event. Crown roots per plant were counted with the number of roots infected with Rhizoctonia used to calculate % crown root infection. Barley plots were harvested on 25 October and wheat on 30 October. Selected treatments were sampled for rhizoctonia inoculum levels in crop rows after harvest.

Data were analysed using Analysis of Variance in GENSTAT version 16, the late seeding and seeding depth >5 cm data was excluded from the analysis because of obviously poor yield performance, thereby improving the basis for the overall comparison among the remaining treatments.

What happened?

The initial Predicta B inoculum level predicted a high risk of severe Rhizoctonia disease (205 pgDNA/g soil). There were only low levels of inoculum for other soil borne diseases.

Plant establishment was the same for all treatments (an average of 112 plants/m^2 for barley and 128 plants/m^2 for wheat) except with deeper seeding of barley (only 87 plants/m^2). Late sown wheat and barley (sown 3 weeks later) had less dry matter at the same number of weeks after sowing than all other treatments.

Rhizoctonia infection on seminal roots was scored six weeks after seeding. Rhizoctonia infection of wheat was higher on treatments with extra N (Table 1). In barley rhizoctonia infection (Table 2) was higher with high nitrogen and lower rate in-furrow fungicide treatments. Rhizoctonia patch scores both early and at anthesis showed some level of Rhizoctonia patches regardless of treatments (data not shown). Infection of crown roots was the same for all treatments (Table 2).

Disease

Table 1 Disease scores and growth measurements, yield and grain quality for CL Kord wheat in EPARF fungicide trial in MAC S3N, 2013

Treatment	Rhizoctonia seminal root score (0-5)	Crown root infection (%)	Late dry matter (g/ plant)	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hL)
Vibrance seed dressing 360 ml/t & SYN SIF1 in-furrow medium rate	1.0	75.6	5.0	2.13	11.7	2.8	82.8
Fluid fertiliser with SYN SIF1 in-furrow higher rate	1.5	82.0	4.6	2.12	11.5	2.2	82.5
SYN SIF1 in-furrow higher rate	1.1	88.6	4.3	2.12	12.0	2.5	82.1
SYN SIF1 in-furrow medium rate	1.3	77.1	4.4	2.08	11.6	2.2	82.5
Vibrance seed dressing 360 ml/t	1.3	71.6	4.3	2.08	11.7	2.5	83.5
Vibrance seed dressing 180 ml/t & SYN SIF1 in-furrow medium rate	1.3	80.1	4.6	2.07	12.2	2.5	81.7
EverGol Prime seed dressing 800 ml/t	1.0	76.6	4.3	2.07	11.9	2.6	82.0
DAP, starter N, Zn, Evergol Prime @ seed dressing 800 ml/t	1.3	73.3	4.2	2.04	12.1	2.6	82.1
DAP and starter N	1.8	77.0	4.2	1.93	11.9	3.2	81.8
Fluid fertiliser with fungicide	1.6	73.9	5.3	1.93	12.0	3.5	82.1
Tillage, DAP, starter N, Zn	1.3	80.4	3.9	1.91	11.7	2.6	82.6
DAP, starter N, Zn, Vibrance seed dressing 360 ml/t	1.7	67.6	4.0	1.93	11.5	2.8	82.4
Fluid fertiliser no fungicide	1.3	81.3	3.9	1.91	11.6	3.0	82.7
DAP, starter N and Zn	2.0	85.8	3.8	1.91	11.8	2.6	82.2
Tillage	1.3	88.4	3.5	1.87	11.9	2.6	82.1
Control	1.5	82.8	4.1	1.86	11.5	2.8	82.3
*Seeding depth >5 cm	1.0	71.8	5.5	1.74	11.9	3.2	81.5
*Late seeding	1.5	85.1	2.7	1.31	13.3	4.3	79.1
LSD (P=0.05)	*0.4*	*ns*	*ns*	*0.15*	*ns*	*0.52*	*ns*

**Data removed from Analysis of Variance using GENSTAT16 because of obviously poor yield performance, thereby improving the basis for the overall comparison among the remaining treatments.*

Table 2 Yield and grain quality for CL Scope barley in EPARF fungicide trial in MAC S3N, 2013

Treatment	Rhizoctonia seminal root score (0-5)	Crown root infection (%)	Late dry matter (g/plant)	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hL)
Fluid fertiliser with SYN S1F1 in-furrow higher rate	1.22	75	5.55	2.63	12.1	11.7	70.7
Vibrance seed dressing 360 ml/t & SYN S1F1 in-furrow medium rate	1.48	78	6.36	2.56	12.4	18.2	69.6
SYN S1F1 in-furrow higher rate	1.31	85.6	4.69	2.52	12.3	15.0	70.1
Fluid fertiliser with fungicide	1.25	67.2	5.62	2.47	11.8	18.5	70.0
SYN S1F1 in-furrow medium rate	1.75	81.7	5.08	2.46	12.0	14.4	69.8
DAP, starter N, Zn, EverGol Prime seed dressing 800 ml/t	1.34	77.5	4.71	2.42	12.9	24.2	69.0
DAP, starter N, Zn, Vibrance seed dressing 360 ml/t	1.27	61.7	6.17	2.42	12.8	26.5	68.6
Vibrance seed dressing 180 ml/t & SYN S1F1 in-furrow medium rate	1.38	76.7	4.79	2.40	12.8	18.9	69.4
Tillage, DAP, starter N, Zn	1.22	74.6	5.22	2.39	13.0	27.1	68.8
DAP and starter N	1.65	77.9	5.80	2.38	11.7	20.7	69.6
DAP, starter N and Zn	1.57	85.9	5.16	2.37	12.6	23.4	69.2
Tillage	1.14	76.3	5.27	2.36	11.9	22.3	69.6
Control	1.49	74.9	5.65	2.34	12.0	23.5	68.8
EverGol Prime seed dressing 800 ml/t	1.23	79.8	5.57	2.32	12.2	22.8	68.5
Fluid fertiliser no fungicide	1.29	75.6	5.34	2.29	12.6	22.6	68.8
Vibrance seed dressing 360 ml/t	1.43	88.5	4.95	2.27	12.6	22.0	68.7
*Seeding depth >5 cm	1.35	75.6	4.58	2.12	12.8	20.5	68.8
*Late seeding	1.10	88.8	3.40	1.70	13.7	28.1	66.9
LSD (P=0.05)	*ns*	*ns*	*ns*	*0.15*	*ns*	*ns*	*ns*

**Data removed from Analysis of Variance using GENSTAT16 because of obviously poor yield performance, thereby improving the basis for the overall comparison among the remaining treatments.*

Fungicide treatments increased yield of wheat by between 0.07 and 0.27 t/ha (Table 1), and of barley by up to 0.28 t/ha compared to district practice (Table 2) with in-furrow and higher rates having the greater effect. In-furrow fungicides at higher rates increased yield but tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments. Delayed sowing for 3 weeks depressed yield in both wheat and barley, as did sowing barley at greater than 5 cm, (a strategy to place the root system below the bulk of Rhizoctonia inoculum).

The yield loss in barley may have been partly due to reduced plant numbers (data not shown).

Grain protein contents and screenings were high in these trials due to lack of rain in September and October (Tables 1 and 2).

Rhizoctonia inoculum post harvest was in the high disease risk level after both wheat and barley regardless of treatments (data not shown). This suggests that fungicide treatments will not decrease Rhizoctonia inoculum levels for the next season.

What does this mean?

There were differences in Rhizoctonia seminal root scores in wheat but not in barley, however scoring at six weeks after sowing in this season (with early and warm conditions at seeding) may not have allowed the greatest differences in seminal root infection to be detected. The extra 20 kg/ha N applied as urea at seeding resulted in higher Rhizoctonia root damage in the seminal root scores in wheat.

At Minnipa in 2013 there were yield increases to fungicide treatments in both wheat (up to 14 % of control) and barley (up to 12 % of control), however there were still visual Rhizoctonia patches present in the treatments. The results indicate in-furrow fungicides and higher rates are more effective than seed treatments. In-furrow fungicides at higher rates increased yield but tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments.

The placement of the fungicides banded below the seed has resulted in only seminal roots being protected not the crown roots, as the Rhizoctonia % crown root infection and numbers of crown roots were not different between treatments.

A three week delay in seeding resulted in significant loss of yield compared to the control, 29% in wheat and 28% in barley, and grain quality was also reduced in this season. High grain protein and high screenings were present in both wheat and barley due to the dry finish to season, with little spring rainfall. PredictaB soil samples were taken at harvest in selected treatments for Rhizoctonia inoculum levels, and all levels were in the high disease risk level after both wheat and barley indicating the fungicide treatments did not decrease Rhizoctonia inoculum levels.

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Disease

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Farmer best bet demonstrations for Rhizoctonia management

Amanda Cook, Nigel Wilhelm, Wade Shepperd and Ian Richter

SARDI, Minnipa Agricultural Centre

DEMO

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Searching for answers

Location: Warramboo - Medic and Vetch
Rainfall
Av. Annual: 300 mm
Av. GSR: 204 mm
2013 Total: 329 mm
2013 GSR: 239 mm
Yield
Potential yield: 2.5 t/ha (Yield Prophet 50% probability wheat on 22 July)
Actual: 1.2 - 1.6 t/ha (W)
Paddock History
2012: Vetch or medic
2011: Wheat
2010: Wheat
Soil Type
Calcareous loamy sand over limestone

Location: Warramboo - Fungicide
Rainfall
Av. Annual: 300 mm
Av. GSR: 204 mm
2013 Total: 329 mm
2013 GSR: 239 mm
Yield
Potential yield: 2.5 t/ha (Yield Prophet 50% probability wheat on 22 July)
Actual: 0.95 - 2.2 t/ha (W)
Paddock History
2012: Mace wheat
2011: Medic pasture
2010: Barley
Soil Type
Calcareous loamy sand

Location: Wynarka
Rainfall
Av. Annual: 335 mm
Av. GSR: 238 mm
2013 Total: 289 mm
2013 GSR: 245 mm
Yield
Potential yield: 2.8 t/ha (Yield Prophet 50% probability wheat on 22 August)
Actual: 2.3 - 2.5 t/ha (W)
Paddock History
2012: Kord wheat
2011: Canola
2010: Hindmarsh barley
Soil Type
Brown sandy loam over limestone

Key messages

- **In 2013 the Rhizoctonia best bets demonstrations using rotations were over-sown with cereal and showed break crops which are grass free are the best option to lower Rhizoctonia inoculum levels.**
- **2013 results also demonstrated the interaction between increasing nitrogen levels and Rhizoctonia seminal root infection, both in a vetch and medic rotation, a canola and fallow rotation and the EPARF trial at MAC where 20 kg/ha starter urea induced greater seminal root infection.**
- **The fungicide products for Rhizoctonia suppression have performed slightly better than the controls in grain yield in these 2013 paddock demonstrations.**
- **There were no differences detected in Rhizoctonia infection of seminal or crown roots with applied fungicides in the paddock demonstrations in 2013.**

Why do the demonstration?

After an increase 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 has been looking at the impact of 2012 break crops on Rhizoctonia inoculum in 2013 and of crop management on disease expression in the 2013 cereal crop. Farmer fungicide strips were also monitored in 2013.

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 – medic and vetch as break crops and banded fungicides at Warramboo, banded fungicides in barley at Wynarka (southern Mallee) and canola and fallow as rotational breaks at Piednippie. Paddock history, PreDictaB 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'. 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

Two demonstration sites were located on this property at Warramboo, a rotation demonstration with medic and vetch as break crops and a fungicide demonstration on a second year wheat crop.

Rotation - medic and vetch break crops

In 2012 90 ha of a 96 ha paddock was sown to Blanchefleur vetch at 40 kg/ha with no fertiliser and a section approximately 2 seeder widths wide was left to self-regenerate with medic (mixture of Harbinger and Parabinga) as a comparison of break crops.

Location: Piednippie
Rainfall
Av. Annual: 298 mm
Av. GSR: 243 mm
2013 Total: 273 mm
2013 GSR: 218 mm
Yield
Potential yield: 1.8 t/ha (Yield Prophet 50% probability wheat on 22 July)
Actual: 1.2 - 1.7 t/ha (W)
Paddock History
2012: CL Kord wheat
2011: CL Oasis
2010: Barley
Soil Type
Highly calcareous grey loamy sand

The whole paddock was grass free sprayed twice, 400 ml/ha Targa in early July and 300 ml/ha Select in early August. The paddock was sprayed with 500 ml/ha glysophate in September and 500 ml/ha Paraquat in October.

The paddock was disc chained in March 2013 and received 300 ml/ha Diuron, 1 L/ha trifluralin and 1 L/ha glysophate pre-seeding. The paddock was sown on 12 May with Mace wheat @ 65 kg/ha using fluid fertiliser with 6 units P, 9 units N (dissolved urea) and trace elements (TE) of 1.5 kg/ha each of elemental Mn and Zn. The previous paddock rotation was; 2012 vetch or medic; 2011 wheat; 2010 wheat.

Fungicides

In 2013 Kane included fungicides in a fluid fertiliser but he also applied some strips of the fertiliser without fungicide, so the +/- fungicide strips were monitored for Rhizoctonia disease incidence. The paddock was sown on 8 May with CL Kord wheat @ 65 kg/ha (but due to smaller seed went out at higher rate) using fluid fertiliser with 6 units P, 9 units N (dissolved urea) and trace elements (TE) of 1.5 kg/ha each of elemental Mn and Zn. Urea @ 35 kg/ha was applied in-crop in early July. The previous paddock rotation was; 2012 Mace wheat; 2011 medic pasture; 2010 barley.

Two fungicide treatments were used: Fungicide A and Fungicide B. The control was the fluid fertiliser and TE mix only. One of each fungicide and one control was sown with two seeder widths and approximately a kilometre in length. The strips were located parallel to each other but due to the undulating sandhills and flats moved from a sandhill (Fungicide B), side of sandhill (Control) to a heavier flat (Fungicide A). Four sampling lines within each strip were monitored during the season. Eight 40 m strips were harvested with the small plot harvester for grain yield and quality. A second area was harvested approximately 800 m into the paddock with 8 40 m strips on a flat with more even soil type across the three treatments.

What happened?

The PreDicta B disease inoculum levels were all below detection for most cereal diseases with *Rhizoctonia solani AG8* risk low at 49 and 50 pg DNA/g soil following vetch and medic respectively. *Pratylenchus neglectus* risk was low with 2-3 nematodes/g soil. There were lower soil nitrogen levels in the top 10 cm after vetch compared to medic, and lower available phosphorus, but no differences in soil moisture availability.

Disease

Table 1 Initial soil data in March 2013, at Warramboo after medic and vetch break crops

Crop	Soil depth (cm)	Seeding water volumetric (mm)	Estimated mineral N 0 - 60 cm (kg/ha)	Colwell P (mg/kg)	Organic C (%)	EC (dS/m)	pH ($CaCl_2$)	Sulphur (mg/kg)	Harvest water volumetric (mm)
Medic	0 - 10	13	42	21	2.3	0.16	8.1	9.1	4
	10 - 40	49	125	8	1.7	0.25	8.2	8.7	26
Vetch	0 - 10	15	30	17	2.3	0.17	8.0	11.5	8
	10 - 40	53	137	8	1.7	0.24	8.1	9.6	30

Table 2 The effect of 2012 medic and vetch break crops on dry matter, disease and grain yield of wheat at Warramboo, 2013

	Medic	Vetch	*LSD (P=0.05)*
Plant establishment (plants/m^2)	174	152	*ns*
Early dry matter (g/plant)	1.4	1.9	*ns*
Rhizoctonia patch score**	0.95	0.73	*ns*
Rhizoctonia root infection***	1.5	1.1	*ns*
Average number of crown roots	15.6	16.5	*ns*
Rhizoctonia crown roots infection (%)	86.1	56.9	*13.9*
Late dry matter (g/plant)	2.4	2.3	*ns*
Grain yield (t/ha)	1.2	1.6	*0.09*
Grain protein (%)	10.9	10.5	*ns*

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

Soil nitrogen levels at the start of 2013 were slightly lower in the 0-10 cm soil zone (where Rhizoctonia inoculum is concentrated) after the vetch crop than the medic. The wheat on vetch had lower Rhizoctonia root infection in crown roots. Wheat after vetch yielded greater than after medic, and the vetch treatment also had greater early and late dry matter during the season. The vetch systems also had greater Take-all damage in the wheat following vetch (average 2.7 plants/m^2) in spring than following medic (0.8 plants/m^2). There were no differences in grain quality (grain protein (%), screenings in grain (%), 1000 grain weight (g), test weight (kg/hL)) between the medic or vetch treatments (data not shown).

For the fungicide demonstration site the PreDicta B disease inoculum levels were all below detection for most cereal diseases except for *Rhizoctonia solani AG8:* risk was high at 332 pg DNA/g soil. *Pratylenchus neglectus* risk was low with 10 nematodes/g soil.

Table 3 Initial soil data for Warramboo fungicide demonstration, 2013

Soil depth (cm)	Water volumetric (mm)	Estimated mineral N 0 - 60 cm (kg/ha)	Colwell P (mg/kg)	Organic C (%)	EC (dS/m)	pH ($CaCl_2$)	Sulphur (mg/kg)
0 - 10	11.8	26	22	1.25	0.10	8.1	6.8
10 - 40	38.0	109	7	0.91	0.12	8.2	5.5

Table 4 The effect of banded fungicides on dry matter, disease and grain yield of wheat at Warramboo, 2013

	Control (side of sandhill)	Fungicide A (in flat)	Fungicide B (on sandhill)	*LSD (P=0.05)*
Sandy Rise				
Early dry matter (g/plant)	0.10	0.10	0.08	*ns**
Rhizoctonia patch score**	2.29	1.30	1.33	*0.54*
Rhizoctonia root infection***	2.24	1.98	1.65	*ns*
Average number of crown roots	9.5	10.0	8.2	*0.60*
Rhizoctonia crown roots infection (%)	79.6	78.8	71.6	*ns*
Late dry matter (g/plant)	0.73	0.91	0.56	*ns*
Grain yield (t/ha)	1.78	2.19	1.67	*0.32*
Grain protein (%)	11.8	12.2	11.4	*0.43*
Screenings in grain (%)	6.7	5.7	5.9	*0.81*
1000 grain weight (g)	36.6	35.6	39.8	*2.6*
Test weight (kg/hL)	80.6	75.5	82.0	*1.2*
Heavier Flat				
Grain yield (t/ha)	0.95	0.96	1.21	*0.13*
Grain protein (%)	10.8	11.4	11.0	*ns*
Screenings in grain (%)	9.2	9.3	10.6	*0.67*
1000 grain weight (g)	38.0	38.1	43.9	*2.89*
Test weight (kg/hL)	82.7	81.7	83.2	*0.90*

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

Due to the undulating sandhills and flats in the Warramboo area the strips on the sandy rise were located parallel to each other but moved from a sandhill (Fungicide B), side of sandhill (Control) to a heavier flat (Fungicide A), and as a result of the change in soil type nitrogen levels may have impacted on the result on this soil type, and the grain yield and protein levels reflect this. Rhizoctonia patch was worse for the control strip than the fungicide treatments (Table 4). Late dry matter, grain yield and grain protein increased from the sandhill down to the flat, where fungicide A performed the best. A second area on a heavy flat with the same heavier soil type across all treatments had lower variation in yield was also harvested and the fungicide B performed best in this area.

Stuart Pope, Wynarka (near Karoonda), southern Mallee

Results - 2012

In 2012 Stuart used fungicides in his fluid fertiliser, one of the fungicide products used was 250 gm/L Flutriafol at a rate of 400 ml/ha. Note: Flutriafol is registered for control of cereal leaf diseases (rusts).

In 2012 the Mallee and Warramboo sites showed large differences in Rhizoctonia crown root infection. Crown roots develop depending on the seasonal conditions and the number of tillers. The Mallee site had 3-4% crown root infection in barley compared to the Warramboo site with 45-83% crown root infection in wheat.

The initial Rhizoctonia inoculum level was much lower at the Mallee site compared to the Warramboo site. Greater infection of the crown roots may have also occurred at the Warramboo site due to plant stress with the seasonal conditions, especially lack of soil moisture from August onwards.

2013 season

This season Stuart used fungicide in his fluid fertiliser, so the demonstration was monitored for any differences in disease incidence and barley yield.

The paddock received a summer spray on 12 February of glyphosate 510 @ 900 ml/ha, amine 625 @ 350 ml/ha and triclopyr @ 70 ml/ha to keep the paddock clean of weeds. Pre-seeding on 7 May it was sprayed with Glyphosate 450 @ 1 L/ha, Amine625 @400 ml/ha, trifluralin @ 1.2 L/ha and paraquat @ 1 L/ha. The paddock was sown with Scope barley @ 55 kg/ha on 25 May with a Morris Concept seeder in a one pass operation. Fertiliser was 28:13 banded below the seed at 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 flutriafol in the liquid cart. The fungicide A was added in one strip at seeding which was compared to the control (rest of paddock). This paddock was top-dressed in June with 40 kg SOA and then 40 kg urea in July. Herbicides applied post seeding were On Duty@ 40 g/ha, MCPA LVE @ 350 ml and Lontrel @ 150 ml/ha.

The fungicide treatment strip, one seeder width wide, and a control treatment located parallel were monitored during the season. Four 20 m strips were harvested within each treatment, with the small plot harvester for grain yield and quality.

What happened?

Predicta B disease inoculum levels were low for Take-all and *Pratylenchus thornei,* and below detection level for other diseases, except *Rhizoctonia solani AG8* risk was high with 386 pg DNA/g soil and Crown rot was also high with 398 pg DNA/g soil.

The soil type where the demonstration was located was a brown sandy loam with limited rooting depth due to limestone rock.

Disease

Table 5 Soil data for the Wynarka paddock demonstration, 2012

Soil depth (cm)	Water volumetric (mm)	Estimated mineral N 0 - 60 cm (kg/ha)	Colwell P (mg/kg)	Organic C (%)	EC (dS/m)	pH ($CaCl_2$)
0 - 10	17.8	32.5	39	1.12	0.07	6.7
10 - 40	40.6	27.3	28	0.72	0.04	6.6

Table 6 The effect of fungicides and trace elements on dry matter, disease and yield of barley at Wynarka (Mallee), 2013

	Control + Trace Element Flutriafol mix	Fungicide A +Trace Element Flutriafol mix
Plant establishment (plants/m^2)	149	168
Early dry matter (g/plant)	1.01	0.99
Rhizoctonia patch score**	1.6	1.6
Rhizoctonia root infection***	2.3	2.8
Average number of crown roots	11.8	11.5
Rhizoctonia crown roots infection (%)	7.4	8.2
Grain yield (t/ha)	2.3	2.5
Grain protein (%)	11.6	12.0

*** number plants affected by Rhizoctonia of 5 selected plants across a row, scored every 2 m.*

****plants roots visually scored for Rhizoctonia root damage where 0=no Rhizoctonia damage and 5=severe Rhizoctonia damage.*

In 2013 the paddock was sown with CL Kord wheat @ 55 kg/ha on 27 April with 55 kg/ha of DAP (18:20:0:0). The paddock was sprayed with 800 ml/ha Treflan, 1 L/ha Round Up PowerMax, and 150 ml/ha Ester 680 pre seeding. A post seeding application of 2 L/ha Zn using LVE Agritone liquid was sprayed. The previous paddock history was barley (with high Rhizoctonia damage) in 2011, and wheat (mouse plague resulted in large bare patch causing the pimpernel weed problem and grass issues in this paddock) in 2010.

A fallow strip was marked and monitored during the 2013 season, while in wheat and the canola strip next to this was used as a comparison. Four sampling points were located within each treatment. Eight 20 m strips were harvested with the small plot harvester for grain yield and quality.

The soil has a lower pH at this Mallee site and nitrogen levels in this paddock are much lower than those measured in paddocks of the demo sites on upper EP. There were no differences in plant growth, Rhizoctonia seminal or crown root scores, grain yield or grain quality between the control and the fungicide treatment at the Mallee site (Table 6, other data not shown).

Dion, Nev and Karen Trezona - Piednippie

A paddock with a pimpernel *(Anagallis arvensis)* weed problem was sown to CL Oasis mustard in 2012 at 3 kg/ha with 60 kg/ha DAP (18:20:0:0) and top-dressed with 35 kg/ha urea in early July. It received a post sowing application of Intervix @ 800 ml/ha, Lontrel @ 90 ml/ha and Targa @ 400 ml/ha. The fallow strip received 400ml of Targa.

What happened?

PreDicta B disease inoculum levels of risk for the canola and fallow areas were all below detection for most cereal diseases. *Rhizoctonia solani AG8* risk was medium with 62 pg DNA/g soil after canola and low (22) after the fallow. Take-all risk was low after the fallow and below detection level after canola.

The soil test data showed a soil pH of 8.1 in a grey calcareous sandy loam with adequate phosphorus levels and high nitrogen levels after canola compared to the fallow (Table 7).

The Rhizoctonia patch score showed greater damage in the canola than the fallow area, and the canola had higher total soil nitrogen levels. The early and late dry matters were greater in the canola than the fallow. Grain yield and grain protein were also higher in the canola than the fallow area. There were no other differences in grain quality (screenings in grain (%), 1000 grain weight (g), test weight (kg/hL)) between the canola or fallow treatments (data not shown).

Table 7 Initial soil data for paddock demonstration, Piednippie 2013

Crop	Soil depth (cm)	Seeding water volumetric (mm)	Total mineral N 0 - 60 cm (kg/ha)	Colwell P (mg/kg)	Organic C (%)	EC (dS/m)	pH ($CaCl_2$)	Sulphur (mg/kg)	Harvest water volumetric (mm)
Canola	0 - 10	14	40.3	34	1.3	0.18	8.1	18.1	11.5
	10 - 40	32	54.6	13	1.0	0.16	8.2	10.7	27.5
Fallow	0 - 10	11	18.2	28	1.4	0.15	8.1	12.3	10.3
	10 - 40	36	19.5	3	0.6	0.12	8.2	7.4	29.5

Table 8 The effect of two break options on wheat dry matter, disease and yield at Piednippie, 2013

	Canola	Fallow/medic	*LSD (P=0.05)*
Early dry matter (g/plant)	1.94	1.25	*0.41*
Rhizoctonia patch score**	0.88	0.65	*0.1*
Rhizoctonia root infection***	1.2	1.0	*ns**
Average number of crown roots	12.7	11.0	*0.96*
Rhizoctonia crown roots infection (%)	75.5	73.6	*ns*
Late dry matter (g/plant)	1.80	1.28	*0.27*
Grain yield (t/ha)	1.70	1.16	*0.06*
Grain protein (%)	11.4	10.3	*0.65*

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

This paddock performed well this season compared to the farm average, however was not the highest yielding due to some frost damage and better yielding varieties being sown on pasture paddocks.

What does this mean?

In 2013 early seeding conditions with warm soils resulted in ideal crop establishment and little Rhizoctonia disease in early sown crops. However, cold wet conditions on EP in June and July resulted in high Rhizoctonia disease incidence in late sown crops, exacerbated by nitrogen deficiency.

In 2013 the low input vetch break crop at Warramboo was the first monitored on EP as a Rhizoctonia break crop and it performed well compared to the medic, with both break crops having low Rhizoctonia inoculum levels and higher yield being achieved with the vetch rotation. Grass free break crops are currently the best recommended option to lower the Rhizoctonia inoculum level, allowing the following cereal crop to have lower initial disease pressure. However the Rhizoctonia inoculum level will increase during the season and be back to a higher level following one cereal crop.

The demonstration cereal crops following the canola break crops at Piednippie in 2012 and 2013 have continued to show a production benefit (compared to a fallow in 2013) validating previous trial research in this region. The canola break has addressed other issues including weed control, achieved close to potential yield in following cereal crops in both seasons, and increased interest in alternative break crops.

The results from 2013 also demonstrated the interaction between higher nitrogen levels and Rhizoctonia seminal root infection, both in the vetch and medic rotation, the canola and fallow rotation and the EPARF trial at MAC where 20 kg/ha starter urea induced greater seminal root infection.

The fungicide products for Rhizoctonia suppression in paddock demonstrations in 2013 have performed slightly better than the controls in grain yield (0.2 t/ha smallest difference). There were no differences detected in seminal or in crown root infection with the fungicides in the paddock demonstrations in 2013.

Acknowledgements

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

Fungicides are not named in this article as companies are currently seeking registration. These results will be presented in full in the future.

Farmer fungicide demonstration strips

Amanda Cook, Wade Shepperd and Ian Richter

SARDI, Minnipa Agricultural Centre

DEMO

Searching for answers

Location: Buckleboo
Graeme and Heather Baldock
Rainfall
Av. Annual: 295 mm
Av. GSR: 210 mm
2013 Total: 319 mm
2013 GSR: 259 mm
Yield
Potential: 3.0 t/ha (W)
Actual: 2.7 t/ha
Paddock History
2013: Wyalkatchem wheat
2012: Mace wheat
2011: Kaspa peas
Soil Type
Brown sandy loam

Location: Lock
Andrew and Jenny Polkinghorne
Rainfall
Av. Annual: 333 mm
Av. GSR: 253 mm
2013 Total: 411 mm
2013 GSR: 285 mm
Yield
Potential: 3.5 t/ha (W)
Actual: 2.1 t/ha (W)
Paddock History
2013: Wheat
2012: Medic pasture
2011: Wheat
Soil Type
Grey calcareous sand

Location: Minnipa Ag Centre
South 3 North Paddock demo
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: 2.9 t/ha (B)
Actual: 2.5 t/ha (B)
Paddock History
2013: Hindmarsh barley
2012: Wheat
2011: Canola
Soil Type
Red sandy loam

Key message

- **There were no differences in yield with fungicide treatments in the farmer demonstrations at Lock, Buckleboo, Minnipa or Mudamuckla in 2013.**

Why do the demonstration?

In response to the recent release of new fungicides for Rhizoctonia suppression, monitoring farmer broad acre strips of the new products was undertaken in 2013.

How was it done?

Farmers used the new fungicide products in strips within broad acre paddocks. Within the two areas of the paddock, treated and untreated, four replicated sampling lines were established to measure and collect data. Four paddock demonstrations were monitored; Graeme and Heather Baldock, Buckleboo, Andrew and Jenny Polkinghorne, Lock, Minnipa Ag Centre, South 3 North and Peter Kuhlmann, Mudamuckla. Plant establishment, dry matter, Rhizoctonia patch, seminal and crown root scores, grain yield and quality were measured in the treated and nil strips. Paddock patch score for Rhizoctonia is a visual score (0-5) of number plants out of 5 plants affected by Rhizoctonia (400 plants scored per treatment) across 4 transects. Rhizoctonia seminal root scores were measured using 0-5 root scoring rating (McDonald and Rovira, 1983) of 80 plants per treatment across 4 transects and tops of plants were collected, dried and weighed for dry matter. Crown roots were counted with the number of roots infected with Rhizoctonia used to calculate % crown root infection.

Buckleboo

The paddock was sown on 8 May with Wyalkatchem wheat @ 55 kg/ha using 18:20:0:0 @ 55kg/ha and ZnSO4 @ 2 L/ha and UAN @ 24 L/ha. Fungicide A was added to fluid and the seed was pre-treated with Raxil seed dressing. Yields were taken from the yield monitor from two runs (12.1 m header width) of 1200 m harvested with the broad acre header.

Lock

The paddock was sown on 6 May with Mace wheat @ 65 kg/ha using fluid fertiliser with 8 units P, 13.8 units N and trace elements (Zn, Mn, Cu, Mg and Co). Fungicide A and flutriafol (registered for control of cereal leaf diseases mainly rusts) were added to the fluid. The control treatment was the fluid fertiliser + TE and flutriafol. The plot header was used to harvest 16 m strips within the treatments and grain quality was measured.

MAC S3N

Broad acre strips were sown on 15 May with Hindmarsh barley @ 55 kg/ha with 60 kg/ha 18:20:0:0 with seed dressings applied as EverGol Prime @ 800 ml/t, Vibrance @ 360 ml/t and no fungicide (control). Green bridge chemical control was applied over the whole paddock on early April with 0.8 L Roundup Attack, 350 ml Ester 680 LVE and 175 ml LI 700. The paddock received 1 L Triflur X, 1 L Roundup Attack, 300 ml Ester 680 LVE, 100 ml Striker and 330ml LI 700 pre sowing. 450ml of Agritone 750 was applied broad acre on 23 July. The plot header was used to harvest 8 m strips within the treatments and grain quality was analysed.

Mudamuckla

Paddock 42 at Mudabie was sown on 7 May with Mace wheat using VRT with seeding rates between 40, 50 and 55 kg/ha and a fluid fertiliser system using rates of 4 to 8 units of phosphorus as phosphoric acid. Fungicide A was added between 74 and 148 ml/ha and selected treatments were monitored, runs 12, 14 and 18. The fluid fertiliser solution was applied at an average rate of 55 L/ha. Each run harvested with the broad acre header was approximately 19.2 ha.

Location: Mudamuckla
Peter Kuhlmann
Rainfall
Av. Annual: 291 mm
Av. GSR: 216 mm
2013 Total: 293 mm
2013 GSR: 220 mm
Yield
Potential: 2.2 t/ha (W)
Actual: 1.3 t/ha
Paddock History
2013: Mace wheat
2012: Wheat
2011: Canola
Soil Type
Grey calcareous sandy loam

What happened?

The broad acre farmer strips monitored at Buckleboo, Lock and Mudamuckla showed no differences compared to the control strips in the measurements taken in 2013 (Tables 1, 2 & 4). At Minnipa in barley with fungicide treatments applied as seed dressings there was no yield or disease benefit over the control (Table 3).

Table 1 Farmer fungicide demonstrations, Baldock's, Buckleboo 2013

	Early dry matter (g/plant)	Patch score for Rhizoctonia	Rhizoctonia seminal root score*	Crown root infection (%)	Late dry matter (g/plant)	Av. Yield (t/ha)
Fungicide A	0.16	0.86	2.50	93.5	5.47	4.24
Control	0.16	1.04	2.40	87.4	5.17	4.34

**(0=nil damage, 5=all seminal roots with spear tips)*

Table 2 Farmer fungicide demonstrations, Polkinghorne's, Lock, 2013

	Early dry matter (g/plant)	Patch score for Rhizoctonia	Rhizoctonia seminal root score*	Crown root infection (%)	Late dry matter (g/plant)	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hL)
Fungicide A	0.26	0.93	2.34	81.3	5.7	3.95	9.5	1.98	83.7
Control	0.21	1.20	2.26	90.0	6.7	3.96	9.8	1.81	83.5

**(0=nil damage, 5=all seminal roots with spear tips)*

Table 3 Farmer fungicide demonstrations, MAC 2013

	Early dry matter (g/plant)	Patch score for Rhizoctonia	Rhizoctonia seminal root score*	Crown root infection (%)	Late dry matter (g/plant)	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hL)
Vibrance (seed dressing @ 360 ml/t)	0.18	1.04	1.30	89	5.40	2.58	9.9	7.1	71.1
EverGol (seed dressing @ 800 ml/t)	0.18	1.29	1.62	93	5.31	2.38	10.2	7.9	70.4
Control	0.19	1.25	1.51	79	5.29	2.69	10.0	10.1	70.7
LSD (P=0.05)	*ns*	*ns*	*ns*	*9.4*	*ns*	*0.23*	*ns*	*ns*	*ns*

**(0=nil damage, 5=all seminal roots with spear tips)*

Table 4 Farmer fungicide demonstrations, Kuhlmann's, Mudamuckla 2013

Run	P Rate	Fungicide A rates (0=nil, 5=highest)	Early dry matter (g/plant)	Patch score for Rhizoctonia	Rhizoctonia seminal root score*	Crown root infection (%)	Late dry matter (g/plant)
12	5.5	3	0.11	1.11	2.5	89.9	3.1
14 control	5.5	0	0.10	1.73	2.2	86.1	3.0
18	4	1	0.08	1.40	2.5	80.6	2.6

**(0=nil damage, 5=all seminal roots with spear tips)*

Table 5 Fungicide, P rates and yield in paddock strips at Mudamuckla, 2013

Run	P Rate	Zone	Fungicide A rates (0=nil, 5=highest)	Av. Yield/run (t/ha)	% compared to controls alongside	Other comments
12	5.5	Rx	3	1.29		
13	5.5	Rx	3	1.25	96	
14*	5.5	Rx	0	1.30		
16	8	set rate	5	1.23	103	
17*	5.5	Rx	0	1.19		
18	4	set rate	1	1.19	100	Large patches of Take-all on hill
19*	5.5	Rx	0	1.18		Small patches Take-all
20	5	set rate	2	1.13	102	Large patches Take-all
21*	5.5	Rx	0	1.03		
22	6	set rate	4	1.14	105	Small patches Take-all on hill
23*	5.5	Rx	0	1.12		

**controls using variable rate fertiliser*

What does this mean?

In 2013 there no differences between the applied fungicides and the control treatments in any measurements of the broad acre demonstration strips located at Buckleboo, Lock, Minnipa and Mudamuckla. There were still Rhizoctonia symptoms present with root damage and visually patches in the treated and untreated strips in the farmer paddocks.

Acknowledgements

Raxil and EverGol Prime - registered trademarks of the Bayer Group. TriflurX, Striker and Agritone 750 – registered trademarks of Nufarm. LV Ester 680 - registered trademark of Crop Care Australasia Pty Ltd. LI 700 - registered trademark of United Agri Products. Vibrance - registered trademark of a Syngenta Group Company. Roundup Attack - is a registered trademark of Monsanto Australia Limited.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

White grain in wheat

Margaret Evans and Hugh Wallwork
SARDI, Waite

Searching for answers

Location:
Buckleboo: Graeme & Heather Baldock
Cleve: Rodney Quinn

Key messages

- **White grain did not affect grain deliveries in South Australia during 2013 due to dry conditions during flowering and grain fill.**
- **It is likely that inoculum levels for white grain will be low in 2014. However, given the opportunistic nature of the pathogens causing white grain it is possible some crops may show 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.**
- **Visual symptoms of infection by the white grain fungi in green cereal heads have been identified as bleached or grey spikelets with the rachis behind the spikelets also being bleached/grey. Care should be taken as this symptom can be confused with those from frost damage.**
- **A break from cereal in a paddock affected by white grain will lead to reduced numbers of air-borne spores present in that paddock in subsequent years.**
- **Air-borne spore numbers obtained from spore traps combined with information about crop development and environmental conditions has the potential to provide a pre-harvest indicator of the risk of white grain in crops.**

Why do the trials?

Three fungal pathogens (*Botryosphaeria zeae* and two unidentified fungi) are associated with white grain in wheat in Australia. White grain was first observed in bread wheat in South Australia (SA) during the 2010 season harvest and caused rejection and down grading of deliveries in that year and also in 2011. In 2012 there were only three grain deliveries (all from Eyre Peninsula (EP)) and in 2013 there were no grain deliveries with confirmed levels of white grain in SA. In 2013 there was one confirmed report of white grain (on EP) at very low levels in grain kept on-farm for stock feed.

White grains can also be a symptom of infection by Fusarium head blight/head scab which produces toxins in the affected grain, but this disease is not present in SA. There is no evidence that the white grain found in SA is associated with toxins, however, it is this concern which continues to cause issues for the industry and underpins the need for research to understand the pathogens which cause the disease here and develop successful management options such as resistance and fungicide strategies.

How were they done?

Screening for resistance

Seventy one bread wheat entries (commercial cultivars and breeders' lines) were acquired from across Australia. These entries represent a broad range of genetic backgrounds, including resistance to fusarium head blight. Small numbers of commercial cultivars of barley, durum wheat, triticale, oat and cereal rye were also included. Trials were located at Buckleboo and Cleve. The trial design (3 replicates) incorporated control plots of Axe spaced through the experiment to assess spatial variability in white grain infection.

Artificially inoculated pot trials were also undertaken on the Terraces at the Plant Research Centre to assess the potential of artificial inoculation as a variety screening tool. Eleven bread wheat and one barley cultivar in four replicates were used for this purpose and were inoculated on three occasions between flowering and maturity. Gridded checks were included to assess our ability to evenly apply the spores.

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

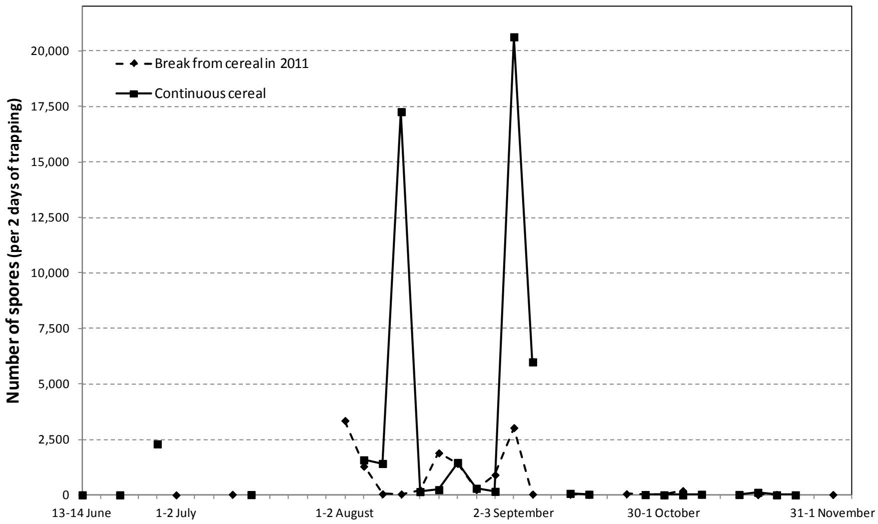

Figure 1 Presence of air-borne spores of the fungi associated with white grain in two paddocks at Buckleboo during 2013

Epidemiology

Two traps based at Buckleboo were used to collect air-borne spores of the pathogens associated with the white grain. One trap was located in the middle of a commercial cereal crop in a paddock which had a cereal crop in 2012 and a legume in 2011. The other trap was located on the edge of the variety screening trial in a paddock which had a cereal crop in 2012 and 2011.

What happened?

Varietal screening and fungicide management trials

Field trials on EP were successfully sown, treated and harvested but levels of white grain were too low to see treatment effects or to draw conclusions as the dry conditions during grain fill meant that conditions were not conducive to infection by the white grain fungi. Similarly there were no symptoms of white grain in any of the National Variety Testing trials sown in SA.

Grain from artificially inoculated pot trials on the Terraces at the Plant Research Centre is still being processed, but preliminary assessment indicates artificial inoculation may provide an avenue for future resistance screening in pot or field-based trials. However, even under ideal conditions with heavy spore loads applied to susceptible plants, only some heads and a few spikelets within those heads developed symptoms.

Epidemiological studies

In collaboration with Alan McKay's group, DNA tests for the white grain fungi have been developed, validated and calibrated. This has allowed fungal DNA to be extracted from spore trap tapes and the results converted to spore numbers.

Using DNA tests we have tracked air-borne spore numbers over time and found that spores were released from stubbles from the first week in August to the first week in September, but were not present in significant numbers after that (Figure 1). Trends in spore release were similar for both paddocks (approximately 1 km apart) although spore numbers were much lower in the paddock where there was a break from cereal in 2011.

What does this mean?

Due to dry spring conditions, white grain expression did not occur in 2013, so there were no results from the two 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.

Artificial inoculation was found to work in pot trials, which means we can undertake screening trials independent of natural infection. However, even where high spore loads were applied to plants at the Plant Research Centre, head and spikelet infection were low and that may make it difficult to reliably get good infection in artificially inoculated field trials. This low infection rate may explain the relatively low levels of white grain found in most commercial crops affected by this disease.

Air-borne spore numbers suggest that a break from cereal will contribute to reduced release of spores. Spore trap results combined with crop development stage and environmental conditions could provide a pre-harvest indicator of the risk of white grain in crops.

In 2014, depending on the level of continued funding, artificially inoculated variety screening trials will be undertaken at the Plant Research Centre. Also, dispersal of air-borne spores will be monitored at a number of sites across SA and the addition of the pathogens causing white grain to the suite of diseases detected by the PredictaB service will be pursued.

Depending on funding, spore trapping will continue at two sites on lower EP and one site on upper EP in 2014, but screening and fungicide trials on the EP will be discontinued.

An information sheet "White grain in cereals" is available on request from Margaret Evans (marg.evans@sa.gov.au or 0427 604 168).

Acknowledgements

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Cereal variety disease guide 2014

Hugh Wallwork and Pamela Zwer

SARDI, Waite

Summary of 2013 season and implications for 2014

Good early growth of cereal crops were made possible by a reasonably early start to the season followed by a warm May and a warmer and wetter than average winter. These favourable conditions also enabled diseases such as crown rot, take all, eyespot and the net blotches to develop early and rapidly where inoculum was present. There was very little disease pressure on oats in 2013. Early bacterial blight on susceptible varieties failed to develop beyond mid-season.

Crown rot and take-all

Crown rot was favoured by high levels of inoculum carried over from 2012 followed by ideal conditions for infection. Relatively dry conditions during grain fill in many areas, particularly the upper Eyre Peninsula, resulted in white head expression and yield losses from crown rot. For those looking for some resistance; the partial resistance to crown rot observed in the varieties Kukri and AGT Katana has been retained in the new variety Emu Rock. Trojan and Phantom have partial resistance derived from Sentinel.

Take-all appeared as a problem on upper/eastern Eyre Peninsula, particularly around Cleve, in 2013. The fungus requires wet spring conditions to build up as occurred in 2010 and 2011. Although the dry spring in 2012 would not have increased inoculum, the dry conditions through spring and summer likely prevented break down of the inoculum. The Cleve experience is a timely reminder that it only takes 1-2 seasons with conducive conditions (presence of a host and a wet spring) for take-all inoculum to build up to potentially damaging levels.

Spot form net blotch

Spot form net blotch was the surprise disease of 2013. Normally not a very damaging fungus, some crops, notably Hindmarsh, saw severe infection levels in some areas that most likely led to significant yield losses. Of particular concern were crops of Scope around Loxton and Cleve that showed susceptibility similar to Hindmarsh (S) whereas in previous years, and at most NVT sites in 2013, Scope has rated as only moderately susceptible. It is likely that there has been a shift in virulence in this pathogen leading to increased virulence on Scope and presumably Buloke. This is reflected in the range of scores provided for these varieties in the disease tables.

Net form net blotch

Net form net blotch was very severe in many Fleet crops showing that virulence on this variety is now widespread in SA. Extensive testing of isolates of the fungus taken across SA in recent years has shown that none of the strains tested have combined virulence on Fleet and Maritime. Consequently, in some NVT trials and crops Maritime has appeared as quite resistant. However, virulence on Maritime remains present in areas where this variety is still grown. Virulence on Commander, Fathom and Navigator was very common. Two Fleet isolates from Wokurna and near Pt Broughton also showed virulence on Oxford, Skipper, SY Rattler, Westminster and Wimmera. In contrast Buloke, Granger, Hindmarsh, Scope, Schooner and Sloop SA have shown consistently good resistance so far. Compass has shown good resistance in the field but testing in controlled conditions indicates that some isolates cause moderate susceptibility.

Rusts

Stripe rust caused few problems in 2013 despite the large area sown to susceptible varieties and infection being observed in early August. Widespread use of in-furrow fungicides, early preventative sprays and rapid response spraying were effective in preventing a damaging epidemic. It is also possible that the prevalent fungal strain in the region may have lost some of its aggressiveness judging from the poor development of symptoms observed in untreated NVT plots. There were no reports of stem or leaf rust infecting wheat crops in SA in 2013.

Leaf rust in barley started late compared to most years and developed more slowly than normal. The greatly reduced areas sown to Keel and a low level of barley volunteers over summer are likely to be key factors responsible for this improved situation.

Eyespot

Eyespot has been increasing in recent years, mainly on the lower Eyre Peninsula and high rainfall areas of the Mid-North. Crops sown in the South-East are also likely to be vulnerable in future particularly if cereal rotations are intensified. Retention of stubbles, close rotations, thick crops, good moisture levels and high nitrogen inputs all favour the disease. Generally varieties are all susceptible although taller and weaker stemmed varieties are likely to lodge more readily after infection. Some variation in the degree of susceptibility is likely to exist in current varieties and this is being investigated.

White grain

White grain was not detected in deliveries to silos in 2013. This was probably due to relatively dry conditions from flowering to the end of grain fill. Traps (funded by GRDC) at Buckleboo on upper Eyre Peninsula indicate that spores were released from stubbles from the first week in August to the first week in September, but were not present in significant numbers after that. This suggests that spore trap results could be used prior to harvest to predict the risk of white grain in crops. See article 'White grain in wheat' in this section for more information.

Loose smut

Many Hindmarsh barley crops across Southern and Western Australia again showed loose smut infection. In many cases this occurred in spite of treatment with seed fungicides that should have controlled infection. Presumably Hindmarsh is too susceptible for some treatments to be effective. Tests are underway on infected seed to determine which seed treatments are capable of providing adequate control in Hindmarsh.

Explanation for Resistance Classification

R The disease will not multiply or cause any damage on this variety. This rating is only used where the variety also has seedling resistance.

MR The disease may be visible and multiply but no significant economic losses will occur. This rating signifies strong adult plant resistance.

MS The disease may cause damage but this is unlikely to be more than around 15% except in very severe situations.

S The disease can be severe on this variety and losses of 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.

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.

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 2014 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, not just before a weekend, to the following address:

SARDI Diagnostics
Plant Research Centre
Hartley Grove
Urrbrae SA 5064

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

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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*					
Axe	MS	RMR	MR	S	S	MSS	SVS	MS	MS	S	MSS	S	S	AH
Bolac	MRMS	RMR	MS	S	S	-	MS	S	MS	S	MS	RMR	MSS	AH
Brennan	MS	RMR	RMR	-	MS	-	MR	-	-	S	-	-	MRMS	Feed
Catalina	MR	MS	R	R	MSS	MSS	MS	S	MR	S	MRMS	RMR	S	AH
Cobra	RMR	MSS	MR	MRMS	MRMS	MSS	MSS	MS	MS	S	MSS	S	MSS	AH
Corack	MR	MS	MS	RMR	MR	VS	MSS	MSS	S	S	MS	S	MSS	APW
Correll	MRMS	MRMS	MSS	MR	SVS	MRMS	MRMS	MS	S	S	MS	R	MS	AH
Emu Rock	MRMS	MRMS	MSS	S	MRMS	MSS	S	MS	MSS	MS	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	R	RMR	MR	S	MRMS	MS	MRMS	S	S	SVS	MS	MR	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	MS	S	S	MRMS	RMR	MS	AH
Impala	RMR	MR	S	S	MSS	RMR	S	-	-	S	MSS	SVS	MRMS	Soft
Kord CL Plus	MR	MRMS	MS	MR	MSS	MSS	MS	MS	MS	S	MRMS	MR	MR	AH
Mace	MR ^	SVS	MR	MRMS	MRMS	MSS	MRMS	MRMS	MRMS	S	MS	S	MS	AH
Mackellar	MR	RMR	S	MS	MRMS	-	MRMS	-	-	-	-	-	S	Red Feed
Naparoo	RMR	R	R	S	MS	-	MR	-	-	S	S	VS	-	Feed/Hay
Orion	MR	MSS	R	S	MSS	-	MS	-	-	S	MSS	S	SVS	Soft/Hay
Phantom	MRMS	MR	MS	MRMS	SVS	MRMS	MRMS	MS	S	MS	MSS	MRMS	MR	AH
Scout	MR	MS	R	R	SVS	MRMS	MRMS	MSS	MS	MSS	S	MR	S	AH
Sentinel	RMR	RMR	R	S	MS	R	MRMS	S	MS	MSS	S	MSS	MSS	ASW
Shield	RMR	MR	R	MRMS	MSS	MR	MSS	MRMS	MS	S	MRMS	S	MS	AH
SQP Revenue	RMR	R	R	S	MS	R	MR	S	MS	S	SVS	S	MSS	Feed
Trojan	MR	MR	MR	MS	MSS	-	MS	MS	-	MS	MS	VS	MRMS	APW
Wallup	RMR	MRMS	MS	MR	MSS	S	S	MRMS	MRMS	S	MS	SVS	MR	AH
Wyalkatchem	MS	S	MS	S	MR	SVS	MR	MR	S	S	MSS	SVS	MS	APW
Yitpi	S	MRMS	MSS	MR	SVS	MRMS	MRMS	MS	MS	S	MS	MR	MS	AH

^ - Some susceptible plants in mix, ‡ - Black point is not a disease but a response to certain humid conditions
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

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	Stripe	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
Saintly	MR	MR	MRMS	MS	MRMS	VS	MRMS	MR	-	VS	MS	R	MS	Durum
Tjilkuri	MR	MR	MR	-	MRMS	S	MRMS	-	MRMS	VS	MS	R	MSS	Durum
WID802	RMR	MR	RMR	MS	MRMS	-	MR	MS	-	VS	MS	-	MSS	Durum
Yawa	RMR	MR	MR	MS	MRMS	MS	MR	MRMS	MR	VS	MRMS	-	MRMS	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	Stripe#	Leaf					*P. neglectus*	*P. thornei*					
Bogong	RMR	MRMS	R	-	MR	R	R	-	-	MSS	MSS	-	-	Triticale
Chopper	MR	MRMS	R	R	MR	R	R	MR	-	MSS	S	-	-	Triticale
Fusion	R	RMR	R	R	MRMS	R	R	R	-	MS	S	-	MSS	Triticale
Goanna	R	MR ^	MR	R	MR	R	R	-	-	-	-	-	-	Triticale
Hawkeye	RMR	MR ^	R	R	MR	R	R	R	-	MS	MSS	-	-	Triticale
Jaywick	MRMS	MRMS	R	R	MR	R	R	R	-	MS	MS	-	-	Triticale
Rufus	RMR	MS	R	R	MR	R	R	RMR	RMR	MS	MS	-	-	Triticale
Tahara	RMR	MS	R	R	MR	RMR	R	R	MR	MS	MS	R	-	Triticale

- The triticale stripe rust ratings are for the common WA Yr17 virulent strain.
More suscepible reactions may occur on some varieties if a rare Tobruk virulent strain appears in SA.

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.
^ - Some susceptible plants in mix
‡ Black point is not a disease but a response to certain humid conditions.

Disease

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	MR-MS	MSS	MSS	MR-S	S	MSS	-	VS	MS	MRMS	MRMS	MS
Buloke	MS-SVS	MR	MS-S	MS-S	S	R	R	MS	MS	MS	MRMS	MS
Charger	MR	SVS	S	VS	R	RMR	-	MS	MS	MR	-	MRMS
Commander	MS-S	MS-S	MSS	S	R	MRMS	R	R	MS	MRMS	MRMS	MSS
Compass	MR	MR-MRMS	MR-MSS	MS	R	MR	-	R	MS	R	-	MS
Fathom	MR-SVS	MRMS-S	MR	R-S	R	MR	-	R	S	MRMS	MRMS	S
Flagship	MS-SVS	MR	MRMS	MS	R	S	MR	MRMS	S	MS	MRMS	MSS
Fleet	MRMS-S	SVS	MR	MS	R	MRMS	MR	MR	MSS	MRMS	MRMS	MS
Flinders	MRMS-S	MR-MS	S	S	S	RMR	-	S	MS	MR	-	MRMS
Granger	MR	MR-MS	S	MS-S	-	S	-	MR	S	MR	MRMS	MS
Hindmarsh	MRMS-S	MR	S	R-VS	R	MS	R	MS	S	MS	MRMS	MSS
Keel	VS	MR-S	MR	MS-S	R	MSS	MS	R	S	MR	MRMS	SVS
La Trobe	S-SVS	MR	MSS	R-VS	R	MR	-	MRMS	S	MR	-	MSS
Macquarie	S	MR	SVS	MR-MSS	S	MSS	-	MSS	MS	MR	-	MR
Maritime	MS-S	MR-VS	MRMS	S	R	SVS	S	MS	S	MR	-	MSS
Moby	S	MR	S	MRMS	S	MS	-	-	-	-	-	-
Navigator	VS	MR-S	MR	R-MR	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	VS	R	MR	S	S	MR	MS
Scope	MS-SVS	MR	MS-S	MS-S	S	R	R	MRMS	MS	MS	MRMS	MSS
Skipper	MSS-SVS	MR	MRMS	S	R	MRMS	-	MS	MSS	MRMS	MRMS	MSS
SY Rattler	MR	MR	MSS	MR-MRMS	-	MR	-	-	MSS	-	-	MRMS
Westminster	MR	MR-MS	S	MR	-	R	-	R	MRMS	-	-	MRMS
Wimmera	R-MRMS	MR	MS-S	MSS	S	MSS	-	MRMS	MS	MRMS	MRMS	MRMS

* 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

Oats	Rust		CCN		Stem nematode		Bacterial blight	Red leather leaf	BYDV*	*Septoria avenae*	*P. neglectus* Nematodes
	Stem*	Leaf*	Resistance	Tolerance	Resistance	Tolerance					
Bannister	MR-S	R	VS	I	-	MI	MR-S	MS	MS	S	-
Brusher	MS-S	MS-S	R	MI	MS	I	MR-MS	MS	MS	MS	MR-MS
Dunnart	MR-S	MR	R	MT	-	MT	MR-S	MS	MR	MR-MS	-
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	-
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
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
Williams	MR-S	R	S	I	-	I	R	MS	MR-MS	MR-MS	-
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 -
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

SARDI, Minnipa Agriculture Centre

Section 4

Farming Systems

Profitable crop sequences with a one or two year break

RESEARCH

Suzanne Holbery[1], Roy Latta[1], Nigel Wilhelm[1] and Michael Moodie[2]

[1]SARDI, Minnipa Agricultural Centre; [2]Mallee Sustainable Farming, Mildura

Searching for answers

Location: Minnipa Ag Centre, Airport paddock
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: 3.0 t/ha (W)
Actual: 1.7 t/ha
Paddock History
2012: Various
2011: Various
2010: Wheat
2009: Wheat
Soil Type
Red sandy loam over light clay
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

- **Continuously cropping cereals has increased grass weeds and root disease to a point that it is no longer the most economical option, due to decreased yield and costs associated with addressing weed and disease issues.**
- **Two year breaks starting to pay their way in the third year of the rotation.**
- **One year breaks have lifted wheat performance but have not kept grassy weeds or diseases under control.**

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-leaf crops make up only a very small proportion of the total area of sown crops. In light of increasing climate variability farmers have adopted continuous cereal cropping strategies as non-cereal crops are perceived as riskier than cereals due to greater yield and price fluctuations. At the same time, this domination of cereals is increasing the need for non-cereal options to provide profitable rotational crops, disease breaks and weed control opportunities to sustain cereal production. Currently, the most common 'break crop' is often a poor 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.

How was it done?

In year three (2013) of the study all of the treatments were sown to wheat at 55 kg/ha with 65 kg/ha DAP (18:20:0:0) on 14 May. Three treatments that had been sown with cereals (wheat or oats) in both the previous two years were sown with the Clearfield variety Kord CL Plus to address grass weed issues. Five treatments that had not had any legume break phase (2 x continuous wheat, vetch/oats mix followed by wheat, oats then canola and canola then oats) in the previous two years also received 50 kg/ha of urea at sowing to compensate for any nitrogen deficiency.

One month post-sowing the Kord plots were sprayed with Intervix @ 0.7 L/ha. The entire trial was sprayed for broadleaf weeds with MCPA+ diflufenican @ 0.75 L/ha on 4 July and any treatment that had had a medic break phase received an additional herbicide application the following day of clopyralid 0.08 L/ha to target volunteer medic.

Seven treatments (Angel medic/wheat, oats/canola, oats/peas, Jaguar medic/wheat, canola/peas, peas/wheat and peas+canola/wheat) with high levels of grassy weeds were subsequently sprayed with grass selective cloqintocet-mexyl + pyroxsulam @ 0.5 L/ha.

Grassy weeds were measured in three ways to gain a greater understanding of what was occurring within rotations. Prior to sowing soil was collected from the west end of each plot to assess weed seed banks. They were grown out in a shade house where emerged plants were counted and recorded. The counting process was repeated following three times of emergence 22 May, 30 May and 3 July. The second assessment was undertaken in the field plots on 20 August when grass species were counted and recorded for each plot, and thirdly on 25 September panicle counts of grass weeds were completed as a measure of potential seed bank for the 2014 season.

Each sub-plot was machine harvested individually to identify any differences as a result of the management strategies employed in years one and two. Grain samples were retained for quality testing.

What happened?

Treatments sown to Kord compared to Mace had fewer plants established with 106 plants/m^2 compared to 124-152 plants/m^2, despite being sown at the same rate of 55 kg/ha. Larger seed size and continuous cereal stubble residues causing poor seed-to-soil contact and intermittent blocking of machinery is likely to have contributed to Kord failing to reach similar plant populations to Mace.

On 15 August roots were collected and scored on a 0-5 (0 being no damage, 5 severe damage) scale for Rhizoctonia wheat root damage. The continuous cereal treatments had significantly higher root disease incidence with levels above two, compared to all other treatments. At these levels nutrient uptake can be reduced and could help explain the poor yields recorded in these treatments.

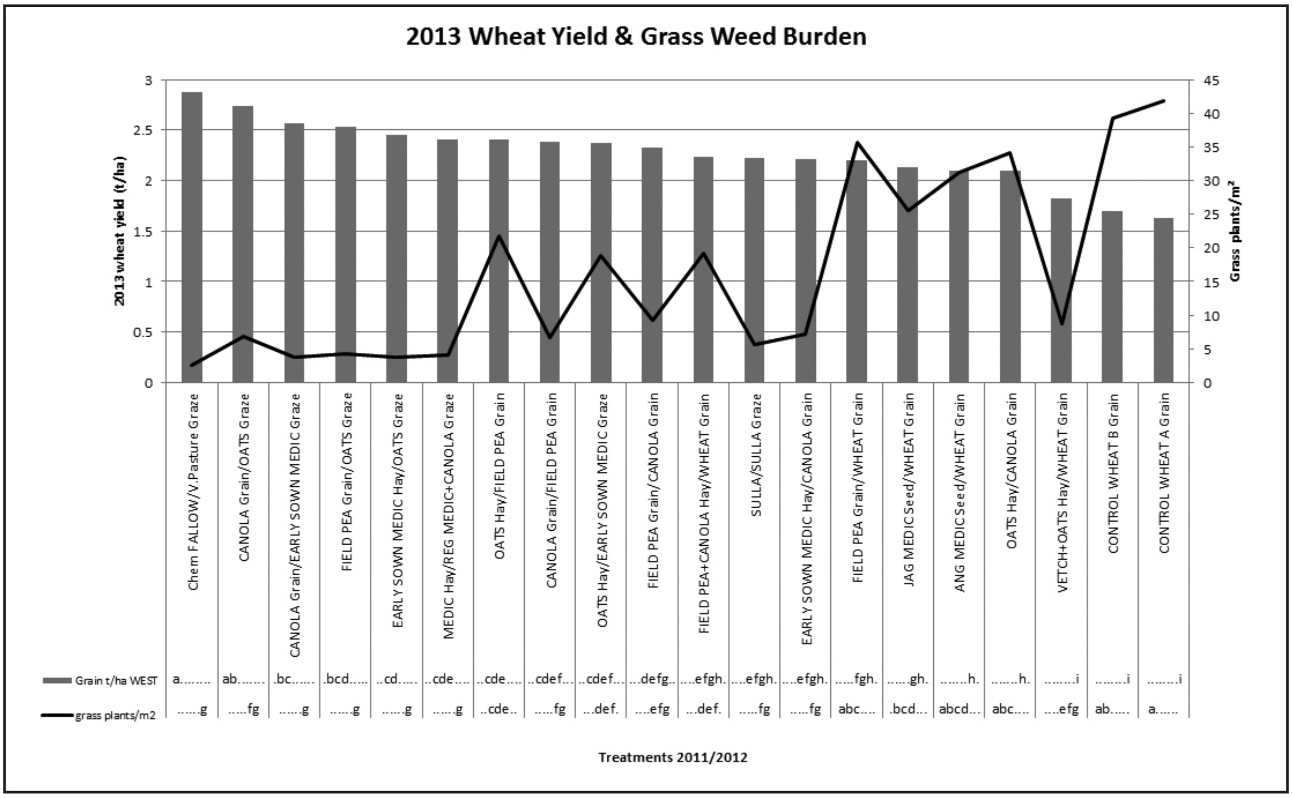
Grain yields averaged 1.7 t/ha with continuous cereals right up to 2.9 t/ha following a 2 year fallow (Figure 1). Wheat following a one year legume break in 2011 still yielded higher than a continuous cereal rotation, highlighting the continued yield benefit two years after a single break.

Screenings greater than 5% were measured with continuous wheat (sown with Kord) which is classified as Australian General Purpose (AGP) despite protein levels of over 13%. This drop in classification from H1 to AGP resulted in a $60/ha reduction in gross margin using Viterra Port Lincoln cash prices 20 November.

Wheat in 2013 following canola yielded on average 0.28 t/ha less than if the break had been medic, peas or oats, regardless of the phase prior to the 2012 canola. Canola following oats yielded lower than canola following peas or medic due to a higher grass weed burden despite several control operations.

Cutting canola for hay in 2012 instead of harvesting for grain increased grain yields in the following wheat crops by up to 0.7 t/ha.

Farming Systems



LSD (P=0.05) wheat yield t/ha 0.21, grass plants/m^2 14.32

Figure 1 2013 wheat yields (t/ha) and grass weed counts plants/m^2 taken 20 August 2013 following treatments imposed in 2011 and 2012

Late germinating barley grass was problematic in this trial. Expensive but effective selective grass herbicides used post emergence in many treatments in 2013 controlled annual rye grass and brome grass. However, barley grass then became dominant in many of these plots.

Simulated grazing by mowing on three occasions (10 July, 17 August and 18 September) in 2012 substantially reduced grassy weeds in 2013.

A two year break with the biennial legume *Hedysarum coronarium* (Sulla) resulted in the lowest amount of water in the profile (111 mm) pre-sowing in 2013, which compares to volunteer pasture/ chemical fallow with 137 mm. Subsequent wheat yields reflected this with 2.2 t/ha, the same as treatments with only a one year 2011 cereal break.

An economic analysis over the 3 years found that continuous cereal cropping was the most profitable through 2011 and 2012, however in year three the positive effects of particular break options became apparent with higher wheat yields recorded. Gross margin comparisons in 2013 saw wheat following two years of fallow as the highest grossing with $558/ha compared to $152/ ha for continuous wheat. A two year break of canola cut for hay following peas for grain was the second highest grossing with $550/ha.

When comparing the treatments over three years canola – graze & grain/oats - hay, oats - hay/medic – graze and canola – grain/oats – graze were the highest grossing with over $900/ha and up to $1006/ha. The most profitable one year break was a pea and canola mixture that was grazed, this grossed $840/ha.

What does this mean?

The value of break phases in the rotation are starting to show through in this trial. Despite very strong wheat yields in the first two years of the trial, disease and grassy weeds are now starting to reduce performance of continuous wheat. However, wheat following two year breaks are now producing gross margins several hundreds of dollars per hectare better than continuous wheat with no major constraints developing yet. One year breaks have improved the following wheat performance, but weeds and diseases are still present.

In 2014 the treatments will be sown again to wheat and this will complete the four year rotation for each of the 20 treatments. Any ongoing benefits of the break treatment options in 2011 and 2012 will continue to be measured.

Acknowledgements

We would like to thank Ian Richter and Wade Shepperd for their technical support. This project is funded by the GRDC - Profitable crop sequencing in low rainfall areas of south eastern Australia (DAS00119).

Intervix – registered product of Crop Care Australasia Pty Ltd.

SARDI
EPARF Eyre Peninsula Agricultural Research Foundation Inc.
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE
Australian Government Department of Agriculture, Fisheries and Forestry
GRDC Grains Research & Development Corporation Your GRDC working with you

Herbicide resistance in barley grass – findings of a survey

Ben Fleet, Lovreet Shergill and Gurjeet Gill

University of Adelaide, Waite

RESEARCH

Key messages

- **Increasing incidence of barley grass in cropping paddocks in southern Australia is likely to be due, at least in part, to selection of more dormant biotypes.**
- **In some districts, barley grass management is becoming difficult because of the development of group A resistance. However, there still appear to be several effective herbicide alternatives for barley grass control in broadleaved crops.**
- **Herbicide resistance in barley grass is generally at a low level across Eyre Peninsula (EP), particularly compared to Upper North. However, two highly resistant paddocks have been identified on EP.**
- **Integrated weed management strategies are critical to delay resistance and prolong the effectiveness of our cheap and effective herbicides.**

Why do the trial?

Feedback from growers and consultants in southern Australia has clearly shown increasing spread of barley grass (*Hordeum murinum ssp glaucum*). In a survey by Fleet and Gill (2008), farmers in low rainfall districts in South Australia and Victoria also 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 growers. This explains why barley grass has become a more problematic weed in cereal crops.

In some locations like Port Germein and Baroota districts, it is now almost impossible to control barley grass in pulse crops. This is mainly due to the presence of group A (fop and dim) herbicide resistance. Currently in these locations barley grass control is reliant on growing Clearfield cereals and the use of imidazolinone (Imi) (group B) herbicides. This management strategy is at high risk of collapsing from the additional development of group B herbicide resistance. Resistance to group B herbicides can develop quickly when large weed populations are sprayed regularly with group B herbicides. The extent and nature of this resistance needs to be better understood and effective management strategies to manage resistant barley grass in pulse crops developed.

How was it done?

Barley grass seed was collected prior to harvest in 2011 from a paddock at Baroota that was suspected to be resistant to group A herbicides. Resistance was confirmed in 2012 in a pot study which justified undertaking a paddock survey to determine the frequency of resistant populations.

Two random surveys were conducted prior to harvest in 2012 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 focussed 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 (Figure 1). Samples from these surveys were screened at the University of Adelaide for herbicide resistance during 2013.

Collected seed was cleaned and planted in pots at the start of the 2013 growing season, herbicides were applied and barley grass survival was assessed. Populations that exhibited any sign of resistance were planted out for a confirmation screening assessment.

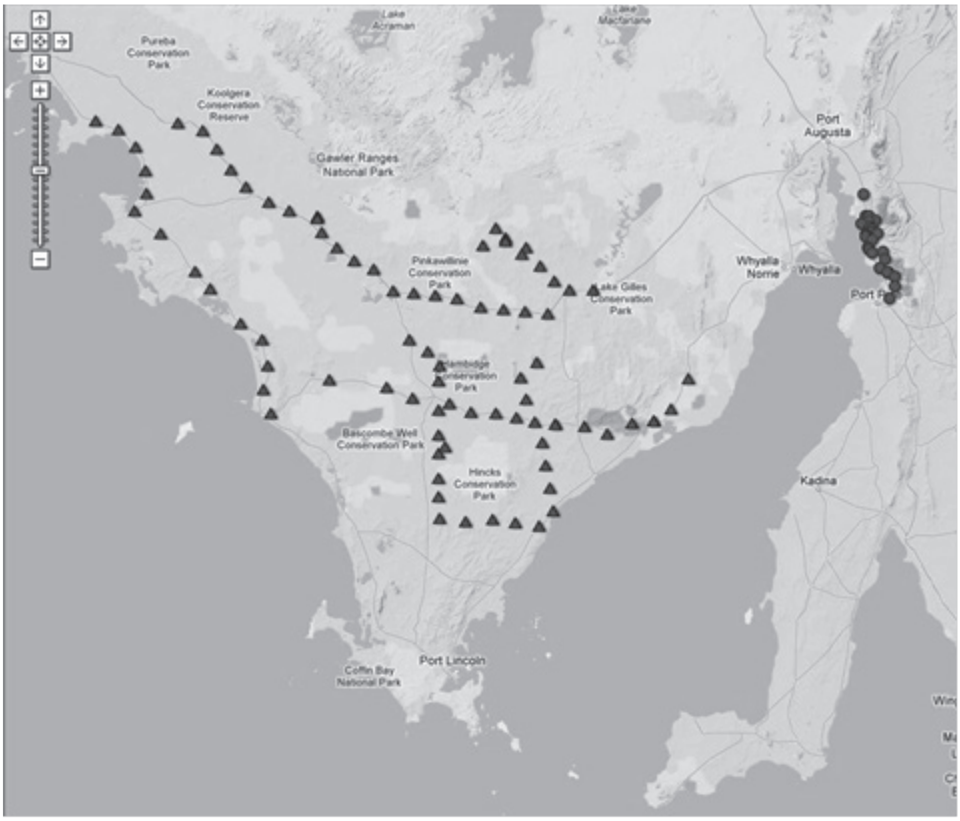


Figure 1 Map of barley grass herbicide resistance survey, EP transects ▲ and UN ●

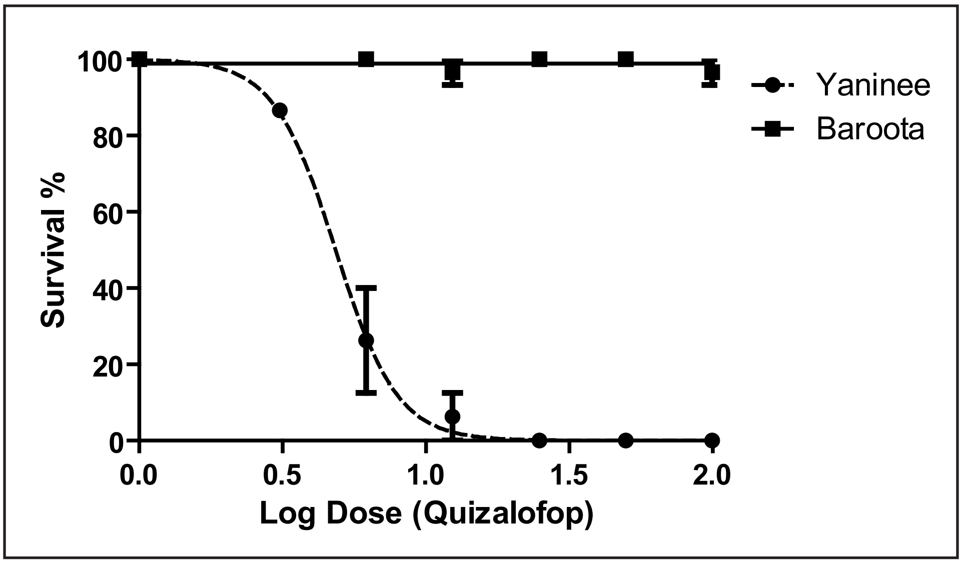


Figure 2 Effect of quizalofop (e.g. Targa) on the survival of barley grass from Baroota (Pt Germein) and from a susceptible population at Yaninee. Herbicide rates are 0, 1/8, ¼, ½, 1, 2, & 4 x field rate (300 ml/ha of herbicide)

What happened?

Barley grass was collected from a trial site at Baroota that had a high level of resistance, probably as a result of repeated exposure to group A herbicides (Figure 2). This population has resistance to quizalofop (Targa), haloxyfop (Verdict) and clethodim (Select).

Survey results for fop (group A) herbicide resistant barley grass are shown in Table 1. Barley grass fop resistance is at a low frequency across EP, particularly in comparison to the Upper North (UN) where almost 50% of barley grass has some level of resistance. While at quite a low frequency, some paddocks on EP have been identified with very strong resistance. Resistance is obviously developing and extra care needs to be taken to delay further resistance development. Always follow up fop applications with another control measure such as a pasture/crop top or a hay-cut and remember that multiple applications of the same herbicide group in one season will increase selection for resistance more than a single application.

Table 1 Survey results, barley grass with quizalofop (group A) resistance for EP & UN. Resistance means more than 20% survival, developing resistance means less than 20% survival but more than 0%

	Random survey samples			Targeted paddock samples
	Paddocks surveyed (% with barley grass)	Poplations with fop resistance	Populations developing fop resistance	Populations with fop resistance
Upper North	24 (80%)	15.4%	31%	83%
Eyre Peninsula	83 (80%)	1.7%	3.3%	17%

Table 2 Survey results of barley grass with Imidazalinone and Sulfonylurea (group B) resistance for EP and UN. No populations were found to be fully resistant to any group B herbicides. Resistance means more than 20% survival, developing resistance means less than 20% survival but more than 0%

	Developing resistance to Imazamox (Raptor)	Developing resist-ance to Imazamox + imazapyr (Intervix)	Developing resistance to Sulfosulfuron (Monza)
Upper North	0%	0%	21%
Eyre Peninsula	4.5%	3%	7.5%

Survey results for Imi and sulfonylurea (SU) (group B) herbicide resistant barely grass are shown in Table 2. While no barley grass was found to be resistant (>20% of population surviving), low levels were identified. The level of developing Imi resistance is of concern, but not surprising given the reliance on these herbicides in controlling barley and brome grass. Levels of Imi resistance were lower in the UN, but likely to increase rapidly with the increased selection pressure on Imi herbicides due to loss of group A herbicides in many paddocks.

What does this mean?

Group A herbicide resistance is at a low frequency across EP, which means these herbicides will still work well in most situations. However individual paddocks have already been identified where group A herbicides no longer work due to resistance and the frequency of such paddocks is likely to increase. Early signs of group B resistance developing in barley grass are also a concern for the future. Care is needed to preserve these herbicides. Always aim to reduce weed seed bank and where possible do not rely on a single herbicide group to control barley grass. Carefully selected weed management tactics should be integrated to delay onset of herbicide resistance in weeds.

Acknowledgements

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Select – registered trademark of Arysta Life Sciences and Sumitomo Chemical Co. Japan. Targa - registered trademark of Nissan Chemical Industries, Co Japan. Verdict - registered trademark of the Dow Chemical Company ("DOW") or an affiliated company of DOW. Intervix-registered trademark of BASF. Monza - registered trademarks of Monsanto Technology LLC used under license by Nufarm Australia Limited. Raptor - registered trademark of BASF.

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The impact of livestock on paddock health

Roy Latta and Jessica Crettenden
SARDI, Minnipa Agricultural Centre

RESEARCH

Try this yourself now

Location: Minnipa Ag Centre

Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm

Yield
Potential: 2.5 t/ha (W)
Actual: 2.1 t/ha

Paddock History
2012: Medic pasture
2011: Wheat
2010: Medic pasture
2009: Wheat
2008: Wheat
2007: Wheat

Soil Type
Red sandy loam

Soil Test
Organic C%: 1.2
Phosphorus: 18 - 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
Perennial or annual plants: Annual
Grazing Pressure: High (1.5 DSE/winter grazed ha) and medium (0.75 DSE/winter grazed ha)

Water Use
Runoff potential: Low

Resource Efficiency
Energy/fuel use: Standard practice
Greenhouse gas emmisions (CO_2, NO_2, methane): Cropping & livestock

Key messages

- **There has been no measured grain production or soil health decline associated with grazing sheep on pastures and crop stubbles over a 4 year pasture-wheat rotation.**
- **Grain yields were higher as a result of increased wheat seed and fertiliser rates in 2013.**
- **Higher applied crop seed and fertiliser rates with an improved medic pasture increased estimated gross margins by $16/ha/annum over a 6 year wheat-wheat-pasture-wheat-pasture-wheat rotation.**

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 (e.g. higher fertiliser and seeding rates, establishment of improved pasture) compared to a lower input and more traditional system (district practice seed and fertiliser inputs, volunteer pasture). The six year (2008-2013) rotation of: wheat, wheat, pasture (volunteer and sown annual medic), wheat, pasture (annual medic – self regenerating) and wheat, was also split into grazed and un-grazed treatments in both the high and low input systems to establish the relative impact of grazing.

How was it done?

In 2008, a 14 ha red sandy loam (pH_{CaCl} 8) portion of a paddock on MAC was divided into four 3.5 ha sections. Each section represented a system treatment: Traditional - grazed, Traditional – un-grazed, High input – grazed and High input – un-grazed. The pasture and grazing treatments were not imposed until 2010. 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.

In 2013 the trial was sown to Mace wheat on 5 May at 50 kg/ha with 7 kg N/ha and 8 kg P/ha (45 kg/ha DAP) and 70 kg/ha with 13 kg N/ha and 15 kg P/ha (75 kg/ha DAP) for the traditional and high input treatments respectively. See EP Farming Systems Summary 2012 p 92 for 2012, pasture performance and 2011, p 113 for 2008 - 2011 crop and pasture inputs. Weed control was imposed on all treatments as required in both summer and during the growing season.

Sampling for pre-seeding soil water content and chemical analysis was completed on 16 April. Plant establishment counts were taken on 25 June followed by a biomass sampling, both from 3 x 1 m rows (1 m^2), taken prior to grain harvest on 4 November. Post harvest soil water contents were collected on 5 November.

What happened?

Soil fertility was estimated prior to seeding in each year of the study. Table 1 presents the 2011, 2012 and 2013 phosphorous, total organic nitrogen and soil organic carbon results. Residual Colwell P levels were similar or trended lower following annual medic in 2012 when no P was applied. 2013 residual mineral N figures suggest there was a greater increase from the 2012 annual medic phase of the rotation in response to grazing compared to not grazing. Soil organic carbon contents are showing no evidence of a separation as a result of high or low inputs, grazing or not grazing.

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

An accurate assessment of the soil chemical and organic carbon response to the treatments imposed requires a statistical analysis with time (years) as a third factor, with treatment and replicate, at the completion of study.
To measure grain production in 2013 an experimental plot harvester reapt four 1.8 x 9 m plots at the four permanent points in each section. Table 2 presents the 2013 grain data and the estimated water use efficiency figures.

The two high input treatments produced similar biomass, similar or more plants, more wheat heads and higher grain yields than the un-grazed traditional treatment. The high input grazed treatment produced higher protein content than both the low input traditional treatments, screening percentages were similar.

Table 1 Colwell P (mg/kg 0-10 cm), total mineral nitrogen (kg N/ha 0-60 cm) and soil organic carbon (%, 0-10 cm) in April 2011, 2012 and 2013 following annual medic, wheat and annual medic respectively

System	Colwell P (mg/kg)			Total mineral nitrogen (kg/ha)			Soil organic carbon (%)		
	2011	2012	2013	2011	2012	2013	2011	2012	2013
Traditional - grazed	41	34	34	134	64	111	1.2	1.3	1.3
Traditional - un-grazed	29	30	27	99	59	84	1.1	1.0	1.2
High input - grazed	23	23	18	119	72	118	1.1	1.2	1.2
High input - un-grazed	34	30	22	84	60	74	1.1	1.2	1.1

Table 2 Plant establishment (PE, plants/m²), biomass yield (DM, t/ha), grain heads (numbers/m²), grain yield (t/ha), protein content (%), screenings (%) and water use efficiency (WUE, kg/ha/mm of plant available water)

System	PE (plts/m²)	DM (t/ha)	Heads (#/m²)	Yield (t/ha)	Protein (%)	Screenings (%)	WUE (kg/ha/mm)
Traditional - grazed	127	5.3	208	1.9	10.3	5.6	15
Traditional - un-grazed	124	5.4	221	1.8	10.3	4.7	14
High input - grazed	175	6.3	262	2.1	11.2	6.3	16
High input - un-grazed	158	6.1	256	2.1	10.8	5.6	16
LSD (P=0.05)	*33.7*	*ns*	*35.7*	*0.24*	*0.66*	*ns*	

Estimated water use efficiency in 2013 was correlated with yields with each treatment having similar available water.

What does this mean?

In 2011 there was a wheat yield benefit as a result of the grazing of both the sown and self-regenerated traditional medic based pastures in 2010, when compared to the un-grazed sown and self-regenerated medics. This may have been due to the higher total soil N levels measured pre-seeding in 2011. There was also a yield benefit in response to the high input treatments (high seed and fertiliser inputs, improved pasture, EPFS Summary 2011, p 113). In 2012 the self-regenerating, 2010 sown high input medic pasture reduced competing annual grass, increased biomass production and carried double the stocking rate, compared to a volunteer self-regenerating medic pasture (EPFS Summary 2012, p 92).

In 2013 the higher grain yields from the high input treatments, compared to the un-grazed traditional system, can only be credited to the 2013 inputs. Neither the grazing nor the observed increased N levels or reduced grass populations resulting from the grazing in 2012 had any yield or protein content response, as was the case in 2011.

The soil organic carbon % may be trending higher but even if this is shown to be correct in the fullness of time, this may only be a response to seasonal conditions and best practice agronomic and livestock management. If the trial continues in a new phase of Grain and Graze a heavier grazing regime on both stubbles and pastures may provide some insights into the soil organic carbon content movements in response to more intensive mixed farming systems.

Economically the high crop and pasture input treatments have produced an extra 1 t/ha of wheat from 4 crops in 6 years, irrespective of being grazed or un-grazed. The value of the extra grazing is reliant on the stocking rate and available growing season pasture area, i.e. there is no benefit unless there is a feed deficit under the current stocking rate requiring handfeeding in the winter/spring period when annual medic is productive. The cost/ha has been an extra 120 kg of DAP ($80), 80 kg of seed wheat ($20) plus the pasture establishment ($40) giving a 6 year increased gross margin of approximately $100/ha plus any increased livestock returns (assuming a wheat price of $240/t).

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Summary of paddock North 1 VRT study at MAC

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RESEARCH

Almost ready

Location: Minnipa Ag Centre, N1
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
Paddock History
2011: Barley
2010: Wheat
2009: Wheat
2008: Wheat
Soil Type
Sandy loam to sandy clay loam
Soil Test
Outlined in article
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
Clash with other farming operations: Standard
Economic
Infrastructure/operating inputs: VRT technology
Cost of adoption risk: Low if improving returns

Key messages

- **The gross margin benefits of not applying fertiliser to almost 50% of the paddock was not considered sustainable as soils were testing deficient in P at the completion of the 4 year study.**
- **To achieve an economic benefit from higher inputs on the deep zone, a yield increase was required. Only a 5% yield improvement on the deep zone would have altered gross margins from -$22/ha to $58/ha over the 4 year period.**
- **VRT struggled to economically justify its implementation over a 4 year run of cropping. This particular paddock study has shown the variable rate technology (VRT) benefit was not considered adequate to justify the capital investment of approximately $25,000 plus GPS guidance if required.**

Why do the trial?

Upper Eyre Peninsula is a landscape of variable soil types and land production capability zones and yet variable rate technology (VRT) is rarely practiced in the region. VRT is considered to have the potential to improve profitability and water use efficiency by more targeted placement of inputs. To assess that potential a paddock on Minnipa Agricultural Centre with a mix of land zones varying from sandy rises (which perform well in dry years) to shallow stony flats (which rarely perform well regardless of the crop or pasture choice) was selected in 2008 to investigate the performance of VRT in a situation typical of the district.

How was it done?

The selected paddock on Minnipa Agricultural Centre was segregated into 3 zones using a combination of yield, EM38 and elevation maps, and ground truthed with soil testing for subsoil constraints. The resultant common factor within each zone, as a result of the mapping, monitoring and sampling, was crop rooting depth, with 52% of the paddock designated as a deep soil type, 22% as a medium soil type and 26% as a shallow soil type.

From 2008 to 2011 three different management strategies were applied to alternating passes of a 9 m seeder across the paddock, sown with 2 cm GPS-guided auto steer on the same seeder runs each year (Figure 1). These management strategies were high input (higher fertiliser rates considered appropriate to the higher yield potential of the deep zone), district practice (what the farm manager would have used for the whole paddock if it had not been treated with VRT) and low input (lower fertiliser and seeding rates considered appropriate to the lower yield potential of the shallow zone).

This strategy resulted in the district practice being a fertiliser and seeding rate considered appropriate for the medium zone, with the high and low strategies bracketing either side of the district practice. This allowed the testing of the sensitivity of crop productivity and soil resources to inputs in each zone. The result was that for each zone in the paddock, there were three strategies imposed – one which was targeted to be appropriate for that zone and then two others to see how close to right that estimate proved to be.

A fertiliser and seeding rate package for each strategy was determined at the start of each year in the light of price, costs and seasonal outlook at the time. This meant that in some years, some of the strategies had similar inputs. Yield monitor data from these treatments coupled with input costs allowed a 4 year comparison of gross margins for each strategy within each zone or across the whole 61 ha paddock.

Annual fertiliser application rates (2008 – 2011) were based on current district practice of 6-8 kg of P and 5-7 of N (30-40 kg/ha DAP) respectively. They were increased to 12 and 11 kg of P and N (60 kg/ha DAP) as a high input treatment and no fertiliser was applied as a low input treatment. In crop nitrogen was applied separately to each strategy based on seasonal conditions and likely crop outcomes. The paddock received common standard weed control across all zones in all years.

What happened?

At the commencement of the study, April 2008, the paddock had adequate to high P and high N reserves (Table 1). Colwell P reserves were maintained at adequate levels until April 2012 when they had declined in the low input treatments in all zones and the district practice treatment in the deep and medium zones. There was a total of 48 and 30 kg/ha of P applied to the high and district practice input strategies respectively over the 4 years, the low input strategy received no P. Mineral N reserves generally declined over the first 3 cropping seasons but were maintained over the 2012 season. There were a total of 108 and 43 units of N/ha applied to the high and district practice inputs respectively, no N was applied to the low input treatment.

Wyalkatchem wheat was sown in 2008, 2009 and 2010, Hindmarsh barley in 2011. Growing season rainfall (mm) of 139, 300, 335 and 242 produced a district practice input yield of 0.5, 4, 3.4 and 2.9 t/ha in 2008, 2009, 2010 and 2011 respectively.

Over the 4 year case study the district practice input treatment produced a total yield of 10.7 t/ha (Table 2) and had an estimated water use efficiency of 17.8 kg/mm of plant available water compared to 17.6 and 18.3 for the blanket low and high input treatments respectively. With district practice inputs applied, the 4 year total grain production was similar in the deep and medium zones at 11.1 t/ha, compared to 9.5 t/ha on the shallow zone. The 1.6 t/ha total deficit from the shallow zone was made up of deficits of approximately 0.5 t/ha in 2009, 2010 and 2011.

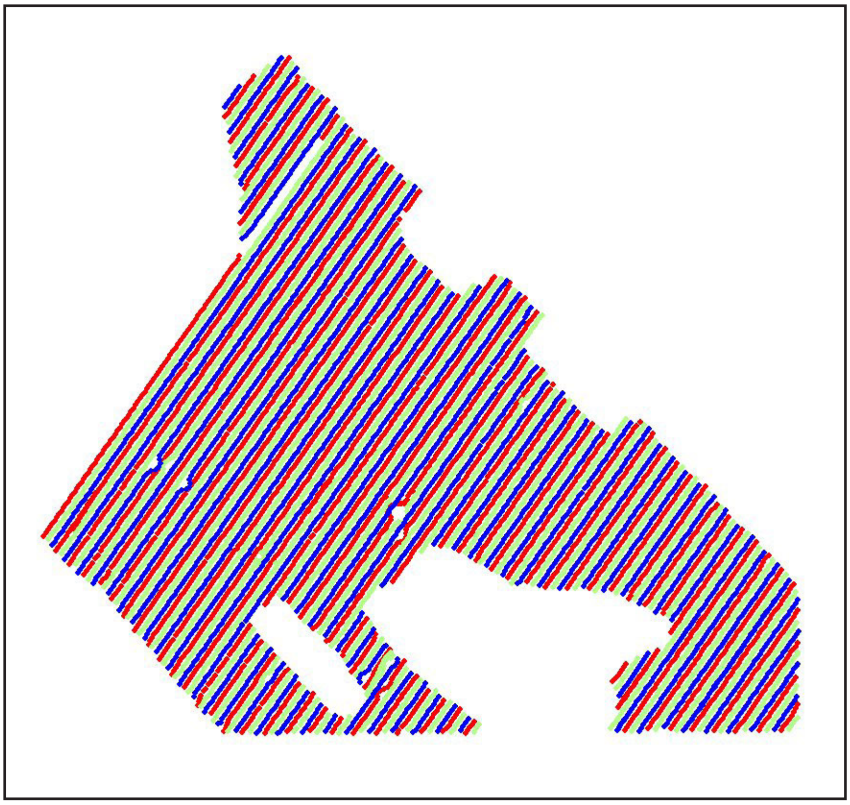

Figure 1 Seed and fertiliser treatment strips applied to paddock from 2008 to 2011. Dark grey signifies low input strips, light grey district practice and black high input

Table 1 Colwell P (mg/kg 0-10 cm) and mineral N (kg/ha 0-60cm) reserves in April 2008, 2009, 2010, 2011 and 2012

Zone	Input strategy	Colwell P (mg/kg)					Mineral N (kg/ha)				
		2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
Deep	High			32	30	29			124	46	48
	District	28	36	34	37	23	226	142	117	53	47
	Low			28	29	16			108	37	55
Medium	High			37	28	31			213	124	128
	District	36	41	37	39	27	275	158	220	93	125
	Low			39	28	20			186	78	63
Shallow*	High			39	33	36			93	54	55
	Distict	48	37	38	35	42	242	231	88	78	69
	Low			37	37	22			65	52	47

**Mineral N kg/ha figures are restricted to the 40 cm soil profile depth in the shallow zone*

Table 2 Grain yield (t/ha) of the district practice, low and high crop inputs imposed on deep, medium and shallow zones in 2008, 2009, 2010 and 2011

Deep	Medium	Shallow	Grain yield (t/ha)				
			2008	2009	2010	2011	Total
District practice			0.51	3.97	3.37	2.87	10.7
High			0.53	3.95	3.42	3.07	11.0
High	District practice		0.52	3.97	3.42	2.97	10.9
High	District practice	Low	0.51	3.92	3.37	3.02	10.8
High	Low		0.52	3.90	3.32	3.00	10.7
District practice	Low		0.52	3.95	3.32	2.84	10.6
Low			0.48	3.79	3.11	2.90	10.2

Table 3 Gross margins ($/ha) of the district practice and $ variations following low, standard and high crop inputs imposed on deep, medium and shallow zones in 2008, 2009, 2010 and 2011

Deep	Medium	Shallow	*Gross margins ($/ha)				
			2008	2009	2010	2011	Total
District practice			130	884	1023	570	2607
High			-33	-26	1	17	-41
High	District practice		-20	-14	6	6	-22
High	District practice	Low	-14	-19	-5	25	-13
High	Low		-2	-20	-14	28	-8
District practice	Low		19	3	-6	9	26
Low			30	-19	-58	39	-18

**Gross margins calculated at 2008, 2009, 2010 wheat and 2011 barley December grain prices and April fertiliser prices of the respective years. The variable rate treatments include a $2/ha annual data analysis consultancy fee.*

There was no benefit in applying fertilizer to the medium and shallow zones in any of the years. There was a yield benefit in applying district practice fertiliser rates on the deep zone in 2008, 2009 and 2010 but no further increase in response to high inputs on that zone (Table 2). However the 4 year total grain yields were positively correlated with increased fertilizer inputs.

Compared to a district practice blanket fertilizer application over 4 years there was a $26 ($6.50/annum/ha) benefit if fertilizer had not been applied to the 48% of the paddock that was zoned medium and shallow coupled with district practice inputs applied to the deep zone (Table 3).

What does this mean?

There were gross margin deficits in response to higher inputs in the deep zone. To achieve an economic benefit from higher inputs on the deep zone coupled with district practice inputs on the medium and shallow zones a yield improvement was needed; a 5% yield increase on the deep zone would have turned around gross margins from -$22/ha to $58/ha, a 10% yield increase would have improved gross margins to $135/ha.

This particular paddock study has shown the VRT benefit was not considered adequate to justify the capital investment of approximately $25,000, plus GPS guidance if required. However, the marginal benefit of not applying fertiliser to almost 50% of the paddock was not considered sustainable as at the completion of the 4 year study the soils, where no fertiliser had been applied, were testing deficient in P indicating a requirement for replacement P.

These results do not provide a long term recipe for this paddock based on district practice blanket inputs. Responses will change based on soil nutrition levels and seasonal conditions. Lower residual P and N levels may increase the response to varying levels of fertiliser rates to deliver yield variations more in line with projected land capability. Soil sampling and analysis is required to support annual decisions on fertiliser inputs based on residual nutrient levels and land capability. As was calculated, only a 5% yield improvement on the deep zone compared to the other zones would have changed the economic outcome significantly.

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SARDI

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Eyre Peninsula Farming Systems 3 – Responsive Farming Systems project summary

Naomi Scholz and Roy Latta
SARDI, Minnipa Agricultural Centre

INFORMATION

The 'EPFS 3 – Responsive Farming Systems' project exceeded its target of improving crop water use efficiency across the low rainfall agricultural areas of EP by 10%. In a survey of local farmers at the beginning and end of the project, an average increase in WUE of 31% from 2007 to 2012 was recorded. The project also increased the capacity of the agricultural community by working with the extensive network of farmer groups across upper EP, collaborating with other groups and projects, providing opportunities for learning events, publication production, and having a dedicated extension officer to support groups and individuals in accessing and applying information.

Project aims and structure

The Eyre Peninsula Farming Systems 3 – Responsive Farming Systems' (EPFS 3) project was funded by GRDC as part of the national Water Use Efficiency Initiative, commencing in 2008 and concluding in 2013.

The project was a collaboration between the University of Adelaide (UoA) (proponent), SARDI Minnipa Agricultural Centre (delivery), CSIRO (modelling) and the Eyre Peninsula Agricultural Research Foundation (EPARF) (industry relevance).

The project had 2 major objectives:

1. Increase capacity of the agricultural community across the low rainfall agricultural areas of Eyre Peninsula to participate in RD&E, access information and training and benefit from the full spectrum of GRDC supported low rainfall research.
2. Measurable improvements in crop and systems water use efficiency across the low rainfall agricultural areas (<375 mm) of Eyre Peninsula.

Project management and review was undertaken via a Steering Committee made up of EP farmers, researchers, consultants and project partners. This committee operated as a sub-committee of EPARF, and provided research direction and support to the project team and ensured relevance to industry and applicability to farmers of project activities. The Steering Committee conducted a mid-term review process in July 2011 and final project review in March 2013.

The project provided funds for a Project Manager (Naomi Scholz), Research Officer (Cathy Paterson), Technical Officer (Wade Shepperd) and Farming Systems Specialist (Linden Masters). SARDI in-kind research support was provided by Roy Latta and Nigel Wilhelm. CSIRO support was provided by Anthony Whitbread, followed by Therese McBeath. Annie McNeill (UoA) provided project supervision, and the project provided funds for a Laboratory Technician at UoA to analyse soil samples.

Research and development activities were undertaken across 3 'focus sites' - Minnipa, Mudamuckla and Wharminda to determine improvements in water use efficiency (Objective 2). Extension activities based on Objective 2 outcomes were undertaken across upper EP to increase the capacity of farmers, researchers and advisors (Objective 1). To monitor and evaluate the success of the project, a knowledge, attitudes, skills and aspiration (KASA) survey was undertaken towards the beginning and at the conclusion of the project (EPFS Summary 2011 p 95, EPFS Summary 2013). Individual activities and events were also recorded and evaluated where possible, to determine success of delivery methods.

This project also created opportunities for adding extra value to many activities. For example, funds from the Eyre Peninsula Natural Resources Management Board (EPNRM) supported the Farming Systems Specialist position and SAGIT funded the complementary "Developing robust and lower risk farming systems by understanding the impact of soil carbon" project.

Other project collaborations included the Low Rainfall Collaboration Project (GRDC), LRCP Profitability and Risk project (GRDC); Baldock (CSIRO Soil Organic Matter Group) - measuring carbon fractions; Eglinton – (UoA Barley Breeding Program) assessing the role, water use efficiency and profitability of ultra-early season barley varieties; Kuchel – (AGT), assessing the role, water use efficiency and profitability of early season wheat varieties; Bennet - Increasing profitability and reducing erosion with No-tillage on Eyre Peninsula (Caring for Our Country); SPAA Training and Demonstration of PA in Practice (GRDC SPA00010); the Eyre Peninsula Grain &Graze 2 project (GRDC/Caring for Our Country UA00117); McNeill - DGT as the soil test of choice for predicting phosphorus requirements (GRDC UA00103); Mason - Using PBI and DGT for accurately predicting phosphorous fertiliser rates (SAGIT UA0511); McDonald – P use efficiency of cereals (SAGIT UA1201).

Research and development

Research activities addressed current and seemingly ongoing seasonal constraints imposed by the millennium drought. It looked for adaptation through crops and management strategies to maximize the utilisation of the plant available water, to improve water use efficiency, but not necessarily to increase total production, but rather sustaining production from a diminishing resource.

Dual purpose peas and early maturing barley were considered as options. Soil protection to limit evaporation, and increase moisture availability later in the season through seeding row direction and width was also evaluated. Developing the correlation between time of sowing and a correlation with wheat maturity type was considered to address the variables associated with time of sowing and the timing of the first effective rain event.

The most significant crop input that was considered suitable for adjustment was fertiliser. Included in the options that were assessed was the comparative P efficiency of alternative wheat varieties, the maintenance of grain production by utilising residual P levels, and the application of a P rate based on previous crop removal. The option most extensively evaluated was the potential for variable rate technology supported by soil chemical analysis, yield mapping, EM38 and elevation maps, and applying fertiliser rates based on the productive capability of the land to improve production and economic outcomes.

It was found that in low rainfall seasons, lines of early maturing peas and barley outperformed current commercial cultivars. They also showed yield benefits of an early maturing cereal in the event of a late sowing.

Fertiliser studies found there was an opportunity to limit, or even delay for several years, P inputs in the presence of high residual P levels in the soil (as measured by either commercial soil test, Colwell or DGT P) without losing production, giving growers financial options to consider after poor years. They also identified that some wheat varieties performed better on low P than others and that still others responded better with added P. These genetic differences will be used to produce more efficient P varieties in the future.

The variable rate studies revealed opportunities to maintain production in the presence of high residual P and N levels by reducing fertiliser rates on zones within paddocks that had less plant available water. However only in one case did they report increased production in response to higher application of fertiliser on the more productive soils within a paddock.

The research outcomes from an industry perspective have been the ongoing development of early maturing barley cultivars through the University of Adelaide barley breeding program. Pulse Breeding Australia has developed a forage pea variety as a response to the call for a dual purpose attribute in the event of seasonal failure. Both introductions utilised data outputs from this project.

The very early maturing Axe wheat variety is a management tool which many EP growers now use to mitigate the impacts of a late break to the season, or as a late sowing option to maintain yield and address other farming system issues like grass control.

There has been an expanded use of variable rate technology, albeit slowly, along with an increased use of soil testing for residual levels. Farmers are making more informed decisions on the fertiliser rates as opposed to using blanket application rates.

Extension

A dedicated extension officer has allowed a better flow of information to the many farming groups linked to the EPFS 3 project. Having two satellite sites beyond the key research site at Minnipa Agricultural Centre increased the opportunity to examine different soil types and farming systems in local areas. Surrounding Farming Systems groups were able to view the trials and talk about water use efficiency (WUE) and be encouraged to increase their WUE. These sites provided an opportunity to view Yield Prophet®, VRT, EM38 mapping and soil testing to land capability. These concepts are still new for most farm managers on upper EP. The Wharminda site allowed good discussion on soil amelioration leading to linking and collaborating with two EP Natural Resources Management soil projects (Soilsmart, Building living soils) which further benefited the improvement in WUE. A new group of farmers in the Lock district was formed to provide better understanding in overcoming soil constraints and improving their farming systems.

For many groups the WUE project became a forum to examine better practices in soil health, soil and plant nutrition and understand how to better manage risk in different soil types. The EPFS 3 project provided support to and utilised the existing network of farmer groups (mostly agricultural bureau based) across upper EP for extension of research results, input into research being conducted and issues arising in their farming systems. Further to this, field days and targeted workshops, such as the Introduction to Farm Finances workshops developed in the Profitability & Risk project, were held throughout the life of the project.

Overall, 10 major field days were conducted over the life of the project, 68 planning and review/harvest report farmer meetings held, 63 sticky beak days supported and 33 workshops delivered. Products included 8 field day booklets, 5 EPFS Summaries, 39 newspaper articles, 2 Ground Cover articles, 5 presentations at GRDC advisor and farmer updates and 3 conference papers. In the final years of the project, EPARF developed a website, which was also used to provide information and updates on the project, as well as Yield Prophet® reports for the focus sites. An e-newsletter is now also being used to extend information to grower members.

A grand total of 238,000 people attended events or received information over the life of the project (obviously a lot of upper EP farmers and advisers attended more than one event or received information several times). 235,000 of these were 'passive', where farmers were provided information in the form of written information (research articles, media articles) or attended events that did not involve interaction with presenters. 3,000 people actively participated in events where there was direct interaction with those providing information. There are approximately 600 farmers on upper EP, so this means people attended multiple events over the life of the project.

Outcomes

An entry and exit survey was conducted on EP in 2010 (48 farmers) and 2013 (38 farmers). WUE of farmer wheat crops, as measured by French-Schultz, increased by 31% from entry (average 36% of potential yield) to exit survey (average 47% of potential yield). This shows for the industry and the community at large what is obvious to those close to the coal face – that modern farming systems are making much more efficient use of one of our scarcest natural resources (rainfall) than ever before.

According to the surveys, the main ways farmers have tried to increase WUE of crops in recent years have been to; seed early if season allows – before mid-May, keeping ground free of weeds over summer to store moisture, keep up the fertiliser use and use no till methods. With regards to fertiliser use, none had reduced their P rates. Six percent increased their P rates by an average of 20%. Sixty-eight percent had kept the same P rate, but all of them had redistributed by land zone. Sixty-three percent apply N in-crop in some situations (same as entry survey 65%).

Fifty-five percent of farmers surveyed match sowing date to variety (compared to less than half in entry survey), 53% use two year breaks and 34% dry sow wheat (other than for sheep feed).

Yield map use increased from 20 to 45%, and the use of variable rate prescription maps increased from 10 to 16%. Sixty-one percent use auto boom shut off, 24% use variable rate seeding (automatically controlled) and 92% used autosteer with corrected GPS (2-30 cm).

The main sources of technical information of farm practices, in order of importance were the EP Farming Systems Summary, other farmers, EPARF/Minnipa Field Days, Ag Bureau/Farm Systems groups, farm consultants, the Stock Journal, GRDC Ground Cover magazine, EPARF Newsletters, internet, other GRDC publications/media vehicles, radio/TV and apps on smart phones.

Recommendations

Messages and recommendations made at events such as farmer meetings and field days included:

- VRT tips for success: Have clear plan on what you are aiming to achieve; back up all data (CD, USB, external hard drive); keep it simple; employ a consultant to get the best out of the technology; reassess zones seasonally to make sure you are getting the best "bang for your buck".
- Zone management:
    - Poor Zone - If an annual system, manage to reduce risk and costs - reduce seeding/fertiliser rate. If an option, change land use.
    - Medium Zone - Manage zone strategically, in season decisions (graze/cut for hay or apply N), options could include short season varieties, dual purpose cereals, sowing early.
    - Good Zone - Intensively crop, soil test, fertilise, consider in-season N application.
- Time of sowing: Sow early, use varieties to match sowing date (i.e. sow long season varieties earliest, short season towards end of sowing program).
- Best bets for minimising Rhizoctonia inoculum levels are; rotation (grass free break crops), summer rainfall, summer weed control, controlling the green bridge. Factors to reduce the impact of Rhizoctonia infection in the crop include: nutrition, 'directed or targeted' disturbance (tillage), reducing herbicide residues especially SU's, seed placement (depth – below 2 cm but not too deep), early sowing (warmer soil temp), new fungicide products and placement.

- Know your nutrition levels to manage inputs effectively.
- P replacement strategy: P replacement works in soils with high P reserves, but in the long term P declines under current replacement calculations (3 kg P/t grain), it's a good responsive strategy in tight times - low cost in low production years. Compared to district practice, WUE has not increased using a replacement P strategy. Economically this strategy has performed better over 3 years.
- Residual P: In a paddock with adequate soil P levels, no extra P is required (no difference in yields between freshly applied P and soil P).
- P nutrition in general: In soils with a HIGH level of soil available P you don't need to add much fertiliser if any to achieve same yield (BUT be prepared to soil test!). Replacement P can be used as a tool to maintain production. In wet years more applied fertiliser P is used (up to 30%) compared to dry years (as little as 3%). DGT is a new tool we can use to assess available P. Phosphorus use efficiency of cereals (some variation in varieties). P rundown is work in progress (T McBeath modelling).
- Predicting yield: Provision of data to validate APSIM. Getting more accurate predictions. APSIM is accurate in higher yielding years and less accurate in low yielding years. Some issues with phenology are being addressed.

Conclusions

In low rainfall farming systems, there are opportunities to improve profitability by reducing input costs, however we were only able to show very limited benefits from increasing inputs.

The capacity to meaningfully engage with farmers has been demonstrated through this project, with increased adoption of practices to increase water use efficiency.

The final GRDC report for this project UA00107 was submitted in November 2013.

Acknowledgements

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Eyre Peninsula WUE survey results 2013

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SURVEY

Searching for answers

Location:
District: upper Eyre Peninsula
Farmer responses: 38 farmers 2013, 49 farmers 2010
Yield (wheat, averaged across upper EP respondents)
2012: 2.40 t/ha
2011: 1.90 t/ha
2010: 2.13 t/ha
2009: 2.03 t/ha
2008: 0.78 t/ha
2007: 0.70 t/ha

Key messages

- **A survey was conducted in early 2010 to determine the management practices of farmers and the average water use efficiency of farms on upper Eyre Peninsula. The survey was repeated in 2013 to see if there were changes in management practices and water use efficiency.**
- **Actual wheat yields were 36% of potential yield in the 2010 survey, increasing to 47% of potential yield in the 2013 survey.**

Why do the survey?

The Minnipa Agricultural Centre (MAC) was funded by Grains Research and Development Corporation (GRDC) to run a research and extension program (Eyre Peninsula Farming Systems 3 – Responsive Farming Systems) to improve water use efficiency on upper Eyre Peninsula (EP) farms by 10%.

An essential part of this program was to determine on farm water use efficiency (WUE) and what practices farmers are using which are thought to improve WUE. A survey was deemed the most efficient method to collect this information from a sample of all farmers across upper EP.

Farmers were surveyed in 2010, and again in 2013, to see if there have been any changes in practices and subsequent changes in overall water use efficiency.

How was it done?

In both 2010 and 2013 a comprehensive 50 question survey was emailed or posted as an excel spreadsheet to the same group of 200 farmers across upper EP.

Information was collected on demographics of people employed on farms; income from different enterprises, changes to farm businesses being made or planned, yields, methods used to increase WUE of cropping and livestock enterprises, stubble management, management over summer, time of sowing, in-crop management, break crops, use of technology, managing risk and future challenges to farming systems on EP.

Individual information is being kept strictly confidential.

What happened?

In 2013, 38 farmers out of 200 responded to the survey, giving a response rate of 19%. The response rate in 2010 was 25%. Figure 1 shows the location (nearest town) of respondents in 2010 and 2013.

Demographics and enterprise mix

In the 2013 survey, farm managers were equally split in the 41+ and 51+ age brackets, and had been farming in the district for an average of 30 years.

On average, farmers were cropping approximately 2,000 ha each year in the 2010 survey; in the 2013 survey they cropped an average 1,800 ha.

The area of cereals planted declined by 4% to 56%, with the same decline in contribution of cereals to farmer's incomes from 78 to 74% of total income. The area planted with canola and grain legumes increased slightly from 2010 to 2013 but were still very low.

Managing risk

In order to manage risk in 2010, farmers said that they use only higher value, lower risk crops (wheat and barley), sow early, reduce expenditure on fertiliser and defer machinery purchases. In 2013, sowing cereals, maintaining their own machinery, altering the crop/livestock balance and forward selling products were the most common options listed to reduce risk.

Practices to increase WUE

In both the opening and closing surveys, farmers thought the following three practices are the most important practices for increasing water use efficiency of crops:

- Seed early if season allows – before mid May
- Keeping ground free of weeds over summer to store moisture
- Use no till methods

In the closing survey however, a greater emphasis was also placed on keeping up fertiliser use and retaining stubble.

Farmers consistently thought the most important practices for increasing WUE of livestock enterprises were dry sowing feed crops, improved grazing management and pasture improvement. Other important improved production practices recorded in the closing survey were feed lotting and adjusting time of lambing.

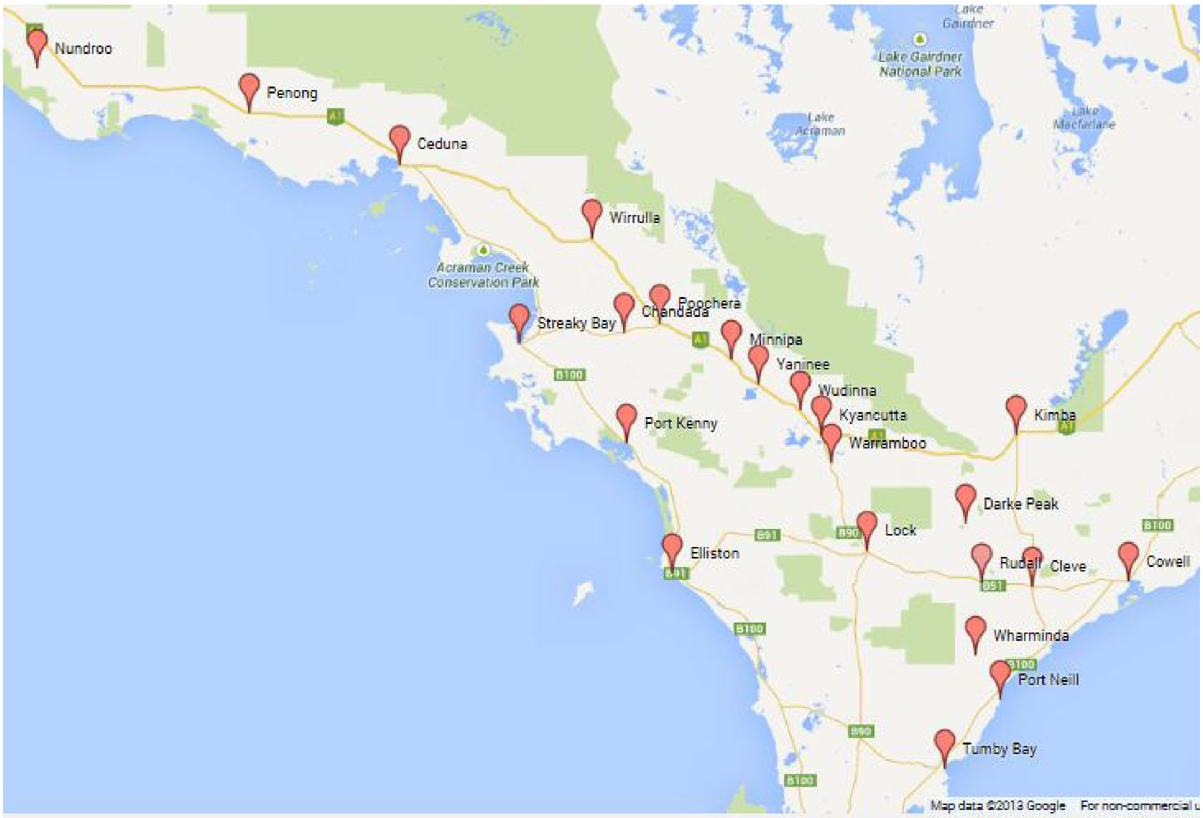

Figure 1 Location (nearest town) of 2010 and 2013 respondents

Summer weeds

All farmers controlled their summer weeds to some extent, with 85% controlling weeds in more than half of their paddocks. By the closing survey, farmers had increased the proportion of their farm on which they were controlling summer weeds. The main reasons farmers controlled their summer weeds were to conserve moisture and to allow earlier sowing. Summer weeds are controlled with herbicides, either alone or in combination with livestock.

Sowing

The number of farmers matching variety to sowing date increased by 7%. Sowing systems have remained the same, 54% use no till on the majority of their farm, almost no discs are used and there is almost no conventional tillage.

The length of seeding time was consistent across surveys, with an average of 24 days, but the average gap from the seasonal break to seeding reduced from 8 days to 4 days, with an average of 85 hectares sown in a day.

The percentage of farmers prepared to dry sow declined from 54% in 2010 to 35% in 2013, citing waiting for weeds to germinate as the main reason for delayed sowing.

Yield constraints

In the entry survey, yield constraints were listed as weather, root diseases and nitrogen and phosphorus nutrition. The same constraints were cited in the exit survey, with the addition of grassy weeds.

Nutrition

Seventy-five percent of respondents had reduced their phosphorus rates in the entry survey, by an average of 30%, as a result of the sharp increase in phosphorus fertiliser prices. Extra nitrogen application was limited on red soils, but more common on grey soils at seeding and mid season, and common practice on sands mid-season. In the closing survey, none had reduced phosphorus applications; they had mostly kept the same rates or redistributed their P depending on production zones. Nitrogen is now commonly applied, two thirds of it in crop rather than at sowing.

Disease

Practices remained similar between entry and exit surveys, with cultivation, rotation, nutrition, grass free medic and weed control commonly used to control disease. Using fungicide sprays, different varieties and rotations are still used to manage leaf diseases.

Rotations

The majority believe cereal on cereal is fine for 1 - 3 years, but in the exit survey 30% of respondents thought having greater than 4 years of cereals in a row was achievable. The majority of farmers did not use two break crops (from cereals) in a row in the entry survey, but half indicated they would use two break crops in a row in the exit survey. Preferred break crops are currently medics, peas and canola. The reasons for using breaks remained consistent between surveys; grass clean-up, increasing N supply, root disease management and rotating herbicide groups.

Precision agriculture technology
In the entry survey, 43% of the farmers surveyed managed their paddocks by zones, but mostly manually. The exit survey showed 55% of farmers managed their paddocks by zones. Guidance was not uncommon but yield mapping and variable rate were rare in 2010. In 2013, 90% had some precision agriculture equipment, more with higher technology options, 63% have maps of various kinds, but no NDVI or gamma maps.

Stubble management
A range of new stubble management questions were asked in the 2013 survey, prior to delivery of the new EP Farming Systems 4 project – Maintaining profitable farming systems with retained stubble. The majority said they treat their stubbles with grazing, with the rest harvesting short or leaving them standing. Farmers handle heavy stubbles (which they said was not common) by harvesting low and grazing, slashing or inter row seeding. Some would never consider cultivating or burning their stubbles, but others would for weeds, especially woody weeds, snails and mice. Farmers will occasionally burn stubbles to manage grass weeds.

All types of stubble are grazed by all types of stock, with famers selecting rotational grazing and maintaining a minimum level of groundcover as methods to avoid uneven grazing. Stock are taken off stubbles depending on erosion risk, when there is insufficient feed, or when livestock condition declines. Ground cover is mainly assessed visually.

Sources of information
In 2013, farmers recorded their main sources of technical information of farm practices as being the EP Farming Systems Summary, other farmers, EPARF/Minnipa Ag Centre Field Days, their farm consultant and Ag Bureau groups. Almost all respondents had heard of the EP Farming Systems and EP Grain & Graze projects.

Changes to farming systems
In the entry survey, some of the main changes farmers had made to their farming programs over the past 5 years (2005-2010) were to fine-tune tillage, agronomy and livestock practices, and changing cropping intensity (up or down). According to the exit survey, the 3 main changes farmers had made in the past 3 years (2010-2013) were reported as upgraded machinery and agronomy practices, purchased land and changed cropping intensity (up or down).

When asked where they saw themselves in 5 years, the 2010 survey respondents were aiming to be at least as large or many larger, with more cropping area but no drastic changes in enterprise mix, whereas the 2013 respondents aimed to be at least as large or many larger, with more sheep.

What does this mean?
Overall, the survey shows that farmers have increased their wheat water use efficiency by 31%. It appears that key messages and recommendations generated in projects such as EP Farming Systems 3, EP Grain & Graze 2 and Crop Sequencing are having an impact. According to the WUE survey, the increase in WUE has been achieved with improved applications of nutrition (rate and placement), earlier time of sowing, the use of precision agriculture technology and managing land based on production zones, continued use of no-till, a greater area of summer weed control, and the use of rotations. Improvements in WUE could also have been made with the adoption of better varieties and improved agronomic options and advice, which would at least partly be the result of an increased capacity of farmers, researchers and advisors supported by the strong extension network across Eyre Peninsula.

Acknowledgements
Thanks very much to the farmers that took the time to fill in the surveys, your efforts were vital to the success of this project. Thanks to Anthony Whitbread, Geoff Thomas and Michael Moodie for assistance with survey design and analysis. The Low Rainfall Collaboration project, GRDC and EP Farming Systems 3 (UA00107) have provided support for this evaluation.

Eyre Peninsula Farming Systems 4 – Maintaining profitable farming systems with retained stubble

INFORMATION

Naomi Scholz and Roy Latta
SARDI, Minnipa Agricultural Centre

Key messages

- **A new GRDC funded project has begun on upper Eyre Peninsula. The project will run for 5 years, and will produce guidelines to overcome the problems with retaining stubble in EP farming systems.**
- **EPARF have received funding for the project, and are engaging SARDI Minnipa Agriculture Centre staff to deliver the project. The EPARF Board and sub-committees will provide oversight and direction for project activities.**

Project aims

The project 'Maintaining profitable farming systems with retained stubble - upper Eyre Peninsula' aims to produce sustainable management guidelines to control pests, weeds and diseases while retaining stubble to maintain or improve soil health, and reduce exposure to wind erosion. The major outcome to be achieved is increased knowledge and skills allowing farmers and advisers to improve farm profitability while retaining stubble in farming systems on upper Eyre Peninsula (EP).

While providing benefits such as increased ground cover and soil protection, retained stubble farming systems present unique challenges compared to conventional or traditional farming systems where cultivation/stubble removal has been an important component of pest and disease management strategies. The local management guidelines developed in this project will include strategic approaches to address locally relevant issues on upper EP in retained stubble systems, in order to maintain or improve profitability and sustainability.

Guidelines will be developed with the use of local advisers, growers, collaboration with other low rainfall farming systems groups and past research findings, and further validated and demonstrated through the development component of this project. Supported with economic and risk analyses to determine profitability of practices adapted to local situations, they will be extended to the local farming and agribusiness community via our already established EP Farming Systems networks, publications and events. They will also utilise social media such as YouTube videos, an e-newsletter and the Eyre Peninsula Agricultural Research Foundation (EPARF) website www.minnipaagriculturalcentre.com.au.

Why do the project?

The greatest potential for land degradation on EP is related to wind erosion. There are 834,000 ha (29% of cleared land) in the region with moderate or higher potential for wind erosion (DWLBC 2007). The most vulnerable areas are the sandy soils, particularly water repellent sands, of eastern and upper EP.

The move to conservation farming systems, with reduced tillage and retaining of stubble residues, has improved soil moisture conservation, which has shown significant yield benefits in dry seasons. More recently, the move to no-till farming systems has further improved moisture and soil conservation across the farming districts. This technology has also significantly reduced soil erosion through lower levels of soil disturbance and higher levels of surface cover. (State of our Resources: Natural Resources Management Plan for the Eyre Peninsula Natural Resources Management Region 2009).

However, on upper EP there are significant issues arising from adopting practices associated with conservation farming systems (based on reduced tillage) and no-till farming. These issues include, but are not limited to, the build-up of snails, fungal disease carryover on cereal stubble and increasing in-crop weed infestation; all with costly but often poor chemical control. Stubble removal by burning and/or cultivation are generally seen by growers and their advisers as short term robust solutions. Growers with a long term history of no-till systems are finding it expeditious to cultivate selected paddocks to remove woody weeds and discourage mice and snail infestations.

Other issues associated with the retention of stubble include the recent occurrence of the white grain fungal disease, difficulty of establishing crops into medic pasture residue and grower and adviser perceptions that burning stubbles sterilises barley grass seed. Growers have also made observations that suggest retaining stubble increases the water repellence of non-wetting soils.

Research and development

The guidelines will be developed from field based activities, using the MAC facility and two regional sites on eastern and western EP, concentrating on specific localised issues. At the major MAC site the development work will be based on demonstrating opportunities to address pest, weed (in particular grasses), disease and crop productivity issues that are considered to be jeopardising the stubble retention systems. Stubble management options will be imposed on a range of field crops at harvest or post-harvest and stubble removal options pre-seeding also tested in representative commercial paddocks. The resultant pest, disease, weed and nutrient outcomes will be monitored and will provide validation for local guidelines and recommendations.

The regional sites will focus on specific local issues limiting profitability in stubble retained situations. On eastern EP the interaction between non-wetting soils and stubble retention with establishment will be a key issue for demonstration. On western EP stubble retention is being viewed as a constraint to effective herbicide use for summer/autumn and in crop weed control. Stubbles are also increasing snail and mice populations while pasture residues can delay the seeding program, by requiring a mechanical chaining.

At a national level, CSIRO has been contracted to assist groups participating in the Stubble Initiative with research expertise and techniques, to encourage consistency and rigour across the projects.

What has happened so far?

Development sites have been established at three regional locations, Mt Cooper, Lock and Minnipa Agricultural Centre. In 2013 both wheat and pasture trial sites were commenced. Initial treatments included reaping wheat at different heights and in pastures pasture-topping and grazing versus selective grass control versus hay-cutting. New treatments will then be imposed in 2014 on those previously established and will include comparisons between crop and pasture residue retention, disturbance or removal prior to seeding. Improved establishment options on non-wetting sands will be assessed through a comparative evaluation of seeding rate, depth and position. The project will continue to consult with growers at March meetings as to regional issues associated with stubble retention and where possible assist with developing and delivering regional demonstrations.

Acknowledgements

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Government of South Australia
Eyre Peninsula Natural Resources Management Board

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SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Eyre Peninsula Grain & Graze 2 project outcomes

Naomi Scholz, Jessica Crettenden and Roy Latta
SARDI Minnipa Agricultural Centre

INFORMATION

The Eyre Peninsula Grain & Graze 2 project officially commenced on 31 March 2010. The aim of the project was to develop and promote the adoption of production practices in mixed farming systems on Eyre Peninsula that improve whole farm profitability and sustainability and increase the efficient use of water and nutrients. The work was to focus specifically on the management of groundcover and biomass by integrating cropping and livestock within conservation farming systems.

The Grains Research & Development Corporation (GRDC) and the Australian Government's Caring for Our Country program provided funding of $808,118, which provided a full time research officer (Jessica Crettenden) and half time project coordinator (Naomi Scholz), project management for the University of Adelaide, funds to partially support a Steering Committee and contracting of consultants to deliver specific works such as Sheep Groups and Profitability & Risk workshops. Cash and in-kind support was provided by SARDI for research support (Roy Latta), technical support, overheads and operating; EPNRM provided cash for extension support via the Regional Landcare Facilitator (Linden Masters) and the University of Adelaide provided administration support and project supervision (Glenn McDonald).

The EP Grain & Graze 2 project has enjoyed strong collaboration with a number of organisations including the Eyre Peninsula Agricultural Research Foundation (EPARF), Lower Eyre Agricultural Development Association (LEADA), Eyre Peninsula Natural Resources Management Board (EPNRM), Ag Ex Alliance (AEA), Low Rainfall Collaboration Group (LRCG), Rural Solutions SA (RSSA) and the CRC for Future Farm Industries (CRC FFI). There were also interactions and collaborations with a large range of projects, including the Eyre Peninsula Farming Systems 3 project and SheepConnect SA.

Outcomes from research

Enrich Perennial Forage Shrub Trial – a program to identify novel native forage species.

Fifteen species of either *Atriplex, Rhagodia, Eremophila* and *Medicago* forage shrubs were established at Minnipa and Piednippie in 2009 to measure their persistence, productivity and palatability to support the establishment of both shrubs and herbaceous perennials for grazing and/or carbon sequestration and soil remediation on low production, constrained soils. Sites were monitored and measured in spring and autumn of 2010, 2011 and 2012. Both sites were grazed for the first time in autumn 2011 and again in 2012; subsequently their recovery was monitored to decide which lines progress to further establishment and evaluation studies. Supported by the national CRC for Future Farm Industries Enrich program it has shown that it is best to have mixed species stands rather than single species. A mix of *A. nummularia, R. preissii, A. semibaccata, E. tomentosa* and *A. amnicola* has been the most productive, calculated by plant establishment, biomass, persistence and palatability. As a progression, three direct seeding trials to investigate low risk/ low cost perennial establishment methodology were established from 2011-2013 with the most productive perennial forage shrubs selected from the results of two of the trial sites. Production and persistence will be monitored on these sites and grazing in their second year of growth will allow further assessments of grazing preference.

The Enrich sites provided excellent information to assist with shrub selection and management, however establishing shrubs from seed appears one of the major hurdles in the further adoption of forage shrubs and more research is required. These sites were used as a 'trial and error' opportunity to understand what the major hurdles for shrub establishment on the EP are. An important conclusion from the demonstration sites was that more work needs to be done on more workable direct seeding practices before promoting it as a cost and production efficient option to growers, especially on time of sowing, site preparation and design and weed management.

Annual and Perennial Species Evaluation Trials

Establishment of a trial to evaluate the potential of alternative herbaceous perennials (Sulla, Tedera and Cullen) compared to lucerne commenced in 2009 with 4 sites sown encompassing low to high EP rainfall zones and alkaline to acidic soil types. After 4 years of evaluation, it has been established that lucerne is well adapted to the better, deeper cropping soils on EP. However it lacks persistence on the shallow soils as opposed to Tedera, which is well adapted in neutral to acid soil types and Cullen to more alkaline soil types. Sulla was highly productive on the neutral to alkaline soil types and is well adapted to a 2-3 year break in an intensive cropping system, not necessarily as a longer term crop replacement on retired cropping land.

The slow rate and lack of commercial development of the Tedera and Cullen species respectively has meant that there has been little opportunity to promote the species as alternative pastures on their specific niches. As a result of this project, Sulla has been included in crop rotation studies as a phase pasture and is being assessed as an alternative break crop, with weed control and animal production benefits, to annual pastures.

Grazing Crops

Several trials were established from 2010 to 2013 to evaluate of a range of dual purpose crops (cereals and broad-leaf) measuring early biomass production for grazing, biomass production at anthesis for hay making, and subsequent grain yield from both grazed and un-grazed plots. Four paddocks were sown to barley in 2011, which were split for plus and minus grazing prior growth stage 31. There was delayed crop development and reduced lodging as a result of grazing, which also provided a feed source to fill the winter feed gap. There were also significant yield losses in response to late, untimely, continued grazing.

A canola grazing trial established near Cummins on lower EP in the same year measured a 60% yield loss in response to untimely and continued grazing. In a barley grazing trial at Wangary in 2011 the grower made the decision to utilise the paddock as a winter feed resource as opposed to an opportunistic grazing resource with grain production as the primary aim. The decision was supported by a delayed sowing date which reduced the early biomass production and the weed infestation which limited the yield in the un-grazed section to 2 t/ha. Grazing until ear emergence reduced yield to an estimated 0.7 t/ha.

In 2012 the same 4 paddocks used for the 2011 trial were sown to canola and medic, which aimed to demonstrate the impact of grazing a grain crop at the optimal stage of growth (6-8 leaf stage for canola) and compare grazed versus un-grazed systems. Due to seasonal conditions, poor early vigour and poor overall growth in the canola, the paddocks were not grazed. Biomass was still measured throughout the year and harvest yields were recorded to report on the decision making process of the trial. This decision making process was documented in the EP Farming Systems Summary 2012, in the article *"Grain and Graze – who, what, when, where, why, how?"* p 126.

In 2013, a broad acre demonstration site was established at Lock with barley, which was sown with the intent to graze for sheep feed with the opportunity to remove stock and cut for hay or harvest grain if the season allowed. Technical advice was provided to the farmer, exclusion cages were placed in the paddock and biomass measurements and feed tests were taken to assist in the decision making process. Results showed 1085 kg/ha higher dry matter in the exclusion area at harvest and 285 kg/ha more yield than measurements taken from the grazed area in the paddock. This showed that grazing has not impacted drastically on grain yields or biomass when compared to the substantial feed utilisation throughout the grazing period.

The in-season decision was to leave the northern side for hay or harvest with the southern side grazed down too far for either end use. Conversely, the opportunity to utilise the northern area as a standing feed source to finish lambs on over the summer period was decided to be the best value for the residual crop with 927 kg/ha of barley grain and roughly 5.8 t/ha of dry matter remaining in this area of the paddock.

Although using the cereal as a forage crop has somewhat affected a higher yield result, the feed value over this time needs to be considered as a beneficial outcome as well as additional advantages of livestock delaying grass growth and the on-set of weed seed set, offering the opportunity to spray-top later in the season. Furthermore, this end use will provide a valuable and substantial feed source for livestock over the summer and will also prevent other stubbles from being over-grazed, thus benefits of this practice need to be understood from a whole mixed farming system perspective (EP Farming Systems Summary 2013, *Flexibility in grazing cereals*: *the yin-yang effect*, Crettenden).

Impact of Livestock on Soil Health

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. Interposed on the input level comparison was the impact of livestock in a pasture-crop rotation to address the perceptions (often negative) associated with animals and soil health. The 6 year wheat, wheat, pasture (annual medic), wheat, pasture (annual medic), wheat rotation was split for plus and minus grazing in both the high and low input systems to establish the impact of grazing between the 2 treatments. Plant production along with soil nutrition has been monitored over the period of the trial. There had been no measured change in soil organic carbon content in response to high and low input systems with or without grazing until 2013 when a higher trend in the 0-20 cm profile was estimated in the 2 grazing treatments (0.15-0.2%), compared to the un-grazed treatments. The study measured increased pasture biomass in 2010 and higher wheat yields in 2011 response to both increased inputs, and grazing. The 2012 pasture phase of the rotation increased pasture biomass production in response to higher plant numbers from the 2010 annual medic establishment, high input treatments. There was increased plant available nitrogen at the 2013 seeding from the 2012 grazing treatments but no increased plant available N in response to higher 2012 biomass production. Grain yield, protein content and screening % following grazing the high input treatment in 2012 was higher than the high input un-grazed treatment, which was higher than the grazed low input treatment which was higher than the low input un-grazed treatment. Grazing has benefited both production and soil health outcomes.

Economically the high crop and pasture input treatments have produced an extra 1 t/ha of wheat from 4 crops in 6 years, irrespective of being grazed or un-grazed. The value of the extra grazing is reliant on the stocking rate and available growing season pasture area, i.e. there is no benefit unless there is a feed deficit under the current stocking rate requiring hand-feeding in the winter/spring period when annual medic is productive. The cost/ha has been an extra 120 kg of DAP ($80), 80 kg of seed wheat ($20) plus the pasture establishment ($40), giving a 6 year increased gross margin of approximately $110/ha plus any increased livestock returns (assuming a wheat price of $250/t).

Other related research is reported elsewhere in the document: Crop sequencing; Extending best practice wool innovations on Eyre Peninsula; Demonstration and extension of flock management strategies to improve lamb weaning percentages in low rainfall mixed farming regions.

Delivery to growers

The Eyre Peninsula Grain & Graze 2 project has had access to the extension networks established by the Eyre Peninsula Farming Systems projects; key messages, research results and new information has been provided to growers throughout the region and over the life of the project.

Each year, growers from 14 agricultural bureaus and groups on upper EP attended harvest report meetings, where research results were presented from the previous season, and grower issues and questions recorded to inform further research, development and extension. A field day showcasing trials and presenting information was held annually at Minnipa Agricultural Centre (MAC Field Day), EPARF hosted an annual targeted workshop (EPARF day) and a Women's Field Day was held every 2 years. Individual group 'Sticky beak days' were held in spring, where growers visited local properties and discussed trials or issues. Growers had access to the EPARF website www.minnipaagriculturalcentre.com.au and an e-newsletter was distributed each month. A Winter Newsletter was produced annually, detailing trials on EP and a couple of feature articles. All research results were published in the Eyre Peninsula Farming Systems Summary, which was available free to all farmers and consultants on EP and interested parties both inter and intrastate. 1200 hard copies were distributed annually and it was posted on the EPARF and SARDI websites. An email distribution list of 345 farmers was established specifically for EP Grain & Graze 2. This list was used to provide mixed farming information and notify people of coming events. The Eyre Peninsula component of the national Grain & Graze 2 website has been maintained, with publications, events and photos uploaded.

In March 2011, 4 Sheep Forums titled 'More Profit, Less Hassle' were held for growers on Eyre Peninsula. From these events, interest was gauged for the formation of 'Sheep Groups', or mixed Farmer Forums, with 4 groups being established at Cummins, Buckleboo, Poochera and Penong. Since then, 2 more groups have formed around the Kimba and Lock districts. The Sheep Groups are coordinated and facilitated by Mary Crawford, Land Management Consultant with Rural Solutions SA. Members of the Sheep Groups are mixed farmers, and each group determines their own agenda for the coming year.

Funding for the operation of the Sheep Groups was provided by EP Grain & Graze 2, SheepConnect SA and the Eyre Peninsula Natural Resources Management Board. This was a very important collaboration as the pooled funds provided flexibility (Sheep Group members were able to determine their own agendas), a greater number of serviced groups and greater ability to attract professional support.

Sheep groups generally met 3 times a year, with the first meeting being a planning session with invited guest speakers, the second was usually a benchmarking session undertaken with Daniel Schuppan, Livestock Consultant with Landmark where growers compared their livestock production to each other and saw changes in their own business over time, and the third was a technical session, usually held in the field visiting grower's properties.

The Sheep Groups explored a range of topics to improve production, profitability and sustainability. Items included animal health and nutrition, soil cover and health, feed availability, new sheep handling technology and innovations, grazing management, Australian Standard Breeding Values, grazing cereals and so on.

A total of 94,968 growers, researchers, consultants and agribusiness and NRM representatives attended or received Grain & Graze related events and publications. 1476 of those people actively participated in events such as workshops, Sheep Group discussions and training sessions e.g. measuring ground cover and determining feed availability.

Profitability & Risk

A dedicated forum with banks, accountants and whole farm consultants on EP demonstrating the '@risk' approach used in Southern Victoria was held in 2012. The aim of the forum was to raise awareness of the availability of a new tool '@risk' to examine production and financial risks of farming businesses to bankers, accountants and consultants on Eyre Peninsula. None of the participants had encountered '@risk' prior to this session, so awareness increased 100% amongst participants. Participants were interested in this type of risk analysis for their clients, but needed more exposure to the program to determine whether they would like to learn to use the tool.

To date, 6 groups of young farmers have participated in 'Introduction to Farm Finance and Risk Management' workshops, presented by Andy Bates (Ag Consultant) and either Brian Wibberley (Accountant) or Phil Stephens (Accountant). The aim was to introduce a group of younger farmers to the basic principles of financial management, with a longer term view to improved risk assessment and management. The workshops were aimed at whole farm business management, and participants were introduced to business structures, tax, measuring equity, cost of production, types of farm finance, common farm business financial tools, cash flow budgets and how to use them, identifying & managing farm business risks, interpreting financial statements and key business measures.

A series of 3 day Profitability & Risk workshops were run in 2009 at Cummins, Kimba, Wudinna, Streaky Bay and Tumby Bay, following the success of the workshops delivered as part of EP Grain & Graze 1, by Mike Krause and Brenton Lynch. Further Plan 2 Profit workshops are being held across Eyre Peninsula in 2014, under the Agrifood Skills Eyre Peninsula project.

Adoption/Change in practice

A KASA (knowledge, awareness, skills and attitude) exit survey was undertaken in March 2013 as part of the EP Farming Systems 3 project in conjunction with the Low Rainfall Collaboration project. 38 growers responded to the survey. A very small component of the growers that responded to the KASA survey were Sheep Group participants, but many had attended events that presented outcomes from Grain & Graze 2. 97% of respondents had heard of the EP Grain & Graze 2 project. The survey investigated changes in practices or attitudes over the previous 5 years.

According to the survey, the percentage of income from pasture/sheep remained the same at around 17%, the area for pasture/sheep declined to 33% of the total farm area (increase in cropping area). The three major changes people had made recently were purchasing land, upgrading equipment and increasing their livestock numbers. Lambing percentages fluctuated with the seasons, with the average being 99%.

To improve their livestock water use efficiency, 19 growers improved their pastures, 16 used containment areas, 15 dry seeded feed crops, 13 sowed cereals for grazing only, 13 had improved their grazing management and 10 had changed their stock management (e.g. timing of lambing) and 9 sowed dual purpose cereals. Other ways growers stated they had improved their livestock water use efficiency were by including the use of perennial shrubs, legumes and native grasses, fencing to smaller paddocks to improve feed utilisation, managing the feedbase better or supplementary feeding.

In March 2013, 29 Sheep Group participants responded to a written questionnaire. They found the most useful components of being part of a Sheep Group were benchmarking their enterprise against others in the district; talking to other farmers in the district and presentations from a range of different speakers. 58% of respondents had made changes to their sheep enterprise/s since they became involved in a sheep group. Those that had not made changes were generally members of the more recently formed groups.

Some of the changes people had made included changed shearing time, increased stocking rates, use of electric fencing, general planning and nutrition, planting feed early (e.g. barley for grazing), changed lambing time, fenced paddocks to better utilise feed and protect sandhills, improved weaner growth rates with higher protein supplements, improved fencing and watering systems, feed budgeting and condition scoring ewes. Being involved in a sheep group helped 83% make decisions about their sheep enterprise, and all of the respondents thought that Sheep Groups should continue in the future.

A further Sheep Group evaluation was carried out in September 2013. Sheep Group members were invited to provide feedback about how they think being involved in a Sheep Group has helped them improve their mixed farming business. Several local businesses provided prizes for the best responses, to encourage participation. Some of the comments included:

- "Several decisions were made after our benchmarking meeting and one of them was to mate our ewes to type rather than age. The second decision was to try lambing a bit later…with far less mortality (and) as a result we should see a huge lift in our production with more wether lambs to sell and more young ewes to shear and breed from."
- "The sheep group meetings allow us as members to see in the plainest of terms, where our own operations sit compared to our surrounding neighbours. We receive a quantitative figure, and no mistake can be made as to how we are performing. It is a safe, confidential environment, which facilitates discussion that delves quite deep into some producers systems, a depth which wouldn't be reached in general discussion over a beer at the local. The group meetings highlight the top producers, who we can then delve into what they may be doing differently to gain this edge."

- “Planting early feed has saved us time, through shortened hand feeding. It has saved us money, because we need to hand feed less. We are now losing less condition from the sheep as a result of this and consequently growing more wool from healthier ewes and lambs, resulting in favourable financial outcomes. The costs are mainly fuel and labour, and these don’t compare to the gains we receive as a result of doing it, not to mention the peace of mind we get from having the sheep on decent feed.”
- “Before we started benchmarking two years ago I had no idea how the sheep enterprise on our mixed farm was performing. After two years of data I now know that there is plenty of room for improvement and I now have a clear plan to make the enterprise profitable into the future. The two key areas I identified for improvement were to improve wool cut and to try and run more sheep through better grazing management.”
- “Through the sheep group and EPNRM I applied for funding to make a central water point and a dividing fence to make four 100 hectare paddocks to be able to rotational graze and help prevent erosion on sand hills. This project has allowed me to run more sheep in a more environmentally friendly manner and has been so successful it has inspired me to re-fence and add more troughs to other areas of my farm to be able to graze sheep in individual paddocks which I am in the process of doing now.”

Benchmarking undertaken by the Sheep Group members has been seen as very beneficial. 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.

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.

Following the success of the Eyre Peninsula Grain & Graze 2 project, GRDC have chosen to invest in a third program (Grain & Graze 3), of which EP will be a part. Other groups involved are East SA managed by Ag Excellence Alliance, BCG, Southern Farming Systems and Mallee Sustainable Farming. EP Grain & Graze 3 will focus on grazing cereals, pastures in the crop rotation and improving farm business decision making skills.

Acknowledgements

Project steering committee members over the life of the project included Dr Glenn McDonald, Peter Kuhlmann, Dean Willmott, Matthew Dunn, Andy Bates, Ed Hunt, Brent Cronin, Bruce Heddle, Dr Annie McNeill, Dr Nigel Wilhelm, Sam Doudle, Mark Stanley, Bryan Smith, Mark Fitzgerald, Simon Guerin, Jordan Wilksch, Craig James, Roy Latta, with Naomi Scholz providing executive support for the committee.

Section 5

Section Editor:
Naomi Scholz
SARDI, Minnipa Agricultural Centre

Nutrition

Efficiency of wheat and barley varieties in a P deficient soil

Sean Mason[1], Glenn McDonald[1], Bill Bovill[2], Willie Shoobridge[3] and Rob Wheeler[3]

[1] School of Agriculture, Food and Wine University of Adelaide; [2] CSIRO Land and Water, Canberra; [3] SARDI, New Varieties Agronomy

RESEARCH

Searching for answers

Location:
Minnipa Ag Centre,
Airport Paddock
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: (W) 2.54 t/ha
Actual wheat: (W) 2.60 t/ha (Mace sown with 25 kg P/ha)
Potential yield: (B) 2.94 t/ha
Actual yield: (B) 3.00 t/ha (Yarra sown with 15 kg P/ha)
Paddock History
2013: Wheat
2012: Wheat
2011: Peas
Soil Type
Light brown sandy clay loam
Plot Size
1.5 m x 5 m x 3 reps
Water Use
Max water use efficiency (based on highest yielding treatments):
Wheat: 11.0 kg/ha/mm GSR
Barley: 12.7 kg/ha/mm GSR

Key messages

- **Even under dry late seasonal conditions, wheat and barley responded strongly to P fertiliser.**
- **Barley had a small (3%) but consistently greater P use efficiency than wheat over two successive years.**
- **Significant yield differences between varieties of wheat and barley could not be attributed to varying P uptake efficiencies.**
- **Within the relative small area of the experiments, DGT P varied 4-5-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. Varieties that have different yield potential may require different amounts of P to reach their potential. Experiments conducted at MAC in 2012 comparing responses among six varieties of wheat and barley showed response in biomass and yield in up to the highest rate of P (16 kg P/ha) but with no significant difference among varieties in the response to P. This experiment was repeated in 2013.

How was it done?

Two replicated field trials (wheat and barley) were established at Minnipa Agricultural Centre in the Airport paddock near the 2012 trial sites. The DGT test for available P in 2013 was 29 μg/L (site average), critical P level is 52 μg/L, which is a slight increase from the 2012 site (DGT P = 20 μg/L).

On 24 May, 6 varieties each of wheat and barley were sown at 5 rates of P: 0, 5, 10, 15 and 25 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 (0:20:0:1.5), drilled with the seed at sowing. Early crop growth was assessed by taking a biomass sample on 12 August when plants were at early stem elongation. At the same time, a soil sample was taken from between the rows in the 0 kg P/ha and 25 kg P/ha plots to measure DGT P.

Table 1 Comparison of the spatial variation in DGT P between 2012 and 2013 for both the wheat and barley trials. The mean and the range in values and the coefficient of variation (CV) are shown

Crop	DGT (µg/L) 2012		DGT (µg/L) 2013	
	Mean	CV (%)	Mean	CV (%)
Wheat	18.8 (6-43)	39	25.6 (11-55)	38
Barley	21.3 (10-67)	44	32.7 (14-60)	36

Table 2 Mean grain yields of barley and wheat varieties grown on the P response trials at Minnipa in 2013. Each yield is the average of 5 P rates

Barley		Wheat	
Variety	Grain yield (kg/ha)	Variety	Grain yield (kg/ha)
Barque73	2740	Correll	1963
Commander	2490	Gladius	2125
Fleet	2825	Mace	2410
Galleon	2683	RAC875	2188
Hindmarsh	2858	Scout	2014
Yarra	2844	Wyalkatchem	2296
LSD (P=0.05)	*168*	*LSD (P=0.05)*	*244*
CV%	3.0	CV%	4.0

Table 3 The mean grain yield (kg/ha) and the PUE of wheat and barley at Minnipa in 2013 and the yield of barley relative to that of wheat at each P rate

Crop	P rate (kg P/ha)					PUE (%)
	0	5	10	15	25	
Wheat	2015	2125	2146	2207	2336	86*
Barley	2589	2683	2744	2833	2852	89
Relative yield of barley (%)	128	126	128	128	122	

**PUE of wheat determined by using yield obtained at highest P rate as maximum not determined*

The P use efficiency (PUE) is defined as the yield at 0P relative to the maximum yield. The P requirement was assessed by fitting a curve through the yield response data and the optimum P rate was estimated as the rate that gave 90% maximum yield. The economic optimum P rate for barley (i.e. when the marginal return = costs of the additional P) was calculated based on a prices of $260/t for wheat and $210/t for barley, and a fertiliser price of $650 (MAP 10:22:0:1.5), as this is more commonly used than triple superphosphate.

What happened?

In 2012, the DGT test was shown to be more sensitive to the spatial variation in topsoil P compared to Colwell P. Similar variations in DGT values were obtained for the two 2013 sites and spatial variation in 2013 was comparable to that measured in 2012 (Table 1).

Significant responses to P applications and significant differences among varieites were obtained in biomass production and grain yield in wheat. In barley there were significant responses to P for biomass production only but significant differences among varieties and in response to P for grain yield (Table 2, Figure 1). There was no significant Variety x P interaction in either wheat or barley. 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 to P in wheat and barley are considered in this report.

Barley yielded more than wheat (Table 2) and had a slightly higher PUE (Table 3). This was similar to the result in 2012. The yield advantage of barley was consistent over all P rates. Among the barley varieties Hindmarsh, Yarra and Fleet were the highest yielding and Galleon and Commander the lowest. Mace was the highest yielding wheat variety followed by Wyalkatchem (Table 2).

Growth and yield responded up to the highest rate of P but with greater responses observed in biomass production (Table 3, Fig 1). The difference in P use efficiency between wheat and barley in 2013 (86% compared to 89%) was similar to that observed in 2012 (80% compared to 83%). The slightly higher P efficiency in barley was because its relative biomass production and yield at 0P was greater than wheat.

Biomass production in wheat increased up to the highest rate with the optimum P rate (rate that gave 90% maximum growth) being 15 kg P/ha (Figure 1a). The grain yield response to P in wheat was linear and an optimum P rate was not identified. From the wheat DGT database, the predicted relative yield for this site was 72% (assuming maximum yield was reached) with a required P rate (90% of yield increase) of 14 kg P/ha. It is unclear why P application rates were comparatively inefficient for the wheat trial. The economically optimum P rate was estimated to be 21 kg P/ha.

In barley the response in biomass was linear and the optimum P rate was not identified (Figure 1b). The optimum rate for grain yield was 10 kg P/ha. The DGT database predicted a relative yield of 76% should have been obtained with a required P rate (90% of yield increase) of 12 kg/ha. In barley the economic optimum P rate was estimated to be 7.5 kg P/ha.

The response in yield to P fertiliser was proportional to the response in biomass production at early stem elongation and responses were similar in 2012 and 2013 (Figure 2). The graph suggests that there is no yield penalty from the promotion of early biomass production from P fertiliser.

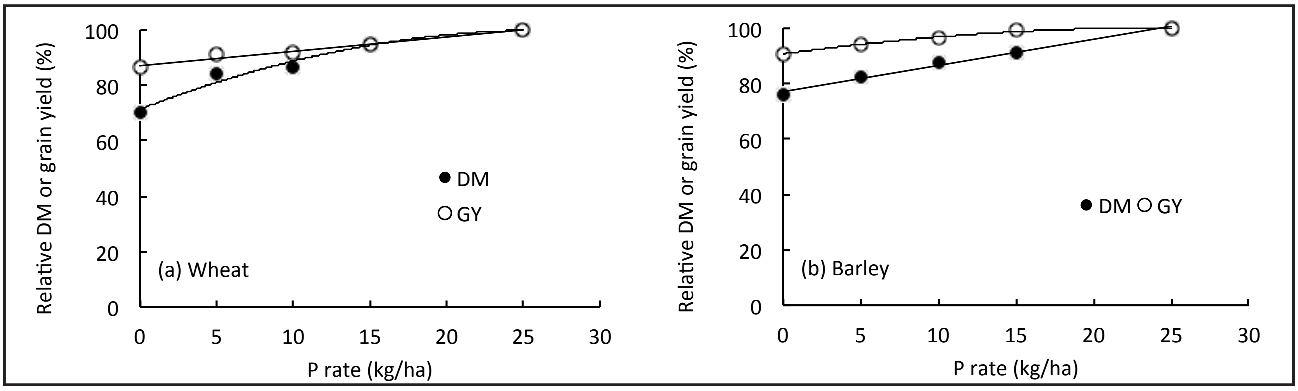

Figure 1 The average responses to P in (a) wheat and (b) barley for crop dry matter at stem elongation and for grain yield. The data are shown as a relative response (expressed as %) where biomass or yield at 25 kg P/ha =100%

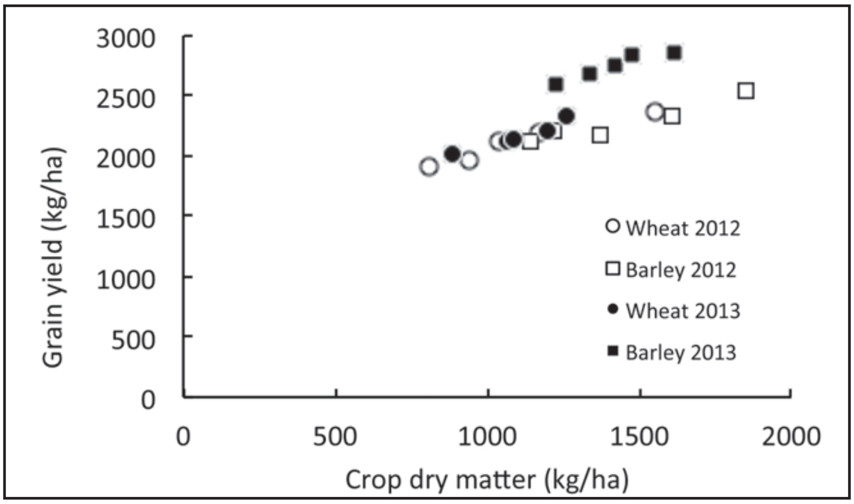

Figure 2 The relationship between grain yield and dry matter production at early stem elongation for wheat and barley over two years

In contrast to some responses to N fertiliser, high amounts of biomass promoted by high rates of P were not detrimental to yield in these experiments. Over two seasons, greater early growth from applications of P favoured high yields. Quality data from the 2012 experiments supports this: thousand grain weight and test weight were unaffected or slightly improved at high rates of P and screenings were either reduced slightly or not affected by high P rates.

Like the 2012 season, the extended periods of dry conditions in the second half of the growing season 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.

What does this mean?

As in 2012, intensive soil sampling has demonstrated the large degree of spatial variation that can occur in available soil P, with a 4 - 5 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.

Despite the dry spring, there was a highly significant (P=0.001) response to P in both wheat and barley which reflected the increase in early biomass production. Early stem elongation is a critical phase of development for yield for two reasons: firstly, the developing ear is entering the period of rapid development when the ultimate number of grain-bearing sites is being determined and secondly, the proportion of tillers that survive to maturity and their productivity is influenced by growth during this growth phase. Having adequate amounts of growth and P at this stage sets the foundation for high yields.

Acknowledgements

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Liquid fertiliser evaluation trial

Tristan Baldock and Cindy Martin

Cleve Rural Traders

RESEARCH

Searching for answers

Location:
Tuckey
Jason & Julie Burton
Rainfall
Av. Annual: 330 mm
Av. GSR: 235 mm
2013 Total: 416 mm
2013 GSR: 313 mm
Yield
Potential: 5.25 t/ha (W)
Actual: 3.11 t/ha (highest yielding plot)
Paddock History
2012: Wheat
2011: Angel medic
2010: Stiletto wheat
2009: Wheat
Soil Type
Grey brown loam
Soil Test - 2012
C_{DGT} 36
Predicted response (DGT) 81%
See EPFS Summary 2012 p113 for full soil test results
Diseases
No disease detected
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 through logistical efficiencies. Fertilisers delivered into on-farm storage tanks well before planting commences.
Labour requirements: Savings in terms of logistics and associated labour costs (economies of scale also required to ensure adequate capacity of equipment to make savings in logistics and labour).
Economic
Infrastructure/operating inputs: Costs associated with set up for storage handling and distribution – minimal in comparison to upgrades of granular fertiliser storage and handling.

Key messages

- **Emergence of granule treatments was equal to that of liquid N and full liquid treatments due to high soil moisture conditions favouring dissolution of granule fertilisers.**
- **Granule N with liquid P treatments supported increased tiller numbers in 2013, compared to full liquid and liquid N granule P treatments.**
- **Wet winter conditions supported above average grain yields, favouring treatments containing granule N, in particular granule N liquid P treatments, a contrast to 2012 results.**
- **The addition of trace elements and fungicide had no effect of the final yields regardless of form applied.**
- **Traditional granule treatments provided returns greater than full liquid treatments, and similar to liquid N granule P and granule N liquid P.**

Why do the trial?

The necessity to evaluate a decision to convert a growers 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 was responsible for such a benefit, thus the establishment of this trial site in 2012. Results from the 2012 season demonstrated yield benefits from liquid fertilisers, with liquid N being a key driver to increased productivity. It was necessary to replicate this trial for another season to determine the outcomes under differing seasonal conditions as well as to determine if there is any cumulative effect of fertiliser treatments.

How was it done?

The trial was established on a uniform grey brown loam top soil over soft limestone subsoil, with a 2012 base Colwell P of 36 mg/kg (sufficient) and nitrate N of 36 mg/kg (sufficient at time, but no individual treatment soil testing was carried out prior to sowing in 2013). Sown with certified Mace wheat on 8 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 flutriafol, designed to establish which component has the greater effect on final yields. The treatments are summarised in Table 1. The treatments were identical to 2012 and were sown plot on plot to determine any cumulative effect.

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 up until the beginning of tillering. Emergence counts were variable and didn't track the same trend as 2012 with the full granule treatments performing as well as liquid N and full liquid treatments. This variation from 2012 results is thought to be due to extremely high soil moisture levels this season, making conditions more favourable for granule fertilisers. It was also observed that higher P levels did not increase emergence in 2013.

Tiller counts also showed a different trend than 2012 with granule N liquid P treatments producing more tillers than those containing liquid N granule P, as well as full liquid treatments. Differences in tillering were visually noted when liquid N treatments showed symptoms of N deficiency mid tillering. Although not measured, it is hypothesised that the liquid N treatments had a lower residual N than the granule N treatments due to their higher yields and subsequent usage in 2012, and that the addition of 20 units of N in all treatments in this above average rainfall year was insufficient to replace N used. The subsequent residual N in the granule N treatments may have also caused the granule and granule N treatments to tiller significantly better than 2012.

Yields increased about 20% on 2012 across the site due to the exceptionally wet winter, which favoured those treatments containing granule N, in particular the granule N liquid P treatments which out-yielded full liquid and liquid N granule P treatments. Observations made in 2011 and 2012 were not supported due to a possible N depletion discussed above, which led liquid P to have a greater impact on yield when fertiliser form was analysed as a factor (Figure 1). As was the case in 2012, trace elements, or the addition of fungicide, had no impact on final yields, nor did the form of the fungicide.

Grain test weight and screenings were the only quality measures 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). The exception to this was Burton Brew and Burton II Brew which both were binned as APW, compared to ASW for all other treatments. Improved yields helped increase the gross margin performance of granule and granule N treatments this season, however granule N liquid P still returned less than full granule or liquid N granule P treatments (Figure 1).

Table 1 Wheat emergence (plants/m^2), tiller count (tillers/m^2), grain yield (t/ha), test weight (kg/hL) and gross margins ($/ha) in response to fertiliser treatments in 2013

Treatment	Treatment descriptor	Emergence (plant/m^2)	Tiller count (tillers/m^2)	Grain yield (t/ha)	Test weight (kg/hL)	Gross margin ($/ha)
15	Burton Double (T15)	153	241	3.11	84.0	629
10	granN liqP (T10)	152	264	3.06	84.0	627
12	granN liqP -fung +te (T12)	152	267	2.97	84.0	601
22	Burton Brew II (T22)	153	262	2.97	84.3	659
2	granN granP +fung -te (T2)	186	242	2.96	83.8	674
14	granN(20)granP(12) -fung -te (T14)	167	243	2.96	83.9	668
17	granNgranP(12) +fung +te (T17)	170	244	2.96	84.1	658
18	granN granP +granfung +H^20 +te (T18)	171	243	2.95	83.9	655
4	granN granP +fung +te (T4)	176	256	2.94	84.0	656
9	liqN granP -fung -te (T9)	154	236	2.93	84.0	626
1	granN granP (T1)	185	254	2.91	83.9	665
11	liqN granP -fung +te (T11)	153	233	2.90	84.0	616
3	granN granP -fung +te (T3)	171	263	2.89	84.1	650
16	liqN liqP(6) +fung +te (T16)	142	225	2.86	84.2	580
5	liqN liqP -fung -te (T5)	187	243	2.85	84.0	575
8	liqN liqP +fung +te (T8)	155	234	2.85	84.0	567
6	liqN liqP +fung -te (T6)	180	243	2.82	84.0	564
13	liqN liqP +fung +te (T13)	163	240	2.80	84.2	532
7	liqN liqP -fung +te (T7)	159	250	2.79	84.0	555
19	nil fert (T19)	176	222	2.67	84.1	670
21	Burton Brew (T21)	174	240	2.66	83.9	739
20	nil fert +fung (T20)	155	213	2.63	84.1	639
LSD (P=0.05)		*23*	*49*	*0.13*	*0.32*	*27.29*

(te) consists of Zn and Mn @480 g/ha and Cu @ 193 g/ha as sulphate, except for treatment 13 which is EDTA chelate. Fungicide consists of flutriafol @ 100 g/ha ai as a liquid, except for treatment 18 which has a coating on granule fertiliser. Furthermore, the Burton Brew contains N-6liquid+14granule, P-6liquid+2 granule, Zn Mn 480 g, Cu 193 g, Burton Double N-12liquid+14granule, P-12liquid+2granule, Zn Mn 1000 g, Cu 42 g, and Burton II N-12liquid+8granule, P-4liquid+4 granule, Zn Mn 480 g, Cu 193 g

Nutrition

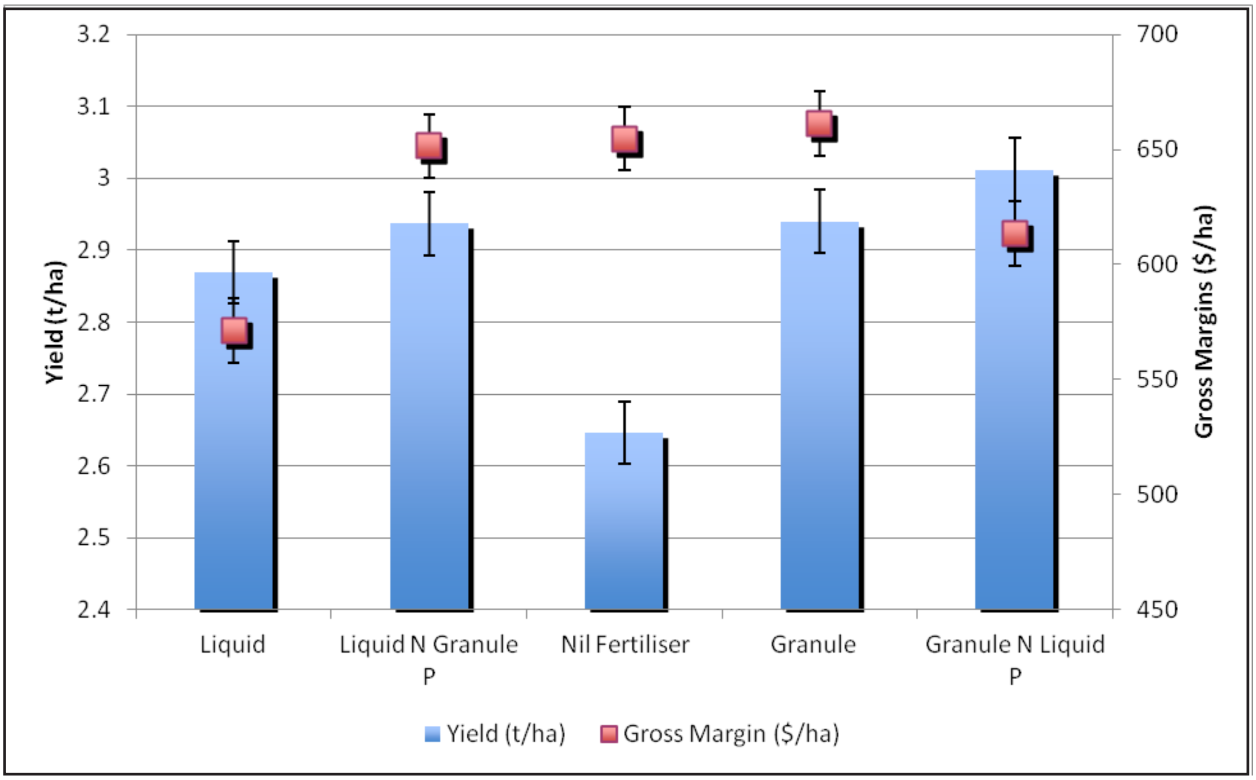

Figure 1 Wheat yield (t/ha) and gross margins ($/ha) of liquid treatments compared to nil fertiliser, granule treatments and granule N + liquid P

Returns were poorest overall under a full liquid treatment, a result of poor tillering and subsequent yields, returning $40/ha less than granule N liquid P treatments and up to $70/ha less than granule and liquid N granule P treatments. This is in contrast to 2012 results where full liquids returned as much as liquid N and granule treatments, and $30/ha more than granule N liquid P.

What does this mean?

Results from previous split paddock trials near this site suggested the potential for large gross margin improvements in a full liquid system over a traditional granule fertiliser system at sowing. In 2012 this study supported some of these observations, showing improvements in crop establishment and early vigour resulting in significant improvements in yield with a liquid N system compared with granule N. In the second year of this replicated study under very contrasting seasonal conditions from year 1, improvements under liquids were limited to emergence and early vigour, with traditional granule treatments performing well in high soil moisture conditions. In 2012 water was the limiting factor, in 2013 lack of nitrogen impeded yield potentials, in particular under liquid treatments where the nutrient extraction in 2012 was greatest.

This study indicated in 2012 that liquid N has had a greater impact on yields and profitability than P on this farm, however in this season traditional granule treatments returned similarly to liquid N granule P treatments. Trace elements have had no impact on final yield in both years, although they have had some impact on crop establishment and tillering in 2012, indicating possible benefits in a more favourable spring, however this wasn't supported in 2013. Likewise, the presence of flutriafol, whether as a liquid stream or as a coating on granule fertiliser, has had no impact on final yield in a season where disease pressure was low.

This study has now captured one year of split paddock trials and two years of replicated plot trials, which has encompassed three very different sets of seasonal conditions. While similar results and trends have been observed between the farmer trials and the first year of this study, 2013 presented variable results with differing trends requiring further research to validate the results and learn more about the impacts of liquids under varying seasonal conditions. The study will therefore continue in the 2014 season allowing further study of treatment responses within seasons as well as allowing measurement of the cumulative effects of each treatment. At this point however results are inconclusive as to what the true advantages may be with the adoption of liquid starter fertilisers in the cropping system.

Acknowledgments

Thank you to the Burton family for providing land for this trial, Cleve Rural Traders, MAC and Spraygro for operational and funding support, and special thanks to Therese McBeath for scientific support.

Charra and Goode district fertiliser trial

Leigh Davis[1], Andrew Ware[2] and Brenton Spriggs[1]

[1]SARDI, Minnipa Agricultural Centre; [2]SARDI, Port Lincoln

RESEARCH

Almost ready

Location:
Charra
Locky and Paul Brown
Charra Ag Bureau
Rainfall
Av. Annual: 303 mm
Av. GSR: 229 mm
2013 Total: 285 mm
2013 GSR: 217 mm
Yield
Potential: (W) 2.15 t/ha
Actual: (W) 1.16 t/ha
Paddock History
2012: Spray-topped pasture
2011: Pasture
2010: Pasture
Soil Type
Brown sandy clay loam
Plot Size
1.5 m x 10 m x 3 reps
Yield Limiting Factors
Dry finish

Key messages

- **CL Kord seed treated with EverGol Prime and 40 kg/ha DAP out-yields standard 40 kg/ha DAP and untreated CL Kord seed.**
- **Very little differences between other treatments at Penong in 2013.**

Why do the trial?

This trial was initiated by the local Ag Bureau groups at Charra and Goode to test if there were potential yield responses and possible money to be gained by increasing fertiliser rates, testing new products and other seeding techniques like fluid fertilisers. Bryan Smith applied for money through the Eyre Peninsula Natural Resources Management Board (EPNRM) Sustainable Agriculture fund on behalf of the two Ag Bureau groups and a grant was secured to undertake the trial.

How was it done?

Twenty four treatments replicated 3 times were sown on 9 May 2013 using CL Kord wheat sown at 50 kg/ha. 40 kg/ha DAP was used as the control rate of fertiliser, this equals 8 units of phosphorus and 7.2 units of nitrogen (8P, 7.2N) The treatments are listed in Table 1. The trial site received 1.5 L/ha Gramoxone, 1 L/ha trifluralin and 60 ml/ha Striker at sowing, then 2 L/ha Sprayseed, 1 L/ha Alpha Cypermethrin just before the trial emerged. On 1 July 2013 the trial was sprayed for broadleaved weed control using 750 ml/ha Intervix, 400 ml/ha Agritone750 and 500 ml/100L SuperCharge.

What does this mean?

The paddock selected for the district fertiliser trial in 2013 was a brown sandy clay loam, not a grey highly calcareous soil type which explains why fluid fertilisers didn't perform as well as expected (EPFS Summary 2003 *'Fluid Fertilisers - After six years, where the heck are we? Where are we going?'* p 77). The trial showed very little differences between most treatments in 2013.

One of the interesting small but statistically significant responses was CL Kord seed treated with EverGol Prime fungicide sown with 40 kg/ha DAP out-yielded the control untreated CL Kord seed with 40 kg/ha DAP by 0.13 t/ha, which is an 11% increase in yield. At a seeding rate of 50 kg/ha the approximate cost of EverGol Prime @ 0.8 L/t is $5.80/ha. EverGol Prime is registered for the suppression of the fungal pathogen Rhizoctonia on wheat and barley. This flowable seed treatment can be used at rates between 400-800 ml/t and also controls smuts and bunts, eliminating the need for another standard seed treatment which costs around $3/ha.

In this case, money was gained through using EverGol Prime as a seed treatment, with a 0.13 t/ha increase in yield above the control treatment. H2 grade wheat at $260/t calculates to an increase of $34/ha, minus $5.80/ha product cost, making this treatment financially attractive at $28/ha above that of the control treatment.

All the other treatments with added nitrogen, application of zinc and fluid fertilisers were not significantly different to 40 kg/ha DAP.

Visual symptoms of rhizoctonia were not observed.

Acknowledgements

Thanks to Paul Brown for the use of his land.

EverGol Prime – registered trademark of Bayer CropScience. Vibrance – registered trademark of Syngenta. N-Pact SRN is a registered trademark of United Agri Products Canada Inc. eNtrench registered trademark of the Dow Chemical Company or an affiliated company of DOW. Gramoxone - registered trademark of Syngenta Group Company. Striker - Striker is a registered trademark of Nufarm Technologies USA Pty Ltd. Spray. Seed - is a registered trademark of Syngenta Group Company. Intervix - registered trademark of BASF. Agritone 750 – is a registered trademark of Nufarm Australia Limited. Supercharge – registered trademark of Syngenta Group Company. Impact - Impact – registered trademark of Cheminova A/S Denmark.

Table 1 Grain yield and quality of wheat sown at Penong in 2013

Treatment	Yield (t/ha)	Protein (%)	Test weight (kg/hL)	Screenings (%)
8 kg P/ha EverGol Prime seed treat + 11.5N urea	1.29	12.4	81.1	1.2
Tristan fluid brew (1) @ 41 L/ha 14N, 14P, 1.17Zn, 1.17Mn, 0.47Cu	1.24	12.6	80.7	1.1
8 kg P/ha + 11.5N UAN foliar	1.20	12.9	80.4	1.3
Tristan fluid brew (2) @ 50 L/ha 21N, 7P, 0.87Zn, 0.87Mn, 0.35Cu	1.20	12.6	80.7	1.1
8 kg P/ha + 23N	1.19	13.0	80.0	1.1
8 kg P/ha Vibrance seed treat + 11.5N urea	1.19	12.7	80.6	1.2
8 kg P/ha + 11.5N eNtrench N in furrow	1.19	13.0	80.5	1.0
8 kg P/ha +11.5N urea + Zn foliar	1.17	12.6	80.6	1.2
14 kg P/ha + 23N	1.16	13.4	80.4	1.1
40 kg/ha DAP (Control)	1.16	12.2	81.0	1.3
14 kg P/ha + 11.5N urea	1.16	13.2	79.9	1.2
0 kg P/ha + 23N	1.15	13.0	80.9	1.2
8 kg P/ha + 11.5N N-Pact applied foliar	1.15	12.9	80.3	1.1
8 kg P/ha + 11.5N urea	1.14	12.7	80.4	1.2
14 kg P/ha as triple super	1.13	12.4	80.7	1.2
0 kg P/ha + 11.5N urea	1.13	12.6	80.6	1.4
36.4 kg/ha MAP	1.13	12.5	80.9	1.1
40 kg/ha DAP + Impact @ 200 ml/ha + 11.5N urea	1.12	12.6	80.5	1.3
60 kg/ha DAP	1.11	13.0	79.7	1.4
0 fertiliser	1.10	12.3	81.0	1.2
Phos acid + nitrogen = 8 kg P/ha + 11.5N	1.09	12.2	81.4	1.5
8 kg P/ha as triple super	1.06	12.5	79.9	1.7
Mean	**1.16**			
LSD (P=0.05)	*0.09*			
CV%	4.9			

Section Editor:
Suzanne Holbery
SARDI, Minnipa Agricultural Centre

Livestock

Management strategies to improve lamb weaning percentages

Jessica Crettenden and Suzanne Holbery
SARDI, Minnipa Agricultural Centre

RESEARCH

Try this yourself now

Location: Minnipa Ag Centre
Rainfall
Av Annual: 324 mm
Av GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Livestock
Enterprise type: Mixed farming
Type of stock/breed: Merino

Key messages

- **Lamb survival increased by 10% from 2012 to 2013 by following a management system developed from Lifetime Ewe Management (LTEM)[1] principles.**
- **Pregnancy scanning is essential to understand flock potential and assists with managing ewe nutrition which is critical to lamb survival.**
- **An on-farm autopsy can provide valuable information to address lamb survival issues.**

Why do the trial?

Benchmarking is a tool used to identify and measure areas that can be improved and should be considered an essential component of a mixed farming business. An opportunity exists in many livestock enterprises to improve reproduction. In this study this opportunity was addressed by identifying, and understanding, the timing and causes of lamb losses from pregnancy scanning through to weaning. Lamb survival issues that have been recognised can then be reduced by implementing management, genetic and/or feed and forage strategies whereby a significant economic benefit accrues to the industry.

Research into identifying the causes of lamb deaths conducted in 2012 (EPFS Summary 2012, p 120) was partly inconclusive because 49% of deaths were un-diagnosed or the lambs were not found. The recommendations from the 2012 study were used as the basis for this project in 2013, which employed various flock management strategies to improve weaning percentages and closely measure and monitor flock performance.

How was it done?

A management system from joining to weaning was developed using guidelines outlined in the Lifetime Ewe Management (LTEM)[1] program in addition to recommendations from the 2012 study.

On 6 February 2013 the 350 flock ewes, which included 130 maiden ewes, were weighed, condition scored and drafted into six randomly selected single-sire mating groups of approximately 48 ewes, ensuring each had equal amount of ewe ages. Another group for artificial insemination (AI) consisted of 64 ewes that had successfully reared one or more lambs to weaning in the past two years. A February joining was chosen being close to the time of peak fertility in this environment and in attempt to match the ewe and lamb nutrition requirements with feed availability (whilst also reducing the need to supplement feed). Rams were allocated and released into their selected groups on 7 February. The AI group was laproscopically inseminated on the same day, apart from two ewes that did not meet the health requirements and five ewes which were inseminated the previous day for demonstration purposes. A back-up ram went out with the AI mob ten days after insemination. Rams were removed on 21 March for a six week joining. At this time ewes were weighed, condition scored and re-established as one mob.

Ewes were pregnancy scanned on 13 May, 13 weeks after the start of joining. Pregnancy scanning identified dry, single and multiple bearing ewes to ensure nutritional requirements could be better managed mid to late pregnancy and throughout lambing. Ewe health was monitored, and maintained through vaccination against common livestock diseases and fly, lice and worm protection.

The vaccine also contained Selenium for improved immune system performance and the vitamin B12 to assist with the ewe's ability to cope with stress.

Monitoring for predator activity via trail cameras with day and night-time capability began in March and continued until the end of lambing. Predator monitoring also included recording of visual observations on the property. Fox lights (devices designed to randomly flash in alternating sequences to simulate the headlights of a vehicle or flashlight typical of hunting procedure with firearms) were put out at beginning of lambing in strategic locations in each paddock in an attempt to frighten foxes away from the lambing ewes. Poison baits were put out on 15 July in response to a wild cat and fox population influx, presumably as a response to lambing, until a rain event three weeks later. A trap was also put out at this time after multiple sightings of cats in a particular paddock. As a demonstration of another predator control option, two wether alpacas were run with the AI mob throughout lambing.

Six paddocks ranging from 3.4 to 6.2 ha in size were chosen for lambing based on feed availability, shelter and optimal space for individual ewes to bond with their lambs after birth. Paddocks consisted of mallee scrub, saltbush, olive trees, annual grasses, medic and broadleaf weeds. Prior to lambing, paddocks were monitored and biomass cuts were taken and tested to ensure that ewes would receive their nutritional requirements. Biomass was also measured on 11 and 23 July to estimate feed on offer. Ewes in paddocks with high stocking rates were allowed access to neighbouring broad-acre pasture once feed reserves became low. Supplements in the form of licks and blocks were provided ad lib from the start of lambing until weaning. Oaten hay was tested for nutritional quality and provided ad lib towards the end of lambing as fresh pastures began to deteriorate.

Ewes were side-branded (for identification) and drafted into lambing groups on 27 June based on their pregnancy scan result. There were four mobs of approximately 45 ewes bearing multiple lambs, one group of 69 single-bearing ewes, the AI mob of 64 ewes and a mob of dry ewes. The AI ewes remained as one mob throughout lambing and were not drafted according to pregnancy scan result.

Lambing commenced on 4 July and the last lamb was born on 17 August. Lamb birth dates were recorded daily, lambs were individually identified (to both sire and dam) and tagged. Birth weight, birth type, rectal temperature, lamb vigour and ewe maternal temperament was also recorded, along with any other observations about ewe or lamb behaviour. In the case of lamb death prior to weaning a basic autopsy was conducted to establish the most likely cause of death. If the cause of death could not be determined laboratory analysis was used to make a diagnosis.

Lamb marking was undertaken on 22 August and included tail docking, castrating, EID ear tagging and vaccination. At weaning on 18 October lamb and ewe weights were recorded and ewes were condition scored to measure the impact of lambing and to understand their requirements for recovery.

What happened?

From the 350 ewes joined, 534 lambs were scanned, equating to 153%. One sire group had a below average result with 29 out of 45 (56%) ewes scanning dry. After establishing that the ram had no physical injury or abnormality, it was concluded he had an unknown fertility issue.

The result for the 350 ewes included 46 dry, 89 singles, 202 twins, 11 triplets and 2 quadruplets. At birth 531 lambs were tagged, equating to152%, including lambs that were found deceased at the birth site. The number of lambs weaned was 448, equating to 128%. In the AI group, 45 out of the 62 ewes inseminated became pregnant with 69 lambs weaned, equating to 111%.

Birth weight (measured at 2-24 hours after birth) ranged from 2.5 to 8.2 kg, averaging 5.4 kg for singles, 6.1 kg for twins, 5.3 kg for triplets and 4.8 kg for quadruplets. Rectal temperature measured on live lambs ranged from 34.5 to 40.5°C with an average of 39°C. The ewe maternal temperament and lamb vigour was measured as an objective score of 1 to 5 (with 1 being poor and 5 being excellent). Interestingly, the maternal temperament score increased with the higher number of lambs born per ewe with a score of 3.5, 3.6 and 4 for the singles, twins and triplets/quadruplets respectively. However, this can possibly be explained by the greater number of maiden and younger ewes that gave birth to single lambs as opposed to multiples (indicative of better maternal instinct in older ewes).

Between scanning and weaning, five ewes died from reproductive-related causes including pregnancy toxaemia, dystocia (labour difficulty) and mastitis. Between tagging at birth and weaning 83 lambs died, with 24% of carcases 'not found' and autopsies unable to be conducted on 10% of the deceased lambs due to secondary predation. These were labelled 'undiagnosed'. The majority of lambs died when they were less than a week old (70%), with 32% of these dead within the first day. Of the deceased lambs, 29 were born to maiden ewes. There were more deceased multiples (83%) than singles (13%), with 4% recorded as unknown birth type. The autopsy results are displayed in Figure 1, which also shows the results from the 2012 study.

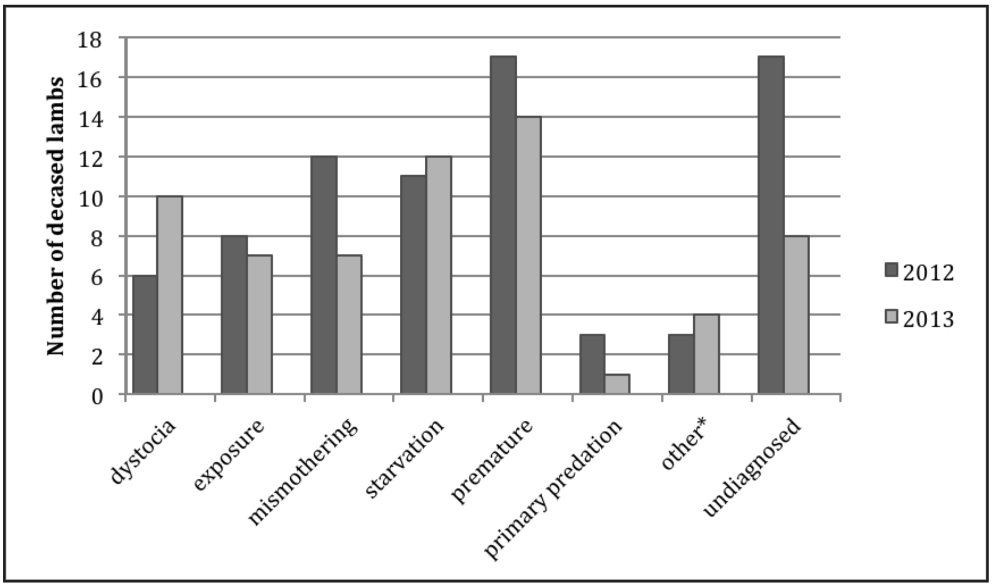

Figure 1 Autopsy results for the deceased lambs in the Minnipa Agricultural Centre flock 2012 and 2013 drop from birth until weaning

**other includes injury, infection and misadventure*

Note: the 43 (2012) and 20 (2013) 'not found' deceased lambs are not displayed on the graph

Table 1 The reproductive performance of the Minnipa flock in 2012 and 2013

Year	Ewes joined	Pregnancy scanning	Lambing	Weaning	Lamb deaths*	Foetuses**
2012	374	557 (149%)	563 (150%)	443 (118%)	120	30%
2013	350	534 (153%)	531 (152%)	448 (128%)	83	25%

**lambs deceased during or after birth*

***per cent mortality from scanning through to weaning, including foetuses aborted*

Monitoring pre-lambing suggested that predator populations were low. However, one week into lambing it became clear from autopsy data that predators had moved into the area. From March until the end of August there were thirteen sightings of cats, eight of foxes, two of dogs and two of eagles. A baiting program was implemented with baits placed at strategic locations in close proximity to the lambing ewes and water points. Over the baiting program only two out of ten baits were taken suggesting there was enough afterbirth and carcases to scavenge during this time. Fox lights may have worked as a deterrent for a short time after they were initially installed in the paddocks but any effect was short lived as predators became accustomed to their presence.

What does this mean?

Using a 'best practice' management system assisted the Minnipa flock to increase lamb survival percentage by 10% (Table 1).

Each individual cause of lamb death from conception to weaning was analysed separately to identify the sequence of events that occurred to both the ewe and lamb during this time. With this information, targeted responses could be implemented immediately and/or into the future.

Lamb survival is an important factor determining success in a flock and this is driven by ewe performance. The importance of understanding ewe nutrition requirements during pregnancy and throughout lambing was the major catalyst for the success. Pregnancy scanning was the initial process by which nutritional decisions needed to be made, as the use of this information and subsequent changes in management practices reduced the chance of potential losses. In particular, the information obtained from scanning for single and multiple bearing ewes increased flock productivity considerably, as multiple bearing ewes required different amounts of nutrition to single bearing ewes and dry ewes, given that a foetus can grow two thirds of its actual size in the third trimester.

In 2013, fewer deaths were associated with starvation, mismothering and exposure (referred to as the SME complex) collectively when compared to 2012. This is most likely attributed to better managed, multiple bearing ewes and a subsequent increase in lamb birth weight combined with reduced stocking rates to alleviate the likelihood of mismothering. By managing ewe nutrition according to pregnancy status, maintenance of body condition in single and twin bearing ewes could be maintained. This result is highlighted by an increase in lamb birth weight of 0.4 kg and 0.6 kg in twins and triplets/ quadruplets respectively from 2012 to 2013. Associated benefits included the ewe spending more time at the birth site (allowing lambs to obtain their first essential drink containing colostrum to build their immune system), better ewe milk supply, more energy for labour and healthier lambs that were able to follow their mother during grazing and were not as susceptible to predation.

More dystocia diagnoses were given in 2013 than in the 2012 study due to the implementation of a more advanced autopsy procedure that explored the complexity of the birthing process and the role that difficulties during labour can have on lamb development post-birth. Dystocia is an issue generally associated with large lambs, which can be caused by excess feeding of predominantly single-bearing ewes, particularly in the last trimester. Problematic labour can be common in maiden ewes or is caused by incorrect presentation of the lamb/s during birth. Dystocia may be more of an issue than originally believed, and can easily be misdiagnosed. Information suggests that haemorrhaging of cerebral tissue and the spinal cord can occur in lambs which have a difficult, or unusually long birth, this can damage the innate response to suckle. Basic post-mortem examination would label these lambs as death due to the SME complex, however further investigation may detect partial haemorrhaging of the brain, confirming cause of death to be a result of dystocia. Cause of death by dystocia can be minimised by correct ewe nutrition, which will better manage lamb size and will also provide ewes with sufficient energy to cope with their labour. However, poor presentation i.e. a lamb that is not correctly positioned during birth, is unavoidable.

The second year of the study found that shelter and paddock allocation go hand-in-hand with managing ewes according to their pregnancy status. Plenty of dense shelter and good quality feed needs to be provided to the multiple-bearing ewes. Single lambs tend to be larger and stronger when first born and have access to more colostrum therefore they are not as susceptible to hypothermia. Paddock design also needs to be considered to allow for bonding between the ewe and lambs.

Unfortunately, some deaths to some extent are inevitable, for example prematurity, misadventure, infection and injury. Some cases of premature deaths are caused by poor nutrition and stress, which can be rectified to prevent death in utero. At lambing time, mobs should be checked regularly (every 1-3 days) but should have minimal disturbance. Losses due to ewe physical abnormalities can be avoided by regular monitoring and treatment where appropriate. Checking udders at weaning time is important (if individuals have not been identified during lambing) in order to determine if the ewe has reared a lamb, lambed and lost, or is dry. Ewes should be culled if they have not reared a lamb for two consecutive years.

The study has found that primary predation was generally not an issue. Observations concluded that efforts should be concentrated more to minimise predator numbers to reduce secondary predation of lambs that are weak or have been mismothered. Autopsies concluded that the majority of predated carcases were scavenged; hence predation was not the primary cause of death. However, it is essential that pest numbers are controlled in order to reduce the incidence of scavenging which builds up predator condition and can result in population increase around lambing time, and possible 'gang' attacks.

Determining your ewe's reproductive potential is the first step to increase weaning percentages – you don't know what you have lost unless you know what you started with. The most efficient way to acquire this information and subsequently better manage your ewes is through pregnancy scanning. The next step is to identify areas that can be improved to reduce the gap between the potential number of lambs and the actual number of lambs weaned.

[1]Lifetime Ewe Management (LTEM)[1] is a nationally accredited course developed from the LTW2 project, which developed management guidelines for improved understanding of the impact of ewe nutrition on the performance of the ewe and her progeny over their lifetime.

[2]Lifetimewool (LTW) was funded and supported by Australian wool producers through Australian Wool Innovation Limited, state government agencies and farm businesses. LTW has a series of ewe and pasture targets that increase productivity and profitability of the Merino sheep enterprise. There are also management guidelines for ewe flocks at all times of the year.

Acknowledgements

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SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SASAG
South Australia Sheep Advisory Group

EPARF
Eyre Peninsula Agricultural Research Foundation Inc.

Grain & Graze
Profit through knowledge
EYRE PENINSULA

Reducing sheep methane emissions through improved forage quality

Roy Latta
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location: Minnipa Ag Centre
EP Agricultural Research Foundation
Livestock
Enterprise type: Mixed farming
Stocking rate: At a rate to allow more than 4 weeks grazing while retaining groundcover
Type of stock/breed: Merino weaners

Key messages

- **Grazing a vetch crop, compared to a standing barley forage crop, increased merino weaner growth rates from 41 to 190 g/head/day.**
- **Data to compare daily methane production per animal is currently being collated and analysed.**
- **The increased growth rates provided the opportunity to sell weaners earlier per unit of production.**

Why do the trial?

Direct emissions from agriculture currently accounts for approximately 15 per cent of Australia's total greenhouse gas emissions of which approximately 65 per cent is methane resulting from sheep and cattle. The emission level is associated with the quality and digestibility of the animal feed; the higher the digestibility and the less feed required to maintain production (higher quality), the lower the amount of methane produced per unit of product (e.g. per kg body weight produced). This trial aims to evaluate forage opportunities which may increase sheep production and reduce methane emissions through improved feed quality in late spring, autumn and early winter in southern Australian livestock production systems. It will contribute new data on methane production with different forage systems under commercial grazing conditions.

How was it done?

The trial commenced on 8 November 2013 with 200 mixed-sex Merino weaners (July 2013 drop) at an average live weight of 28 kg split equally into 2 groups of 100 animals. Group 1 was placed on a 15 ha unharvested vetch stubble; oats were supplied in a lick feeder. Group 2 were placed, with another 242 weaners, onto 35 ha of standing dry sown unharvested barley stubble with an annual medic pasture residue understory; a grain mixture of barley and field pea were available in a lick feeder. The weaners were weighed on 8 November following an overnight fasting and prior to being placed on their respective paddocks.

The 2 groups were retained on their treatments until 3 December when methane production measurements commenced. Each group had 50 animals allocated as replicate 1 and the second 50 as replicate 2, with methane measurements completed over 4 days with 30 animals from each replicate within each group being measured at the same time each day. Sheep were removed from grazing respective fields at 7:30 a.m., drafted into identified group and placed in a "polytunnel" from 8:30 a.m. for 3 hours (Group 1, Rep1on 3 December, Group 2, Rep1 on 4 December, etc.). A polytunnel is a large inflatable tent into which the group of sheep is temporarily placed, with air containing all gases produced by the sheep extracted through a duct. Methane is analysed in real-time with a sensor, and data logged to a computer every 10 minutes for later analysis. CSIRO staff from Perth completed the measurements and are currently analysing the data. Sheep were returned to respective fields until they were removed on 8 December, and weighed after an overnight fast at 9:00 a.m. on 9 December.

Data which is being reported are the weaner live weights from the commencement and completion of the trial with the comparative forage availability, utilisation and quality. The pre- and post-grazing samples, 0.1 m^2 quadrants, were collected from the same 10 randomly selected points within each paddock and sorted into their specific components. Quality of the different forage components was estimated through a FEEDTEST analysis.

What happened?

The group 1 weaners gained a total of 5.5 kg/head live weight, the group 2 weaners an average 1.2 kg/head live weight gain over the 29 day trial.

Livestock

Table 1 Forage biomass (tDM/ha, 8 November – 8 December) disappearance (kg/head/day) crude protein (CP) (% of DM), digestibility (% of DM) and estimated mega joules of energy (MJ/kg of DM) of a legume and cereal based crop residue

Forages		Biomass (tDM/ha)	Disappearance (kg/head/day)	Quality		
				CP (%)	Digest (%)	MJ/kg DM
Group 1						
Vetch	Pods/Grain	0.3 - 0.1	1.2	28.9	88	12.6
	Residue	1.9 - 1.6	1.5	12.9	54	7.8
Oats			0.25	15.3	78	14.0
Group 2						
Barley	Heads/Grain	0.6 - 0.3	1.3	12.8	80	12.6
	Residue	1.9 - 1.5	1.3	8.7	60	9.4
Pasture	Medic pods	0.5 - 0.6	0	0	0	0
	Residue	0.9 - 0.7	0.9	8.7	48	6.6
Field pea			0.06	26.2	90	13.0
Barley			0.02	11.3	86	13.2

**As the feed intake capacity of a 28+ kg weaner is <1 kgDM/day some grain and most residue losses are attributed to stock traffic*

What does this mean?

The increase from 50 grams/head/day to more than 190 grams/head/day from the flock grazing the vetch residue as compared to the flock grazing the barley/pasture residue reflects the higher nutritional quality of the vetch stubble compared the barley stubble, particularly the protein content. A higher supply of protein can improve the utilisation of the high-fibre components of stubble. Referring to the NSW DPI Primefacts No 347 weight gains of 190 grams/day from Merino weaners requires more than 0.8 kg of forage at 15%+ CP and a minimum 13 megajoules of metabolisable energy (MJ/kg DM).

The group 1 weight gain of 190 grams/day indicated that the diet was 0.8 kg vetch grain augmented by 0.2 kg of oats to provide the required CP and ME intake levels, 26% CP and 13 MJ/kg of DM. The group 2 weight gain result, 41 grams/head/day indicates a much lower protein intake from a barley grain heads diet 12.8% CP and 12.6 MJ/kg of DM, augmented with lower quality crop and pasture residue.

We await the methane production results, however, irrespective of the results the potential to achieve the increased weight gains measured in the study provides the opportunity to sell young sheep at an earlier age and thereby reduce methane emissions intensity (methane produced per unit of weight gain).

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SARDI

Australian Government
Department of Agriculture

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Flexibility in grazing cereals: the yin-yang effect

Jessica Crettenden

SARDI, Minnipa Agricultural Centre

DEMO

Try this yourself now

Location:
Lock
Gus Glover

Rainfall
Av. Annual: 345 mm
Av. GSR: 265 mm
2013 Total: 385 mm
2013 GSR: 270 mm

Paddock History
2012: Mace wheat
2011: Medic pasture
2010: Yitpi wheat

Soil Type
Grey sandy loam

Plot Size
60 ha (electric fence splitting northern 35 ha and southern 25 ha)

Yield Limiting Factors
Early finish

Livestock
Enterprise type: Mixed
Type of stock/breed: First cross Dohne x White Suffolk

Key messages

- **Opportunities in grazing cereals should not be limited by deciding on the final outcome of the crop at the beginning of the season – it should be a flexible decision.**
- **Priorities need to be set according to farming system concerns (livestock production, feed availability, crop yield, weed control etc).**
- **Seasonal variability plays a major role in the successes of decisions made within mixed farming systems and outcomes can vary depending on in-season choices.**
- **Although grain yield was compromised by pasture topping in this demonstration, the dry matter remained unaffected and provided a valuable standing forage source.**

Why do the demonstration?

The common mixed farming practice of grazing cereals could be described as a physical manifestation of the yin-yang concept, whereby livestock can help, hinder or neutralize the success of a cereal crop, depending on the desired outcome. Crops and livestock can be thought of as complementary (rather than opposing) forces interacting to form a dynamic system in which the whole is greater than the parts. Of course this leads to a more complex system, which requires priorities to be made, and can often result in completely different outcomes, according to the rank of priorities and seasonal variability.

The opportunity to graze a cereal crop provides a number of options for in-season and end-use outcomes. A one year demonstration was conducted on a mixed farm at Lock on the Eyre Peninsula to show an example of the flexibility available in mixed farming systems and the interconnections that occur within a livestock and cropping enterprise relationship.

How was it done?

A 60 ha paddock was chosen east of Lock that was in the break phase of its rotation and was subsequently sown with Flagship barley @ 55 kg/ha with 40 kg/ha of DAP (18:20:0:0) on 29 April 2013. The paddock received 1.2 L/ha of Treflan, 1 L/ha glyphosate and 100 ml of Striker pre-seeding. The original intention was to use the paddock as an in-season feed source, removing livestock after a period of grazing and possibly harvesting the crop at the end of the season, however controlling grass seed set by pasture topping was required, which compromised this option.

Pre-grazing biomass cuts were taken three times with a 0.1 m^2 quadrant on 6 June at 12 sampling points in the paddock to calculate feed on offer (FOO). Collected samples were sent away for a feed test analysis. Twelve exclusion cages measuring 1 m^2 were placed at each sampling point.

On 7 June, 310 first cross Dohne x White Suffolk ewes and 360 April/May drop lambs were put in the paddock. Eleven days later an electric fence was erected to split the paddock in two with 35 ha in the northern section and 25 ha in the southern section and sheep were moved into the northern section the same day. A small fence was also built around an exposed sand hill to prevent further erosion.

On 25 July sheep were moved from the north to the south side of the paddock and biomass cuts were taken to determine feed utilisation. Three cuts x 0.1 m^2 were taken at each of the six sampling points on the northern side and a biomass cut of 0.1 m^2 was taken from inside of each exclusion cage.

On 4 August, 200 lambs were drafted off the ewes and sold averaging $130/head. The electric fence was taken down at the same time to allow sheep to graze the entire paddock. On 20 September the remaining 160 lambs were sold averaging $110/head and the ewes were removed from the paddock. The entire paddock was then spray-topped with 500 ml/ha of glyphosate 450.

On 11 December harvest index and grain samples were taken from 1 m of row inside each exclusion cage and from 2 x 1 m rows in the paddock at each sampling point on the northern side of the exclusion cage

Table 1 Dry matter (DM) and yield results (t/ha) from paddock and exclusion cage pre-grazing, post-grazing and harvest measurements in the northern area of the 2013 Lock demonstration paddock

Date	6 June	30 July		11 December			
Sample	Pre-grazing DM	Post-grazing DM		Harvest DM		Grain yield	
Area	all	paddock	exclusion	paddock	exclusion	paddock	exclusion
t/ha	0.5	1.3	3.7	5.8	6.9	0.9	1.2

What happened?

The cereal was well established when grazing began, therefore it took a substantial amount of time to graze the whole paddock evenly and this was better achieved using the electric fence to increase stocking pressure. Post-grazing biomass and harvest measurements were taken only from the northern side due to negligible biomass remaining after grazing in the southern area. Sheep tended to camp near the sand hills on the southern area when distributed over the whole paddock, resulting in poor crop recovery and some erosion, hence there was a shorter grazing period in this section.

The paddock was grazed for a total of 107 days, with sheep allowed to graze the entire paddock for 59 of these days. Grazing was rotated from the northern to the southern side according to cereal height (targeted approximately 10 cm), with the aim to achieve an even grazing whist preventing erosion on the sand hills. The northern side of the paddock had a bigger area and sand hills were less prevalent, therefore this area was grazed for a longer period of 38 days compared to 10 days in the southern side.

The pre-grazing feed test reported above adequate levels of crude protein of 34.8% (16% required) and metabolisable energy of 11.9 MJ/kg DM (11 MJ/kg DM required) for lambs and lactating ewes and acceptable levels of neutral detergent fibre, dry matter and digestibility (DOMD) with test results of 39%, 18.9% and 73.5% respectively.

At the commencement of grazing 1126 DSE were allocated to the entire paddock, calculating a stocking rate of 18.8 DSE/ha with an initial allocation of approximately 0.5 t/ha of DM (Table 1).

In Table 1, biomass samples taken from the northern area show a feed utilisation of 2.3 t/ha between 6 June and 30 July with this area having a higher stocking rate of 32.2 DSE/ha for 38 days of grazing and a lower stocking rate of 18.8 DSE/ha for 11 days over this period.

Results showed 18.5% more dry matter in the exclusion area at harvest and 31% more yield than measurements taken from the grazed area of the paddock. However, this portrays that the impact of grazing was minimal, considering the feed utilisation and other advantages (such as resting other pastures) of using this paddock for grazing throughout this period. The low harvest index in both the paddock and exclusion cages can be explained by the effect of pasture topping.

The decision to leave the northern side for hay or harvest versus leaving the crop standing for a feed source to finish lambs over summer came down to getting the most benefit from the remaining crop. In this instance the 0.9 t/ha of barley grain and 5.8 t/ha of DM was more valuable as a standing crop for lambs during a time of feed shortage.

Although using the cereal as a forage crop and to control grass seed set by pasture topping has reduced yield, the feed value over this time needs to be recognised as a profitable outcome. Grazing with livestock also provides additional advantages including delaying grass growth and the on-set of seed set, offering the opportunity to spray-top later in the season. Furthermore, this end use will provide a valuable and substantial feed source for livestock over the summer and will also prevent other stubbles from being over-grazed, thus benefits of this practice need to be understood from a whole mixed farming system perspective.

What does this mean?

This demonstration portrays the yin-yang effect of how one paddock can produce two completely separate results according to the decisions made when combining livestock and cropping enterprises. Grazing a cereal crop created a flexible farming system, however results show the importance of understanding how grazing management practices can affect the crop in both the short and long term. In order to undertake the practice of grazing crops, farming system priorities first need to be decided on (e.g. feed requirement, grass control, hay cut, crop yield etc.). With these priorities in mind a flexible approach is required during the season to produce the desired outcome.

Over-grazing can easily become an issue that is not often apparent until later in the season. Keeping track of crop recovery will determine if erosion is a concern and if it poses a threat to crop persistence. In the event of over-grazing livestock should be taken out to let plants recover and stabilize before grazing again. In this demonstration the southern side of the paddock, which was a lighter soil type, was negatively impacted by the presence of livestock in conjunction with a dry spring to the point that plant recovery was compromised.

It is also essential to be aware of groundcover over the summer period and the importance of stubble retention. Utilising electric fences to increase stocking pressure and being mindful of watering, feeding and shelter points and how this effects grazing movement can assist in achieving a more even grazing across the paddock.

Conversely, seasonal variability is the most significant and unfortunately unpredictable factor, that will contribute to the success or failure of decisions made throughout the season for grazing cereals within low rainfall mixed farming systems. The interrelation of livestock and cropping should be looked upon as a favourable opportunity to improve productivity and profitability in farming enterprises, however the key to success in this complex system is that practice makes perfect.

Acknowledgements

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Grazing cereals demonstration site at Lock, 2013

Enriching upper EP forage options

Jessica Crettenden
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location:
Minnipa Ag Centre
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Soil Type
Red sandy loam
Environmental Impacts
Soil Health
Soil structure: Stable
Compaction risk: Nil
Ground cover or plants/m²: Forage shrubs
Perennial or annual plants: Perennial
Water Use
Runoff potential: Low
Resource Efficency
Energy/fuel use: Standard
Greenhouse gas emmisions (CO_2, NO_2, methane): Minimal
Social/Practice
Time (hrs): Site establishment time
Clash with other farming operations: Standard practice
Labour requirements: Minimal
Economic
Infrastructure/operating inputs: Establishment costs
Cost of adoption risk: Low-medium, depending on establishment success

Key messages

- **Perennial shrub-based systems can be a productive addition to conventional feed sources particularly to address feed shortages and complement other forages such as stubbles.**
- **Increased plant diversity is important for feed utilisation, nutrition and animal performance.**
- **Direct seeding is an option for establishing perennial shrubs, however further study needs to be done in order to understand time of sowing, site preparation and design and the best options for weed management.**

Why do the trial?

Forage shrubs are an ideal option for producers wanting to develop a beneficial and profitable use for their unproductive cropping land, particularly due to the perennial nature of these shrubs to offer out-of-season feed. A shrub-based system provides the opportunity for a valuable forage source not only in the summer-autumn period, but also at other stages of the year when pasture is not a viable option, making this an efficient alternative to manage seasonal variability in low rainfall mixed farming regions.

The research aimed to investigate alternative shrub based grazing systems using perennial native shrubs and to evaluate the use of these shrubs as a feed base for multiple benefits in farming systems, including improved livestock production and health, environmental resource management and sustainability of farming landscapes for the future.

How was it done?

The *Enrich* project at Minnipa, Piednippie and Elbow Hill sites on Eyre Peninsula (EP) established a sound foundation to introduce perennial forage shrubs to EP farming systems (EPFS Summary 2010, p 138-139, EPFS Summary 2011, p 135-138 and EPFS Summary 2012, p 143-145). The trial allowed species performance to be evaluated under three key environments in the region, which has generated key outcomes to furthering perennial shrub research in the area. A crucial result from the research was determining species 'best-bets' through analysing establishment, growth, edible biomass, palatability, recovery and persistence of the shrubs. This work linked to the national *Enrich* project, which conducted further research into species adaptation, nutritive value, grazing management strategies and the overall contribution of forage shrubs to the whole farm.

Following this evaluation, the project generated sufficient interest to continue work to test a more efficient establishment option for forage shrubs in mixed farming systems on the EP. Direct seeding of the 'best-bets' species from the *Enrich* project was trialled at Minnipa from 2011 to 2013.

What happened?

Enrich Minnipa: This site was grazed for the last time for 18 days in March 2012. A dry spring resulted in poor shrub recovery with significantly low survival measurements recorded in November. Lack of summer rainfall over 2012/13 decreased the number of shrubs surviving even further when measured in autumn 2013 and subsequently a deficiency of biomass lead to no grazing occurring in 2013. Survival measurements will be taken in autumn 2014 to determine future opportunities for this *Enrich* site.

Enrich Piednippie: This site was grazed for the last time over two weeks in April 2012. This graze was only a partial graze as sheep were allowed to leave the *Enrich* site to graze the surrounding paddock. This resulted in shrubs thriving on winter and early spring rainfall in 2012 and significant overgrowth was observed during the last survival measurements in October 2012. Some maintenance will need to be carried out on the site to graze or slash the shrubs down to a more manageable level in autumn 2014 when survival measurements will be taken. The farmer will use this site as a livestock feed base, particularly in the autumn/winter feed gap, in the future.

Hay yard: The hay yard forage shrub direct seeding site was sown in June 2011. 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 plots caused some shrubs to be out-competed by weeds. The most successful species included ruby saltbush *(Enchylaena tomentosa)*, creeping saltbush *(Atriplex semibaccata)* and mallee saltbush *(Rhagodia preissii)* which established well and have grown significantly since sowing. Sandhill wattle *(Acacia ligulata)* also established well but subsequent survival has been poor. Higher seeding rates and/or better seed quality are required for old man saltbush *(Atriplex nummularia)* and river saltbush *(Atriplex amnicola)* with only a small number of plants emerging. Survival measurements have been taken each year in spring and autumn since sowing and biomass measurements were taken in spring 2013. The site will be grazed over the autumn/summer period and recovery and shrub survival after grazing will be measured to determine the future of the site.

North 1 (A): This site was sown in August 2012 to put into practice some of the lessons from the hay yard site. Unfortunately rainfall totals were significantly low from sowing until autumn in 2013 and subsequently the site had poor establishment and was abandoned.

North 1 (B): Another direct seeding forage shrub site was sown next to the North 1 (A) site in June 2013 as a mixed stand of the successful species from the hay yard site, with an increased seeding rate to improve shrub establishment and weed competition. Good rains after sowing have resulted in successful establishment of some species; however shrub resilience will be determined after the 2013/14 summer period. This site will be monitored and shrub survival recorded to determine the trial success. Grazing will be undertaken if shrubs survive in the future.

What does this mean?

The *Enrich* sites provided excellent information to assist with shrub selection and management, however establishing shrubs from seed appears one of the major hurdles in the further adoption of forage shrubs and more research is required. These sites were used as a 'trial and error' opportunity to understand what the major hurdles for shrub establishment on the EP are. An important conclusion from the demonstration sites was that more work needs to be done on more workable direct seeding practices before promoting it as a cost and production efficient option to growers, especially on time of sowing, site preparation and design, and weed management.

There has already been excellent research undertaken in establishing perennial shrubs resulting in some good information available about important management strategies that should not be overlooked. The following essential points should be considered in applying shrub systems on farm:

- ***Site design:*** Much work has been done in the areas of shrub-based system designs, however ultimately the design of a feedbase is determined by species choice, site size and location, machinery, labour availability and personal choice. Layout (block, alley or belt), shelter, purpose and shrub structure, size, and variety are important factors that need to be considered for shrub success. Layouts that comprise opportunities for cropping and grazing in the same area will maximise the return on investment for shrub-based systems as the complementary feedbase will provide benefits that will promote production.

- ***Site preparation:*** Considerations include weed control (critical pre and post sowing in the establishment year), pest control and seed bed preparation. Information regarding species tolerance to herbicides is quite limited and therefore other options including cultivation, scalping (removing top layer of soil from sowing row to reduce weed competition in increase water catchment) and most importantly forward planning need to be used.

- ***Time of sowing:*** In this region, research specifies that sowing should occur soon after the break of the season, allowing plants time to establish before the warmer and drier conditions over summer with the disadvantages of frost risk, weed competition and possible slower plant growth over winter.

- ***Sowing method:*** Success of direct seeding is extremely variable under all methods of sowing. Depth control is the most important factor in the sowing operation and establishment will decline if the seed is buried at depths greater than 5 mm. Seed source, viability, pre-treatment and mixture are also noteworthy influences that need to be considered as part of the seeding operation.

- ***Grazing management:*** The aim for these grazing systems is for livestock to incorporate the forage shrubs into their daily diet. They will take time to adjust to a new feed source when first introduced to the shrubs and may focus on other feed sources before they become accustomed to the shrubs. However it is more ideal for livestock to balance their diet and include different feed sources for optimal animal nutrition and production. Increasing grazing pressure, rotating animals through smaller paddocks (providing a fresh allocation of feed), using animals with different levels of experience and using watering points and/or feed supplements to control livestock movement are options for managing grazing behaviour and achieving dietary mixing.
- ***Plant and site maintenance:*** Plant size (grazing or slashing) and health (avoiding under or overgrazing shrubs, especially during particular periods of the year) are two other factors that need to be maintained for optimal productivity. The role of forage shrubs can be to provide shelter, ground cover and/or a component of the livestock diet.

Perennial forage shrubs are well adapted to EP and can contribute to the farm feedbase and livestock productivity. Experimenting still needs to be undertaken in order for shrub-based systems to become established via direct seeding as a potential broadacre option in this region. The successful establishment of perennial forage shrubs through direct seeding is currently very dependent on seasonal variability, and until better practices are determined and the issues that have been encountered in this study can be overcome, more research needs to be done in order to achieve success.

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Benchmarking EP sheep enterprises

Daniel Schuppan[1], Mary Crawford[2] and Naomi Scholz[3]

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Key messages

- **There are 3 main steps to improving your sheep enterprise:**
  - **Assess your current situation,**
  - **Set targets for key performance indicators (KPIs) and where you would like to be in the short, medium and long term,**
  - **Make plans to achieve targets.**
- **Benchmarking can assist in knowing your current situation and enables monitoring of changes over time.**

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.

How was it done?

Five 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. Thirty eight businesses completed benchmarking for the 2012/13 season, with one group completing benchmarking for the past three years, two groups for two years and two new groups completing it for the first time in 2013. Benchmarking periods for the sheep groups run from 1 April to 31 March.

To maintain confidentiality and anonymity, the groups will be named Group A, Group B, Group C, Group D and Group E.

What happened?

The sheep flocks benchmarked were dominated by ewes with most producers having around 60-70% of their flock as breeding ewes and 25-35% as replacement ewes (Table 2). Generally, all prime lambs and merino wether lambs are sold by one year of age. There were a range of enterprise structures but the main two were self-replacing merino flocks and or terminal sire over merino ewes. There was one producer who had a self-replacing dorper enterprise. There were also three producers who operated a stud as well as their commercial flock. The studs were merino, white suffolk and poll dorset. Approximately 10% of the producers purchase lambs to utilise stubbles in most years. This however could be as high as 50% of producers, when the ideal trading opportunity presents itself with feed and prices.

There were no notable changes in the physical sheep production figures over the 3 years. There were some general trends across all groups, these included:

- Sheep losses decreased.
- Lambing percentage decreased in the 2012/13 season. Although all groups had difficult conditions for lambing due to a poor spring and limited feed reserves, Group B had a 20% decrease in lambing percentage. This may be improved with in future with planning, management and monitoring, that is, condition scoring ewes and providing the correct nutrition required at lambing.
- The stocking rates remained similar although there were variations according to the season. With a poorer season the stocking rate decreased as less area was cropped and the sheep had more winter grazed hectares.
- Although the stocking rates varied, the producers who had the highest stocking rate in a good season also had the highest stocking rate in a poorer season.
- The size of the sheep enterprises remained constant, although the sheep numbers and winter grazed hectares for group A slightly increased over the 3 years benchmarked.
- The enterprise mix in groups A, D and E were very similar with approximately 65-70% of the farm cropped and 30% for winter grazing due to majority of their farm being all arable (Table 1). Group B cropped around 45% due to more un-arable country. Group C was in a higher rainfall location and the farms in this benchmarking group had a large hill area that was un-arable and used for grazing, therefore only 50% of their farm was cropped.

The financial results are shown in Table 3. The gross margin per DSE and per hectare in 2012/13 was on average less than the previous two years, although there was a large variation within a group and between groups. The sheep and wool prices had a low period in the second half of 2012 compared to the previous 2 years. Producers with a good strategic and tactical management plan for their sheep enterprise were still able to achieve above $30/DSE, which was a good result in 2012/13.

Due to the poor spring in 2012 any producers who had stocking rates set to the extreme and/or no exit strategies did crash the system, resulting in low gross margins (per hectare and DSE). This was generally around 20% of the producers.

Table 1 Soil type, average rainfall, average percentage of farm cropped and numbers of businesses participating in benchmarking from sheep groups across Eyre Peninsula in 2013

Group	District soil type	Number of businesses participating in 2013	Av annual rainfall (mm)	Av growing season rainfall (mm)	Average % of farm cropped
Group A	Red sandy loams to sandy clay loams	9	310	212	65
Group B	Grey calcareous sandy loams	5	324	245	42
Group C	Red brown earth	6	425	344	51
Group D	Red sandy loams to sandy clay loams	11	342	248	66
Group E	Calcareous sandy loams	7	350	260	67

Table 2 Physical and production traits for all participants surveyed in the 2010/11, 2011/12 and 2012/13 seasons

Sheep	Mean	Range Low-High	Mean	Range Low-High	Mean	Range Low-High
	2010/11		2011/12		2012/13	
Total dry sheep equivalent (DSE)	1780	1110 - 3940	1520	1300 - 5570	2340	625 - 5982
Ewes (%)	70	42 - 99	72	40 - 81	65	33 - 99
Ewe Hoggets (%)	24	0 - 46	27	9 - 37	28	0 - 55
Losses (%)	5	2 -13	3	1 - 6	3	0.6 - 6.4
Stocking Rate						
Winter Grazed (WG) hectares	810	240 - 2100	790	320 - 1550	1119	166 - 6800
DSE/WG ha	2.9	1.3 - 6.4	2.1	1.0 - 4.8	3	0.5 - 8.3
DSE/WG ha/100 mm rainfall	1.0	0.6 - 2.8	0.9	0.5 - 1.8	2	0.2 - 6.7
Sheep Trading						
Marking (%)	92	78 - 103	96	73 - 120	92	65 - 150
Lambs/ha (No/ha)	1.5	0.4 - 2.3	1.1	0.3 - 2.0	1	0.2 - 4.5
Sale price (av $/hd)	122	101 - 155	112	92 - 165	85	42 - 156
Wool Production						
Wool price (av $/kg)	6.23	5.16 - 8.44	7.61	6.71 - 8.66	6.00	4.22 - 8.51
Total kg*	9540	4020 - 26080	6,780	4900 - 23940	8743	4012 - 23400
kg wool/DSE*	5.1	3.6 - 6.6	4.5	3.2 - 5.5	4	2.2 - 6.3
kg wool/WG ha*	14.8	5.7 - 32.1	9.4	5.1 - 26.7	13	1.3 - 31.6

**note, Dorper enterprise not included in wool production figures*

The low gross margins could be attributed to an over-supply in the meat market that forced prices down, when producers had no alternative but to sell. Properties in the higher rainfall environments were affected the greatest as they had higher stocking rates, no spring feed and less stubbles available.

Sheep trading income has been the major source of sheep enterprise income for all producers in the groups over the past two seasons. For example the sheep trading income for Group A in 2010/11 represented 60% of the income, in 2011/12 54% and in 2012/13 54% (data not shown). Wool still plays an important part of the sheep enterprise income and the average across all groups ranged from 37% up to 52%. The variation in sheep and wool prices in 2012/13 resulted in producers achieving mixed gross margins per DSE and per hectare depending on timing of sales.

Lower operating expenditure did not necessarily relate to a higher gross margin, and in some cases the highest expenditure on pasture, animal health inputs and feed still achieved the highest gross margin per DSE. This is due to less deaths, higher reproduction rate and, greater wool and meat production resulting in more kilograms to sell. Most producers had their costs under control with very good cost efficiencies. Due to the increased cost of supplementary feeding and reduced income for sheep and wool in 2012/13 the cost efficiency decreased and did not reach the returns of the previous two seasons. The cost efficiency (dollar of cost to generate dollar of income) is calculated by total variable cost divided by total income. The average cost efficiencies for the groups in 2012/13 were Group A $0.30, Group B $0.66, Group C $0.53, Group D $0.41 and Group E $0.47. A good cost efficiency range to be in for the 2012/13 season was $0.30 to $0.40. Many of the producers do their own crutching and shed hand work which was not included in their figures making their cost efficiencies very good.

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 their returns on a dollar per DSE and dollar per hectare basis.

Table 3 Financial results for all participants surveyed for 2010/11, 2011/12 and 2012/13 seasons

	Mean	Range Low-High	Mean	Range Low-High	Mean	Range Low-High
	2010/11		2011/12		2012/13	
$/DSE - Income						
Wool Proceeds*	32	18 - 48	34	28 - 42	24	9 - 39
Sheep Trading Profit	48	23 - 81	38	29 - 53	28	1 - 53
Total Sheep Income	80	42 - 109	72	54 - 89	52	24 - 89
$/DSE - Expenses						
Total Variable Costs	13.2	5.6 - 19.9	11.4	7.6 - 19.5	22.9	8.8 - 38.0
Gross margin/DSE	67	36 - 97	61	46 - 79	29	-2 - 68
$/WGha - Income						
Wool Proceeds*	92	29 - 199	71	34 - 207	94	9 - 225
Sheep Trading Profit	142	37 - 328	79	31 - 215	93	2 - 208
Total Sheep Income	234	66 - 527	150	66 - 410	174	13 - 393
$/WG ha - Expenses						
Total Variable Costs	37	9 - 66	22	8 - 82	78	10 - 232
Gross margin/WG ha	198	58 - 445	128	57 - 328	96	-2 - 221

**note, Dorper enterprise not included in wool production figures*

The local information from the groups allows producers to focus on targets that are being achieved in their own district and gives them confidence to implement change as they have the support of the local group members and advisors.

The returns that sheep producers achieved in the 2010/11 and 2011/12 were exceptional due to a combination of good seasons and high commodity prices for both meat and wool. Returns were lower in 2012/13 than the previous two years of benchmarking, due to a poor spring, and sheep and wool prices fluctuating. The benchmarking has highlighted that there is a large variation between the returns producers are receiving within the same rainfall environment. However, there was no stand-out sheep enterprise, and it was generally the case of 'do what you do and do it well'.

This variation provides some opportunities for producers to be more productive and profitable. Over the 3 years of benchmarking the stand-out area in which improvements could be made was in the reduction of sheep losses and the increasing of lamb marking percentage. This could be progressed through closer monitoring of stock numbers, meeting nutritional requirements and managing animal health e.g. vaccinations and fly control.

As expected gross margin per hectare was influenced greatly by the stocking rate, which in turn impacted the number of lambs per hectare and the wool production per hectare. The producers paying attention to detail are achieving higher production with greater financial rewards.

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 the 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 a number of back door or 'exit' strategies.

The livestock system is critical to get right first; therefore time and effort should be made for planning. As seen by the benchmarking, sheep losses are easy to control but areas such as stocking rate and lambing percentage, which are influenced by a number of factors are harder to change within 2-3 years.

The high performing enterprises in each group based on highest gross margin per hectare had:

- Higher stocking rates
- Lower death rates
- Higher reproduction
- Higher growth rates of meat and wool

Some of the other attributes of the high performing enterprises are:

- Have a simple system
- Timeliness - get operations done on time
- Good pasture and grazing management. For example defer graze and sow some feed for winter grazing
- Pay attention to breeding and genetic improvement
- Have a marketing plan and targets
- Have stable sheep numbers
- Pay attention to detail.

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Reference

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Soils

Increasing carbon storage in alkaline sodic soils

RESEARCH

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Searching for answers

Location:
Minnipa Ag Centre
Paddock South 7
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: 2.54 t/ha (W)
Actual: 1.83 t/ha (experiment average); 2.02 t/ha (highest yielding treatment)
Paddock History
2013: Wheat
2012: Medic
2011: Wheat
2010: Medic
Soil Type
Light brown sandy clay loam
Plot Size
1.5 m x 5 m x 3 reps
Water Use Efficiency
7.7 kg/ha/mm GSR (experiment average)
8.5 kg/ha/mm GSR (highest individual treatment)

Key messages

- **Alkaline soils can have high concentrations of dissolved organic C and the concentration is sensitive to pH.**
- **Soil organic C was strongly related to soil pH suggesting accumulation and retention of organic C in alkaline soils will be limited by high pH.**
- **Relatively small changes in pH may have a significant effect on the retention of organic C and a reduction in dissolved organic C.**
- **A gypsum application of between 2.5 and 5 t/ha reduced soil pH by 0.2-0.5 pH units over a year.**

Why do the trial?

- After rainfall, soil pH has been suggested to be a major influence on the amount of organic C in soils. Under high pH the solubility of organic C changes and the amount of water soluble C increases.
- Ultimately the amount and form of organic C influences important soil processes such as nutrient cycling, microbial biomass and diversity and soil structure.
- Much of the detailed work on soil C has been done on neutral to acidic soils and there is little research to understand organic C accumulation in alkaline soils and the influence of high pH on the changes in the chemical form of organic C in alkaline soils.
- Under acidic conditions soil pH can be changed by adding lime. Under alkaline conditions, the use of legumes and gypsum can potentially lower pH.
- The aim of the project is to improve our understanding of the accumulation and retention of soil organic C under high pH and to investigate ways of directly managing pH.
- Detailed studies of soil chemistry and buffering capacity are being conducted in the laboratory and glasshouse and field trials are being used to investigate these changes in the field.

Paddock survey

Surveys of soils conducted in three areas where alkaline soils occur – the upper Eyre Peninsula, western Victoria and the lower North of South Australia. These are being conducted to provide a benchmark of current levels of dissolved organic C. Initial sampling was conducted on upper Eyre Peninsula during autumn 2013. Samples were taken at 0-10, 10-20 and 20-30 cm depths, dried and sieved and analysed for pH (1:5 soil: water), total C, total organic C and dissolved organic C.

Table 1 Summary of a preliminary survey of pH, organic C and dissolved organic C (% of organic C) in paddocks on upper Eyre Peninsula in 2012. Values are shown as means ± standard error of the mean and the coefficient of variation (CV%)

Depth (cm)	pH	Organic C (%)	Dissolved organic C (%)
0 - 10	7.79 ± 0.143	1.25 ± 0.152	0.78 ± 0.097
CV (%)	4.5	24.3	24.9
10 - 20	8.34 ± 0.123	0.95 + 0.203	1.07 ± 0.214
CV (%)	3.6	42.8	40.1
20 - 30	8.66 ± 0.096	0.90 ± 0.247	1.04 ± 0.158
CV (%)	2.7	54.7	30.2

Rotation trials

Two short term rotation trials were established at Minnipa and Birchip in 2012 to examine the effects of legume, legume productivity and gypsum rate on soil pH. At each site three legumes [medic (a mixture of Herald, Paraggio, Caliph, Parabinga), peas (cv Morgan) and vetch (cv Morava)] were grown under standard and high inputs (doubled sowing rates and P fertiliser rates). The purpose of the high input treatment was to increase biomass production and hence the amount of N_2 fixation.

Each legume treatment was grown at three treatments (0, 2.5 t/ha and 5 t/ha of gypsum; gypsum quality ~60% $CaSO_4$). The treatments were replicated 3 times. Soil was sampled to a depth of 30 cm in May 2013, dried and sieved, and analysed for pH (1:5 soil: water), total C, total organic C and dissolved organic C. The trial was sown to wheat in 2013 and biomass production at stem elongation (GS 32), anthesis (GS 65) and grain yield and grain quality measured.

What happened?

Paddock survey

Soil organic C decreased with depth and there was a corresponding increase in the proportion of C found as dissolved organic C. These trends followed the increases in pH with depth. The high CV (%) indicates the high level of variability among the seven surveyed paddocks. The amount of dissolved organic C measured in these profiles was relatively high.

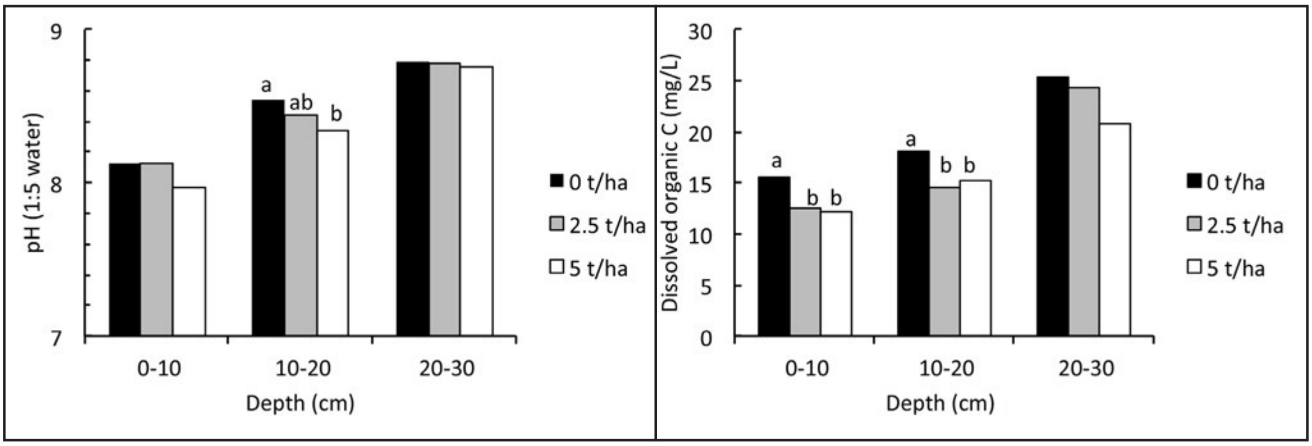

Figure 1 The effect of gypsum application rate in 2012 on soil pH and dissolved organic carbon in 2013 at Minnipa. Means within each depth with different letters are significantly different; where there are no letters means are not significantly different

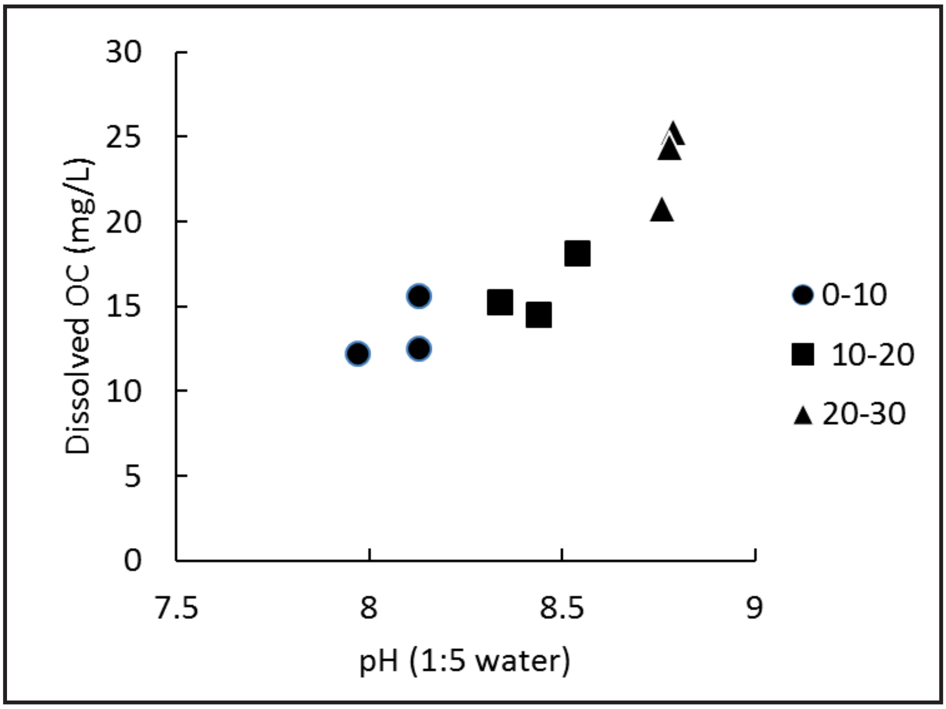

Figure 2 The relationship between pH and dissolved organic carbon in soils from Minnipa gypsum trial 2013

Rotation trial

In 2012, biomass production of legumes was not significantly affected by gypsum rate but it was increased by 50-60% when sowing rate and P rate were increased.

In 2013 both pH and dissolved organic C increased with depth (Figure 1). Applying gypsum in 2012 significantly reduced the pH at 10-20 cm by 0.2-0.5 pH units in 2013 and there was a corresponding reduction in the amount of dissolved organic C. There was no influence of the type of legume or the level of inputs on soil pH. The variation in dissolved organic C was proportional to the changes in pH within the profile (Figure 2). Comparable results were observed at Birchip.

While there were significant changes in pH from the 2012 gypsum treatments there were no measurable effects on the yield of wheat in 2013, the only effect of gypsum at Minnipa was a small reduction in grain protein concentration from 11.3% with no gypsum to 11.0% with 5 t/ha gypsum. In two similar experiments at Birchip, one showed a 12% increase in wheat yields from the 2012 gypsum treatment, while the other showed no effect of gypsum.

What does this mean?

- High soil pH can increase the solubility of organic carbon which is susceptible to washing out.
- The results showed that the concentration of dissolved organic carbon are significant and increase with depth in alkaline soils of SA.
- Dissolved organic carbon leached from decomposing organic matter is important in the leaching of nutrients from the root zone.
- Application of gypsum can significantly lower pH and reduce dissolved organic carbon over a single growing season. The effect of these changes on subsequent productivity of crops and whether the changes are long-lasting needs further investigation.

Acknowledgements

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Australian Government

THE UNIVERSITY OF ADELAIDE AUSTRALIA

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Stubble and nutrient management trial to increase soil carbon

RESEARCH

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Searching for answers

Location:
Minnipa Ag Centre, South 2/8
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: 3.0 t/ha (W)
(Yield Prophet)
Actual: 1.14 - 1.37 t/ha
Paddock History
2013: Mace wheat
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

- **No difference in yield or quality was noted for the stubble or nutrient treatments.**
- **It is likely that soil carbon is being increased as the additional nutrients did not increase yield.**
- **Increasing soil carbon is a slow process and several years are needed to see whether these treatments do increase soil carbon.**
- **A range of sites across southern Australia have been chosen to see if soil carbon can be increased.**

Why do the trial?

The soil organic matter content of Australian soils is either decreasing or remaining stable. Trials have demonstrated that No-Till stubble retention systems are adding to the partially broken-down particulate organic carbon fraction but are not contributing to the stable humus fraction. Without an increase in soil humus the important functions of soil organic matter (i.e. improved soil water holding capacity, increased nutrient supply (N and cations), pH buffering capacity and better soil structure) are unlikely to be realised.

What is humus and how can it be increased?

Humus consists of the remains of bacteria and other micro-organisms that consume and break down plant material returned to the soil from a crop or pasture. This plant material consists mainly of carbon (C). For soil microbes to consume this material they also need nitrogen (N), phosphorus (P) and sulphur (S) otherwise they cannot thrive and multiply. Australian soils are inherently low in nutrients and in most soils there is insufficient N, P and S for soil micro-organisms to rapidly break down the plant material returned to the soil. If we want to break down plant material such as stubble to increase the stable humus fraction in the soil, we need to supply soil microbes with additional N, P and S - this may have to be supplied as extra fertiliser.

How much N, P and S need to be supplied to stubble to form humus?

Dr Clive Kirkby, from CSIRO, has been working on this question and found that:

- In humus 1000 kg of C is balanced with 80 kg N, 20 kg P and 14 kg S.
- Wheat stubble has a lower nutrient:C ratio and 1000 kg of C is balanced with 11 kg N, 1.1 kg P and 2.2 kg S.
- Dr Kirkby argues that for soil micro-organisms to breakdown stubble and form humus, we need to add sufficient nutrients (N, P and S) to feed the micro-organisms.

This DAFF funded national trial will examine existing, new and alternative strategies for farmers in the cereal 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).

Identical trials are being run by eight farm groups in SE Australia (Victoria: Mallee Sustainable Farming, Birchip Cropping Group, Southern Farming Systems; NSW: FarmLink, Central West Farming Systems; SA: Hart and Eyre Peninsula Agricultural Research Foundation, both through Ag Ex Alliance; and Tasmania: Southern Farming Systems) so information can be collected nationally across the southern cereal zones.

How was it done?

Four wheat stubble samples from 2012 were collected from the Minnipa Agricultural Centre farm in paddock south 2/8 in February across the trial site and dried at 40°C for 24 hours to calculate the stubble load.

Soil samples were collected 14 March for Yield Prophet (0-10, 10-40, 40-70, 70-100 cm) for soil available nitrogen and soil moisture.

In March the stubble management treatments: (i) stubble left standing, (ii) stubble worked in with single operation of the seeder before sowing (1 March) and (iii) stubble raked and burnt (2 March) were imposed.

Nutrient application treatments at seeding were: (i) normal practice for P at sowing and N in crop as per Yield Prophet and (ii) normal practice PLUS extra nutrients (N, P, S) required to break down of the measured wheat stubble. The extra nutrient requirement applied (N, P and S) on 23 April with a rainfall event to break down the stubble load was 3.8 units P, 10.2 units N and 1.6 units S, which was applied as DAP (18:20:0:0) @ 19 kg/ha, ammonium sulphate (21:0:0:24) @ 16 kg/ha and urea (46:0:0:0) @ 7.5 kg/ha. The treatments were replicated 4 times.

The trial was sown on 6 May with Mace wheat @ 60 kg/ha and base fertiliser of DAP (18:20:0:0) @ 50 kg/ha. Pre seeding chemical applications were sprayseed @ 1.5 L/ha, trifluralin @ 1.5 L/ha and a wetter. Using Yield Prophet predictions, UAN was applied @ 50 L/ha on 28 July using the broadacre boom on all the trial plots.

Emergence counts, flowering date, grain yield and grain quality were measured.

What happened?

The mean stubble load calculated from 2012 was 1.76 t/ha so additional nutrient treatments were applied as above.

Emergence counts were taken on 27 May with an average of 133 plants/m^2. There was no difference between treatments with plant emergence (range 118-144 plants/m^2). The seasonal conditions resulted in little rainfall after August, so there were no differences in flowering date (GS 65 (when 50% of heads have anthers)) which occurred between 30 and 31 August. The trial was harvested on 24 October.

Table 1 Grain yield and quality as affected by stubble treatments and additional nutrients at Minnipa 2013

Stubble treatment	Nutrition treatment	Yield (t/ha)	Protein (%)	Test weight (kg/hL)	1000 Grain weight (g)	Screenings (%)
Stubble removed	DAP @ 50 kg/ha	2.58	11.1	80	35.7	3.2
Stubble removed	normal practice PLUS N,P&S	2.54	11.4	80	35.0	3.4
Stubble standing	DAP @ 50 kg/ha	2.56	11.3	80	34.6	3.9
Stubble standing	normal practice PLUS N,P&S	2.54	11.4	80	33.8	3.7
Stubble worked	DAP @ 50 kg/ha	2.60	11.2	80	34.2	3.6
Stubble worked	normal practice PLUS N,P&S	2.63	11.6	80	33.8	3.7
LSD (P=0.05)		*ns*	*ns*	*ns*	*ns*	*ns*

Yield Prophet was used early in the season (22 July) to predict if extra nitrogen fertiliser was required to achieve potential yield. UAN @ 50 L/ha was applied on 28 July using the broadacre boom over all the trial plots. The mid-flowering date was 30 August and harvest date 24 October.

On 22 July Yield Prophet predicted a 50% probability of yield greater than 3 t/ha, however a dry spring prevented this potential being achieved.

There was no difference in grain yield or quality for all treatments in 2013 (Table 1). The trial at Hart in 2013 also showed the same results.

What does this mean?

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 next year.

Acknowledgements

Funding provided from DAFF, and project management through Ag Ex Alliance and EPARF. 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.

Australian Government
Department of Agriculture, Fisheries and Forestry

Ag Excellence Alliance

EPARF
EYRE PENINSULA
Agricultural Research Foundation

Section 9

Sharing Info

Section Editor:
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SARDI, Minnipa Agricultural Centre

African boxthorn control trial

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EXTENSION

Try this yourself now

Key messages

- **African boxthorns *(Lycium ferocissimum)* are a declared weed for the whole of South Australia and listed as a Weed of National Significance.**
- **Boxthorns invade native vegetation and pastures, provide shelter and food for feral animals such as foxes, rabbits and starlings, and reduce access for livestock, native animals and people.**
- **On Eyre Peninsula the main growing season for boxthorns is during the winter and spring periods, whilst summer normally leads to moisture stress and the plant loses most of its leaves.**
- **Several control options are available for African boxthorn, this trial evaluated the two most common methods against the use of a granular residual herbicide.**
- **A planned, strategic approach to Boxthorn control is essential to ensure the success of your control program.**

Why do the trial?

The trial was conducted to evaluate the effectiveness of tebuthiuron residual herbicide pellets on open grazing country in Central Eyre Peninsula (EP) in comparison to two other traditional control methods - foliar spraying and cut and swab. The major impairments to a weed control program are the time and cost factor of the control options. If the control options are too costly or take a considerable amount of time the likelihood of success is reduced. Control options which are quick, effective and reasonably priced allow for a higher success rate and longer term weed suppression.

How was it done?

The trial commenced in June 2011 on two sites with different soil types in open grazing country. Site one was loamy sand over limestone and site two was sandy clay loam over limestone. Timing of the trial coincided with the winter months and the growing season for Boxthorns. The tebuthiuron pellets require rainfall to dissolve and allow the herbicide to travel through the soil to the plant's root zone. Each site was divided into three one hectare sections. Of these three sections, one was treated with foliar spray with glyphosate 480 g/L @ 750 ml per 100 L of water, LI700 surfactant @ 350 ml per 100 L of water and metsulfuron methyl 600g/kg @ 7gm per 100 L of water, one with cut and swab with neat glyphosate 480 g/L, and the third section was treated with tebuthiuron residual herbicide pellets @ 2 grams per m^2.

The treatments were applied to the trial sites on the same day and monitoring was undertaken after 12 months and 24 months. Details for each treatment such as cost of control per plant, time spent on each control method, percentage of plants killed by initial treatment and rainfall received were evaluated.

What happened?

Tebuthiuron herbicide pellets achieved a success rate of 100% on both sites over the 24 month period, which was a higher rate of success than the other two control methods and was achieved at lower cost and less time expended (Table 1). The trial showed that plants treated with tebuthiuron can take up to 24 months to die. The speed of a plant's demise is controlled by the amount of rainfall which falls over this period. The more rainfall, the quicker the herbicide is leached into the soil and becomes available for uptake by the boxthorn's root system.

Table 1 Boxthorn control results from sites one (loamy sand over limestone) and two (sandy clay loam over limestone) at 24 month inspection

Method	No. of boxthorns treated	No. of boxthorns not dead or have regrowth	Plants killed by initial treatment (%)	Average time spent on boxthorn control per plant	Average cost of materials per boxthorn ($)	Average cost per boxthorn - labour (at $55/hr) and materials ($)	24 month total rainfall (mm)
Site 1							
Foliar spray	57	10	84	1 minute 5 seconds	0.07	1.03	
Cut and swab	53	3	93	2 minutes 18 seconds	0.17	1.90	
Tebuthiuron	87	0	100	23 seconds	0.12	0.33	583
Site 2							
Foliar spray	60	3	95	1 minute 33 seconds	0.08	1.30	
Cut and swab	42	3	93	3 minutes 57 seconds	0.21	3.48	
Tebuthiuron	131	0	100	26 seconds	0.21	0.37	583

What does this mean?

Tebuthiuron herbicide pellets offer landholders another option for controlling African boxthorns. Caution is advised when using a residual herbicide in and around native vegetation and waterways due to the risk of off target damage. The trial sites will be monitored for a further two years for signs of regrowth and newly emerged seedlings.

Government of South Australia

Low Rainfall Collaboration Project winds up

Geoff Thomas[1] and Nigel Wilhelm[2]

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The Low Rainfall Collaboration Project (LRCP) commenced in 2003 at the instigation of the Grains Research and Development Corporation (GRDC) and was based on the premise that the groups (Eyre Peninsula SA; Upper North SA; Mallee in SA, Vic and NSW; Central West NSW; and Birchip Vic) had many issues in common and would gain from greater information sharing and a more collaborative approach.

Over the past ten years GRDC has invested $1.63M or $163,000 per year on the project. In addition SARDI invested $334,000 over the life of the project and a substantial in-kind contribution through provision of corporate services.

Included in the final report is an evaluation of this project, based on a survey of stakeholders, as well as various feedback and reports during the life of the project. They all indicate that it has been highly effective and good value for money.

The highlights are:

- Many of the past ten years have seen serious drought across most of the low rainfall area, creating a special environment requiring support and flexibility to cope with often difficult situations. LRCP has been a key to providing that support.
- The benefits of networking beyond the LRCP groups with external science bodies such as CSIRO and Universities, consultants, and other groups and their staff. These links have stimulated increased sharing of issues and approaches and joint projects to address them.
- Closer working relationships and two way communication with GRDC staff, Southern Panel, and more recently the Regional Cropping Solutions Network (RCSN). This has resulted in better appreciation of issues and opportunities facing the low rainfall areas as part of the work of Southern Panel, the RCSN, and the development of GRDC Investment Plans.
- The establishment of a process for the exploration of issues of importance to farmers, the development of projects to address those issues, and the extension of the results. This process has many of the elements of the template now used in planning within GRDC.
- Greater coordination of approaches to various funding sources, especially to the Australian government which has been effective in securing many of those projects.
- The provision of expert technical and extension advice to the groups, including day to day support as well as special services in areas such as statistical design and analysis.
- The development of a range of major project initiatives and the conduct of these by and with the groups. These include Low Rainfall Canola, How Crops Grow technical workshops, Profit/Risk workshops and planning, Water Use Efficiency, and Crop Sequencing to name just a few.
- Having the trust and support of group staff and Boards in resolving a large range of internal issues from staffing, to finances, to overall management. This has resulted in a strong *esprit de corps* between the groups, which is important given their individual isolation.
- The establishment of a stronger approach to farm business understanding as a basic component by groups of the assessment of research outcomes and extension planning, as well as building the capacity of farmers. This has lifted the profile of the farm business area to the point where it is now accepted by groups as a core part of their operation. GRDC has itself also lifted this component of their work.
- Evaluation of project outcomes in terms of changes in farmer practice (rather than just evaluating activities themselves) has been a major emphasis of LRCP. Groups now appreciate the need for more comprehensive evaluation but need further support in this area.

- In communication, LRCP has contributed directly to several GRDC initiatives including more than 30 articles to Ground Cover and the production of specific publications in responding to drought. It has also contributed numerous articles for group publications including their annual Harvest Reports and Newsletters.
- LRCP has undoubtedly lifted the profile of low rainfall agriculture. This has partly been due to the personalities involved but also to their frequent attendance at events and their production of submissions to various investigations and formal inquiries into issues of importance to the low rainfall areas, such as funding for R,D&E, the withdrawal of State investment in agricultural services, carbon farming initiatives, drought policy etc.
- So successful has the project been that the LRCP Groups wish to see it continue in a reduced form so that the networking, coordination of projects, and communication continues. They are prepared to commit resources to this end, with matching support from GRDC.
- Furthermore, the groups and LRCP management believe that other groups would benefit from a similar approach, supported in part by GRDC.

All of this has required a leadership which is technically sound, politically street smart, well networked, energetic, and with a "can do" mind set dedicated to the task. It has also required a team of group managers who are prepared to work together in the joint interest whilst still pursuing the needs in their individual groups. This has all come together to provide what have been very productive, cost effective, intellectually rewarding, and, enjoyable project outcomes.

Figure 1 Nigel Wilhelm and Geoff Thomas led the Low Rainfall Collaboration Project

TPS THOMAS PROJECT SERVICES

LOW RAINFALL COLLABORATION GROUP

GRDC Grains Research & Development Corporation Your GRDC working with you

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

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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
RD&E	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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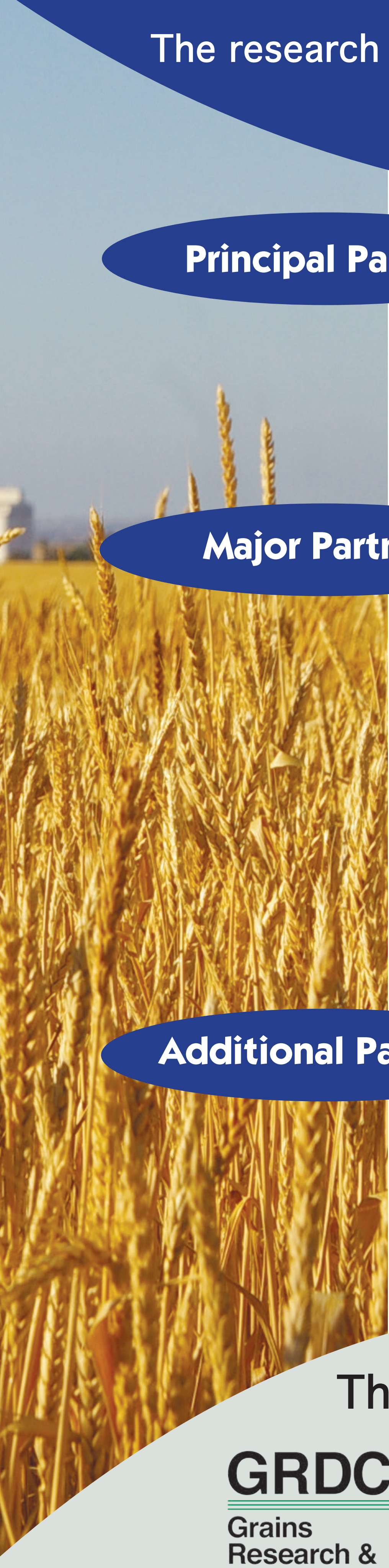

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