# Eyre Peninsula Farming Systems

## 2007 SUMMARY

2007

This publication is proudly sponsored by

ABB

GRDC Grains Research & Development Corporation

Grain & Graze EYRE PENINSULA

## The research contained in this manual is supported by

### Principal Sponsor

GRDC Grains Research & Development Corporation

### Major Sponsors

SARDI R&D South Australian Research and Development Institute

The University of Adelaide Australia

SAGIT

Grain & Graze™ Profit through knowledge Eyre Peninsula

mla Meat & Livestock Australia

australian wool innovation limited

GRDC Grains Research & Development Corporation

Australian Government Land & Water Australia

Drought Response South Australia

### Additional Sponsors

EPARF Eyre Peninsula Agricultural Research Foundation Inc

SANTFA

ABB

Australian Government

CSIRO

Government of South Australia Eyre Peninsula Natural Resources Management Board

This publication is proudly sponsored by

ABB

GRDC Grains Research & Development Corporation

Grain & Graze

PIRSA_PS 203680-071130

# Foreword

ABB is proud to once again sponsor the Eyre Peninsula Farming Systems Summary for 2007.

This is an important publication, not only for the growers and producers of the Eyre Peninsula but for those across South Australia. The trials that are carried out during the year and summarised on the following pages are important in ensuring the future of our industry, and what we can learn from these trial results will certainly play a part in ensuring long term viability for farmers.

As South Australia's largest agricultural company we are happy to lend our support to this publication to ensure its messages are received by farmers. It's just one of the ways we provide support to growers of South Australia, indeed Australia-wide, through our sponsorship program which provides funding to a number of various bodies and projects linked to research and development.

Farming conditions across Australia were varied during the 2007 season – from drought to above average production in some areas – such is the unpredictable nature of the industry. This unpredictability and constant change that we experience demonstrate to me why there is such a need for the activities that are detailed in this publication, and why our investment in research and development is so important.

I applaud those involved in the research that was carried out throughout the year, for their hard work and dedication.

Finally, I wish everyone the best for the following season; here's hoping for a successful 2008.

**Michael Iwaniw**
**Managing Director**
**ABB Grain Ltd**

# Foreword

The GRDC and the Grain & Graze Program are pleased to welcome you to the 2007 edition of the Eyre Peninsula Farming Systems (EPFS) Summary.

As always, the Summary remains an excellent and effective presentation of information relevant to grain growers and mixed farmers on the Eyre Peninsula and beyond. It reports on the main activities of innovation carried out in the region during 2007 together with some insights from other similar low rainfall areas working together in the Low Rainfall Collaboration Project.

The face of agriculture is changing rapidly, and once again 2007 highlighted the uncertainties of climate, the market and the traditional institutional arrangements supporting it. Farming systems research is about building resilience into the operations of today's farming businesses. Much of this resilience lies in the capacity to be flexible and adaptive, and to make decisions based on risk assessment. It is here that the work of GRDC's farming systems projects promises to address grain grower needs.

Of course, building resilience in exceptional years is tough, and 2007 was among the toughest. In fact despite the dry conditions experienced during the second half of the year, 2007 delivered us one of the wettest Decembers on record. Building resilience therefore is also about building resolve – resolve to change; resolve to improve; resolve to be prepared.

The history of Australian agricultural tells us that those who don't or won't change, adapt and improve don't attain the productivity gains needed year after year to remain viable. For this reason, farming systems research will always have a role to play in providing grain growers with options to reduce costs, overcome constraints and open up new opportunities. On traditional specialist grain farms, this may mean diversifying into, perhaps even back into, pasture and animal production.

The Eyre Peninsula remains an important part of Australian agricultural production, and GRDC continues to view the region as an important area to invest. Through Grain & Graze, other investors are seeing the benefits of investing here too. As with any investment, however, there must be seen to be a return to the investor. An initial indicator of whether an investment will yield dividends or not lies in the participation rate in the learning process. Sitting on the fence, watching others and waiting for results can be self defeating in that investors may not sense the value of their investment has to grain growers.

The Program Management Committee of the Grain & Graze Program visited the region in 2007 and members were extremely impressed with the quality of the work conducted by staff on Eyre Peninsula and their level of engagement with mixed farmers. The participation rate on the Eyre Peninsula has now set the benchmark for other regions to aspire to.

As you will see, the projects cover a wide range of research work from plant available water to analysis of profitability and risk management in mixed farming enterprises.

The work outlined in this book goes a long way to provide a better understanding of the soil constraints and potential future management options to allow growers in the region to improve yields, productivity and farm income for the benefit of individual grain growers, communities on the Eyre Peninsula and the grains industry as a whole.

These activities are a collaborative effort with continued support from SARDI, the University of Adelaide, SAGIT, SANTFA and grain growers throughout the Eyre Peninsula.

The GRDC believes that local agribusiness can offer far more opportunities to projects like these than just sponsorship. In some GRDC supported projects agribusiness are already a key partner.

The Summary this year, as always, highlights the breadth of farming systems activities for you to participate in. The ultimate success of projects like the Eyre Peninsula Farming Systems and Grain & Graze rests largely in your hands, getting involved in the research and extension activities on offer to get the best from the research being carried out on the Eyre Peninsula.

We hope you find the articles useful and hope that you have an ideal season in 2008.

**STUART KEARNS**

Manager,
Validation & Integration
GRDC

**RICHARD PRICE**

National Coordinator
Grain & Graze

# Eyre Peninsula Farming Systems 2007 Summary

**Editorial Team**

| | |
|---|---|
| Naomi Scholz | SARDI, Minnipa Ag Centre, (MAC) |
| Amanda Cook | SARDI, MAC |
| Sam Doudle | SARDI, MAC |
| Alison Frischke | SARDI, MAC |
| Jon Hancock | SARDI, MAC |
| Nigel Wilhelm | SARDI, MAC |
| Neil Cordon | SARDI, MAC |
| Michael Bennet | SARDI, MAC |
| Liz Guerin | Rural Solutions SA, Streaky Bay |
| Mark Stanley | EP Natural Resources Management Board, Port Lincoln |

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

**This manual was compiled by PIRSA Publishing Services**
March 2008

**Front cover**
From left to right: EPARF Disease Day 2007, EPARF Member Bruce Heddle with GRDC Southern Panel Members, Inspecting canola trials at the 2007 Minnipa Agricultural Centre Field Day.

**Back cover**
From top to bottom: Competition Paddock Teams, Grazing cereals trial site, Canola crop at Wangary deep ripping trial site, Grain & Graze pasture walks near Cleve.

**Inside back cover**
Photos from various Eyre Peninsula agricultural events in 2007.

**Cover design**
PIRSA Publishing Services

**ISBN 978-1-921399-08-4**

**IMPORTANT NOTICE**
Although PIRSA has taken all reasonable care in preparing this advice, neither PIRSA nor its officers accept any liability resulting from the interpretation or use of the information set out in this document.

Information contained in this document is subject to change without notice.

PIRSA_PS_071130

# About this manual

Hi Everyone,

This year the Eyre Peninsula Farming Systems Summary 2007 is supported by ABB Grain Ltd and Grains Research & Development Corporation (GRDC) through the Eyre Peninsula Farming Systems Project, and Meat & Livestock Australia, Australian Wool Innovation, Land & Water Australia and GRDC through the Eyre Peninsula Grain & Graze Project. We would like to thank the sponsors for their contribution to Eyre Peninsula (EP) for research, development and extension and enabling us to extend our results to all farm business on EP and beyond in other low rainfall areas.

The EPFS project is currently in the process of funding renegotiations within a tighter funding round due to the flow on effect of droughts on grain levies. The EPFS III project will hopefully be funded for five years and aims to integrate the whole farming system by optimising the use of all resources and responding to seasonal conditions as they develop.

The Grain & Graze Program ends in June 2008, and at the time of printing no indication has been given that a new program will be offered, so we are keeping our fingers crossed! If we are given the opportunity we will certainly submit a new project.

Unfortunately due to the poor 2007 season some trials were established but not harvested and these are listed in this Summary. Every season is a challenge (so let's get prepared for 2008) and once again this Summary presents some very useful information. Look out for the release of the Planning Guide for Low Risk Farming, developed by the Low Rainfall Collaboration Project. This resource is free to all farmers and advisors, and provides a handy guide to planning for the 2008 season.

Some of the highlights in this Summary include disease suppression, investigating realistic potential yields and grazing cereals work. For the first time ever, we have included a section devoted to research being done on lower EP in collaboration with the Lower Eyre Agricultural Development Association (LEADA).

Dates to remember for this year are the 2008 EPARF Field Day on 27 August and the MAC Annual Field Day on 17 September.

I hope you enjoy the 2007 Summary of research results and extension from EP and we will see you soon at the farmer meetings.

I look forward to working with you all and seeing you at our events, and hope 2008 is a good season!

**Naomi Scholz**

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

# Eyre Peninsula Agricultural Research Foundation

## Gold Sponsors

## Silver Sponsors

## Bronze Sponsors

# Contents

# Eyre Peninsula Agricultural Research Foundation

**EPARF**
EYRE PENINSULA
Agricultural Research Foundation Inc.

## 2007 Report

### Peter Kuhlmann, Chairman

Most farming businesses and communities are being stretched to the limit. These difficult times also flow through to the research establishment as the levy contributions to GRDC and SAGIT fall and our industry partners also feel the pinch. The question is, how should EPARF respond to these events? This set of circumstances has helped EPARF to refocus on what we have to achieve to keep our farming businesses operating profitably in an environment with short and long term climate variability. As an example, the new Eyre Peninsula Farming Systems project bid, which we are currently negotiating with GRDC, is focused specifically on these issues.

We'd like to express our thanks to our members. Your continued involvement provides the strength of EPARF and makes it possible for us to promote EP agriculture on your behalf as a great place to invest. We recognise that times are tough, but we urge you to try and see your way clear to continue to support EPARF to ensure we can maintain and build on our scientific and technological edge.

Thanks to the SA Government through SARDI for its continued support, to GRDC and the Federal Government, SAGIT and all of our industry partners.

We once again acknowledge our sponsors and sincerely thank you for your continuing support:

**GOLD SPONSORS**

- AGCO – Navigation System
- AUTO-GUIDE – MAC Farm, 2 cm guidance system
- AWB Ltd – MAC Farming Systems Competition
- ABB Grain Ltd – EPFS Summary

**SILVER SPONSORS – EPARF Field Day**

- ABB Fertiliser – MAC Farm
- Rabobank – EPARF Field Day
- BankSA – EPARF Field Day
- Nufarm Ltd Australia – EPARF Field Day & MAC Farm
- Elders – EPARF Field Day

**BRONZE SPONSORS**

- Bayer Crop Science – EPARF Field Day
- Kotzer Silos – MAC Farm, silo ventilation fans for high moisture harvesting
- Letcher & Moroney – accountancy services

The 2007 EP Cereal Disease Focus Day was held in September with support from Rabobank, BankSA, Nufarm, Elders and Bayer Crop Science. The day was a great success with many expert presentations and hands on workshops to identify diseases. The annual MAC field day attracted around one hundred and fifty farmers and was another highlight of the year.

Retiring chairperson Rowan Ramsey announced at the 2007 AGM that his political ambitions would not enable him to continue on the EPARF committee. We thank Rowan for his commitment to EPARF, his involvement with research, his passion, optimism and faith in farming on Eyre Peninsula.

Tim Richardson from Cummins, special skills committee member of EPARF, resigned due to other commitments. Thank you for your support Tim. Andy Bates has filled this position with his expertise and Simon Guerin of Port Kenny has filled the grower position vacated by Rowan.
The current committee members are:

- Peter Kuhlmann – farmer Mudamuckla (Chairman)
- Bruce Heddle – farmer Minnipa
- Dean Willmott – farmer Kimba
- Matthew Dunn – farmer Rudall
- Brent Cronin – farmer Chandada
- Simon Guerin – farmer Port Kenny
- Andy Bates – consultant Streaky Bay – Special Skills & Expertise
- Geoff Thomas – consultant Blackwood, Adelaide – Special Skills & Expertise
- Dr Mike Keller – University of Adelaide, Waite Campus
- Prof Simon Maddocks – Chief Scientist, Livestock & Farming Systems, SARDI, Roseworthy
- Sam Doudle (Ex Officio) – Leader Minnipa Agricultural Centre, SARDI, Minnipa
- Jim Egan (Ex Officio) – SARDI, Port Lincoln
- Dot Brace – SARDI, Minnipa Executive Officer

We are indeed fortunate to have a group of committed and capable staff at Minnipa and EPARF provides direction and support to their valuable output. Your continued involvement as an EPARF member is essential in sustaining our profile, sponsorship, projects and alliances into the future.

# Eyre Peninsula Agricultural Research Foundation Members 2007

| | | |
|---|---|---|
| Atkinson | Phillip | KIMBA SA |
| Baillie | Terry | TUMBY BAY SA |
| Baldock | Jeff | KIMBA SA |
| Baldock | Graeme | KIMBA SA |
| Baldock | Heather | KIMBA SA |
| Baldock | Tristan | PORT LINCOLN SA |
| Bammann | Geoff | CLEVE SA |
| Bammann | Paul | CLEVE SA |
| Bammann | Neville | CLEVE SA |
| Barns | Ashley | WUDINNA SA |
| Bates | Andy | STREAKY BAY SA |
| Beinke | Peter | KIMBA SA |
| Beinke | Lance | KIMBA SA |
| Berg | Dean | COOTRA EAST SA |
| Berg | Ben | COOTRA EAST SA |
| Blumson | Bill | SMOKY BAY SA |
| Brace | Reg | POOCHERA SA |
| Brace | Dion | POOCHERA SA |
| Bubner | Daryl | CEDUNA SA |
| Buchanan | Neville | KIMBA SA |
| Burrows | Ian | LOCK SA |
| Burrows | Warren | LOCK SA |
| Burton | Jason | RUDALL SA |
| Byerlee | Garry | ORROROO SA |
| Cant | Mark | KIMBA SA |
| Cant | Robert | KIMBA SA |
| Cant | Brian | CLEVE SA |
| Carey | Peter | MINNIPA SA |
| Carey | Paul | STREAKY BAY SA |
| Carey | Shaun | STREAKY BAY SA |
| Carey | Matthew | STREAKY BAY SA |
| Cleve Area School | | CLEVE SA |
| Cliff | Trevor | KIMBA SA |
| Cook | Matthew | MINNIPA SA |
| Crettenden | Brenton | LOCK SA |
| Cronin | Brenton | STREAKY BAY SA |
| Cronin | James | STREAKY BAY SA |
| Cronin | Patrick | STREAKY BAY SA |
| Cummings | Richard | LOCK SA |
| Cummings | Lyn | LOCK SA |
| Dart | Robert | KIMBA SA |
| Davey | Brad | PORT NEILL SA |
| Deakin | Richard | KIELPA SA |
| Dolling | Brian | CLEVE SA |
| Dolling | Paul | CLEVE SA |
| Dolling | Mark | CLEVE SA |
| Dolphin | Neville | PORT KENNY SA |
| Duncan | Tony | WIRRULLA SA |
| Duncan | John | WIRRULLA SA |
| Dunn | Matthew | RUDALL SA |
| Dutschke | Richard | LOCK SA |
| Dutschke | Dennis | LOCK SA |
| Eatts | Austen | KIMBA SA |
| Edmonds | John | WUDINNA SA |
| Edmonds | Graeme | WUDINNA SA |
| Edwards | Mark | CLEVE SA |
| Elleway | David | KIELPA SA |
| Elleway | Ray | KIELPA SA |
| Endean | Jim | MINNIPA SA |
| Fitzgerald | Leigh | KIMBA SA |
| Fitzgerald | Brendan | KIMBA SA |
| Forrest | Scott | MINNIPA SA |
| Forrest | Jane | MINNIPA SA |
| Francis | Brett | KIMBA SA |
| Franklin | Ashley | COWELL SA |
| Freeman | Shaun | CEDUNA SA |
| Freeth | John | KIMBA SA |
| Freeth | Tom | KIMBA SA |
| Fromm | Jon | MINNIPA SA |
| Fromm | Jerel | MINNIPA SA |
| George | Leighton | MINNIPA SA |
| Gosling | Leigh | LOCK SA |
| Gosling | Jenny | LOCK SA |
| Grund | John | KIMBA SA |
| Grund | Gary | KIMBA SA |
| Guerin | Simon | PORT KENNY SA |
| Guest | Terry | SALMON GUMS WA |
| Haagmans | John | ELLISTON SA |

| | | |
|---|---|---|
| Hamence | Les | WIRRULLA SA |
| Hamlyn | Jim | KIMBA SA |
| Harris | John | KIMBA SA |
| Heath | Basil | PORT LINCOLN SA |
| Heddle | Bruce | MINNIPA SA |
| Hentschke | Andrew | LOCK SA |
| Hentschke | Stuart | LOCK SA |
| Herde | Bill | RUDALL SA |
| Hitch | Max | PORT LINCOLN SA |
| Hitchcock | Peter | LOCK SA |
| Hitchcock | Nathan | LOCK SA |
| Holman | Kingsley | LOCK SA |
| Holman | Barry | LOCK SA |
| Hood | Ian | PORT KENNY SA |
| Hood | Mark | PORT KENNY SA |
| Horgan | John | STREAKY BAY SA |
| Horgan | Mark | STREAKY BAY SA |
| Horgan | Danny | KIMBA SA |
| Howard | Tim | CEDUNA SA |
| Hunt | Edmund | PORT NEILL SA |
| James | Craig | CLEVE SA |
| Jericho | Neville | MINNIPA SA |
| Jericho | Marcia | MINNIPA SA |
| Jones | Jeff | ARNO BAY SA |
| Jones | Brenton | DARKE PEAK SA |
| Kaden | Paul | COWELL SA |
| Kaden | Tony | COWELL SA |
| Karcultaby Area School | | MINNIPA SA |
| Kelsh | Craig | PORT KENNY SA |
| Kitson | Stacey | WUDINNA SA |
| Kobelt | Rex | CLEVE SA |
| Kobelt | Myra | CLEVE SA |
| Koch | Daryl | KIMBA SA |
| Koch | Jeffrey | KIMBA SA |
| Kuhlmann | Peter | GLENELG STH SA |
| Kwaterski | Robert | MINNIPA SA |
| Lawrie | Campbell | UNGARRA SA |
| Lawrie | Andrew | TUMBY BAY SA |
| LeBrun | Dion | TUMBY BAY SA |
| LeBrun | Maria | TUMBY BAY SA |
| Lee | Howard | STREAKY BAY SA |
| Lienert | Hayden | KIMBA SA |
| Lienert | Matthew | KIMBA SA |
| Lienert | Kerin "Nick" | KIMBA SA |
| Lienert | Roger | ARNO BAY SA |
| Longmire | Andrew | SALMON GUMS WA |
| Longmire | Donna | CLEVE SA |
| Longmire | Jeffrey | LOCK SA |
| Longmire | Caroline | LOCK SA |
| Lymn | Allen | WUDINNA SA |
| Lymn | Chris | WUDINNA SA |
| Lynch | Brenton | STREAKY BAY SA |
| Lynch | Chris | STREAKY BAY SA |
| Lynch | Aden | STREAKY BAY SA |
| Lynch | Bradley | STREAKY BAY SA |
| Lynch | Damien | POOCHERA SA |
| Maitland | Stephen | KIMBA SA |
| Malcolm | Shane | ARNO BAY SA |
| Masters | John | ARNO BAY SA |
| Matthews | Wesley | KYANCUTTA SA |
| May | Nigel | ELLISTON SA |
| May | Debbie | ELLISTON SA |
| May | Paul | KYANCUTTA SA |
| May | Ashley | KYANCUTTA SA |
| May | Lyndon | CLEVE SA |
| McBeath | Chris | PORT LINCOLN SA |
| McClelland | Ian | BIRCHIP VIC |
| McKenna | Phil | KYANCUTTA SA |
| Merchant | Sam | GLEN OSMOND SA |
| Michael | John | WUDINNA SA |
| Michael | Heather | WUDINNA SA |
| Modra | John | YEELANNA SA |
| Mudge | Carolyn | STREAKY BAY SA |
| Mudge | Darren | STREAKY BAY SA |
| Murray | Lynton | PENONG SA |
| Newton | Len | ELLISTON SA |
| Newton | Joy | ELLISTON SA |
| Nicholls | Anthony | CEDUNA SA |
| Nield | Ricky | CLEVE SA |
| Nield | Roger | CLEVE SA |
| Nield | Joel | CLEVE SA |
| O'Brien | Peter | KYANCUTTA SA |
| O'Brien | Darren | KYANCUTTA SA |
| O'Brien | Craig | KYANCUTTA SA |
| O'Brien | Brett | KYANCUTTA SA |
| O'Brien | Wade | KYANCUTTA SA |
| O'Callaghan | Stephen | MILDURA VIC |
| Octoman | Nick | TUMBY BAY SA |
| Octoman | Carol | TUMBY BAY SA |
| Octoman | Matthew | TUMBY BAY SA |
| Oswald | Clint | YANINEE SA |
| Oswald | John | YANINEE SA |
| Ottens | Timothy | WHARMINDA SA |
| Patterson | Simon | STREAKY BAY SA |
| Pearce | Kym | CLEVE SA |
| Pearson | Jeff | PORT LINCOLN SA |

| | | |
|---|---|---|
| Penfold | Liz | PORT LINCOLN SA |
| Phillips | Darcy | MINNIPA SA |
| Phillips | Ashley | MINNIPA SA |
| Phillips | Glen | MINNIPA SA |
| Phillis | Kevin | UNGARRA SA |
| Phillis | Jamie | UNGARRA SA |
| Polkinghorne | Andrew | LOCK SA |
| Pope | Lindsay | WARRAMBOO SA |
| Pope | Mark | WARRAMBOO SA |
| Pope | Ben | WARRAMBOO SA |
| Preiss | Kevin | ARNO BAY SA |
| Prime | Peter | ARNO BAY SA |
| Prime | Chris | ARNO BAY SA |
| Prime | Andrew | ARNO BAY SA |
| Ramsey | Rowan | KIMBA SA |
| Ramsey | Teresa | KIMBA SA |
| Ranford | Ben | CLEVE SA |
| Rayson | Peter | KIMBA SA |
| Rayson | Colin | KIMBA SA |
| Redden | Scott | KIMBA SA |
| Rehn | Gavin | ARNO BAY SA |
| Rehn | Peter | ARNO BAY SA |
| Richardson | Bill | TUMBY BAY SA |
| Rodda | Lee | WUDINNA SA |
| Rodda | Marty | KIMBA SA |
| Rule | Craig | STREAKY BAY SA |
| Ryan | Martin | KIMBA SA |
| Sampson | Allen | KIMBA SA |
| Sampson | Coralie | KIMBA SA |
| Schaefer | John | KIMBA SA |
| Schaefer | Michael | KIMBA SA |
| Schmucker | Terry | KYANCUTTA SA |
| Schmucker | Thomas | KYANCUTTA SA |
| Scholz | Greg | WUDINNA SA |
| Scholz | Lyle | YANINEE SA |
| Scholz | Julieanne | YANINEE SA |
| Scholz | Nigel | WUDINNA SA |
| Scholz | Neville | WUDINNA SA |
| Schwarz | Noel | CEDUNA SA |
| Seal | Brooke | KIMBA SA |
| Simpson | John | WUDINNA SA |
| Siviour | Allen | ARNO BAY SA |
| Smith | Bryan | COORABIE SA |
| Story | Rodger | COWELL SA |
| Story | Suzanne | COWELL SA |
| Thomas | Geoff | BLACKWOOD SA |
| Trezona | Neville | STREAKY BAY SA |
| Trowbridge | Shane | CEDUNA SA |
| Turnbull | Mark | CLEVE SA |
| Turnbull | John | CLEVE SA |
| Van der Hucht | Peter | WUDINNA SA |
| Van Loon | Tim | WARRAMBOO SA |
| Veitch | Simon | WARRAMBOO SA |
| Veitch | Leon | WARRAMBOO SA |
| Watson | Peter | WIRRULLA SA |
| Webb | Paul | COWELL SA |
| Webber | Ken | PORT LINCOLN SA |
| White | Brian | TOOLIGIE SA |
| Wilhelm | Brenton | WALKERVILLE SA |
| Wilkins | Gregor | YANINEE SA |
| Wilkins | Barry | YANINEE SA |
| Williams | Dene | KIMBA SA |
| Williams | Ken | STREAKY BAY SA |
| Williams | Kim | STREAKY BAY SA |
| Williams | Dion | STREAKY BAY SA |
| Williams | Michael | KIMBA SA |
| Williams | David | PORT NEILL SA |
| Williams | Jenny | PORT NEILL SA |
| Willmott | Dean | KIMBA SA |
| Willmott | Peta | KIMBA SA |
| Woolford | Peter | KIMBA SA |
| Woolford | James | KIMBA SA |
| Woolford | Graham | KIMBA SA |
| Woolford | Barb | KIMBA SA |
| Woolford | Michael | CLEVE SA |
| Woolford | Simon | KIMBA SA |
| Zacher | Michael | LOCK SA |
| Zerk | Michael | LOCK SA |
| Zerna | Allan | COWELL SA |

# 2007 Eyre Peninsula Seasonal Summary


## Neil Cordon[1], Kieran Wauchope[2] and Joshua Telfer[3]

[1]SARDI, Minnipa Agricultural Centre, [2]Rural Solutions SA Port Lincoln, [3] Rural Solutions SA Cleve


### Western Eyre Peninsula

Who would expect two consecutive seasons to have similar rainfall events, pasture growth and marketing constraints? Well that is what happened in 2007 compared to 2006 except grain prices helped relieve the pressure of low productivity this season.

- January and February were typical summer months, hot, dry and windy. The skies opened up in March and April, and all areas received well above their average monthly rainfall. Oats were sown in March with general seeding operations under way by the end of April. May saw seeding completed and farmers were commenting that it was one of the "best starts ever". Strong winds did cut emerging crops on light sandy soils even where no-till was adopted. From June onwards it was below average monthly rainfall, which limited crop growth and reduced grain yields.
- All areas received below average annual rainfall and well below average growing season recordings. Rainfall (mm) at selected centres (growing season in brackets) was Streaky Bay 287 (207), Penong 231 (132), Nundroo 321 (189), Minnipa 305 (141), Mt Cooper 284 (205), Elliston 363 (283) and Ceduna 255 (127).
- The root disease *Rhizoctonia* was wide spread during 2007, regardless of whether good agronomic techniques were used to minimise its effect in the farming system. Later in the season Crown rot and Take-all was evident in wheat paddocks.
- Farming systems using no-till faced weed issues such as marshmallow, horehound and Lincoln weed. A full cut at seeding could be considered in the system.
- Pasture growth was excellent especially in early sown oaten pastures, and although production was not bulky, the feed value was extremely good resulting in good stock condition throughout the season.
- Yields from early sown crops were slightly better than expected (0.8 to 1.4 t/ha) whilst those from crops sown last yielded poorly (0.2 to 0.6 t/ha). Districts most affected by the season were Wirrulla, Cungena, Chandada and land near the Gawler Ranges whilst Elliston, Nundroo, Charra and south of Minnipa were the more favourable areas. Field pea and canola yields were very low with some paddocks not harvested. There is a high risk of growing alternative crops with many farmers preferring to have a productive pasture paddock for their livestock enterprise in 2008.
- Overall harvest quality was good with low screenings, high protein and high test weights.

### Lower Eyre Peninsula

The season started in a similar fashion to 2006 with good falls during the early months, but by June rainfall was less than a decile 2 and remained that way until October. There was good stock feed due to the increase in perennial pasture production and summer rainfall, which helped balance the risk for those in the more reliable areas.

- January, March and April were high rainfall months, providing subsoil moisture, resulting in good weed germination and allowing farmers to start an early seeding program with relatively clean paddocks. The great start to the season was hampered by low rainfall from June onwards; this greatly reduced yield potential and placed an even greater emphasis on risk management in terms of financial and environmental impacts.
- The only months to produce high rainfall deciles were those at the very start and end of the year. Total rainfall for the region was well below the yearly average. Rainfall (mm) for selected centres (growing season rainfall in brackets) was: Cummins 328 (223), Tumby Bay 262 (159), Koppio 502 (373), Yeelanna 368 (226), Mount Hope 336 (250) and Pt Lincoln 460 (353).
- Huge feed supplies were available to those who sowed cereals very early for their stock – most could not keep on top of it. Perennials helped stock, and the land, get through summer to the break of season in good condition.
- Early rains allowed farmers to get the majority of their canola sown during April, which helped create a high yield potential. Most farmers, in the areas that received good early rains, had their cropping program completed by the first week of June. A shortfall in the supply of fertiliser held up sowing programs significantly, forcing some farmers to sow with reduced or no fertiliser, or to blend triple super and urea to continue.
- Early sown crops were flowering in July and some in the drier districts (north of Tumby Bay through Lipson) had crops with white tipped heads – showing the severity of the moisture stress for that area that early in the season. Stock was beginning to be turned onto failing crops as pastures began to fail, and some selling excess stock.

- Windy conditions damaged flowers and further depleted soil moisture levels. Large numbers of Heliothis and Diamond Back Moth were found in canola, lupins, beans and peas. These caused some yield loss and resulted in extra spraying at the start of spring. Dry seasonal conditions limited the incidence of foliar disease.
- Rain in October was too late to impact on crop yields, proving more of a hindrance to harvest. Pastures responded well and Italian ryegrass was a stand out with its amazing recovery from a year of hard grazing.
- Overall yields across the region were below average with a few exceptions. Canola yields ranged from less than 0.1 t/ha on the more northeastern parts to 1.8t/ha south of Cummins; oil levels recorded around 40-46%. The east coast struggled, with barley yielding up to 0.7 t/ha, compared to Cockaleechie and Koppio reportedly reaping 4 and 5 t/ha respectively. The average for lower EP was around 2 t/ha but the majority had excess protein for the malting grades. Wheat quality was good with few screenings and high protein, similar yields and variation as barley were experienced across the region. Peas and beans averaged near 1 t/ha and lupins were similar or just below this level with great variability for these crops throughout lower EP.
- For many it was the earliest finish to harvest and there was huge variability across the region in regards to yield. The variation had some claiming the worst year recorded, while others claimed it to be their best financial year on record.

### Eastern Eyre Peninsula

The season on Eastern Eyre Peninsula was similar to the rest of Eyre Peninsula in rainfall distribution patterns, which saw farmer's hopes rise as a result of the seasonal opening, only to be dashed by the end. Other issues to concern farmers were fertiliser prices, grain marketing, grain contracts and the attraction of employment in the mining industry.

- Coming off the back of the 2006 drought, there were very little crop stubbles around to provide ground cover protection and livestock feed.
- Spring rain was sadly missing in 2007 throughout the district. Cleve Airport and Kimba received 304 and 282 mm for the January to December period, but only 154 and 157 mm in the growing season respectively. For the spring period Cleve airport received less than 50% of its mean rainfall for the period, and that was after significant falls in late October and November. These centres were by no means the worse in the district. Some areas and soil types were able to store some soil water from late summer-autumn, but areas that received none were clearly worse off.
- Good rains around late April saw large cropping areas sown early in May. This proved to be very timely given the spring, as those early crops were the higher yielding. Some very early crops were so advanced they grew too much bulk and were unable to finish with the harsh spring.
- Some seeding operations were held up by fertiliser shortages during autumn whilst other landholders kept sowing at reduced fertiliser rates.
- Frost in spring from Kimba through to Wharminda resulted in significant crop damage in susceptible crops such as peas, but also wheat given the early nature of the season. Some of these crops were cut for hay.
- *Rhizoctonia* was a concern in the western parts of eastern EP, but did not appear to be such a major concern along the eastern regions.
- Grain yields were up to1 t/ha where there was stored moisture from the autumn falls, or crops received some showers in August. However large areas were closer to around 0.5 t/ha and lower with some areas only returning seed. Pea crop yields were no more than 0.5 t/ha, and the small areas of canola planted struggled to yield between 0.1 to 0.2 t/ha.

# Understanding Trial Results and Statistics


## Jim Egan

SARDI, Port Lincoln


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

### The average (or mean)

The results of replicated trials are often presented as the average (or mean) for each of the replicated treatments. Using statistics, means are compared to see whether any differences are larger than is likely to be caused by natural variability across the trial area (such as changing soil type).

### The LSD test

To judge whether two or more treatments are different or not, a statistical test called the Least Significant Difference (LSD) test is used. If there is no appreciable difference found between treatments then the result shows "NS" (not significant). If the statistical test finds a significant difference, it is written as "P 0.05". This means there is a 5% probability or less that the observed difference between treatments 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 a replicated trial

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

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

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

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

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

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

### On-farm testing – Prove it on your place!

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

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

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

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

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

Choose your test site carefully so that it is uniform and representative - yield maps will help, if available.

Identify the treatments you wish to investigate and their possible effects. Don't attempt too many treatments.

Make treatment areas to be compared as large as possible, at least wider than your header.

Treat and manage these areas similarly in all respects, except for the treatments being compared.

If possible, place a control strip on both sides and in the middle of your treatment strips, so that if there is a change in conditions you are likely to spot it by comparing the performance of control strips.

If you can't find an even area, align your treatment strips so that all treatments are equally exposed to the changes. For example, if there is a slope, run the strips up the slope. This means that all treatments will be partly on the flat, part on the mid slope and part at the top of the rise. This is much better than running strips across the slope, which may put your control on the sandy soil at the top of the rise and your treatment on the heavy flat, for example. This would make a direct comparison very tricky.

Record treatment details accurately and monitor the test strips, otherwise the whole exercise will be a waste of time.

If possible, organise a weigh trailer come harvest time, as header yield monitors have their limitations.

Don't forget to evaluate the economics of treatments when interpreting the results.

Yield mapping provides a new and very useful tool for comparing large-scale treatment areas in a paddock.

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

# Types of work in this publication

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

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

# Some Useful Conversions

**Area**

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

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

1 ha = 2.471 acres

**Mass**

1 t (metric tonne) = 1000 kg

1 imperial tonne = 1016 kg

1 kg = 2.205 lb

1 lb = 0.454 kg

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

1 bu (wheat) = 60 lb = 27.2 kg

1 bag = 3 bu = 81.6 kg (wheat)

**Volume**

1 L (litre) = 0.22 gallons

1 gallon = 4.55 L

1 L = 1000 mL (millilitres)

**Speed**

1 km/h = 0.62 miles/h, 10 km/h = 6.2 miles/hr, 15 km/h = 9.3 miles/h

10 km/h = 167 m/minute = 2.78 m/second

**Pressure**

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

25 psi = 1.7 bar = 172 kPa

**Yield**

1 t/ha = 1000 kg/ha

**Yield approximations**

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

# 2007 Trials Sown but not Harvested or Reported

### Pea, Canola and Mustard Demonstrations – Leigh Davis

The Streaky Bay demonstration at Ken Williams opposite the NVT Barley site, was not harvested due to the lack of moisture. The trial germinated well but poor follow up rains restricted growth and yield. The demonstration at Penong was harvested, but produced low yields.

This small demonstration included varieties of peas (Parafield yielding 0.22 t/ha and Kaspa yielding 0.21 t/ha), canola (Tarcoola yielding 0.07 t/ha) and mustard (Dune yielding 0.17 t/ha). These were selected as best bet varieties for low rainfall environments. The aim of the demonstration was to see if pulses and oilseeds could successfully grow in the Penong area.

This demonstration showed that pulses and oilseeds can grow even in a drought year but definitely suffer compared to wheat, which averaged 0.60 t/ha in the NVT trial alongside. Peas seem to be the best bet and further evaluation needs to be conducted to see if they are a viable option in very low rainfall areas.

The Penong growing season rainfall was 142 mm and total rainfall was 306 mm. The trial was sown on 21 May, which was late considering the break of the season was in March.

### Canola Water Use Efficiency – Kieran Wauchope

LEADA, with support from the National Landcare Program, aimed to investigate ways to improve the water use efficiency of canola on lower EP. Due to seasonal conditions several treatments were unable to be implemented and there were no significant results.

### Competitive Cropping – Michael Bennet

These cropping trials sown at Edillilie aimed to investigate wheat varieties, seeding systems at various seeding rates on their competitive ability with ryegrass. The trial at Edillilie suffered from reduced germination which, combined with the natural variability of the background ryegrass made the trial difficult to interpret, so therefore is not included in the 2007 summary.

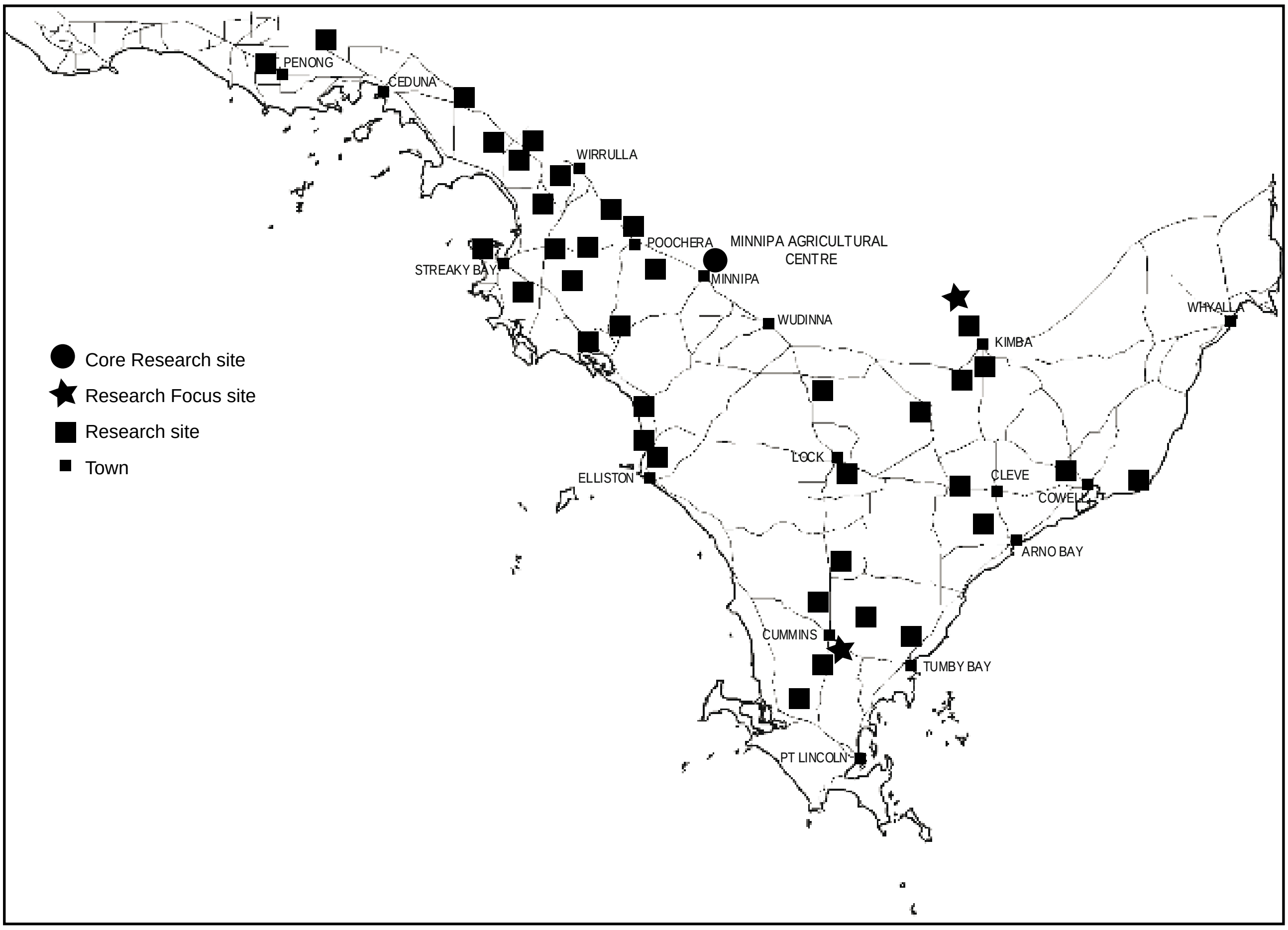
### Effectiveness of Microbial Agents in the Field – Nigel Wilhelm

Field trials were conducted across EP in 2007 as part of an ongoing program to field test microbial agents as improved rhizobia for pulses, for improved P nutrition of crops and for reduced root diseases. The results of this program from 2007 have not yet been fully interpreted but will be extended later in 2008.

### Benefits of Deep Placed Nutrients for Improving Crop Production on Deep Sands – Nigel Wilhelm

Field trials were conducted across southern Australia in 2007 as part of an ongoing program to develop a viable technique for placing nutrients at depth in deep sands for improved crop production. The results of this program from 2007 have not yet been fully interpreted but will be extended later in 2008.

# Eyre Peninsula
# Agricultural Research Sites 2007



SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

# Section 1

**Section editor:**
**Neil Cordon**
SARDI,
Minnipa Agricultural Centre

# Cereals

## The total 2007 production figures for Eyre Peninsula were approximately 650 000 t of wheat, 280 000 t of barley, 15 000 t of oats and 8 000 t of triticale.

***Triticale Variety Yield Performance at Eyre Peninsula sites***
*2007 and long term (2001–07) yields expressed as a % of Tahara's yield.*

| Variety | 2007 | | | | 7 year average (2001–07) | | | |
|---|---|---|---|---|---|---|---|---|
| | Greenpatch | Minnipa | Streaky Bay | Wharminda | Greenpatch | Minnipa | Streaky Bay | Wharminda |
| Abacus | 105 | 17 | 19 | 125 | 94 | 89 | 90 | 90 |
| Hawkeye (TSA0108) | 107 | 112 | 92 | 125 | 109 | 109 | 110 | 110 |
| Jaywick (TSA0124) | 108 | 102 | 95 | 107 | 108 | 107 | 107 | 107 |
| Kosciuszko | 102 | 113 | 94 | 184 | 106 | 107 | 107 | 108 |
| Speedee | 98 | 122 | 122 | 110 | 100 | 105 | 105 | 105 |
| Tahara | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Tickit | 100 | 90 | 92 | 120 | 101 | 100 | 101 | 102 |
| Tobruk (AT574) | 100 | 13 | 7 | 152 | 111 | 102 | 104 | 103 |
| Treat | 88 | 98 | 96 | 149 | 99 | 98 | 98 | 99 |
| Tahara Yield (t/ha) | 4.69 | 0.33 | 0.28 | 0.43 | 3.36 | 1.28 | 1.34 | 1.27 |
| Sowing date | 09 May | 09 May | 18 May | 08 May | | | | |
| Soil type | SL | SL | SL | S | | | | |
| pH (water) | 6 | 8.2 | 8.6 | 7.6 | | | | |
| Apr-Oct rain (mm) | 344 | 141 | 160 | 147 | | | | |
| Site stress factors | lr, w | de, dl | de, dl, rh | de, dl, rh | | | | |

***More information:*** *Richard Saunders (08) 8595 9152 or e-mail saunders.richardj@saugov.sa.gov.au*
*de=moisture stress pre flowering, dl=moisture stress post flowering, w=weeds, lo=lodging, sh=shattering, pe=poor establishment, s=sulphur deficiency, ap=aphids, hd=herbicide damage, bl=blackleg, wind=wind loss, ls=late sown, sn=snails, f=frost*

***Wheat Variety Yield Performance at EP sites***

*2007 and long term (2001–06) yields expressed as t/ha and % of Frame's yield*

| Variety | Upper, Eastern and Western Eyre Peninsula | | | | | | | | | | | | | | Mid and Lower Eyre Peninsula | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2007 (% Frame) | | | | | | | 7 year average (2000–06) (% Frame) | | | | | | | 2007 (% Frame) | | | 7 year average (2000–06) (% Frame) | | |
| | Kimba | Min-nipa | Mitch-elville | Nun-jikompita | Penong | Streaky Bay | War-ramboo | Kimba[#] | Mitch-elville | Min-nipa | Nun-jikompita | Penong | Streaky Bay | War-ramboo | Cum-mins | Rudall | Ungarra | Cum-mins | Lock/ Rudall | Ungarra |
| ***AGT Scythe*** | 135 | 125 | 159 | 148 | 154 | 131 | 108 | 109 | 111 | 108 | 105 | 107 | 104 | 108 | 119 | 105 | 120 | 105 | 110 | 107 |
| ***Annuello*** | | | | | | | | 101 | 98 | 100 | 95 | 99 | 94 | 97 | 109 | 86 | 116 | 103 | 101 | 104 |
| ***Axe*** | 142 | 141 | 200 | 147 | 184 | 167 | 150 | | 115 | 110 | 104 | 107 | 107 | 110 | 130 | 115 | 126 | 105 | 114 | 108 |
| ***Carinya*** | | | | | | | | | 108 | 106 | 101 | 104 | 101 | 106 | 99 | 102 | 104 | 104 | 107 | 106 |
| ***Catalina*** | 118 | 118 | 155 | 129 | 151 | 152 | 129 | | | | | | | | 113 | 105 | 115 | | | |
| ***Correll*** | 109 | 133 | 187 | 175 | 181 | 152 | 139 | | 116 | | 107 | 110 | 106 | 110 | 115 | 112 | 127 | 106 | 111 | 108 |
| ***Derrimut*** | 101 | 118 | 132 | 102 | 155 | 111 | 116 | | 111 | | 104 | 107 | 103 | 107 | 121 | 113 | 133 | 105 | 109 | 107 |
| ***Espada*** | 155 | 123 | 172 | 152 | 172 | 146 | 138 | | | | | | | | 114 | 114 | 137 | | | |
| ***Excalibur*** | 98 | 132 | 182 | 141 | 167 | 162 | 128 | 110 | 111 | 108 | 106 | 110 | 107 | 110 | 121 | 107 | 123 | 105 | 110 | 106 |
| ***Frame*** | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| ***GBA Ruby*** | | | | | | | | 109 | 107 | 106 | 102 | 104 | 103 | 107 | | | | 104 | 109 | 105 |
| ***Gladius*** | 127 | 131 | 185 | 174 | 185 | 175 | 148 | | 120 | | 113 | 115 | 111 | 115 | 126 | 126 | 138 | 107 | 116 | 110 |
| ***Guardian*** | 116 | 140 | 165 | 121 | 135 | 142 | 114 | | | | | | | | 128 | 106 | 115 | | | |
| ***H46*** | 80 | 118 | 165 | 136 | 145 | 155 | 114 | 110 | 109 | 107 | 101 | 105 | 102 | 108 | 117 | 120 | 117 | 106 | 112 | 108 |
| ***Janz*** | 56 | 108 | 117 | 122 | 146 | 102 | 86 | 96 | 97 | 99 | 94 | 96 | 92 | 97 | 94 | 97 | 110 | 99 | 98 | 102 |
| ***Krichauff*** | 113 | 132 | 157 | 141 | 170 | 176 | 130 | 105 | 109 | 107 | 102 | 106 | 104 | 106 | 120 | 117 | 133 | 104 | 108 | 104 |
| ***Kukri*** | 92 | 121 | 153 | 125 | 139 | 135 | 113 | 96 | 99 | 98 | 93 | 95 | 94 | 96 | 105 | 107 | 110 | 98 | 98 | 99 |
| ***Magenta*** | 82 | 126 | 154 | 128 | 127 | 126 | 103 | | 114 | 107 | 104 | 108 | 102 | 107 | 113 | 95 | 118 | 104 | 109 | 105 |
| ***Peake*** | 106 | 132 | 157 | 136 | 166 | 138 | 136 | | 112 | 108 | 104 | 107 | 103 | 108 | 119 | 118 | 141 | 105 | 111 | 108 |
| ***Pugsley*** | 107 | 115 | 131 | 114 | 120 | 104 | 104 | 113 | 114 | 107 | 106 | 109 | 105 | 108 | 91 | 101 | 111 | 106 | 110 | 108 |
| ***Wyalkatchem*** | 116 | 113 | 145 | 136 | 153 | 133 | 114 | 115 | 113 | 110 | 105 | 109 | 106 | 110 | 119 | 119 | 121 | 109 | 117 | 110 |
| ***Yitpi*** | 85 | 117 | 135 | 119 | 142 | 113 | 104 | 109 | 111 | 106 | 105 | 107 | 105 | 106 | 106 | 115 | 112 | 103 | 106 | 104 |
| ***Young*** | 144 | 128 | 165 | 124 | 163 | 162 | 134 | 108 | 112 | 108 | 104 | 106 | 104 | 109 | 127 | 123 | 116 | 105 | 111 | 107 |
| ***Frame yield (t/ha)*** | 0.51 | 0.57 | 0.19 | 0.24 | 0.41 | 0.35 | 0.97 | 1.33 | 0.92 | 1.55 | 1.23 | 1.18 | 1.39 | 1.45 | 1.59 | 0.94 | 1.71 | 3.82 | 1.78 | 3.14 |
| **Durums** | | | | | | | | | | | | | | | | | | | | |
| ***Jandaroi*** | | No | | | | | | | | | | | | | 93 | No | 108 | | | |
| ***Kalka*** | | valid | | | | | | | | 95 | | | | | 94 | valid | 109 | 101 | 98 | 101 |
| ***Tamaroi*** | | result | | | | | | | | 100 | | | | | 100 | result | 100 | 100 | 100 | 100 |
| ***Tamaroi yield (t/ha)*** | | | | | | | | | | 1.36 | | | | | 1.53 | | 1.17 | 3.47 | 1.35 | 2.57 |
| ***Date Sown*** | 7 May | 9 May | 8 May | 21 May | 21 May | 18 May | 6 May | | | | | | | | 24 May | 17 May | 16 May | | | |
| ***Soil Type*** | L | SL | SL | SL | L | SL | SL | | | | | | | | HC | S | C | | | |
| ***A-O rain (2007)*** | 126 | 141 | 72 | 130 | 142 | 132 | 148 | | | | | | | | 223 | 172 | 244 | | | |
| ***pH (water)*** | 8.9 | 8.2 | 8.7 | 8.7 | 8.7 | 8.2 | 8.7 | | | | | | | | 8.4 | 9.6 | 8.4 | | | |
| ***Stress factors*** | de,dl | de,dl,bt | de,dl,e | de,dl | de,dl | de,dl | de,dl | | | | | | | | de,dl | de,dl | de,dl | | | |

***Abbreviations***

***Soil type:*** *S=sand, L=loam, C=clay, Li=light, M=medium, H=heavy, F=fine*

***Site stress factors:*** *bt=boron toxicity, de=pre flowering moisture stress, dl=post flowering moisture stress, e=reduced establishment*

***Data source:*** *SARDI/GRDC & NVT trials (long term data based on weighted analysis of sites) *Durum varieties trialed separately and not completely valid to compare against bread wheats*

*[#] Data based on 7 year period 1999–2005 due to no result in 2006*

**Barley Variety Yield Performance at EP sites**

*2007 and long term (2000–06) yields expressed as t/ha and % of Schooner's yield*

| Variety | Lower Eyre Peninsula | | | | Upper Eyre Peninsula | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2007 (% Schooner) | | 7 year average ( 2001–06 ) (% Schooner) | | 2007 (% Schooner) | | | | | 7 year average ( 2001–06 ) (% Schooner) | | | |
| | Cummins | Wanilla | Cummins | Wanilla | Darke Peak | Elliston | Minnipa | Streaky Bay | Wharminda | Elliston | Minnipa[#] | Streaky Bay | Wharminda |
| Barque | 109 | 109 | 105 | 107 | 78 | 121 | | 116 | 75 | 111 | 108 | 110 | 102 |
| Baudin | 97 | 86 | 103 | 104 | 79 | 109 | | 86 | 76 | 100 | 105 | 104 | 97 |
| Buloke | 103 | 108 | 108 | 111 | 90 | 123 | | 114 | 87 | 107 | 109 | 104 | 102 |
| Capstan | 98 | 103 | 108 | 107 | | | | | | 109 | 116 | 111 | 100 |
| Flagship | 101 | 109 | 103 | 104 | 108 | 107 | | 94 | 89 | 104 | 110 | 105 | 99 |
| Fleet | 111 | 107 | 111 | 111 | 78 | 141 | | 127 | 103 | 115 | 115 | 114 | 105 |
| Gairdner | 76 | 111 | 99 | 101 | 87 | 114 | | 94 | 77 | 105 | 103 | 104 | 90 |
| Hannan | 108 | 97 | | | 88 | 121 | | 78 | 85 | | | | |
| Hindmarsh | 136 | 115 | | | 124 | 121 | | 125 | 59 | | | | |
| Keel | 123 | 113 | 107 | 107 | 131 | 142 | No valid result droughted | 121 | 60 | 111 | 115 | 109 | 105 |
| Lockyer | 100 | 97 | | | | | | | | | | | |
| Maritime | 100 | 102 | 108 | 111 | 116 | 121 | | 84 | 82 | 105 | 108 | 106 | 102 |
| Roe | | | | | 106 | 124 | | 97 | 79 | | | | |
| Schooner | 100 | 100 | 100 | 100 | 100 | 100 | | 100 | 100 | 100 | 100 | 100 | 100 |
| Sloop | 93 | 101 | 98 | 101 | 104 | 114 | | 99 | 68 | 100 | 99 | 99 | 94 |
| Sloop SA | 107 | 104 | 100 | 100 | 89 | 115 | | 96 | 98 | 100 | 103 | 101 | 95 |
| Sloop VIC | | | 98 | 98 | | | | | | 98 | 95 | 98 | 93 |
| Vlamingh | 94 | 94 | 99 | 102 | 95 | 108 | | 77 | 73 | 95 | | 94 | 87 |
| Yarra | 99 | 105 | 109 | 109 | 107 | 122 | | 115 | 92 | 112 | 116 | 108 | 101 |
| Schooner's yield (t/ha) | 2.24 | 4.27 | 3.93 | 3.42 | 1.06 | 2.00 | | 0.58 | 1.25 | 2.04 | 1.83 | 1.76 | 1.80 |
| Date Sown | 8 June | 10 May | | | 7 May | 16 May | 14 May | 17 May | 8 May | | | | |
| Soil Type | HC | SL | | | S | S | SL | SL | S | | | | |
| A-O Rain (2007) mm | 223 | 250 | | | 156 | 260 | 141 | 160 | 147 | | | | |
| PHw | 8.4 | 7.3 | | | 7 | 8.6 | 8.2 | 8.6 | 7.6 | | | | |
| Site Stress factors | dl | | | | dl | dl | bt,de,dl | de,dl,r | de,dl,r | | | | |

***Abbreviations***

***Soil type:*** *S=sand, L=loam, C=clay, Li=light, M=medium, H=heavy, F=fine, / = separates top soil from sub soil*

***Site stress factors:*** *bt=boron toxicity, de=moisture stress pre flowering, dl=post flowering moisture stress, r=rhizoctonia*

***Data source:*** *SARDI/GRDC & NVT trials (long term data based on weighted analysis of sites)*

*[#] Data based on 7 year period 1999–2005 due to no result in 2006*

# District Cereal Trials and Demos

**Neil Cordon**
SARDI, Minnipa Agricultural Centre

Research

Demo

**Try this yourself now**

**Location**
Cowell: Brenton Smith
Franklin Harbour Ag Bureau

**Rainfall**
Av. annual: 400 mm
Av. GSR: 256 mm
2007 total: 290 mm
2007 GSR: 181 mm

**Yield**
Not harvested

**Paddock History**
2004 – 2006: Pasture

**Soil Type**
Reddish brown clay loam

**Location**
Elliston: Nigel May
Elliston and Districts Farmers

**Rainfall**
Av. annual: 410 mm
Av. GSR: 340 mm
2007 total: 343 mm
2007 GSR: 260 mm

**Yield**
Potential: (W) 3.0 t/ha

**Paddock History**
2006: Pasture
2005: Barley
2004: Pasture

**Soil Type**
Grey calcareous sand

**Plot Size**
10 m x 1.5 m x 3 reps

**Location**
Mt Cooper: Stewart Gunn
Mt Cooper Ag Bureau

**Rainfall**
Av. annual: 415 mm
Av. GSR: 335 mm
2007 total: 283 mm
2007 GSR: 206 mm

**Yield**
Potential: (W) 1.9 t/ha, (B) 2.3 t/ha

**Paddock History**
2006: Pasture
2005: Barley
2004: Wheat

**Soil Type**
Reddish brown loam

## Key Messages

- **The new hard quality varieties Axe, Correll and Gladius performed well and should be considered in most districts.**
- **Correll appears to have a low test weight varietal characteristic.**
- **Evaluate historic trial data and yields from 2007 together with agronomic characteristics when selecting a new variety for a farming system.**

## Why do the trials?

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

## FRANKLIN HARBOUR CEREAL DEMO

### How was it done?

Eleven wheat and three barley varieties were sown @ 80 kg/ha in demonstration strips on 29 June with 52 kg N/ha and 11 kg P/ha.

### What happened?

Late sowing together with very cold wet weather at and after sowing produced uneven and poor establishment, and this carried through to maturity. Grain harvest was not possible, as site variability would not give an accurate indication of variety yields, therefore only wheat grain quality was measured (Table 1).

Varieties that had the highest screenings were Guardian, Correll and Young, whilst Correll was the only entry to have a grain weight below 80 kg/hL.

## ELLISTON WHEAT TRIAL

### How was it done?

Twelve wheat varieties were sown @ 67 kg/ha in replicated plots on 16 May with 23 kg N/ha and 16 kg P/ha. Grain yield and quality were measured.

### What happened?

Growth throughout the year was good but *Rhizoctonia* and dry weather at grain filling limited yields to 82% of potential.

Gladius clearly had the top yield and gross income (Table 2) and was significantly better than all other entries. Frame was the lowest yielding variety at this site, which was similar to 2006. Correll had the lowest test weight.

## MT COOPER CEREAL DEMO

### How was it done?

Eleven wheat and nine barley varieties were sown @ 80 kg/ha and 75 kg/ha respectively, in demonstration strips on 23 May with 15 kg N/ha and 16 kg P/ha. Grain yield and quality were measured.

*Table 1 Grain quality of Wheat at Franklin Harbour Ag Bureau site 2007*

| Variety | Protein (%) | Screenings (%) | Test Weight (kg/hL) |
|---|---|---|---|
| **Frame** | 11.6 | 0.8 | 85 |
| **RAC 1263** | 11.8 | 1.7 | 83 |
| **Wyalkatchem** | 11.7 | 1.5 | 84 |
| **Guardian** | 11.0 | 4.2 | 84 |
| **Catalina** | 12.2 | 2.8 | 85 |
| **Correll** | 11.9 | 7.1 | 79 |
| **Yitpi** | 12.2 | 0.7 | 85 |
| **Young** | 11.5 | 3.8 | 85 |
| **Derrimut** | 11.4 | 1.2 | 88 |
| **Gladius** | 12.1 | 1.6 | 83 |
| **Axe** | 11.9 | 1.7 | 84 |

*Table 2 Yield, grain quality and gross income of Wheat at Elliston 2007*

| Variety | Protein (%) | Screenings (%) | Test Weight (kg/hL) | Yield (t/ha) | Gross Income* ($/ha) |
|---|---|---|---|---|---|
| **Gladius** | 11.7 | 0.8 | 81 | 2.47 a | 960 |
| **Axe** | 11.9 | 1.2 | 81 | 2.29 b | 893 |
| **Correll** | 11.5 | 1.3 | 78 | 2.29 b | 888 |
| **Wyalkatchem** | 11.4 | 0.6 | 82 | 2.26 bc | 878 |
| **Pugsley** | 12.6 | 0.3 | 83 | 2.22 bc | 871 |
| **Yitpi** | 12.3 | 0.5 | 82 | 2.21 bc | 863 |
| **Derrimut** | 11.4 | 1.1 | 82 | 2.20 bc | 853 |
| **Guardian** | 11.5 | 1.9 | 82 | 2.14 bc | 824 |
| **Young** | 11.9 | 1.3 | 80 | 2.12 bc | 822 |
| **Carinya** | 11.9 | 0.4 | 82 | 2.09 cd | 815 |
| **H46** | 12.1 | 0.5 | 82 | 1.94 de | 759 |
| **Frame** | 13.1 | 0.3 | 85 | 1.85 e | 726 |
| *LSD (P=0.05)* | | | | *0.18* | |

** Gross income is yield x price (with quality adjustments) delivered to Port Lincoln as at 14 December 2007. Treatments followed by the same letter are not statistically different.*

## What happened?

The plots were sown into damp soil with good growing conditions through to July, but prolonged dry conditions later in the season limited grain production. Varieties yielded up to 67% of the potential. There were little differences between the top nine wheat and five barley varieties (Table 3). The new wheat variety Axe did perform well whilst the malting classified barleys Sloop SA and WI 3416 had poor yields and gross incomes. High grain protein saw the malt varieties down graded to feed whilst high screenings saw Hindmarsh classified as Feed 2.

## What does this mean?

This work suggests that farmers should consider Axe, Gladius and Correll as a replacement for any existing hard quality varieties. Correll's lower test weight supports data from other trials, which may limit its widespread adoption if there is a risk of quality downgrading on farms. The high screenings of Hindmarsh barley casts doubt on its role as a variety and will need further evaluation in 2008.

NB: Test weight of Correll was still well above receival standards.


## Acknowledgments

Thanks to the farmer co-operators Stewart Gunn, Nigel May and Brenton Smith for their time and land. Ben Ward, SARDI Minnipa Agricultural Centre and the Port Lincoln SARDI team for assisting in the trial management and harvesting. Longreach Plant Breeders, Crop Care, Plant Tech and AGT Plant Breeders supplied seed.


***Table 3 Yield, grain quality and gross income of cereals at Mt Cooper 2007***

| Variety | Grade | Protein (%) | Screenings (%) | Test Weight (kg/hL) | Yield (t/ha) | Gross Income* ($/ha) |
|---|---|---|---|---|---|---|
| **Axe** | AH | 10.7 | 0.4 | 79 | 1.28 | 496 |
| **Derrimut** | AH | 11.5 | 0.5 | 81 | 1.27 | 494 |
| **Correll** | AH | 10.3 | 1.3 | 82 | 1.25 | 478 |
| **Yitpi** | AH | 10.8 | 0.3 | 82 | 1.22 | 473 |
| **RAC 1263** | APW | 10.6 | 0.7 | 82 | 1.23 | 473 |
| **Gladius** | AH | 11.6 | 0.6 | 83 | 1.19 | 465 |
| **Catalina** | AH | 11.5 | 1.1 | 81 | 1.18 | 457 |
| **Guardian** | APW | 11.3 | 1.6 | 83 | 1.16 | 447 |
| **Frame** | APW | 11.9 | 0.2 | 86 | 1.11 | 434 |
| **Wyalkatchem** | APW | 11.8 | 0.5 | 83 | 1.08 | 422 |
| **Young** | AH | 11.7 | 2.0 | 78 | 1.08 | 416 |
| **Keel** | F1 | 12.6 | 8.8 | 67 | 1.32 | 366 |
| **Fleet** | F1 | 12.1 | 0.8 | 73 | 1.23 | 341 |
| **Hindmarsh** | F2 | 13.3 | 16.6 | 72 | 1.25 | 334 |
| **Flagship** | F1 | 13.8 | 6.9 | 75 | 1.06 | 294 |
| **Maritime** | F1 | 14.5 | 0.2 | 72 | 1.03 | 286 |
| **Sloop SA** | F1 | 14.3 | 1.8 | 78 | 0.85 | 236 |
| **WI 3416** | F1 | 13.9 | 1.2 | 73 | 0.82 | 227 |

** Gross income is yield x price (with quality adjustments) delivered to Port Lincoln as at 14 December 2007.*

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

GRDC Grains Research & Development Corporation

# Wheat Varieties with Improved Drought Tolerance

Research

Extension

Cereals

**Steve Jefferies[1], Haydn Kuchel[1] and Willie Shoobridge[2]**

[1]Australian Grain Technologies (AGT), [2]SARDI, Minnipa Agricultural Centre

## Key messages

- **Breeding for improved drought tolerance in wheat varieties is proving successful with the recent release of Gladius followed by two new varieties, Axe and Espada, available to growers for the 2008 cropping season.**
- **An important drought tolerant parent RAC875 has been incorporated into a Yitpi background resulting in the variety Correll which has shown far superior adaptation to low rainfall environments.**
- **Growers who purchased Gladius and Correll seed from recognised seed retailers are now permitted to sell or trade that seed to neighbours subject to returning the appropriate documentation to AGT.**

SA wheat growers in low rainfall areas rely on capturing as high as possible returns in the good years to buffer against poor or negative financial returns in the drought years. The South Australian Grains Industry Trust (SAGIT) and the SA Government Drought Response joined forces to support the fast track release of wheat varieties aimed at providing SA growers with tools to help minimise losses in drought years while capturing maximum benefits in the good years.

The challenge for the wheat breeder however, is to develop varieties that rarely completely fail in the drought years while performing solidly in the good years. Research conducted by Australian Grain Technologies (AGT) in collaboration with Minnipa Agricultural Centre staff over the past 8 to 10 years has identified parents that were used in crosses to develop such varieties.

Excalibur became recognised for its excellent tolerance to drought stress during the series of severe droughts encountered in SA in the mid to late 1980s. It has since been a valuable risk management tool particularly for upper EP growers. This is despite its rust susceptibility and relatively poor quality. RAC875 was a breeders line which also had exceptional performance under drought stress in the late 1980s and mid 1990s, but it had a serious quality defect and was very susceptible to leaf rust so was never released to growers.

These important parents have been combined, in various ways, with other parents including Kukri (rust resistance and quality), Krichauff (hostile soil tolerance) and Trident (yield potential) to generate three new varieties that all perform well under water stressed conditions, namely Gladius, Axe and Espada. In addition, RAC875 was crossed with Yitpi with the aim of improving Yitpi's drought tolerance and stem rust resistance and this strategy culminated in the release of Correll.

Gladius was released to growers in 2007 (limited volumes of winter and summer grown seed) and has performed exceptionally well with both farmers and in NVT trials and regional trials over the past three years (including the higher yielding 2005 season). To help more farmers get quick access to this new variety, AGT has allowed growers who purchased Gladius seed from recognised retailers to sell or trade seed to neighbours subject to the completion of a transaction form provided by AGT. Despite this new seed-sharing model, seed is in limited supply as most who grew it in 2007 are keeping all they produced. EP growers that haven't already placed orders with Minnipa Agricultural Centre or other AFCA members or retailers will probably need to source seed from outside the district.

Axe was launched at the 2007 Minnipa Field Day and seed is available for planting in 2008. While this variety takes some time to complete grain fill and reach full maturity, it sets its yield potential very early through exceptionally rapid early to mid plant development. While this may be interpreted as drought avoidance it does also appear to have maintained some of the "drought tolerance" characteristics of Excalibur and RAC875. Axe has been the highest yielding variety in NVT trials on upper EP over the past two years. Axe also has very good stripe and leaf rust resistance, grain size, and is eligible for the AH grade.

Espada (tested as RAC1263) was launched by AGT on 6 February and seed is available for the 2008 season. Espada is closely related to Gladius but fills the need for a variety that does not fail in drought conditions, can reliably achieve high grain yield under medium to high rainfall conditions, and can also help withstand the pressures that rust often poses in these environments. Espada is eligible for the APW grade.

Limited seed of Correll was released to growers in 2006, and due to the 2006 drought, seed supply was again limited for 2007 planting. Correll is a close relative of Yitpi but the drought tolerant parent RAC875 was also used in its breeding. Correll, like Yitpi, has adequate leaf and stripe rust resistance, CCN resistance, boron tolerance and is eligible for the AH grade. However Correll also provides good levels of stem rust resistance, now a serious problem for Yitpi. Correll tends to produce lower hectolitre weights than Yitpi. While Correll is very similar to Yitpi in most characteristics, Correll has proven to be far better adapted to the lower rainfall areas of southern Australia. Growers who purchased seed of Correll from a recognised seed retailer are also permitted to sell/trade seed of Correll to neighbours subject to the completion and return of a transaction form provided by AGT.

Table 1 presents a summary of the performance of these new varieties against other common and new varieties in NVT trials on upper EP over the past two drought affected years.

Table 2 presents the gross income ($/ha) for each variety, based on the mean yield of varieties across upper EP NVT trials in 2007 and the AWB prices delivered to Port Lincoln. Despite the low yielding season, Axe and Gladius have provided approximately $55/ha to $75/ha greater gross income than Wyalkatchem and Yitpi respectively. Across an estimated 680,000 ha of wheat on upper EP in 2007 this would have equated from $37 million to $52 million greater income to upper EP farmers in 2007.

In a recent issue of Ground Cover (Issue 72, Jan-Feb 2008) John Passoiura (CSIRO) summarised the outcomes of a recent national workshop on pre-breeding research on drought tolerance aimed at providing GRDC with direction on research issues (AGT breeders and management were not able to attend this meeting). One of the important points (listed first in the summary) coming from this workshop and presented in this article was;

"Because farmers get almost all of their income in moderate to good seasons and little or none during severe droughts, it is better to invest predominantly in ensuring that they can make the best of the moderate to good seasons. This conclusion was backed by the breeders, who pointed out that with the current EPR system, they too depend on moderate to good seasons for their income. If a new variety does well in poor seasons as well as good seasons then that's a bonus, but specifically targeting poor seasons does not interest them."

AGT does not support this conclusion. In contrast to this conclusion, we have observed that when the issues that limit yield in drought affected environments are dealt with by focussed breeding conducted within the target environment, we can also achieve solid yield performance in high rainfall situations. Even if the 2007 grain prices were halved in the above model these new varieties would still deliver substantial economic benefit to growers that

***Table 1 Summary of wheat yield results of upper Eyre Peninsula NVT trials in 2006 and 2007 drought years***

| Variety | 2007 | | 2006 | | Mean of drought years | |
|---|---|---|---|---|---|---|
| | Grain yield (t/ha) | % Yitpi | Grain yield (t/ha) | % Yitpi | Grain yield (t/ha) | % Yitpi |
| **Axe** | 0.72 | 139 | 0.52 | 140 | 0.64 | 140 |
| **Gladius** | 0.71 | 136 | 0.48 | 129 | 0.61 | 135 |
| **Excalibur** | 0.64 | 122 | 0.50 | 134 | 0.58 | 127 |
| **Espada** | 0.68 | 130 | 0.43 | 117 | 0.58 | 126 |
| **Correll** | 0.68 | 130 | 0.43 | 116 | 0.57 | 126 |
| **Krichauff** | 0.65 | 125 | 0.45 | 122 | 0.57 | 124 |
| **Peake** | 0.63 | 121 | 0.40 | 108 | 0.54 | 117 |
| **Guardian** | 0.59 | 114 | 0.42 | 114 | 0.52 | 114 |
| **Wylkatchem** | 0.58 | 111 | 0.43 | 116 | 0.52 | 113 |
| **Derrimut** | 0.55 | 105 | 0.36 | 97 | 0.47 | 102 |
| **Yitpi** | 0.52 | 100 | 0.37 | 100 | 0.46 | 100 |
| **Pugsley** | 0.51 | 99 | 0.35 | 95 | 0.45 | 97 |
| **Frame** | 0.46 | 89 | 0.33 | 90 | 0.41 | 89 |

could be the difference between financial survival and insolvency. It is unfortunate that AGT staff were not able to attend this important GRDC workshop, however we can assure readers that AGT will continue to direct substantial breeding effort at the low rainfall environments including upper Eyre Peninsula.

With support from SAGIT, AGT is also working closely with the Australian Centre for Plant Functional Genomics (ACPFG) and SARDI staff at Minnipa Agriculture Centre, to identify the genetic basis to the drought tolerance expressed in these varieties, and also in other germplasm, and by doing so greatly enhance the future rate of genetic progress for drought tolerance in wheat.

***Table 2 Gross income from different varieties using mean yield of 2007 upper EP NVT trials***

| Variety | AWB Grade | Gross Income* ($/ha) |
|---|---|---|
| Axe | AH | 279 |
| Gladius | AH | 275 |
| Correll | AH | 264 |
| Espada | APW | 260 |
| Krichauff | ASW | 246 |
| Peake | AH | 244 |
| Excalibur | ASW | 242 |
| Guardian | APW | 226 |
| Wylkatchem | APW | 222 |
| Derrimut | AH | 213 |
| Yitpi | AH | 202 |
| Pugsley | APW | 195 |
| Frame | APW | 176 |

** AH $388/t; APW $383/t; ASW $378/t*

# Types of work in this publication

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

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

# Field Evaluation of Barley Lines for Salinity Tolerance

Research

**Stewart Coventry, Daniel Smith and Jason Eglinton**
University of Adelaide

## Key messages

- **Salinity occurs in many soils of the agricultural production zone.**
- **Leaf boron symptoms and sodium levels do not relate to grain yield.**
- **Flagship has the ability to achieve high yields despite very high leaf boron symptoms.**

## Why do the trial?

The aim of this trial was to characterise barley lines for tolerance to salinity in the field. Hostile subsoils are prevalent throughout the southern Australian cropping zone and include physical, biotic, and chemical constraints that inhibit healthy root growth and consequently water and nutrient capture in the root zone. Two prevalent chemical toxicities are high sodium and boron, and the University of Adelaide (UA) Barley Program has recently investigated these abiotic stresses in the field. Boron toxicity tolerance has been thoroughly investigated in barley but relatively little attention has focused on salinity tolerance, and nothing is known of the combined influence of these stresses. Lots of work on boron tolerance has failed to deliver a yield advantage, yet combining boron and sodium tolerance may be the answer to improved productivity.

## How was it done?

Trial sites at Whitwarta and Georgetown were chosen to characterise salinity tolerance of barley. Each site had high pH and uniform distribution of electrical conductivity (EC), an indicator of salinity across the trial at the 0-30 and 30-60 cm levels as characterised by soil coring. The EC (sampled mid growing season) at Whitwarta and Georgetown respectively for the 0-30 and 30-60 cm depths was 3.6/8.5 and 1.9/7.2 dS/cm. An EC of 8 dS/cm is considered high enough to cause a 25% yield reduction in barley. A set of genetically diverse barley including Australian and international varieties and lines with putative salinity tolerance were planted in a randomised block design with three replications.

Trials were sown on 31 May and 4 June for Georgetown and Whitwarta respectively, at a seeding rate of 145 plants/m$^2$ in 3.2 x 1.2 m plots. For each plot, the fully expanded penultimate leaf (leaf below the flag leaf) was taken from 10 random plants, and analysed for sodium and potassium content by flame photometry. The sodium to potassium ratio (NaK) was used to determine the proportion of potassium taken up in preference to sodium, an indicator of salinity tolerance. At Whitwarta each plot was assessed for boron by visually scoring leaf symptom expression. Grain yield was assessed from both sites.

## What happened?

Whitwarta was characterised by very low rainfall that exacerbated boron leaf symptom expression and moisture stress in plants from early in the growing season. Georgetown experienced sufficient moisture during the growing season. This was reflected in the rankings of genotypes for yield (Table 1), with later maturing varieties such as Capstan and WI4262 performing better at Georgetown, and the early maturing variety WI4025 at Whitwarta. Some international genotypes matched the yield of Australian lines in these environments, but Australian feed varieties took top honours along with malting varieties Flagship and Sloop.

There was not a correlation between Na uptake, NaK discrimination, or boron leaf symptom score and yield. At both sites potassium uptake was higher than sodium as expected since the penultimate leaf was taken at full leaf expansion. Sodium levels were within an expected discriminative range comparable to controlled environment experiments. The variety Chevron had the lowest Na uptake and NaK ratio (indicating discrimination) at both sites with comparatives including Mundah, WI3788, Sloop, YU6472 and Taixing 9425. Some other varieties showed low Na and NaK only in specific environments, the two most notable being Capstan and Keel. Interestingly Flagship maintained yield across these environments despite having high sodium uptake.

## What does this mean?

It appears from this data that consistent differences in Na uptake and NaK discrimination across sites and between genotypes can be found from field leaf sampling. Also there is no clear relationship between these parameters and yield within this diverse set of barley lines, but that does not mean there is none since a number of different traits are involved in salinity tolerance.

A more powerful approach is to use populations segregating for these traits to examine the influence of both boron and sodium on yield. This will be conducted in 2008. It is likely that true tolerance to salinity (high sodium uptake and yield) is more important than sodium uptake and discrimination alone. If tolerance is defined as yield despite high tissue sodium levels, then Flagship may represent the preferred ideotype, as it yields well in both environments despite accumulating the highest amount of sodium. This is an interesting parallel to the performance of Flagship under boron stress, where it typically exhibits high yield despite very high leaf symptoms.


## Acknowledgements

The Authors would like to thank the financial support of the MPBCRC, the UA Barley Program field team for trial management, and the support of Alan Mayfield, Scott Crawford (Georgetown), and Andy Wilson (Whitwarta).


GRDC Grains Research & Development Corporation

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

THE UNIVERSITY OF ADELAIDE AUSTRALIA

***Table1*** ***Yield (t/ha), Na uptake (mm/kg dry weight), NaK discrimination (NaK) of the penultimate leaf and boron (B) leaf symptom score of barley lines (9=severe symptoms) grown in saline sites at Whitwarta and Georgetown, 2007***

| | Whitwarta | | | | | | Georgetown | | |
|---|---|---|---|---|---|---|---|---|---|
| Barley Line | Yield | Na | NaK | B | | Barley Line | Yield | Na | NaK |
| ***Mundah*** | **1.76** | **109** | **0.13** | 7 | | Capstan | **2.90** | 119 | **0.20** |
| WI4025 | **1.73** | 155 | 0.17 | 4 | | Fleet | **2.74** | 211 | 0.34 |
| ***Keel*** | **1.72** | **98** | **0.12** | 4 | | ***Mundah*** | **2.61** | **139** | **0.21** |
| ***Chevron*** | **1.64** | **63** | **0.08** | 7 | | Keel | **2.49** | 177 | 0.24 |
| CM72 | **1.63** | 153 | 0.18 | 2 | | Flagship | **2.49** | 255 | 0.28 |
| Flagship | **1.62** | 187 | 0.19 | 8 | | WI3788 | **2.46** | **146** | **0.25** |
| WI3788 | **1.60** | **109** | **0.13** | 5 | | Buloke | **2.40** | 242 | 0.36 |
| Sloop | **1.58** | **82** | **0.13** | 6 | | WI4262 | **2.36** | 271 | 0.36 |
| Rihane-03 | 1.42 | 137 | **0.13** | 4 | | Rihane-03 | **2.30** | **177** | **0.21** |
| Gairdner | 1.41 | **118** | 0.16 | 5 | | Sloop | **2.28** | **166** | **0.23** |
| Schooner | 1.31 | 181 | 0.20 | 5 | | WI3416-1572 | 2.15 | 212 | 0.30 |
| Chebec | 1.25 | 186 | 0.20 | 3 | | Gairdner | 2.12 | **190** | 0.29 |
| Skiff | 1.23 | 152 | 0.15 | 3 | | Skiff | 2.06 | 234 | 0.33 |
| Fleet | 1.23 | 198 | 0.21 | 4 | | Chebec | 1.88 | 220 | 0.27 |
| Buloke | 1.23 | 201 | 0.21 | 6 | | CM72 | 1.85 | **165** | **0.25** |
| Capstan | 1.08 | 136 | 0.16 | 6 | | Maritime | 1.83 | **173** | 0.26 |
| WI3416-1572 | 0.99 | 167 | 0.18 | 7 | | Chevron | 1.80 | **116** | **0.18** |
| YU6472 | 0.97 | **116** | **0.13** | 5 | | WI4025 | 1.75 | 297 | 0.33 |
| Franklin | 0.85 | 207 | 0.27 | 4 | | Schooner | 1.64 | **198** | **0.23** |
| WI4262 | 0.83 | 166 | 0.17 | 1 | | Taixing 9425 | 1.56 | **175** | **0.18** |
| Taixing 9425 | 0.74 | **85** | **0.13** | 9 | | YU6472 | 1.49 | **127** | **0.19** |
| Maritime | 0.73 | 182 | 0.22 | 4 | | Franklin | 1.32 | **143** | **0.24** |
| Yuyaoxiangtiaxerleng | 0.19 | **119** | 0.16 | 3 | | Yuyaoxiangtiaxerleng | 0.92 | **122** | **0.22** |
| *LSD (P=0.05)* | *0.29* | *64* | *0.04* | | | *LSD (P=0.05)* | *0.31* | *88* | *0.08* |

***Note:*** *For the barley line column, those indicated bold italics have significantly higher yield combined with low sodium uptake. For the individual traits (Yield, Na, NaK) those in bold are significantly different than those unbolded. Flagship is underlined as having high yield despite high sodium uptake.*

*EPARF Cereal Root Disease field day, Minnipa 2007.*

# Section 2

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

**Section editor:**
**Amanda Cook**
SARDI,
Minnipa Agricultural Centre

# Break Crops

## The total 2007 production figures for Eyre Peninsula were approximately 12 000 t of peas, 24 000 t of lupins, 4 000 t of beans and 44 000 t of canola.

***Field Pea Variety Trial Yield Performance at Eyre Peninsula sites***
*2007 (t/ha) and long term (2000–06) yields expressed as a % of Kaspa's yield)*

| Variety | Eyre Peninsula | | | | | |
|---|---|---|---|---|---|---|
| | 2007 | | | 2000–06~ | | |
| | Rudall | Minnipa | Yeelanna | Rudall/Lock | Minnipa | Yeelanna |
| Bundi | 1.05 | 1.09 | 0.95 | 97* | 98 | 96 |
| Kaspa | 0.69 | 1.04 | 1.09 | 100 | 100 | 100 |
| Parafield | 0.86 | 0.99 | 1.31 | 97 | 95 | 96 |
| Sturt | 1.04 | 1.09 | 1.42 | 101 | 99 | 97 |
| SW Celine | 0.91 | | 1.39 | | | 96* |
| SW Circus | 0.85 | | 1.14 | | | |
| Yarrum | 0.85 | 0.88 | 1.28 | 94* | 92 | 97 |
| Kaspa's yield (t/ha) | 0.69 | 1.04 | 1.09 | 1.88 | 1.31 | 3.06 |
| Date sown | 18/5 | 8/5 | 26/5 | | | |
| Soil type | S | SL | C | | | |
| pH (water) | 7.7 | 8.8 | 8 | | | |
| Apr–Oct rainfall (mm) | 137 | 141 | 220 | | | |
| Site stress factors | de,dl ht | de,dl ht | de,dl ht | | | |

***Soil type:*** *S=sand, C=clay, L=loam, H=heavy, M=medium, Li=light, / = over*
***Site Stress Factors:*** *dl=post flowering moisture stress, de=pre flowering moisture stress ht=high temperatures during flowering/pod fill*
**Varieties have only had 2 years evaluation at these sites, treat with caution*
*~2007 long term figures not available at time of print*
***Data source:*** *SARDI/PBA/GRDC & NVT trials (long term data based on weighted analysis of sites)*
***More information:*** *Larn McMurray (08) 8842 6265 or e-mail mcmurray.larn@saugov.sa.gov.au*

***Canola yield at Minnipa in 2007 (t/ha) and long term (2000–06) as a % of AG-Outback or ATR-Stubby and grain quality at Lock in 2007***

| Variety | 2007 | 2000-2006 | | Lock grain quality 2007 | | |
|---|---|---|---|---|---|---|
| | Minnipa | Lock | Minnipa | Oil (%) | Protein (%) | Glucosinolates |
| AG-Comet | | 95 | 93 | | | |
| AG-Muster | 0.18 | 101 | 100 | 32.9 | 31.0 | 10 |
| AG-Outback | 0.22 | 100 | 100 | 34.0 | 30.5 | 8 |
| AG-Spectrum | 0.17 | | 95 | 33.5 | 30.4 | 6 |
| AV-Jade | 0.15 | | 92 | 36.0 | 30.3 | 8 |
| AV-Opal | | 96 | 92 | | | |
| Dune | 0.24 | | | 36.1 | 31.3 | 14 |
| Hyola 50 | 0.16 | 118 | 124 | 34.8 | 30.5 | 5 |
| Pioneer 44C11 | | 109 | 108 | | | |
| Pioneer 44C73 | 0.17 | 95 | 89 | 34.1 | 29.9 | 5 |
| Pioneer 44Y06 | 0.26 | 100 | 97 | 35.2 | 29.5 | 6 |
| Pioneer 45Y77 | | 100 | 99 | | | |
| Rivette | 0.27 | 102 | 102 | 34.1 | 31.2 | 6 |
| Tarcoola | 0.27 | 99 | 102 | 36.9 | 29.9 | 6 |
| Warrior CL | 0.13 | | 77 | 34.1 | 30.9 | 10 |
| Ag-Outback yield | | 1.25 | 0.75 | | | |
| ATR Banjo | 0.24 | 96 | 92 | 34.9 | 29.8 | 12 |
| ATR Beacon | 0.21 | 99 | 92 | 33.0 | 31.8 | 11 |
| ATR Cobbler | 0.43 | | 99 | 34.1 | 30.3 | 15 |
| ATR Stubby | 0.39 | 100 | 100 | 34.1 | 28.9 | 13 |
| BravoTT | 0.28 | 103 | 102 | 34.5 | 31.3 | 15 |
| CB Boomer | 0.29 | 96 | 91 | 33.8 | 30.6 | 5 |
| CB Tanami | 0.50 | | 103 | 33.8 | 29.3 | 9 |
| CBA Trigold | | 101 | 98 | | | |
| Rottnest TTC | 0.36 | | 92 | 33.6 | 30.7 | 7 |
| Surpass 501 TT | 0.19 | 95 | 88 | 36.1 | 30.1 | 3 |
| Hurricane TT | 0.28 | | | 33.8 | 30.7 | 7 |
| TawrifficTT | 0.29 | | | 37.1 | 29.7 | 6 |
| TornadoTT | 0.33 | 101 | 99 | 35.0 | 30.0 | 5 |
| ATR-Stubby yield | | 1.33 | 0.65 | | | |
| Date sown | 04 May | | | | | |
| Soil type | SL | | | | | |
| pH (water) | 8.2 | | | | | |
| Apr–Oct rainfall (mm) | | | | | | |
| Stress factors | de, dl | | | | | |

***Soil type:*** *S=sand, C=clay, L=loam, H=heavy, M=medium, Li=light, F=fine, K=course, lime=limestone / divides topsoil from subsoil*
***Site stress factors:*** *de=moisture stress pre flowering, dl=moisture stress post flowering, w=weeds, lo=lodging, sh=shattering, pe=poor establishment, s=sulphur deficiency, ap=aphids, hd=herbicide damage, bl=blackleg, wind=wind loss, ls=late sown, sn=snails, f=frost*
***More information:*** *Trent Potter (08) 8762 9132 or e-mail potter.trent@saugov.sa.gov.au*

***Chickpea Variety Trial Yield Performance at Eyre Peninsula sites***

*2007 and long term (2000–06) yields expressed as a % of Howzat's - desi chickpeas or Genesis 090's - kabuli chickpeas yield*

| Variety | Eyre Peninsula | | | |
|---|---|---|---|---|
| | 2007 | | 2000–06~ | |
| | Cockaleechie | Rudall** | Cockleechie | Rudall/Lock |
| *Desi trials* | | | | |
| Genesis 508 | 70 | 41 | 88 | 85 |
| Genesis 509 | 70 | 118 | 95 | 96 |
| Genesis 079# | 89 | 171 | | |
| Genesis 090# | 70 | 53 | 97 | 96 |
| Howzat | 100 | 100 | 100 | 100 |
| Sonali | 80 | 182 | 99 | |
| Howzat's yield (t/ha) | 1.55 | 0.17 | 1.75 | 0.99 |
| *Kabuli trials* | No Valid Result Variable Data | | | |
| Almaz | | | 87 | |
| Genesis 079 | | | 108 | |
| Genesis 090 | | | 100 | |
| Genesis 114 | | | 84 | |
| Nafice | | | 82 | |
| Genesis 090's yield (t/ha) | | | 1.69 | |
| Date sown | 5/6 | 18/5 | | |
| Soil type | C | S | | |
| pH (water) | 7.7 | 7.7 | | |
| Apr–Oct rainfall (mm) | 263 | 137 | | |
| Site stress factors | dl | de,dl,ht | | |

*# Kabuli line* ***** = Low yield due to drought, use caution.***

***Soil type:*** *S = sand, C = clay, L = loam, H = heavy, M = medium, Li = light, / = over*

***Site Stress Factors:*** *de = pre flowering moisture stress, dl = post flowering moisture stress, ht = high temperatures during flowering/pod fill*

*~2007 long term figures not available at time of print*

***Data source:*** *SARDI/PBA/GRDC & NVT trials (long term data based on weighted analysis of sites)*

***More information:*** *Larn McMurray (08) 8842 6265 or e-mail mcmurray.larn@saugov.sa.gov.au*

***SA Lentil Variety Trial Yield Performance at Eyre Peninsula sites***
*2007 and long term (2000–06) yields expressed as a % of Nugget's yield*

| Variety | Eyre Peninsula | | | |
|---|---|---|---|---|
| | 2007 | | 2000–06~ | |
| | Rudall | Yeelanna | Cockaleechie | Yeelanna |
| Aldinga | No Valid Result Droughted | No Valid Result Droughted | 96 | 96 |
| Boomer | | | | |
| Digger | | | 96 | 97 |
| Matilda | | | 96 | 95 |
| Nipper | | | 100 | 100 |
| Northfield | | | 93 | 93 |
| Nugget | | | 100 | 100 |
| Nugget's yield (t/ha) | | | 2.10 | 2.25 |
| Date sown | 18 May | 26 May | | |
| Soil type | S | C | | |
| pH (water) | 7.7 | 8 | | |
| Apr–Oct rainfall (mm) | 137 | 220 | | |
| Site stress factors | de,dl,ht | de,dl, ht | | |

***Soil type:*** *S = sand, C = clay, L = loam, H = heavy, M = medium, Li = light, / = over*
***Site Stress Factors:*** *de = pre flowering moisture stress, dl = post flowering moisture stress, ht = high temperatures during flowering/pod fill*
*~2007 long term figures not available at time of print*
***Data source:*** *SARDI/PBA/GRDC & NVT trials (long term data based on weighted analysis of sites)*
***More information:*** *Larn McMurray (08) 8842 6265 or e-mail mcmurray.larn@saugov.sa.gov.au*

***Lupin Variety Yield Performance at Eyre Peninsula sites***
*2007 and long term (2000–06) yields expressed as % of Mandelup's yield*

| Variety | 2007 | | | 7 year average (2000–06) | | |
|---|---|---|---|---|---|---|
| | Tooligie | Ungarra | Wanilla | Tooligie | Ungarra | Wanilla* |
| Coromup | No valid results | 104 | 106 | n.a. | n.a. | n.a. |
| Jenabillup | | 83 | 106 | n.a. | n.a. | n.a. |
| Jindalee | | 55 | 80 | 94 | 96 | 97 |
| Mandelup | | 100 | 100 | 100 | 100 | 100 |
| Moonah | | 60 | 99 | 91 | 94 | 95 |
| Wonga | | 80 | 94 | 91 | 94 | 94 |
| Mandelup yield (t/ha) | 0.26 | 0.75 | 2.31 | 1.38 | 2.31 | 2.85 |
| Date sown | 05 May | 15 May | 09 May | | | |
| Soil type | Sand | Sand | Sand | | | |
| pH (water) | 6.7 | 6.1 | 7.4 | | | |
| Apr–Oct rainfall (mm) | 199 | 207 | 250 | | | |
| Site stress factors | dl, f, ht, sh | dl, e | dl | | | |

*Tooligie 2007 NVT trials harvest data not released due to low yields and high variability.*
** Wanilla Long Term yield is a composite of Kapinnie (2000–02) and Wanilla (2003–06) results.*
***Site stress factors:*** *de=pre-flowering moisture stress, dl=post-flowering moisture stress, f=frost, sh=shattering, ht=high temperatures during flowering/podfill*
***Data source:*** *SARDI/GRDC and NVT trials (long term data based on weighted analysis of sites)*
***More information:*** *Jim Egan (08) 8688 3424 or e-mail egan.jim@saugov.sa.gov.au*

***Faba Bean Variety Yield Performance at Eyre Peninsula sites***
*2007 and long term (2000–06) yields expressed as % of Farah's yield*

| Variety/Line | 2007 | | | 7 year average (2000–06) | | |
|---|---|---|---|---|---|---|
| | Cockaleechie | Rudall | Minnipa | Cockaleechie | Lock / Rudall * | Minnipa |
| Cairo | 111 | | 79 | 96 | 98 | 100 |
| Doza (SP01040) | 95 | | 114 | n.a. | n.a. | n.a. |
| Farah | 100 | | 100 | 100 | 100 | 100 |
| Fiesta | 110 | No valid results | 92 | 100 | 101 | 99 |
| Fiord | 123 | | 78 | 98 | 94 | 90 |
| Manafest | 90 | | 70 | 90 | 91 | 87 |
| Nura | 104 | | 32 | 104 | 103 | 101 |
| Farah yield (t/ha) | 1.79 | 0.22 | 0.19 | 3.42 | 1.76 | 0.92 |
| Date sown | 10 May | 18 May | 16 May | | | |
| Soil type | C | S | SL | | | |
| pH (water) | 7.7 | 7.7 | 8.2 | | | |
| Apr–Oct rainfall (mm) | 263 | 137 | 141 | | | |
| Site stress factors | dl | dl, ht | de, dl, ht | | | |

*Rudall 2007 NVT trials harvest data not released due to low yields and high variability.*
** Lock/Rudall Long Term yield is a composite of Lock (1999–2004) and Rudall (2005) results.*
***Soil type:*** *S=sand, C=clay, L=loam*
***Site stress factors:*** *de=pre-flowering moisture stress, dl=post-flowering moisture stress, ht=high temperatures during flowering/podfill*
***Data source:*** *SARDI/GRDC, NVT trials and PBA - Australian Faba Bean Breeding Program (long term data based on weighted analysis of sites)*
***More information:*** *Jim Egan (08) 8688 3424 or e-mail egan.jim@saugov.sa.gov.au*

# Types of work in this publication

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

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

# Low Rainfall Canola and Mustard

Research

**Trent Potter[1], Willie Shoobridge[2] and Leigh Davis[2]**

[1]SARDI, Struan, [2]SARDI, Minnipa

**Almost Ready**

**Location**
Minnipa Ag Centre

**Rainfall**
Av. annual: 325 mm
Av. GSR: 246 mm
2007 total: 286 mm
2007 GSR: 141 mm

**Yield**
Potential: Canola 0.8 t/ha
Actual: (Conv.) Ag Outback 0.1 t/ha, (TT) ATR Stubby 0.13 t/ha

**Paddock History**
2006: Wheat
2005: Barley
2004: Wheat

**Soil Type**
Loam

**Plot Size**
10 m x 1.5 m x 3 reps

**Yield Limiting Factors**
Poor germination, aphids, drought

## Key messages

- **Canola and mustard yields were low in 2007.**
- **Only early maturing lines produced reasonable yields.**

## Why do the trial?

The Brassica trials aim to develop lines that are better adapted to low rainfall conditions to increase the break crop options available for farmers. The low rainfall zone has few break crop options and canola has value in years when an early break occurs. Problems have included low yields and poor oil content with late breaks and dry finishes. Research has been done over the past 6 years to develop early maturing canola and mustard lines that have higher grain yield and oil contents. This work follows up from previous reports in the past EPFS Summaries.

## How was it done?

A range of early maturing canola and mustard lines and varieties were tested at Minnipa and Lock. Plot size was 8 rows at 18 cm row spacing by 10 m long. All agronomic treatments were as normal farm practice. Grain yield was measured by machine harvest at Minnipa. Grain yields at Lock were too low to report but grain quality was measured on these samples.

## What happened?

Canola yields in 2007 were low with the poor finish to the season. With these low yields the sites were also very variable, resulting in more unreliable yield estimates than usual. Long term results for Minnipa between 2000 and 2006 are included where entries have been in trials for at least two years. Highest long term yields among the conventional varieties were Hyola 50, 44C11 and Tarcoola. For the Triazine tolerant (TT) varieties, only BravoTT had a higher long term yield than ATR-Stubby. However, Tanami produced high grain yields in 2007 and is worth growing. Further testing is needed for many of the varieties that will be commercially marketed in 2007 or 2008.

A range of new varieties have been released for low rainfall areas in 2007 and for 2008. While little information is available due to the drought conditions in 2006 and low rainfall in 2007, several of these show promise.

**Varieties that may be suited to low rainfall areas of Eyre Peninsula, upper North and Murray Mallee:**

(Blackleg ratings are from 2006, updated ratings were not available at the time of writing)

***Conventional varieties***

**AG-Muster.** New release (coded AGC323). Early maturing. High to very high yielding. Tested in NVT trials in 2005. Moderate oil and protein content, similar to AG-Outback. Blackleg rating 6. Bred by Ag-Seed Research. Marketed by Crop Care Seed Technologies.

**Hyola® 50.** New release (coded CBI4403). Mid maturing hybrid. High yielding. Tested in NVT trials in 2005 and 2006. High oil and moderate protein content. Blackleg rating 9. Bred by Canola Breeders International. Marketed by Pacific Seeds. Probably too late for low rainfall areas of EP.

**Tarcoola.** New release (coded BLN2026*SL902). Early maturing variety for low rainfall areas. Tested in NVT trials in 2005 and 2006. High oil and moderate protein content in 2005 trials. Blackleg rating 6. Bred by NSW DPI and SARDI. Marketed by Nuseed Pty Ltd.

***Triazine tolerant (TT) varieties***

Triazine tolerant (TT) varieties have lower yield and oil content than conventional varieties when sown in comparative trials with non-TT varieties. However, they can give good yields in weedy paddocks, when sprayed with atrazine and/or simazine herbicides. Yield comments are made in comparison with other TT varieties.

**ATR-Banjo.** New release for NSW (coded AGT346). Released in SA and Vic in 2006. Early to mid maturing. Tested in NVT trials in 2005 and 2006. Moderate oil and high protein content. Blackleg rating 7. Developed by Ag-Seed Research and DPI-Victoria. Marketed by Crop Care Seed Technologies. Too late for low rainfall areas except for a very early start.

**CB™ Tanami.** New release (coded CBTT-061). Early maturing. Targeted for low rainfall areas. First year of testing in NVT trials in 2006. Canola Breeders WA indicate high yielding, vigorous early growth, tolerant of drought stress and moderate oil and protein content. Blackleg rating 6. Bred by CBWA, and marketed by Graintrust in Eastern Australia. An End Point Royalty (EPR) applies.

**ATR-Cobbler.** (coded NMT040). Early to early-mid maturing. Nuseed indicate the variety to be very high yielding. Tested in NVT trials 2006 and 2007. Medium-short height. Blackleg rating 7.0P. Developed by Nugrain. Marketed by Nuseed.

**Rottnest TTC.** (coded ATR-501). Early – Mid maturing. Crop Care indicate the variety is high yielding with excellent vigour with moderate oil content. Blackleg rating 7.5. Medium height with good uniformity and shatter resistance. Developed by Ag-Seed Research and DPI-Victoria. Marketed by Crop Care Seed Technologies.

**Hurricane TT.** New release (coded PacT2202). Early-mid maturing variety. Pacific Seeds indicate good yield, oil and protein content. Ideally fits low to medium rainfall areas, exhibits good vigour. No official blackleg rating. Pacific Seeds anticipate blackleg rating 7.5. First year of testing in NVT trials in 2007. Bred and marketed by Pacific Seeds.

***Clearfield varieties***

**44C79.** New release (coded NS6082). Early maturing, similar to 44C73. Pioneer indicate good vigour, high yield and oil content. Blackleg rating 7 (provisional). Targeted to replace 44C73. Limited seed quantities in 2008. Not yet tested in NVT trials. Bred and marketed by Pioneer Hi-Bred Australia.

***Juncea canola***

The first juncea canola variety (Dune) was marketed in very small quantities in 2007. This is a conventional variety with no herbicide tolerance but may fit into low rainfall areas. Juncea canola was evaluated in NVT trials for the first time in 2007. In 2007 the juncea canola variety Dune was only to be marketed in NSW and Victoria under a closed loop marketing option but greater quantities of seed may allow this variety and possibly Oasis CL (see below) to be sold on Eyre Peninsula in 2008.

**Oasis CL.** New release (coded J05Z-08920). First herbicide tolerant Clearfield Juncea canola. Seed quality as good as, or slightly better than Dune. Very limited seed quantities for 2008. Bred by DPI-Victoria and Viterra (Canada). Marketed by Pacific Seeds.

## What does this mean?

Although grain yields were lower than in previous years, the data adds to the long term results and confirms which varieties have promise in low rainfall areas. In addition, over the past five years, single plant selections have been taken from canola and mustard lines at Minnipa and Lameroo. These selections have been tested in S1 trials in previous years and the better lines have been promoted into S2 trials that allow wider scale testing throughout Australia. Results from S3 trials at Minnipa in 2007 showed that many of these selections are producing higher grain yields than commercial controls and have promise for future years. Results from S3 trials at Minnipa are presented in Tables 1 and 3. A triazine tolerant canola trial was also sown at the break of the season and produced higher grain yields by extending the growing season (Table 2).

We have now developed some canola lines that are much better suited to low rainfall areas. Early maturing conventional varieties such as Tarcoola are well suited to these conditions and can be considered an option when we get early to relatively early seasonal breaks. Triazine tolerant varieties such as ATR-Stubby, Tanami and several others also are good options when broad leaf weeds mean that the herbicide tolerant canola is needed. Less developed lines are also showing that further improvements are going to be achieved, making canola a safer and more reliable option in low rainfall districts.

We have been developing mustard as a possible feedstock for biodiesel over the past few years with trials initially at Minnipa and Lameroo. Several mustard lines have been developed (Tables 4 and 5) and the line SARDI515M is a possible release in future. These lines have similar quality to the juncea canola but lower levels of oleic acid, therefore they are not suitable as a food crop. Table 5 shows the yields obtained from earlier generation lines with the best lines likely to be promoted into wider scale testing.

Grains Research & Development Corporation

*Table 1 Grain yield at Minnipa in 2007 S3TT canola trial*

| Entry | t/ha | % site mean |
|---|---|---|
| SARDI613TT | 0.49 | 148 |
| SARDI620TT | 0.43 | 129 |
| SARDI519TT | 0.42 | 127 |
| SARDI614TT | 0.41 | 125 |
| SARDI609TT | 0.41 | 124 |
| SARDI617TT | 0.41 | 124 |
| SARDI524TT | 0.38 | 114 |
| ATR-Stubby | 0.34 | 102 |
| BravoTT | 0.28 | 84 |
| SARDI621TT | 0.26 | 79 |
| CB-Boomer | 0.25 | 77 |
| SARDI624TT | 0.20 | 61 |
| ATR-Summitt | 0.18 | 53 |
| ATR-Barra | 0.17 | 53 |
| Site mean | 0.33 | |
| CV% | 6.2 | |
| *LSD (P=0.05)* | *0.036* | |

*Table 2 Grain yield at Minnipa in 2007 early sown TT canola trial*

| Entry | t/ha | % site mean |
|---|---|---|
| CB Trigold | 0.63 | 153 |
| CB Tanami | 0.54 | 131 |
| ATR-Cobbler | 0.45 | 109 |
| SARDI519TT | 0.43 | 104 |
| Trilogy | 0.40 | 98 |
| RottnestTTC | 0.40 | 97 |
| SARDI524TT | 0.39 | 96 |
| ATR-Stubby | 0.38 | 93 |
| BravoTT | 0.33 | 80 |
| TornadoTT | 0.29 | 72 |
| ATR-Banjo | 0.19 | 45 |
| Site mean | 0.41 | |
| CV% | 4.60 | |
| *LSD (P=0.05)* | *0.042* | |

*Table 3 Grain yield at Minnipa in 2007 S3 conventional canola trial*

| Entry | t/ha | % site mean |
|---|---|---|
| SARDI601 | 0.32 | 127 |
| SARDI604 | 0.32 | 127 |
| SARDI602 | 0.32 | 125 |
| Tarcoola | 0.31 | 124 |
| SARDI607 | 0.27 | 106 |
| SARDI603 | 0.20 | 78 |
| Ag-Outback | 0.19 | 76 |
| Ag-Muster | 0.19 | 74 |
| Hyola 50 | 0.16 | 64 |
| Site mean | 0.25 | |
| CV% | 7.89 | |
| *LSD (P=0.05)* | *0.035* | |

*Table 4 Grain yield at Minnipa in 2007 S2 biodiesel mustard trial*

| Entry | t/ha | % site mean |
|---|---|---|
| SARDI515M | 0.40 | 134 |
| Tarcoola | 0.36 | 118 |
| JM06026 | 0.36 | 118 |
| JM06010 | 0.34 | 114 |
| JM06011 | 0.34 | 113 |
| SARDI631M | 0.33 | 111 |
| JM06012 | 0.32 | 105 |
| JM06019 | 0.31 | 101 |
| JM06009 | 0.29 | 98 |
| SARDI629M | 0.29 | 96 |
| SARDI518M | 0.24 | 81 |
| SARDI628M | 0.24 | 80 |
| Ag-Muster | 0.24 | 79 |
| Ag-Outback | 0.20 | 68 |
| Hyola 50 | 0.17 | 56 |
| Site mean | 0.30 | |
| CV% | 9.74 | |
| *LSD (P=0.05)* | *0.054* | |

*Table 5 Grain yield at Minnipa in 2007 S1x biodiesel mustard trial, earlier generation than the S2 entries in Table 4*

| Entry | t/ha | % site mean |
|---|---|---|
| SARDI728M | 0.45 | 143 |
| SARDI721M | 0.43 | 134 |
| SARDI736M | 0.41 | 129 |
| SARDI745M | 0.40 | 127 |
| SARDI746M | 0.40 | 126 |
| SARDI725M | 0.40 | 125 |
| SARDI731M | 0.39 | 123 |
| SARDI747M | 0.39 | 123 |
| SARDI727M | 0.38 | 120 |
| SARDI765M | 0.38 | 119 |
| SARDI741M | 0.37 | 118 |
| SARDI743M | 0.37 | 117 |
| SARDI744M | 0.37 | 115 |
| SARDI767M | 0.36 | 114 |
| SARDI631M | 0.36 | 113 |
| SARDI739M | 0.36 | 113 |
| SARDI724M | 0.35 | 111 |
| *Tarcoola* | 0.35 | 110 |
| SARDI733M | 0.35 | 110 |
| SARDI754M | 0.35 | 110 |
| SARDI515M | 0.35 | 110 |
| SARDI764M | 0.35 | 109 |
| SARDI719M | 0.34 | 108 |
| SARDI722M | 0.34 | 107 |
| SARDI749M | 0.34 | 107 |
| SARDI734M | 0.34 | 106 |
| SARDI737M | 0.34 | 106 |
| SARDI757M | 0.33 | 104 |
| SARDI723M | 0.33 | 103 |
| SARDI761M | 0.33 | 103 |
| SARDI756M | 0.33 | 102 |
| SARDI629M | 0.32 | 100 |
| SARDI760M | 0.32 | 100 |
| *Dune* | 0.31 | 97 |
| SARDI729M | 0.30 | 94 |
| SARDI753M | 0.30 | 94 |
| SARDI735M | 0.30 | 94 |
| SARDI718M | 0.30 | 94 |
| SARDI755M | 0.29 | 93 |
| SARDI740M | 0.29 | 92 |
| SARDI751M | 0.29 | 92 |
| SARDI726M | 0.29 | 91 |
| SARDI752M | 0.29 | 90 |
| SARDI732M | 0.28 | 89 |
| SARDI742M | 0.28 | 89 |
| SARDI758M | 0.28 | 87 |
| SARDI763M | 0.27 | 86 |
| SARDI750M | 0.27 | 86 |
| SARDI748M | 0.26 | 82 |
| AG-Outback | 0.25 | 78 |
| ATR-Stubby | 0.24 | 76 |
| AG-Muster | 0.24 | 75 |
| SARDI766M | 0.24 | 75 |
| SARDI759M | 0.24 | 75 |
| SARDI730M | 0.24 | 75 |
| SARDI720M | 0.23 | 71 |
| SARDI518M | 0.22 | 71 |
| SARDI762M | 0.22 | 70 |
| SARDI628M | 0.20 | 62 |
| SARDI738M | 0.19 | 61 |
| Site mean | 0.3175 | |
| CV% | 9.162 | |
| *LSD (P=0.05)* | *0.0506* | |

# How Do Mustards Stack Up Against Canola?

**Jim Egan[1], Brian Purdie[1], Ashley Flint[1], Willie Shoobridge[2] and Leigh Davis[2]**
[1]SARDI, Port Lincoln, [2]SARDI, Minnipa Agricultural Centre

Research


## Key messages

- **Tarcoola, an early conventional canola variety, was the highest or equal highest yielding oilseed in 4 of the 5 comparison trials with juncea canola and biodiesel mustards on Eyre Peninsula in 2007.**
- **As in 2006, the earlier flowering and maturing lines of both canola and mustards produced the highest yields, especially at lower rainfall sites where the dry spring was again particularly acute in 2007.**
- **The first canola quality mustard (juncea canola) varieties Dune and Oasis CL have been released, but only for closed loop marketing in NSW and Victoria at this stage.**
- **Mustard lines suitable for biodiesel production have been identified for potential release once commercialisation and marketing arrangements are resolved.**

## Why do the trials?

Mustard (*Brassica juncea*) has been promoted in recent years as a potentially better suited and more profitable break crop option than canola (*Brassica napus*) for low rainfall districts. Advantages claimed for mustard over canola include lower costs of production, mainly through the ability to direct head rather than windrow, better seedling vigour and greater yield stability over a range of seasonal conditions. Earlier trials have suggested that mustard tends to outyield canola when yields are below 1 to 1.5 t/ha.

An intensive breeding effort has been directed at mustard in Australia over the past decade and more to develop locally adapted varieties. Initially breeding was aimed at developing mustards with canola quality oil, termed juncea canola. The first such variety release, Dune, was marketed in NSW and Victoria in 2007 with a very limited amount of seed. A second juncea canola variety Oasis CL will be available in 2008, but again with limited seed supply. Oasis CL has "Clearfield" herbicide tolerance, which should improve its management flexibility in low rainfall districts.

More recently mustard breeding has broadened to develop lines with oil suitable for biodiesel production, i.e. lower oleic acid types. SARDI's biodiesel mustard breeding program has identified several lines with high oil yields in low rainfall environments that are now being considered for release.

As these mustard alternatives are likely to become available to Eyre Peninsula growers over the next few years, there is interest in seeing how they measure up against canola varieties in a range of environments across the Eyre Peninsula.

Similar comparisons in previous years have been reported in the EPFS Summary 2006, pp. 49-50 and EPFS Summary 2005, pp. 46-47, and earlier work on mustards in the EPFS Summary 2004, pp. 39-40.

## How was it done?

Oilseed comparison trials were sown adjacent to the NVT trials conventional canola trials at Lock, Yeelanna and Mount Hope, and at the Lower Eyre Agricultural Development Association (LEADA) "Better Canola" field site at Cummins, in 2007. These trials compared the two new juncea canola varieties (Dune and Oasis CL (in trials as J05Z-08920)) with two biodiesel mustard lines (SARDI 515M and SARDI 518M) and two conventional canola varieties (Tarcoola and AG-Muster). Another comparison of these lines (but not including Oasis CL) was taken from the S1 mustard breeding trial on Minnipa Agricultural Centre. All trial plots were the standard crop evaluation dimensions of 10 m long by 1.5 m (8 rows) wide, replicated three times in randomised blocks. A standard seeding rate equivalent to 4 kg/ha was used for all lines.

All trials were direct headed at maturity and grain yield measured. Grain samples were retained from all sites for oil analysis, but these results were not available at the time of writing.

## What happened?

Grain yield results are shown in Table 1. There was no shattering or grain loss prior to harvest in any of the canola or mustard lines at any of the sites. The early flowering and maturing conventional canola variety Tarcoola produced the highest or equal highest yields at four of the five sites, and was well ahead on average across all trials. Only at Yeelanna was Tarcoola significantly out-yielded, by the mustard line SARDI 518M.

Sowing time was in the optimum window of early to mid-May at all sites except Cummins, which was sown slightly later on 24 May. Despite the good start, the very dry spring conditions were not favourable for oilseeds, and early flowering and maturity were once again critical for lines to be able to set and fill pods, especially at the lower rainfall Lock and Minnipa sites.

Despite its superior performance, Tarcoola's yields were still well below the French and Schultz potential yield for canola. Tarcoola's yields ranged from 0.28 t/ha at Lock (25% of potential) to 1.72 t/ha at Mount Hope (81% of potential) (Table 1). Total April–October rainfall is an overestimate of the effective growing season rainfall at most sites in 2007, since crops matured earlier than normal under the dry conditions and the 20–30 mm rain that most sites received around the last week of October would have been too late to contribute to grain yield. It can be argued therefore that the observed yields were closer to the true potential than the calculations based on April–October rainfall indicate.

Oasis CL was the higher yielding of the two juncea canola varieties, being earlier flowering than Dune. However yields of Oasis CL were still well behind Tarcoola canola at all sites except Yeelanna, and averaged only 88% of Tarcoola.

The biodiesel mustard lines were also lower yielding to Tarcoola at all sites except Yeelanna. Again the better of these was the earlier flowering SARDI 515M, which averaged 91% of Tarcoola.

## What does this mean?

In the dry spring conditions of 2007, canola (cv. Tarcoola) outyielded the best mustard lines at 2 of the 5 trial sites across Eyre Peninsula, and was beaten for yield by a mustard in only one of these trials.

Reviewing the past three years of trials to compare canola and mustard performance, as reported in Eyre Peninsula Farming Systems Summary for 2005 and 2006, shows that:

There have been seven comparisons where yields were less than 1 t/ha: mustards outyielded canola in two trials, and canola ahead of mustards in one. No significant yield difference in four trials.

In seven trials, yields were above 1 t/ha: mustards out-yielded canola in one of these, and canola ahead in two. No significant yield difference in four trials.

On average, mustard and canola have yielded similarly, even at lower yielding sites, but there have been strong differences in yield between lines and varieties. In the dry spring years of 2006 and 2007, highest yields have been achieved with the earliest maturing lines, regardless of whether they are canola or mustard. This highlights the potential value of evaluating and selecting oilseed lines in our low rainfall environments, to develop and identify lines of both canola and mustard with superior adaptation to these environments.

Tarcoola canola has been developed in this way as a well-adapted low rainfall variety, and there are a number of lines in the low rainfall canola and biodiesel mustard selection programs that are showing improved adaptation to low rainfall conditions, as reported by Potter *et al*. in "Low Rainfall Canola and Mustard" on p. 36. Early generation juncea canola lines from the Victorian Department of Primary Industries breeding program are also being evaluated at Minnipa Agricultural Centre, to improve low rainfall adaptation characteristics over the initial juncea releases Dune and Oasis CL.

## Acknowledgements

Funding support from SAGIT for break crops development on Upper EP is gratefully acknowledged. Our thanks to Wayne Burton (Victorian Department of Primary Industries) and Trent Potter (SARDI) for supplying seed of juncea canola and biodiesel mustard lines for evaluation.

***Table 1** Yield of mustard lines (juncea canola and biodiesel types) compared with canola varieties at Eyre Peninsula sites in 2007. Yields are in t/ha and as % of Tarcoola canola (in brackets).*

| Variety/Line | Type | Lock | MAC | Yeelanna | Cummins | Mt Hope |
|---|---|---|---|---|---|---|
| **Dune** | Juncea canola | 0.14 (49%) | 0.31 (88%) | 1.3 (105%) | 0.97 (63%) | 1.21 (70%) |
| **Oasis CL** | Juncea canola | 0.26 (90%) | Not tested | 1.25 (100%) | 1.31 (85%) | 1.31 (76%) |
| **SARDI 515M** | Biodiesel | 0.21 (76%) | 0.35 (99%) | 1.26 (101%) | 1.41 (91%) | 1.48 (86%) |
| **SARDI 518M** | Biodiesel | 0.18 (62%) | 0.22 (64%) | 1.48 (119%) | 1.15 (75%) | 1.38 (80%) |
| **AG-Muster** | Conv. canola | 0.06 (21%) | 0.24 (68%) | 1.35 (108%) | 1.45 (94%) | 1.73 (101%) |
| **Tarcoola** | Conv. canola | 0.28 (100%) | 0.35 (100%) | 1.25 (100%) | 1.54 (100%) | 1.7 (100%) |
| ***LSD (P=0.05)*** | | *0.06* | *0.05* | *0.11* | *0.13* | *0.15* |
| **Date sown** | | 5 May | 14 May | 9May | 24May | 11 May |
| **Apr–Oct rainfall (mm)** | | 169 | 141 | 217 | 223 | 250 |
| **Potential yield (t/ha)** | | 1.10 | 1.08 | 1.77 | 1.75 | 2.13 |
| **Tarcoola yield % of potential** | | 25% | 32% | 71% | 88% | 81% |

*Potential yield calculated using French and Schultz formula.*

# Field Pea Improvement for Low Rainfall Regions

Research

**Larn McMurray[1], Tony Leonforte[3], Jenny Davidson[4], Matt Dare[1], Willie Shoobridge[2] and Mark Bennie[1]**

[1]SARDI, Clare; [2]SARDI, Minnipa Agricultural Centre, [3]DPI Victoria, Horsham, [4]SARDI, Waite

## Key messages

- **Advanced breeding lines from Pulse Breeding Australia, similar to Kaspa in plant type but with earlier and longer flowering, improved yield stability and substantially higher yields in dry seasons, performed well in 2007 and are being seed increased for possible release in 2010.**
- **Early sowing of field peas is essential for economic yields in dry years in low rainfall environments, providing frost, weed and blackspot risks are considered.**
- **Sowing field peas on the season break will increase blackspot risk but with careful paddock selection can maximise yields.**
- **A number of field pea varieties have similar grain yield potential in low rainfall environments. Variety selection should also therefore consider agronomic advantages of each variety and marketability of the grain.**

## Why do the trials?

This work aims to expand the field pea industry in low rainfall areas of southern Australia through the development of cultivars and agronomic methods that will increase and stabilise production in the more variable soil and climate cropping environments.

Pulse Breeding Australia (PBA) Field Peas has a focus on increasing adaptation to the medium to low rainfall areas of Australia. Minnipa is a key site in South Australia focusing on developing field pea varieties for low rainfall/ short season environments. Currently key selection criteria at these sites include resistance to blackspot, shattering, lodging, tolerance to soil boron and soil salinity, and appropriate flowering/ maturity time. PBA also includes a germplasm enhancement (pre-breeding) program focusing on identifying and incorporating genes with tolerance to frost, transient drought and heat at flowering/podding into current adapted varieties.

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

## How was it done?

A replicated Stage 3 pea breeding trial containing 7 commercial entries and 132 advanced breeding lines and a replicated Stage 2 breeding trial containing 5 commercial checks and 379 preliminary breeders lines were sown into reasonable moisture levels on 8 May and 15 May respectively at Minnipa.

An agronomic pea time of sowing trial with three varieties (Alma, Kaspa and Parafield) and two fungicide treatments (nil and 2 kg/ha of mancozeb at fortnightly intervals) was sown on the 30 April (early) and 15 May (average) at Minnipa.

All trials were sown with 70 kg/ ha of 18:20:00 and 1 L/ha Triflur X. A high level of weed control was achieved with the application of Lexone @ 180 g/ha post sowing pre-emergent and Select @


250 ml/ha with 1% Hasten on 9 July. The trials were harvested between 3 and 12 October, almost a month earlier than 2006. Insect sprays were applied as required.

Scores for establishment, early vigour, flowering, maturity, lodging, shattering and selection potential were recorded during the year and grain yields were measured at harvest.

## What happened?

### Commercial variety evaluation 2007

An early break to the season allowed field peas to be sown at an optimum time for low rainfall environments in 2007. Establishment and early growth was exceptional with no disease, pest or weed interference. Field pea lines started flowering in early August, some 7–10 days earlier than in 2006, and seven weeks earlier than the same lines in 2005, due to the early sowing date and high temperatures. Moderate levels of moisture stress pre flowering were followed by high levels of moisture stress post flowering with little rainfall after July. As in 2006 most lines were still able to fill pods despite the dry conditions due to good levels of plant biomass and early flowering dates. High levels of moisture stress during podding reduced grain yield potential in all lines with late flowering lines severely penalised. Field peas matured quickly and were harvested in early October.

The site mean yield was 1.03 t/ha with the highest yielding commercial lines being the white pea types Bundi and Sturt at 1.09 t/ha (Table 1), a similar result to 2006. Grain yields were very good given the extremely short and dry season with growing season rainfall only 59% of the long-term average and the French-Schultz yield potential for field peas at Minnipa in 2007 was only 0.78 t/ha.

## SAGIT Agronomic trial 2007

Early sowing was of significant benefit in 2007 with highest grain yields achieved when all cultivars were sown on the season break (30 April). Delaying sowing by fifteen days resulted in a yield reduction of approximately 40% (Table 2) highlighting, for the second year in a row, the importance of early sowing field peas in low rainfall environments to ensure yield in dry years. There was no interaction between cultivar and sowing date. Parafield was slightly higher yielding than Kaspa (Table 2). There was no significant level of blackspot in either sowing date due mainly to dry seasonal conditions but also to a long rotational break from peas (over ten years) and the lack of neighbouring pea stubbles from 2006.

The final disease severity in the trial was compared against the disease levels predicted by the SARDI blackspot disease prediction model (DIRI). The actual 2007 weather data from the site was entered into the model to generate a predicted disease value. This was compared with the actual disease data from plots for each sowing date. The values calculated by DIRI for sites at Hart and Turretfield in 2007 were highly correlated with real disease data, but the predictions for Minnipa were much higher than was realised in the field trial (Figure 1). This confirms research on DIRI in earlier projects that the upper Eyre Peninsula region behaves differently to the rest of South Australia's pea growing areas and requires a separate blackspot model to predict disease levels.

## Future pea varieties for low rainfall areas

Advanced breeding lines (OZP series) from PBA Field Peas with improved performance in low rainfall environments have been promoted to the NVT trials program over the last two years. These lines are derived from Kaspa with very similar plant and disease characteristics however have been earlier flowering and have shown greater yield stability across seasons in low rainfall regions. OZP0601, OZP0602 and OZP0705 have been the three most consistent performers of these advanced lines in trials since 2005.

In particular OZP0601 and OZP0705 have shown significantly greater yields in SA trials where Kaspa has yielded less than 1.0 t/ha (Figure 2). OZP0705 was evaluated as 02-230-33 at MAC in 2006 and was the highest yielding line in Stage 2 trials in that season. These lines were also higher yielding than Kaspa at the Rudall NVT trials in 2007 with OZP0705 yielding 61% higher than Kaspa (Table 1). All three lines are earlier flowering than Kaspa with a pattern similar to Bundi (Table 1) but have shown significantly greater yields in more favourable seasons than Bundi in limited evaluations.

Numerous breeding lines in the Stage 2 and Stage 3 breeding trials at MAC in 2007 were higher yielding than Kaspa and will continue to be evaluated in 2008. A number of these lines have significantly higher tolerance to soil boron relative to Kaspa and Parafield in glasshouse screening and from field observations at MAC in 2007. The incorporation of boron tolerance into high yielding adapted varieties is likely to improve pea yield stability in dry

***Table 1 Minnipa PBA trial pea flowering dates 2007 (& no. of days flowered), grain yield (t/ha), long term predicted yield (2000–06*) as % of Kaspa (& no. comparisons) and 2007 Rudall NVT trial grain yields (t/ha)***

| Variety/Line | Flowering Date MAC | 2007 Yield MAC | Flowering Date MAC | Long term yield MAC* | 2007 Yield Rudall |
|---|---|---|---|---|---|
| **Bundi** | 3 August (24) | 1.09 | 3 August (24) | 98 (5) | 1.05 |
| **Kaspa** | 17 August (12) | 1.04 | 17 August (12) | 100 (9) | 0.69 |
| **Parafield** | 10 August (19) | 0.99 | 10 August (19) | 95 (7) | 0.86 |
| **Sturt** | 7 August (22) | 1.09 | 7 August (22) | 99 (7) | 1.04 |
| **Yarrum** | 14 August (13) | 0.88 | 14 August (13) | 92 (3) | 0.85 |
| **OZP0601** | 7 August (20) | 1.13 | 7 August (20) | | 1.09 |
| **OZP0602** | 7 August (20) | 1.12 | 7 August (20) | | 1 |
| **OZP0705** | 3 August (24) | 1.12 | 3 August (24) | | 1.11 |
| ***LSD (P=0.05)*** | | *0.09* | | *Kaspa (t/ha) = 1.31* | *0.09* |

** 2007 long-term data not available at time of printing.*

years in low rainfall environments as boron is thought to have a major role in the variable yield of field peas in dry years. Currently all commercial varieties are rated as susceptible to this soil constraint.

## What does this mean?

Regardless of current variety choice, early sowing continues to maximise yield of field peas in low rainfall areas providing consideration for black spot, weeds and frost risk occurs. In low rainfall environments, providing management strategies like using rotations with at least four years gap and not sowing pea crops next to neighbouring pea stubbles will minimise the risk of blackspot. It is likely a greater yield loss will occur from delayed sowing than from blackspot infection.

DIRI is an accurate model of the blackspot risk associated with different sowing dates and agronomic practices in the medium and high rainfall regions of South Australia, however a separate model is required for the low rainfall regions. Data from the Minnipa trial in 2007 and trials to be conducted in 2008 will assist in developing this model.

Kaspa, Parafield, Sturt and Bundi are all options for low rainfall environments. Sturt and Bundi are white seed types and will require alternative arrangements for marketing and storage of grain. Kaspa is better suited to the more favourable seasons in these environments due to its later flowering characteristic, and Bundi is more suited to the shorter drier seasons. Sturt and Parafield are

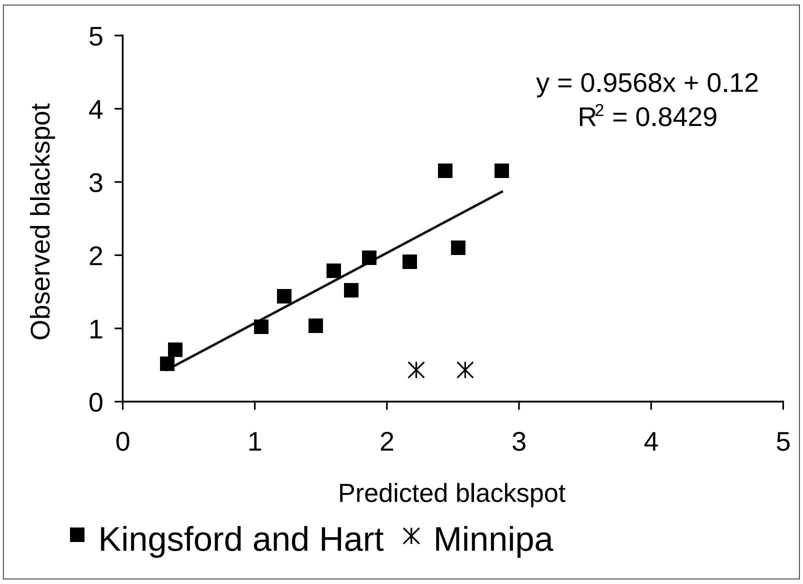



***Figure 1** DIRI blackspot validation 2007, 0–5 disease scale (5 = 100% infection).*

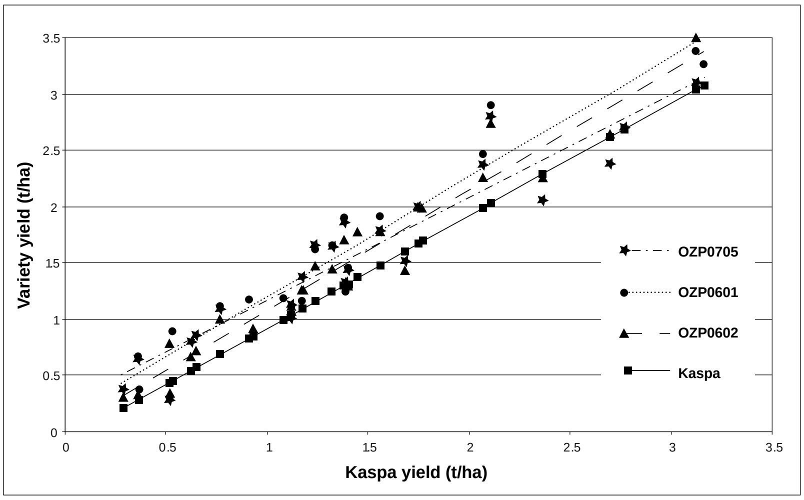



***Figure 2** Relative yields of advanced PBA lines OZP0601, OZP0602 & OZP0705 and Kaspa field peas across SA PBA and NVT trial sites 2005–07.*

***Table 2** Grain yield (t/ha), disease severity (%) and flowering date and duration from Minnipa sowing date trial, 2007*

| Date sown | Grain yield | Disease severity rated Aug 6 | Flowering date & duration | | |
|---|---|---|---|---|---|
| | | | Alma | Parafield | Kaspa |
| **30 April** | 1.08 | 2.8 | 10 Aug (17) | 3 Aug (20) | 10 Aug (13) |
| **15 May** | 0.7 | 0.7 | 23 Aug (18) | 20 Aug (21) | 27 Aug (7) |
| *LSD (P =0.05)* | *0.05* | *1.7* | | | |
| **Variety grain yield (t/ha) across both sowing dates.** *LSD (P=0.05) = 0.03* | | | 0.86 | 0.95 | 0.85 |

generally more consistent in yield but are more susceptible to downy mildew, lodging, shattering and in the case of Sturt metribuzin. Kaspa has agronomic advantages (e.g. lodging and pod shattering resistance) over Sturt and Parafield and therefore is still a good choice for low rainfall environments providing early sowing can be achieved.

OZP0601, OZP602 and OZP705 have shown significant yield advantages over Kaspa in low rainfall environments particularly in dry years. Further evaluation will occur in 2008 before a decision on their release is made. Advanced breeding lines with considerably higher yields than Kaspa in low rainfall environments and incorporating many of Kaspa's characteristics along with earlier flowering time, soil boron and salinity tolerance, powdery mildew resistance, virus resistance and bacterial blight resistance are being progressed through the breeding program of PBA Field peas.

## Acknowledgements

This agronomic trial work was funded by the South Australian Grains Industry Trust (SAGIT) and SARDI. The breeding trial work was completed by GRDC and SARDI and forms part of Pulse Breeding Australia Field Peas with collaborators from DPI Victoria, DPI NSW, DAWA and University of Sydney, Narrabri. Thankyou to Leigh Davis for his assistance with the management of the trial work at MAC.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

GRDC Grains Research & Development Corporation

# Faba Beans on Upper Eyre Peninsula

**Jim Egan[1], Willie Shoobridge[2] and Leigh Davis[2]**

[1]SARDI, Port Lincoln, [2]SARDI, Minnipa Agricultural Centre

Research

## Key messages

- **The 2007 season at Minnipa showed many similarities to 2006, with early sowing leading into a very dry spring, resulting in faba bean trial yields from 0.2 to 0.4 t/ha.**
- **Farah was the top yielding variety in the 2007 trials, and over the past 8 years has averaged marginally ahead of Fiesta and Nura. The 8-year average for Fiesta at Minnipa is around 0.8 t/ha, but yields have ranged from 0.3 to 1.9 t/ha.**
- **Several breeding lines have been identified with significantly improved yields over these varieties at Minnipa and other low rainfall environments. These are being progressed through reselection, seed multiplication and wider evaluation.**

## Why do the trial?

While faba beans are well established as a pulse crop option in the medium to high rainfall grain-growing districts, current varieties are not well suited to lower rainfall environments. This research program aims to test if better adapted bean varieties can be developed for low rainfall districts by early generation selection and evaluation of faba bean breeding lines in a low rainfall environment. It is a component of the SAGIT funded project to develop a range of break crop options for the low rainfall upper Eyre Peninsula region and other similar environments, and complements the selection and evaluation being undertaken in field peas, canola and mustard.

## How was it done?

Faba bean lines for field testing at Minnipa Agricultural Centre were provided from the Pulse Breeding Australia (PBA) Australian Faba Bean Breeding Program led by Dr Jeff Paull at the University of Adelaide. Early generation lines were included in the Stage 2 (S2) trial with between one and three replicates per line depending on seed availability. This trial contained 31 lines, including 16 from single plant selections taken at Minnipa in 2004, on the basis of height, vigour, standing ability, maturity time and high level of podding. Fiesta, Farah and Nura check plots were repeated throughout the trial to allow statistical analysis with limited replication of test lines.

More advanced lines which had shown promise in previous field testing were included in a fully replicated Stage 3 (S3) trial with 30 entries in total. This trial contained all entries that are in the SA National Variety Trial (NVT) series, including seven commercial varieties, so that the results can be used to supplement the NVT trials variety database now available to growers on its website. Five lines from single plant selections made at Minnipa in 2003 were also retested in the S3 trial, following good results in the 2005 S2 trial, and encouraging yields in the hard 2006 season. The S2 and S3 trials also had a high number of entries in common with other faba bean breeding trials conducted by Jeff Paull's team, SARDI and interstate collaborators across southern Australia, so that line performance data can be pooled across a number of sites for analysis to identify lines worthy of progression for advanced testing.

### Try this yourself now

**Location**
Minnipa Agricultural Centre, Paddock North 6 West

**Rainfall**
Av. annual: 325 mm
Av. GSR: 242 mm
2007 total: 286 mm
2007 GSR: 141 mm

**Yield**
Potential: 0.78 t/ha (pulse crop)
Actual: Site mean 0.26 t/ha, Fiesta 0.26 t/ha

**Paddock History**
2006: Wheat (Wyalkatchem)
2005: Wheat (Wyalkatchem)
2004: Grass-free pasture

**Soil Type**
Sandy loam pH 8.5 over light sandy clay loam pH 8.5

**Plot Size**
1.5 m x 10 m x 3 reps (S3) or 1-3 reps (S2)

**Yield Limiting Factors**
Good season start but minimal rainfall after mid-August

Both faba bean trials were sown at Minnipa Agricultural Centre on 16 May, at a standard rate of 24 seeds/m$^2$, with 18:20:00 fertiliser @ 70 kg/ha. The trial area was given a knockdown herbicide spray of 0.8 L/ha Roundup Powermax plus 250 ml/ha Hasten two weeks prior to sowing, then a pre-sowing herbicide spray of 1.2 L/ha Sprayseed, 50 ml/ha Hammer, 1.0 L/ha TriflurX and 1% BS1000. A grass herbicide spray of 250 ml/ha Select with 1% Hasten was applied on 9 July. Four insecticide sprays were applied between pre-sowing and mid-September to protect against insect attack (Red-legged earthmite, aphids and native budworm). The trials were harvested on 6 November.

Flowering dates (start and end) were recorded. Height to bottom pods was measured shortly prior to harvest to assess harvestability, along with comments on shattering or other problems. Grain yields were recorded at harvest, and grain samples retained for seed size measurement.

## What happened?

Excellent opening rains in March and April allowed for timely early sowing of the faba bean trials at MAC on 16 May. This was about one week later than in 2006. While June and July rainfall were adequate for the slow winter growth, the season became progressively drier after this, painfully reminiscent of 2006. Total rainfall for the critical August to October period was only 32 mm, giving a growing season total (April to October) of 141 mm (decile 1 range).

As in 2006, faba bean yields were very low under these conditions, with mean yields of only 0.26 t/ha in the S3 trial and 0.19 t/ha in the S2. Again the low yields were accompanied by a relatively high degree of variability in the trials, resulting in a high level of uncertainty about variety and line performance. Farah was the top yielding variety in the S3 trial, about 5% higher than Fiesta and 87% above Nura (Table 1). Over the past eight years of testing at Minnipa, Farah and Nura have averaged 2% and 1% respectively higher yields than Fiesta. Nura's shorter height and later flowering generally put it at a disadvantage in lower rainfall, shorter growing season environments. The graph of variety yields at Minnipa from 2000 to 2007 (Figure 1) shows that Nura outyielded Fiesta, Farah and Fiord in earlier years (2000 to 2002) when yields were above 1.0 t/ha, but has been inferior to these in recent years (2003 to 2007) when yields have been below the 1.0 t/ha mark.

The top yielding line in the S3 trial was **AF03001**, at 0.38 t/ha (46% above Fiesta). This line was also top at MAC in 2006, and performed well in its first year of testing there in 2005. It is very early flowering – it commenced flowering 18 days earlier than Farah and Fiesta at MAC in 2007 – hence has yielded well in the past two years.

Several other lines that have yielded well at Minnipa in recent years are now in seed increase and more widespread testing:

- **683*834/16 –** average of 19% higher yielding than Fiesta over past 5 years. Slightly taller than Fiesta and Farah and has a similar flowering time. Has been screened for ascochyta resistance and to eliminate green seeds, and seed of this reselected line is being multiplied.
- **1270*278/10** – average of 11% above Fiesta at Minnipa over past 4 years. Has also performed well in WA breeding trials and was promoted to NVT trials in 2006. Reasonable chocolate spot resistance (between Fiesta and Nura) and has been reselected for ascochyta resistance.

The highest yielding Minnipa selection line was ranked at eighth in the S3 trial, 14% above Fiesta's yield.

***Table 1 Yield of faba bean varieties and top lines in MAC breeding trials in 2007 and previous years (number in parentheses for long-term yield is the number of years tested at MAC)***

| Variety/Line | 2007 Yield (t/ha) | 2007 Yield (% Fiesta) | Long-term Yield (% Fiesta) | Comments |
|---|---|---|---|---|
| ***S3 Trial*** | | | | |
| **Fiesta** | 0.26 | 100 | 100 (8) | |
| **Farah** | 0.28 | 105 | 102 (8) | |
| **Nura** | 0.15 | 56 | 101 (8) | |
| **Doza (SP01040)** | 0.31 | 117 | - | New variety for northern NSW and Qld |
| **AF03001** | 0.38 | 146 | - | Top in MAC S3, 2006 & 2007, 3rd in MAC S2, 2005 |
| **683*834/16** | 0.32 | 121 | 119 (5) | Promise in low rainfall |
| **1270*278/10** | 0.29 | 109 | 111 (4) | In NVT trials in 2006 and 2007 |
| **IX101/1-63** | 0.31 | 117 | - | 2nd in MAC S2, 2006 |
| ***S2 Trial*** | | | | |
| **Fiesta** | 0.22 | 100 | 100 | |
| **AF04087** | 0.29 | 135 | - | Top in 2007, but only average in 2006 |
| **611*722/45W-4-Min** | 0.29 | 135 | - | 2nd in trial – selection made at MAC in 2004 |

Two Minnipa selection lines from 2004 were in the top three yielders in the S2 trial, at 35% and 33% above Fiesta.

A major factor limiting harvest yields under low rainfall conditions, such as in 2006 and 2007 at Minnipa, is the height of the bottom pods. Low pods can be left behind at harvest, and this will represent more of yield loss in shorter lines and varieties, such as Nura.

## What does this mean?

The best of the faba beans only achieved around 49% of the theoretical potential (French and Schultz) yield in 2007. The very dry latter half of the season, with the last effective rainfall event of around 10 mm on 16 August, was a major factor in the low water use efficiency observed. While Fiesta's eight-year average yield at Minnipa (2000–07) is 0.8 t/ha, the last 5 year average is slightly less than 0.5 t/ha. Figure 1 shows how bean trial yields have varied between years from lows of near 0.3 t/ha for Fiesta in 2003 (sown 8 June), 2006 (sown 8 May), and 2007 (sown 16 May) to a high of 1.9 t/ha in 2001 (sown 4 June). These results suggest that a 20 May cut-off date for sowing beans in this environment may not be a sound rule of thumb – only two such opportunities have occurred at MAC in the past 8 years, both resulting in 0.3 t/ha yields, while good yields (1 t/ha or more) have been achieved with sowings into June.

At this stage, Farah is the most suitable faba bean variety for low rainfall districts such as the upper Eyre Peninsula, with marginally higher yields and generally adequate disease resistances.

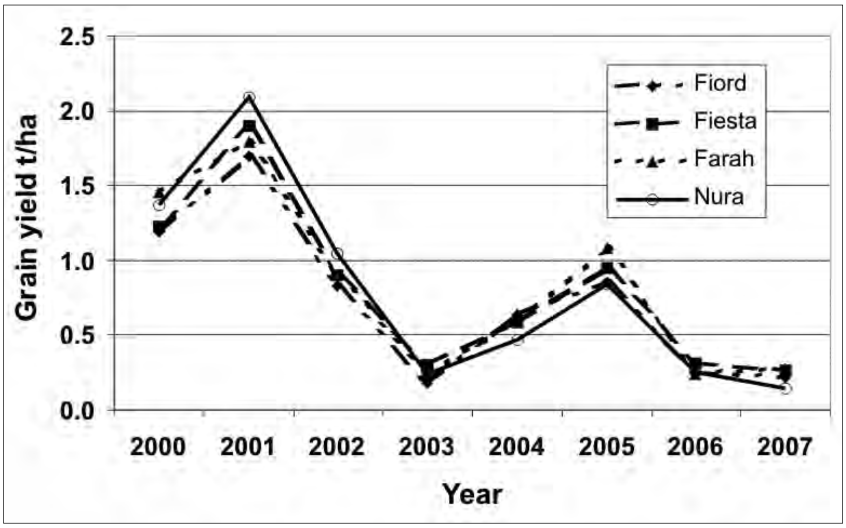



***Figure 1 Yield of faba bean varieties at Minnipa Agricultural Centre, 2000 to 2007.***

While Nura has better chocolate spot and rust resistance than Farah, its shorter height and lower pods can cause higher harvest losses in some low rainfall situations. This is likely to be more critical for commercial harvesting than in small plot trials. Several lines showing consistently higher yields in low rainfall environments are in advanced evaluation stages.

Performance of breeding lines in the 2007 trials at MAC will be reviewed along with results from all other locations, to determine whether they should be progressed or deleted from the program in 2008. Agronomic, disease and seed quality characteristics will be included in the final determination.

## Acknowledgements

This work is funded by SAGIT and SARDI, but is only made possible with the support of the GRDC-funded National Faba Bean Improvement Program, through Dr Jeff Paull and his team at the University of Adelaide, Waite.

PBA PULSE BREEDING AUSTRALIA

THE UNIVERSITY OF ADELAIDE AUSTRALIA

SAGIT

GRDC Grains Research & Development Corporation

Break Crops

# Types of work in this publication

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

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

# Section 3

Lower Eyre Agricultural Development Association

LEADA

# Lower Eyre Peninsula Work

**Section editor:**

**Mark Stanley**
EPNRM Board,
Port Lincoln

## Our vision

Formed in 2005, LEADA is a farmer driven organisation bringing together local researchers, farmers, agribusiness, government and private advisors.

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

In 2007 LEADA established a central trial site adjacent to the Cummins township and plans to continue to operate this site into the future. It is anticipated that this site will evolve to become one of the premier research and demonstration sites in South Australia providing a valuable resource for local farmers. LEADA also holds an annual Expo in March. This year's forum will be held in Cummins and will give farmers with the latest information to ensure the right decisions are made heading into the coming season.

The central trial site will be supported by satellite sites, chosen to represent the variable soil types and rainfall on lower EP. Local Ag Bureaus will run the satellite sites which will act as activity hubs to feed ideas into the main site. Tours of satellite sites will be organised with association to other regional sites with a BBQ to foster discussion and interaction between farmers and service providers.

Membership is crucial for building the profile and credibility of LEADA and strengthens the case for future funding support. The cost of membership will be kept to the entry price of the annual Expo to encourage involvement and participation. Support will be sought from commercial organisations and Government alike and we will work hard to build partnerships between these sectors.

### Current projects

LEADA is currently focussed on two projects on lower EP, one funded through a Community Grant with the National Landcare Program (NLP) and the other a new project supported by GRDC.

The NLP project is focussing on improving options for managing changing climatic and economic environments through addressing soil constraints, which is investigating crop and pasture options for various soil types and the potential for soil amelioration. The GRDC project, aimed at Realising Yield Potential through Farming Systems Research, Development and Extension, will investigate best management for canola and barley on the LEP and explore various integrated pest management (IPM) options to improve efficiency and avoid resistance issues. This project has received commitment for five years funding, and will make a significant contribution to assisting farmers improve the profitability of their farming system.

Contact Kieran Wauchope,
Rural Solutions SA,
Phone: 8688 3400

For further information on work done on lower EP, refer to the following articles:

2007 Eyre Peninsula Seasonal Summary

2007 Trials sown but not harvested or reported

Break Crop Charts

How Do Mustards Stack Up Against Canola?

Sheep Production Analysis

Grazing Cereals at Edillilie

Soil Compaction Survey

Soil Compaction Trials

# Wheat Varieties for Lower Eyre Peninsula

**Joanne Crouch, Jim Egan and Ashley Flint**
SARDI, Port Lincoln

**Try this yourself now**

**Location**
Cummins, LEADA Focus site

**Rainfall**
Av. annual: 425 mm
Av. GSR: 344 mm
2007 total: 327.7 mm
2007 GSR: 222.9 mm

**Yield**
Potential: (W) 2.3 t/ha
Actual: 1.98 t/ha

**Paddock History**
2006: Wheat
2005: Canola
2004: Pasture

**Soil Type**
Sandy clay loam

**Plot size**
1.5 m x 10 m x 3 reps

**Yield Limiting Factors**
Dry spring

## Key messages

- **Young, Gladius, H46 and Axe topped the yield rankings, with yields near 2 t/ha.**
- **Peake, Derrimut and Wyalkatchem yielded slightly lower (1.7 to 1.8 t/ha), although they were not significantly lower than the top yielding varieties.**
- **Grain quality was poor due to seasonal conditions and high soil nitrogen.**

## Why do the trial?

The wheat variety comparison trial was established at the LEADA Cummins field site in response to interest from local growers, to assist their wheat variety choices.

## How was it done?

- **Treatments:** 20 commercial wheat varieties (Table 1).
- **Sowing date:** 25 May 2007.
- **Fertiliser:** Sown with 18:20:00 (DAP) @ 100 kg/ha.
- **Herbicides and insecticides:** Knockdown spray of Roundup @ 1 L/ha, plus Hammer @ 20 ml/ha with pre-sowing Trifluralin @ 800 ml/ha. In-crop sprays of Chlorpyrifos @ 200 ml/ha, Lemat @ 100 ml/ha and Bromicide @ 1 L/ha.
- **Measurements:** Grain yield and quality.

## What happened?

Good rain in April and follow–up rain in May allowed for optimum sowing on 25 May. The advantageous conditions were short lived however, as by June the rainfall fell to less than decile 2 and remained that way until October.

Under these weather conditions, the wheat yields were considerably lower at the Cummins LEADA site compared with the potential yields. The mean yield of all varieties was 1.49 t/ha, compared to the potential wheat yield of 2.34 t/ha, based on the growing season rainfall (April to October) received in 2007.

A group of four varieties, Young, Gladius, H46 and Axe lead the yield rankings, with yields of 1.94 to 1.98 t/ha (Table 1). Their yields were not significantly different from the next group of Peake, Derrimut and Wyalkatchem (1.69 to 1.83 t/ha), but were significantly higher than the rest of the varieties compared in this trial. Not surprisingly, the later maturing varieties Frame and Yitpi were at the lower yielding end of the table.

Screenings ranged from 9% for H46 up to 19% for Derrimut, while proteins ranged from 14.9% for Derrimut to 16.5% for Gladius and Correll (Table 1).

Table 2 shows the average quality of grain delivered to the AWB National Pool at Cummins, for each pay grade, for comparison. The average percentages of screenings and protein and the test weight at the Cummins LEADA site were 14.7%, 15.6% and 75.6 kg/hl respectively, compared with 1.6% screenings, 12.6% protein and 80.2 kg/hl test weight for the APW grade in the AWB National Pool at Cummins.

## What does this mean?

The highest yielding varieties achieved around 84% of the theoretical potential yield (French and Schultz model) in the challenging seasonal conditions. Of the 32 mm of rain for October, 27 mm fell in the last 9 days of the month, when even the later varieties were at a very advanced stage. Therefore the late rain may have had minimal impact on yield. If we disregard the late October rainfall, then the potential yield comes back to 1.83 t/ha, which is similar to what the top varieties achieved.

The top ranked varieties are all early to mid season flowering, which was the key characteristic for performance in the dry growing season experienced last year.

The late rains in October arrived too late for the varieties to take advantage of, even later flowering varieties like Frame, Correll and Pugsley.

The top yielding variety Young is an early maturing hard wheat, with CCN resistance and is MS to all three rusts. Its screenings were amongst the highest of the varieties at the Cummins site, which is expected as it has similar grain plumpness to Janz and is susceptible to dry finishes.

It was also anticipated that both Gladius and Axe would perform well in these seasonal conditions. Gladius is a widely adapted, hard, early to mid flowering variety and Axe is a vigorous growing, very early flowering variety that is well suited to very dry sharp finishes. Both these varieties lack CCN resistance so this needs to be considered in areas where CCN is a problem.

H46, like Axe, is an early maturing variety. Its reaction to the new stripe rust strain is expected to be quite susceptible and along with it being susceptible to CCN and Septoria tritici there is now little place for H46 in SA.

Peake is a new, mid maturing, hard variety that is suitable for low to medium rainfall areas. It is CCN resistant and is reported to have resistance to the current strains of stem and leaf rust and MR/MS for the current stripe rust strains. Peake has had limited evaluation in the NVT trials program in SA.

Derrimut, a hard, early to mid maturing variety, is CCN resistant and shows useful levels of resistance to all three rusts. Derrimut is suited to the medium to high rainfall zones.

The final top yielding variety, Wyalkatchem, released back in 2001, is still showing competitive yields on lower EP. However it is likely to be susceptible to the new strains of stem and stripe rusts, thus some consideration will be needed to assess if this variety still has a place here.

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

The high screenings in the Cummins wheat trial caused all varieties, except H46 and Pugsley, to be downgraded to the pay grade AUW, which receives an automatic deduction of $12/t when the screenings are above 10%. Fortunately for growers, there were no loads of wheat delivered to the Cummins silos in the AWB National Pool that were downgraded into the AUW pay grade due to high screenings.

The high screening results from the Cummins LEADA trial were due the combination of extreme moisture stress that occurred at grain fill and the high soil fertility. The uneven distribution of the little rain that did fall in late September and October was a major factor in the production of small, pinched grains. The soil had extremely high levels of organic carbon and nitrogen, which had an impact on both the screenings and protein levels. A benchmark figure of nitrogen required by wheat plants is that a 1 t/ha wheat crop requires 50 kg/ha of nitrogen. The soil at the LEADA site contained 580 kg/ha of nitrogen in the 0–20 cm layer. This is enough nitrogen to produce a 12 t/ha crop! Soil nutrient levels will be considered when the site for 2008 LEADA trials is selected.

## Acknowledgements

Thanks to Craig Povey at Landmark, Port Lincoln for providing the receival standard information for the AWB National Pool.

***Table 1 Yield and quality results of wheat varieties at Cummins LEADA site, 2007***

| Variety | Grain Yield (t/ha) | | Screenings (%) | Moisture (%) | Protein (%) | Test Weight (kg/hl) | Pay Grade |
|---|---|---|---|---|---|---|---|
| **Young** | 1.98 | a | 16.8 | 10.7 | 15.8 | 76.6 | AUW |
| **Gladius** | 1.96 | a | 12.0 | 10.7 | 16.5 | 75.2 | AUW |
| **H46** | 1.95 | a | 9.0 | 10.7 | 15.7 | 78.8 | APW |
| **Axe** | 1.94 | a | 10.2 | 10.4 | 15.2 | 76.8 | AUW |
| **Peake** | 1.83 | ab | 16.3 | 10.7 | 15.0 | 77.0 | AUW |
| **Derrimut** | 1.73 | abc | 19.0 | 10.8 | 14.9 | 78.2 | AUW |
| **Wyalkatchem** | 1.69 | a,b,c,d | 12.0 | 10.8 | 16.0 | 73.4 | AUW |
| **Barham** | 1.57 | b,c,d,e | 15.7 | 10.8 | 15.0 | 73.4 | AUW |
| **Guardian** | 1.54 | b,c,d,e,f | 17.0 | 10.7 | 15.0 | 77.0 | AUW |
| **Westonia** | 1.46 | c,d,e,f | 15.2 | 10.8 | 16.0 | 74.2 | AUW |
| **Excalibur** | 1.41 | c,d,e,f,g | 12.4 | 10.8 | 15.7 | 75.6 | AUW |
| **Pugsley** | 1.36 | d,e,f,g | 9.8 | 10.8 | 16.3 | 78.0 | APW |
| **Correll** | 1.35 | d,e,f,g | 13.4 | 10.8 | 16.5 | 72.8 | AUW |
| **GBA Ruby** | 1.34 | e,f,g | 14.2 | 10.8 | 15.5 | 75.4 | AUW |
| **Catalina** | 1.33 | e,f,g | 15.0 | 11.0 | 15.0 | 77.4 | AUW |
| **Clearfield Janz** | 1.26 | e,f,g | 16.7 | 10.7 | 15.3 | 76.0 | AUW |
| **Carinya** | 1.25 | e,f,g | 18.8 | 10.8 | 15.3 | 75.2 | AUW |
| **AGT Scythe** | 1.25 | e,f,g | 16.9 | 10.5 | 16.1 | 74.0 | AUW |
| **Yitpi** | 1.22 | f,g | 13.8 | 10.7 | 16.0 | 76.8 | AUW |
| **Frame** | 1.07 | g,h | 10.0 | 10.9 | 15.9 | 76.2 | AUW |
| **Mean** | 1.49 | | 14.7 | 10.7 | 15.6 | 75.6 | |
| ***LSD (P=0.05)*** | *0.34* | | | | | | |

*AUW Pay grade: screenings above 10%*

***Table 2 Average wheat quality receival standards for grain delivered at Cummins, 2007***

| Pay Grade | Screenings (%) | Moisture (%) | Protein (%) | Test Weight (kg/hl) |
|---|---|---|---|---|
| **AH** | 2.8 | 10.2 | 13.0 | 79.4 |
| **APW** | 1.6 | 10.2 | 12.6 | 80.2 |
| **ASW** | 2.6 | 10.5 | 13.0 | 85.7 |
| **AGP** | 1.5 | 7.5 | 8.5 | 59.5 |
| **FEED** | 2.1 | 10.2 | 13.4 | 79.8 |

*Source: AWB*
*AUW Pay grade: screenings above 10%*

# Canola Varieties for Lower Eyre Peninsula

Research

Extension



**Joanne Crouch, Jim Egan, Ashley Flint and Brian Purdie**
SARDI, Port Lincoln

## Key messages

- **Bravo TT and Storm TT were the highest yielding varieties in the trial and produced the best gross returns.**
- **Other varieties that yielded well were Thunder TT and ATR-Summitt and the new varieties Rottnest TTC and Flinders TTC.**
- **Limited rainfall during flowering and pod fill produced yields well below the potential.**

## Why do the trial?

The Wangary TT canola trial was established in response to interest from local growers involved in the LEADA group, to provide local performance data to assist variety choice on lower Eyre Peninsula, in the absence of an NVT canola trial south of Cummins.

## How was it done?

- **Treatments:** 16 commercial TT canola varieties. (Table 1).
- **Sowing date:** 10 May 2007.
- **Fertiliser:** Sown with 19:13:0:9 @ 150 kg/ha, Urea @ 150 kg/ha (in split application) and SprayGro (Zinc, Manganese & Copper) @ 2 L/ha.
- **Herbicides & insecticides:** Knockdown spray of Roundup @ 1.2 L/ha, Simazine @ 2 L/ha and Lorsban @ 250 ml/ha. In-crop sprays of Fastac @ 250 ml/ha, Chlorpyrifos @ 500 ml/ha, Piramol @ 18 ml/ha, Aramo @ 4 ml/ha, Lontrel @ 200 ml/ha, Karate @ 40 ml/ha.
- **Measurements:** Grain yield and quality.

## What happened?

The good opening rains in March and the follow-up rains in April allowed for optimum sowing on 10 May. Although total growing season (April–October) rainfall was 372 mm, the timing of this rain was a principal contributor to the lower than potential yields achieved at the site. Rainfall was lowest during the critical periods of flowering and pod fill with only 20% (78 mm) of the total season rainfall falling from August through to late October.

Under these conditions, canola yields were considerably lower than the potential yield at the Wangary site. The mean yield in the trial was only 1.08 t/ha, well short of the potential yield of 4.19 t/ha, based on the 2007 growing season rainfall.

The top two yielding varieties were Bravo TT and Storm TT (tested as PacT2203) with yields of 1.30 t/ha and 1.29 t/ha respectively. A group of varieties that yielded similarly to Bravo TT and Storm TT (1.18 to 1.27 t/ha) were Rottnest TTC, Thunder TT, Flinders TTC and ATR Summitt. The remaining varieties tested all yielded significantly lower than Bravo TT and Storm TT (Table 1).

Samples of each variety were quality tested (Table 1). The average oil content across all varieties in the trial was 45%, with Tornado TT having the highest oil at 46%. This is well above the base receival standard of 42% oil. Glucosinolate levels were excellent, the average of 8 µmoles/g being well below the maximum acceptance level of 18 µmoles/g.

**Try this yourself now**

**Location**
Wangary: Peter Puckridge
Group: LEADA and SARDI

**Rainfall:**
Av. annual: 500 mm
Av. GSR: 408 mm
2007 total: 509 mm
2007 GSR: 372 mm

**Yield:**
Potential: (C) 4.19 t/ha
Actual: 1.08 t/ha

**Paddock History:**
2006: Wheat
2005: Canola
2004: Barley

**Plot size:**
10 m x 1.6 m x 3 replications

## What does this mean?

The highest yielding varieties, Bravo TT and Storm TT, achieved around 30% of the theoretical potential yield (French and Schultz model) in the challenging seasonal conditions. The large difference between potential and actual yields emphasizes a major frustration for canola growers, i.e. the inability to achieve full canola potential. This is a major focus of the LEADA program in the Better Canola Project. Information on the Better Canola project and the 2007 trial results are given in the report "Lower Eyre Peninsula Better Canola trials, 2007", in the Lower Eyre Peninsula section of the EPFS 2007 Summary p. 55.

The top ranked variety Bravo TT, is a mid-season variety with a blackleg rating of 6.5 and is still producing high yields on lower Eyre Peninsula. The new variety Storm TT that yielded similar to Bravo TT is also a mid-season variety. Results from the first year of evaluation indicate good vigour, yield and oil with moderate protein.

Of the other top ranked varieties, Thunder TT, Flinders TTC and ATR-Summitt are all mid-season varieties while Rottnest TTC is early season. Rottnest TTC and Flinders TTC are new varieties likely to be released this year. Rottnest TTC is high yielding, with a blackleg rating of 7.5. It has excellent vigour and moderate oil content. Flinders TTC is best suited to medium-high rainfall zones, with good vigour and oil and a blackleg rating of 7. Thunder TT has good oil content and a blackleg rating of 7.5. ATR-Summitt has moderate oil content and a blackleg rating of 6.7.

Although the high yielders only achieved mediocre oil contents in the trial, they still showed the highest gross income (Table 1) due to their high yield compensating for lower oil content.

Variety choice needs to take into consideration maturity, blackleg resistance, herbicide tolerance and early vigour along with the highly important yield and oil content. This information is available in the SARDI Crop Harvest Report February/March edition of Grain Business or on the NVT trials website, <www.novtonline.com.au>. Results of NVT canola trials, including those at Mount Hope and Yeelanna, can also be accessed from the NVT trials website and are included in the NVT trial tables in this EPFS Summary 2007.


## Acknowledgements

Thanks to Peter Puckridge and family, for making their land available for the trial and the Struan SARDI team for supplying the seed. Also thanks to Nick Booth at Landmark, Port Lincoln for providing the canola receival price and standard information to calculate gross returns.


***Table 1 Triazine tolerant canola yields (t/ha), quality and gross income ($/ha) at Wangary, 2007***

| Variety | Yield (t/ha) | | Moisture (%) | Oil (%) | Protein (%) | Glucosinolates (µmoles/g) | Gross income* ($/ha) |
|---|---|---|---|---|---|---|---|
| **Bravo TT** | 1.30 | a | 5.8 | 43.7 | 22.7 | 11 | 752 |
| **Storm TT** | 1.29 | a | 5.7 | 44.2 | 23.1 | 6 | 755 |
| **Rottnest TTC** | 1.27 | a,b | 6.1 | 42.7 | 22.0 | 8 | 725 |
| **Thunder TT** | 1.26 | a,b,c | 6.1 | 43.2 | 23.4 | 5 | 723 |
| **Flinders TTC** | 1.22 | a,b,c,d | 5.7 | 44.2 | 23.2 | 10 | 713 |
| **ATR-Summitt** | 1.19 | a,b,c,d,e | 5.8 | 44.3 | 22.2 | 6 | 693 |
| **ATR-Cobbler** | 1.13 | b,c,d,e | 5.7 | 45.6 | 21.2 | 12 | 672 |
| **ATR-Barra** | 1.11 | c,d,e,f | 6.1 | 43.1 | 24.2 | 6 | 636 |
| **CB Argyle** | 1.10 | d,e,f | 5.5 | 45.5 | 22.7 | 6 | 654 |
| **Tawriffic** | 1.09 | d,e,f | 5.5 | 46.2 | 21.8 | 6 | 657 |
| **ATR-Beacon** | 1.09 | d,e,f | 6.0 | 42.5 | 23.8 | 10 | 618 |
| **ATR-Marlin** | 1.07 | e,f | 5.4 | 45.5 | 21.7 | 7 | 635 |
| **Tornado TT** | 1.06 | e,f | 6.0 | 46.2 | 21.9 | 6 | 637 |
| **ATR Banjo** | 0.96 | f,g | 5.7 | 43.8 | 24.2 | 12 | 556 |
| **NMT320 (Monola)** | 0.85 | g | 5.7 | 45.6 | 22.4 | 8 | 509 |
| **Surpass501 TT** | 0.65 | h | 5.5 | 45.6 | 22.7 | 5 | 387 |
| **Site Mean** | 1.08 | | 5.8 | 44.5 | 22.7 | 7.6 | 641 |
| ***LSD (P=0.05)*** | *0.15* | | | | | | |

** Gross income is yield x oil x price delivered to Port Lincoln silos as at 18 December 2007*

# “Better Canola” on Lower Eyre Peninsula

Research

Extension


**Joanne Crouch[1], Jim Egan[1] and Kieran Wauchope[2]**

[1] SARDI, Port Lincoln, [2] Rural Solutions SA, Port Lincoln




## Key messages

- **Yields in LEADA “Better Canola” trials at Cummins in 2007 were around 60% of the French and Schultz potential. The very dry spring was a major factor in this shortfall.**
- **Management factors that influenced yields were variety choice, seed size (large seed gave higher yields than medium and small seed) and use of commercial seed in preference to retained.**
- **Nitrogen management (rates and timing of application) and seeding rates had no effect on yield in the 2007 trials at Cummins.**

## Why do the trial?

In recent years, canola yields have failed to reach their potential and canola has been perceived to be unsuccessful against more reliable winter crops. Late breaks, low rainfall, poor yields, high input costs and negative gross margins are all reasons given for declining grower confidence, to the point where many growers now consider canola too risky to grow. In light of this, the “Better Canola” project was developed with funding from Australian Oilseeds Federation (AOF) and Grains Research and Development Corporation (GRDC), to determine and demonstrate best management options for canola.

Four trial and demonstration sites were established in major South Australian canola production districts, at Cummins, Riverton, Struan and Frances. The Cummins trials were located at the Lower Eyre Agricultural Development Association (LEADA) focus site, with five trials to examine the following canola management issues:

N management, in terms of rates and timing of N applications

A hybrid versus open pollinated variety at a range of sowing rates

Effect of grading for seed size

Effect of seed source – commercial seed versus farmer-retained seed

Comparison of oilseed types – canola versus canola quality mustard (juncea canola) and biodiesel quality mustard.

Results of the first four trials are presented and discussed in this article. Oil content results are not yet available, so the discussion addresses yield effects only. The oilseeds comparison trial results are presented in “How Do Mustards Stack Up Against Canola?” on p. 39 in this Summary, with similar trials at other sites on Eyre Peninsula.

## *NITROGEN MANAGEMENT TRIAL*

### How was it done?

- **Variety:** 45Y77 (Clearfield hybrid).
- **Fertiliser:** Two passes at seeding - urea treatments deep-banded on first pass, basal fertiliser of 19:13:0:9 (Croplift 19) @ 150 kg/ha on all plots on second (seeding) pass, drilled just below seed.
- **Sowing Date:** 24 May.
- **Treatments:** N rates and timing as shown in Table 1. All additional N was applied as urea, except in treatments 9 and 10, which were given ammonium sulphate as an N and S source. In-crop applications (at mid-vegetative and budding stages) were top-dressed ahead of a rain event.
- **Measurements:** Grain yield and oil content (not reported) and quality.

**Try this yourself now**

**Location**
Cummins, LEADA Focus site

**Rainfall**
Av. annual: 425 mm
Av. GSR: 344 mm
2007 total: 327 mm
2007 GSR: 223 mm

**Yield**
Potential: (C) 1.75 t/ha
Actual: Average across trials 0.9 t/ha

**Paddock History**
2006: Wheat
2005: Canola
2004: Pasture

**Soil Type**
Grey cracking clay

**Plot size**
1.5 m x 10 m x 3 reps

**Yield Limiting Factors**
Moisture stress in spring, with an early finish

*Table 1 Yield of 45Y77 canola with different nitrogen management treatments at Cummins LEADA site, 2007*

| Treatment | Description | N application (kg n/ha) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Basal at Seeding | Extra at seedling | Mid-Veg | Budding | Total | Grain Yield (t/ha) |
| 1 | Basal (Control) - 19:13:0:9 @150 kg/ha at seeding, and no extra N | 28 | 0 | 0 | 0 | 28 | 1.02 |
| 2 | Extra 22 units N at seeding | 28 | 22 | 0 | 0 | 50 | 1.03 |
| 3 | 50:50 split N application - seeding + mid-veg | 28 | 6 | 33 | 0 | 67 | 0.98 |
| 4 | 50:50 split N application - seeding + budding | 28 | 6 | 0 | 33 | 67 | 1.03 |
| 5 | Extra 72 units N at seeding | 28 | 72 | 0 | 0 | 100 | 1.03 |
| 6 | 50:50 split N application - seeding + mid-veg | 28 | 22 | 50 | 0 | 100 | 0.99 |
| 7 | 50:50 split N application - seeding + budding | 28 | 22 | 0 | 50 | 100 | 1.23 |
| 8 | 33:33:33 split N application - seeding + mid-veg + budding | 28 | 6 | 33 | 33 | 100 | 1.07 |
| 9 | Extra S - same as Treatment 6, but AS at mid-veg | 28 | 22 | 50 (AS) | 0 | 100 + S | 1.04 |
| 10 | Max + S - same as Treatment 8, but AS for both in-crop applications | 28 | 6 | 33 (AS) | 33 (AS) | 100 + S | 0.97 |
| **Mean yield across all treatments** | | | | | | | **1.04** |

*AS = Ammonium Sulphate*

*Table 2 Yield of canola varieties 45C75 and 45Y77 over a range of seeding rates at Cummins LEADA site, 2007*

| Seeding rate (plants/m$^2$) | 45c75 grain yield (t/ha) | 45y77 grain yield (t/ha) |
|---|---|---|
| **20** | 1.09 | 0.94 |
| **40** | 1.12 | 1.07 |
| **60** | 0.98 | 1.16 |
| **80** | 0.81 | 1.08 |
| **100** | 1.01 | 1.04 |
| **150** | 0.90 | 1.01 |
| **Variety Mean** | **0.99** | **1.05** |

## What happened?

The good opening rains in April and May were short lived, and by June the rainfall fell to less than decile 2 and remained that way through to mid-October. Under these conditions, effective application of in-crop N was difficult. A number of additional N treatments were planned in the experiment, including the use of decision support tools (CSIRO nitrogen calculator, PYCAL and Your Soils Potential N decision making tool) to guide N decisions. As a result of the low growing season rainfall, these tools indicated no additional N was required at any time during the season. Late N application treatments at flowering were also planned, but these were dropped in view of the very dry spring conditions and lack of a suitable rain event with which to top-dress urea.

The N management treatments produced no yield response, with the basal fertiliser (control) treatments yielding just as well as treatments supplying up to 100 kg N/ha (Table 1). Additional sulphur also gave no yield effect.

The average yield in this trial was 1.04 t/ha, only 60% of the French and Schultz potential for a canola crop on 223 mm of April to October rainfall. Despite the good start to the season and timely sowing, the high level of moisture stress from August through to crop maturity is a likely major cause of yields falling well short of potential. The trial site had high levels of available (mineral) soil N at the start of the season, estimated at 417 kg N/ha, which was more than adequate for the yields obtained, hence the lack of response to additional N is not surprising.

## *HYBRID VS. OPEN-POLLINATED VARIETY BY SEEDING RATES*

### How was it done?

- **Varieties:** 45C75 (open-pollinated) and 45Y77 (closed-pollinated or hybrid) Clearfield canola.
- **Treatments:** Both varieties were sown to achieve 20, 40, 60, 80, 100 and 150 plants/m$^2$.
- **Sowing Date:** 24 May.
- **Fertiliser at sowing:** 19:13:0:9 (Croplift 19) @ 150 kg/ha, drilled below seed.
- **Measurements:** Grain yield and oil content and quality (not reported).

## What happened?

Grain yield results are shown in Table 2. These were again well below the potential, with a mean yield for the trial of 1.02 t/ha. There was no significant difference between the two varieties or between seeding rates within each variety – 20 plants/m$^2$ yielded just as much as 150 plants/m$^2$. Both varieties showed this same flat response to seeding rate. This failure to respond to higher seeding rates is again attributed to the high moisture stress in spring, at the critical flowering and pod-filling stages.

**45C75** is a mid to early maturing canola variety tested for tolerance to soil sulphonyl urea (SU) herbicide residues and imidazolinone herbicides (IT or Clearfield variety). It has a moderate to high grain oil content (41–45%) and a blackleg rating of 6.

**45Y77** is a hybrid Clearfield canola variety, with high grain oil content of 41–45% and a blackleg rating of 8.

More detailed analysis of results will be conducted when oil content results are available.

*Table 3 Yield of Bravo TT at different seed size and seeding rates at Cummins LEADA site, 2007*

| Seed size | Sown at | Seeding rate (Plants/m$^2$) | Grain yield (t/ha) |
|---|---|---|---|
| Large | 120 plants/m$^2$ | 120 | 0.93 |
| Large | 4 kg/ha | 97 | 0.87 |
| *Large seed mean* | | | ***0.90 a*** |
| Medium | 120 plants/m$^2$ | 120 | 0.75 |
| Medium | 4 kg/ha | 122 | 0.78 |
| *Medium seed mean* | | | ***0.73 b*** |
| Small | 120 plants/m$^2$ | 120 | 0.76 |
| Small | 4 kg/ha | 160 | 0.64 |
| *Small seed mean* | | | ***0.70 b*** |
| *Mean for 120 plants/m$^2$* | | 120 | **0.81** |
| *Mean for 4 kg/ha* | | 4 kg/ha | **0.76** |

*Yields followed by the same letter are not significantly different.*

## *SEED SIZE TRIAL*

## How was it done?

- **Variety:** Bravo TT.
- **Treatments:** Seed graded into Small (<1/18"), Medium (1/18"–1/14") and Large (>1/14") seed lots. All sown at 120 plants/m$^2$ and 7 g/plot (4 kg/ha), the district practice sowing rate.
- **Sowing Date:** 24 May.
- **Fertiliser at sowing:** 19:13:0:9 (Croplift 19) @ 150 kg/ha, drilled below seed.
- **Measurements:** Grain yield and oil content and quality.

## What happened?

Grain yield results are shown in Table 3. Once again, the average trial yield of 0.79 t/ha was well down on the canola potential yield.

Seed size had a significant effect on grain yield, with the large seed (>1/14") producing a higher yield (0.9 t/ha) than either the medium (1/18"–1/14") or small seed (<1/18"). This was a 25% yield advantage to the large seed, but no difference between the small and medium seed.

There was no yield difference between seeding rates of 120 plants/m$^2$ (i.e. adjusted for seed size to give a constant plant density) or 4 kg/ha (fixed weight per area, giving different plant densities with different seed sizes). Large seed sown at 4 kg/ha resulted in 97 plants/m$^2$, while small seed at 4 kg/ha gave 160 plants/m$^2$. These results support the seeding rate trial results reported in Table 2, showing no yield response to plant density under these seasonal conditions. The interaction between seed size and seeding rate was also not significant.

## *SEED SOURCE — FARMER-RETAINED SEED VS. COMMERCIAL SEED*

## How was it done?

- **Varieties:** four canola varieties, from both commercial and farmer-retained seed sources.
- **Sowing Date:** 24 May.
- **Fertiliser at sowing:** 19:13:0:9 (Croplift 19) @ 150 kg/ha, drilled below seed.
- **Measurements:** Grain yield and oil content and quality (not shown).

## What happened?

Grain yield results are shown in Table 4. The mean trial yield of 1.17 t/ha was the highest of the "Better Canola" trials at the Cummins site, but still well below potential of 1.75 t/ha.

There were strong yield differences between varieties in this trial, with the Clearfield (IT) variety 44C73 best at 1.59 t/ha, ahead of Bravo TT on 1.13 t/ha, which in turn was better than AV-Sapphire and Tornado TT. 44C73's yield came closest to the potential, particularly the commercial seed of this variety, which yielded 1.64 t/ha.

Commercial seed produced superior yields to the farmer-retained seed, by an average of 11% across all four varieties. This advantage could flow from several factors, including a better growing environment and hence higher nutrient content and vigour, seed grading and seed treatment with fungicides or insecticides.

## What does this mean?

An overall good risk management package is required to allow canola crops to reach their yield potential, which some growers have failed to do in recent seasons. Variety choice, nitrogen management, seeding rates, seed size and source are all management options that need to be fine-tuned to produce optimum yields.

The 2007 season finished in a similarly very dry fashion to 2006 and left yields well below the potential set up by early rains. The potential yield, as calculated by the French and Schultz growing season rainfall model, was well above the yields of most treatments in the Cummins "Better Canola" trials.

The lack of useful rains at the critical flowering and pod-filling stages was a major factor in failing to achieve near potential yields.

The seeding rate trial demonstrated canola's well known ability to compensate for lower seeding rates by increasing the number and size of branches and pods in response to available moisture, light and nutrients, with minimal impact on yield. This was apparent in the trial as all seeding rates produced similar yields from 20 plants/m$^2$ up to 150 plants/m$^2$. More favourable growing conditions may have seen higher yields at the higher seeding rates.

Seed size affects crop establishment, plant growth and final grain yield. In theory, larger seeds will give better establishment, larger seedlings, flowing through to an increase in grain yield. This was demonstrated in the seed size trial where the large seeds produced a 20% increase in grain yield over the medium and small seed size seeds.

Sowing the larger seeds at the standard 4 kg/ha resulted in fewer plants/m$^2$, but this had no adverse effect on yield.

The importance of high quality canola seed for sowing was verified in the seed source trial. If keeping own seed, it should be sourced from more fertile areas of the farm and graded for larger seed size. Fungicide treatment is also advisable, as well as a viability test to avoid poor germination.

## Acknowledgements

LEADA acknowledges the generous support of ABB Grain Ltd by providing land for the Cummins Focus site. Funding for the "Better Canola" project is provided by the Australian Oilseeds Federation and GRDC. Scientific oversight for the project is provided by Steve Marcroft, Trent Potter and Mark Stanley, and technical support at the LEADA trial site provided by Ashley Flint, Tim Markey and Brian Purdie of SARDI.

***Table 4 Yield of commercial and farmer-retained canola seed at Cummins LEADA site, 2007***

| Treatment effect | Grain yield (t/ha) | |
|---|---|---|
| ***Variety*** | | |
| 44C73 | 1.59 | a |
| Bravo TT | 1.13 | b |
| AV-Sapphire | 0.98 | c |
| Tornado TT | 0.97 | c |
| ***Seed source*** | | |
| Commercial seed | 1.23 | a |
| Farmer-retained seed | 1.10 | b |
| ***Variety x seed source*** | | |
| 44C73 – Commercial | 1.64 | |
| 44C73 – Farmer | 1.54 | |
| Bravo TT – Commercial | 1.31 | |
| Bravo TT – Farmer | 0.96 | |
| Tornado TT – Commercial | 1.08 | |
| Tornado TT – Farmer | 0.86 | |
| AV-Sapphire – Commercial | 0.91 | |
| AV-Sapphire – Farmer | 1.05 | |

*Yields followed by the same letter are not significantly different.*

# Optimal Planting Date for Barley Varieties on Lower EP

**Martin Lovegrove**[1] **and Joanne Crouch**[2]
[1]SARDI, Waite, [2]SARDI, Port Lincoln

Research



## Key messages

- **Time of sowing affected receival quality characteristics of barley varieties.**
- **Across all sowing dates, Hindmarsh and Keel produced the highest grain yields and Baudin and Gairdner produced the lowest.**
- **Time of sowing had no effect on barley yield.**
- **Lack of interaction between variety and sowing date indicates growers don't need to change barley variety to suit a changed sowing date.**

## Why do the trial?

The importance of time of sowing has been highlighted by recent years of variable breaks to the season. New barley varieties continue to be released, and it is important to gain specific knowledge of how individual varieties respond to a range of planting dates. This trial is designed to investigate the optimal time of sowing for individual barley varieties on lower Eyre Peninsula.

## How was it done?

A replicated trial was established through the LEADA farming systems group at the Cummins trial site owned by ABB. The trial evaluated nine barley varieties across three planting dates.

The trial was sown @ 140 plants/m$^2$ with 100 kg/ha of 18:20:00 fertiliser on 17 cm row spacings using knifepoints and press wheels. Sowing depth was 40 mm.

The early time of sowing (TOS) was 13 May, mid TOS was 6 June, and late TOS was 22 June.

Dry matter cuts for assessment of early growth and grazing potential were taken during the tillering growth stage. There was some variation between maturity of varieties the time of sampling. Early TOS plots were sampled on 27 June, 59 days after sowing. Middle TOS plots were sampled on 30 July, 54 days after sowing, and the late TOS plots were sampled 45 days after sowing.

Date of harvest for the early TOA treatments was 7 November, mid TOS was harvested on 13 November and the late TOS plots were harvested on 16 November.

All varieties were assessed on time of flowering, maturity, straw strength and grain yield. Grain quality was assessed for retention (% >2.5 mm), protein (% dry basis), screenings (% <2.2 mm), test weight (kg/hectolitre) and 1000-grain weight.

## What happened?

A good wet start to the season allowed the trials to be sown in optimum conditions. Establishment of the crop was even and crop growth was unaffected by pests or weeds. Throughout the season low levels of powdery mildew were found in the early TOS treatments. Rainfall became limiting during June and moisture stress affected the later TOS treatments (22 June) which had yet to establish a root system. July to October recorded below decile 2 rainfall. Early sown treatments reached 50% flowering around the end of the first week in September; middle TOS treatments reached 50% flowering between the 24 and 26 September, while the late TOS treatments flowered during the last week of September until the end of the first week of October. The dry conditions matured the crop quickly, which resulted in harvest beginning on 7 November.

Dry matter (DM) cuts showed that at all three times of sowing, Fleet had the highest production. Maritime also produced higher DM weights compared to other varieties at all times of sowing. The lowest DM cuts across all three times of sowing was from the potential new malting line, WI3416_1572, with Schooner also producing less dry matter than other varieties.

**Try this yourself now**

**Location**
Cummins, LEADA Focus site

**Rainfall**
Av. annual: 425 mm
Av. GSR: 344 mm
2007 total: 327 mm
2007 GSR: 223 mm

**Yield**
Potential: 2.7 t/ha
Actual: 1.93 t/ha

**Paddock History**
2006: Wheat
2005: Canola
2004: Pasture

**Soil Type**
Grey cracking clay

**Plot size**
10 m x 1.6 m plots, 3 replicates

**Yield Limiting Factors**
Moisture stress in spring, with an early finish.

The trial found a difference in grain yield between varieties (Figure 1). Hindmarsh and Keel out yielded all other varieties, while Baudin and Gairdner yielded less then all other varieties.

There was no interaction between variety and time of sowing.

Table 1 shows the difference in grain plumpness (>2.5) and protein across three times of sowing. Grain retention was best when sown early, but was not significantly higher than the mid TOS.

Protein levels were significantly higher at the early TOS. There was no difference in protein levels between the mid and late times of sowing.

Fleet, Maritime and WI3416_1572 were comparatively plumper than all other varieties and Baudin, Gairdner and Hindmarsh were the least plump varieties (Table 2).

Protein levels were highest in Maritime and lowest in Keel (Table 2).

Baudin showed high levels of screenings when sown at the mid and late seeding dates. Earliest TOS produced significantly less screenings (Table 3) and Gairdner showed the same trend. Keel produced the greatest screenings at the early TOS, with no significant difference between the mid and late timings. Across all varieties the lowest screenings were recorded at the earliest time of sowing.

The barley variety relationship between test weight and time of sowing showed Baudin scoring best weights at the early TOS. Fleet and Gairdner also produced best test weights at the early TOS. All other varieties showed no test weight response to TOS. The mean for test weight showed the early time of sowing having significantly higher test weights compared to the late timing.

Baudin, Fleet, Gairdner, Maritime, Schooner and WI3416_1572 all scored highest 1000-grain weight when sown early, as did the mean across all varieties. Barley varieties, Flagship, Hindmarsh and Keel, had no interaction between 1000-grain weight and timing of sowing.

***Table 1 Time of sowing effect on plumpness (>2.5) and protein at Cummins, 2007***

| | Plumpness | Protein @ |
|---|---|---|
| **Time of Sowing** | >2.5 | 0% (dry basis) |
| **Early** | 40.2 | 20.04 |
| **Mid** | 38.7 | 18.28 |
| **Late** | 33.3 | 18.48 |
| *LSD (P=0.05)* | *5.48* | *0.4* |

***Table 2 Variety effect on plumpness (>2.5) and protein at Cummins, 2007***

| Variety | Plumpness >2.5 | Protein @ 0% (dry basis) |
|---|---|---|
| **Baudin** | 21.2 d | 18.49 c |
| **Flagship** | 33.6 bc | 19.48 b |
| **Fleet** | 51.6 a | 18.61 c |
| **Gairdner** | 24.4 cd | 19.01 bc |
| **Hindmarsh** | 27.4 bcd | 19.49 b |
| **Keel** | 34.4 b | 16.83 d |
| **Maritime** | 50.9 a | 20.49 a |
| **Schooner** | 33.6 bc | 19.46 b |
| **WI3416_1572** | 59.7 a | 18.53 c |
| *LSD (P=0.05)* | *9.5* | *0.7* |

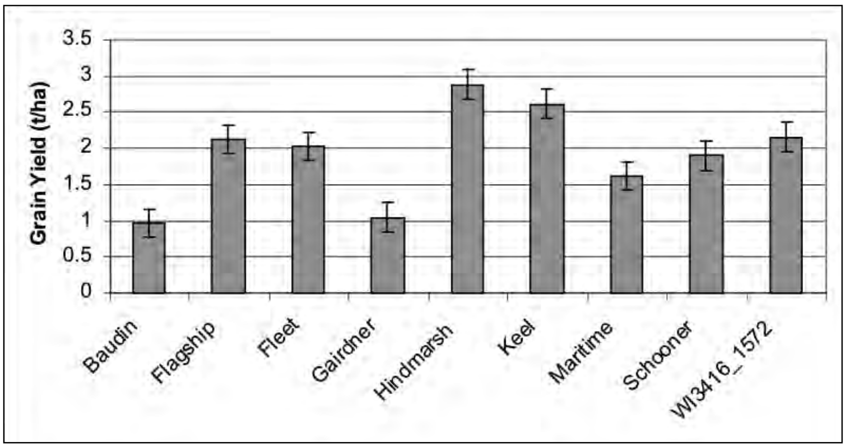



***Figure 1 Barley variety grain yields at Cummins, 2007.***

## What does this mean?

The high DM production from Fleet and Maritime are the best options for opportunistic early grazing.

Due to the poor finish to the season, 2007 trial yields were well below the Cummins district average. Yield differences were seen between varieties but not between times of sowing. The difference in variety yields was largely due to time of flowering and maturity of the variety with the early varieties, Hindmarsh and Keel, yielded higher than all others. Conversely, Baudin and Gairdner are in comparison later to reach maturity and yielded less then all other varieties.

Despite this, at Ardrossan and Yorke Peninsula the same trial was carried out, which did show a time of sowing response. Early and mid times of sowing both significantly out yielded the late time of sowing.

Receival specification grain quality for varieties varied significantly with time of sowing. Later maturing Baudin and Gairdner showed higher grain quality characteristics when sown early. Flagship and Hindmarsh showed no interaction between grain quality and time of sowing due to these varieties flowering much earlier. Keel produced higher screenings when sown early compared to mid and late times of sowing. This is likely due to Keel at the early time of sowing treatment finishing flowering prior to a late rainfall event which all other later flowering varieties benefited from.

Based on these trial results, you would not change barley variety when deciding on planting time. This trial will continue through 2008 with the aim to reach a more definite conclusion.

## Acknowledgements

We thank GRDC for funding the research, SARDI Port Lincoln for the management of the trial and ABB for provision of the land.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

GRDC Grains Research & Development Corporation

***Table 3 Screenings (<2.2) interaction between barley variety and time of sowing, Cummins 2007***

| TOS | Baudin | Flagship | Fleet | Gairdner | Hindmarsh | Keel | Maritime | Schooner | WI3416 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| **Early** | 16.12 | 13.84 | 6.07 | 12.26 | 16.85 | 28.18 | 5.47 | 10.38 | 5.41 | 12.73 |
| **Mid** | 30.26 | 14.71 | 8.89 | 33.49 | 14.94 | 15.52 | 5.68 | 11.36 | 9.23 | 16.01 |
| **Late** | 38.58 | 20.15 | 15.48 | 46.34 | 15.35 | 17.21 | 10 | 16.77 | 11.13 | 21.22 |
| ***LSD (P=0.05)*** | *8.96* | *ns* | *ns* | *8.96* | *ns* | *8.96* | *ns* | *ns* | *ns* | *2.99* |

***Table 4 Test weight, kg/hectolitre, interaction between barley variety and time of sowing, Cummins 2007***

| TOS | Baudin | Flagship | Fleet | Gairdner | Hindmarsh | Keel | Maritime | Schooner | WI3416 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| **Early** | 67.1 | 68.2 | 66.1 | 68.07 | 68.73 | 63.5 | 66.77 | 69.23 | 68.33 | 67.34 |
| **Mid** | 65.2 | 69.17 | 65.07 | 64.87 | 67.3 | 64.03 | 67.37 | 69.73 | 68.17 | 66.77 |
| **Late** | 63.3 | 68.27 | 63.37 | 61.2 | 68.5 | 64.87 | 67.3 | 69.37 | 68.37 | 66.06 |
| ***LSD (P=0.05)*** | *2.07* | *ns* | *2.07* | *2.07* | *ns* | *ns* | *ns* | *ns* | *ns* | *0.69* |

***Table 5 1000-Grain weight interaction between barley variety and time of sowing, Cummins 2007***

| TOS | Baudin | Flagship | Fleet | Gairdner | Hindmarsh | Keel | Maritime | Schooner | WI3416 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| **Early** | 31.21 | 36.11 | 44.55 | 36.17 | 31.19 | 31.67 | 37.31 | 34.48 | 37.89 | 35.62 |
| **Mid** | 27.18 | 34.76 | 41.49 | 29.54 | 32.02 | 34.28 | 36.23 | 33.15 | 34.66 | 33.7 |
| **Late** | 24.11 | 33.49 | 37.49 | 26.95 | 31.77 | 33.46 | 34.23 | 31.18 | 33.54 | 31.8 |
| ***LSD (P=0.05)*** | *2.803* | *ns* | *2.80* | *2.80* | *ns* | *ns* | *2.80* | *2.80* | *2.80* | *0.93* |

# Farm Gross Margin Guide 2008


**Contains both the latest price estimates and indicative gross margins for the coming season, as well as gross margin templates and information to guide you in your own calculations.**

Obtain your copy for only $11. The Guide allows you to:

- Choose the most profitable enterprise options for this year
- Easily calculate the effect of prices on this years profitability
- Easily calculate your own crop or livestock gross margin
- Compare the performance paddocks, enterprises and rotations.

**Available from any Rural Solutions SA office**
**Phone 1800 356 446**

RURAL SOLUTIONS SA

**Visit our online shop**
**www.ruralsolutions.sa.gov.au/bookshop**

Government of South Australia

# Making the right decisions for your crop easier


***Four ready to use and convenient charts for daily use when on the job.***

- Weed, disease and insect control information
- Wheat, barley, pulses and canola
- When and where you need it:
  - chemicals
  - products
  - rate
  - costs
  - critical comments
  - withholding periods
  - tank mixes
  - minimum cropping intervals
  - insect thresholds
  - calibration formula
  - and much more!

RURAL SOLUTIONS SA

**Available from any Rural Solutions SA office, phone 1800 356 446**
**Visit our online shop, www.ruralsolutions.sa.gov.au/bookshop**

Government of South Australia

**Section 4**

**Section editor:**
**Liz Guerin**
Rural Solutions SA,
Streaky Bay

# Pastures

## Nutritional Value of Weeds


**Emma McInerney and Neil Cordon**
SARDI, Minnipa Agricultural Centre


Research

Extension

**Try this yourself now**

**Location**
Minnipa Agricultural Centre
**Rainfall**
Av. annual: 325 mm
Av. GSR: 236 mm
Actual annual: 233 mm
Actual GSR: 140 mm

### Key messages

- **Iceplant and Onion weed as the sole feed source cannot sustain livestock.**
- **Lincoln weed, Indian hedge mustard, Ward's weed, Marshmallow and Long fruited wild turnip can provide valuable feed at pre and full flowering stage.**
- **There is a general decline in the nutritional value of weeds post flowering.**
- **Most weed species pre-flowering are high in metabolisable energy and crude protein and low in fibre.**

### Why do the survey?

Producers have reported interesting behaviour in their sheep when grazing on various weed dominant pastures. Sheep have appeared to thoroughly enjoy a feed of Lincoln weed and others will quickly increase body condition by chewing through Ward's weed, however at different times of the year, the same sheep will commit snobbery on the Lincoln weed and appear to go backwards on the Ward's weed.

Meeting the nutritional requirements of an animal is important to properly perform a desired function i.e. grow muscle, lactate, produce wool or simply maintain body weight. Sheep select what they want to eat based on palatability and nutritional value of the feed on offer. Palatability is difficult to measure and might be considered less important than nutritional value if stock are given no choice. A basic survey was conducted to demonstrate the nutritional value of common upper EP weeds throughout the year.

### How was it done?

Common weed species were sampled at the Minnipa Agricultural Centre at three different growth stages; pre-flowering, full flowering and post-flowering and analysed by the FeedTest laboratory. FeedTest produced reports on the analysis of dry matter, crude protein, metabolisable energy, fibre and digestibility. The weeds sampled include Horehound, Iceplant, Indian hedge mustard, Lincoln weed, Long fruited wild turnip, Marshmallow, Onion weed and Ward's weed.

### What Happened?

Figures 1, 2, 3 and 4 illustrate the tested values of crude protein (CP), metabolisable energy (ME), digestibility and neutral detergent fibre (NDF) for the different weed species.

### Pre flowering:

Crude protein was very high (in excess of animal needs) for most species except Iceplant and Onion weed while metabolisable energy was high in most species except Horehound. Fibre content was generally low, varying between 12.3% in Iceplant to just above 30% in Horehound. Digestibility was good across all species.

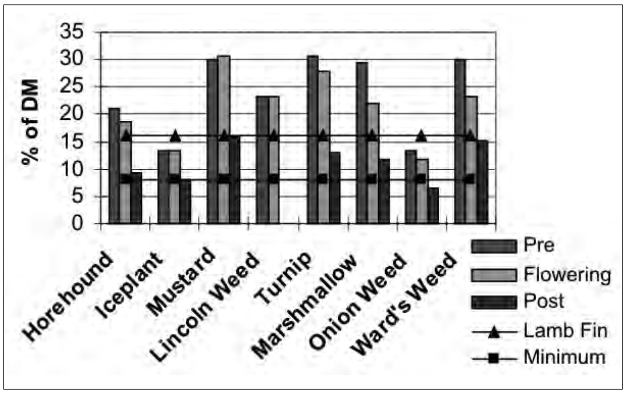



***Figure 1 Crude protein of common EP weeds at different growth stages***

*Lamb Fin = the optimum value for finishing weaner lambs (CP – 16%)*
*Minimum = the minimum requirement for maintaining stock (CP – 8%)*

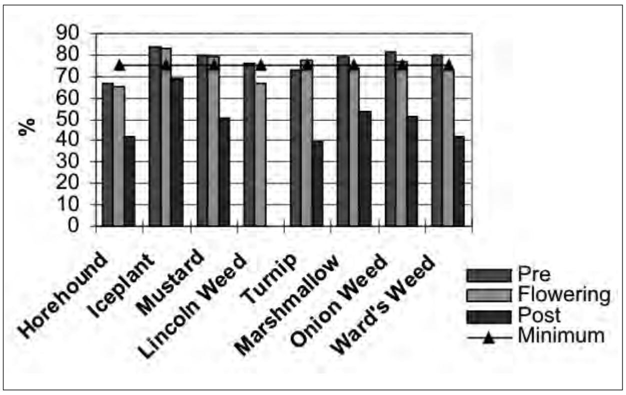



***Figure 3 Digestibility of common EP weeds at different growth stages***

*Minimum = inefficient use of feed below 75% digestibility*

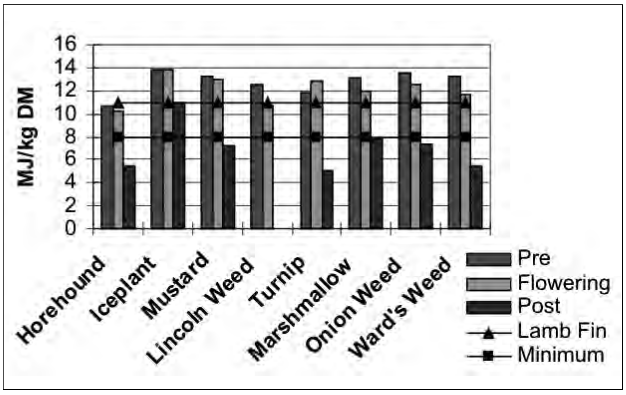



***Figure 2 Metabolisable energy of common EP weeds at different growth stages***

*Lamb Fin = the optimum value for finishing weaner lambs ME – 11 MJ/kg DM)*
*Minimum = the minimum requirement for maintaining stock (ME – 8 MJ/kg DM)*

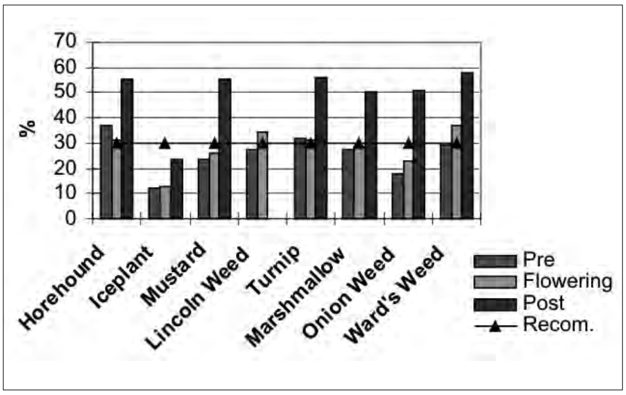



***Figure 4 Neutral Detergent Fibre of common EP weeds at different growth stages***

*Recom. = Recommended 30% fibre content*
***NB:** Post flowering sample for Lincoln weed was unavailable at the time book went to press*

## Full flowering:

The results were very similar to pre flowering; once again, CP was high with the exception of Iceplant and Onion weed while a slight drop in ME for Horehound was the only change in ME with the other species remaining high. There was very little change in the fibre except a slight increase in Lincoln weed and Ward's weed. Digestibility at full flowering remained at the same desirable level as the pre flowering analysis. The dry matter percentage (DM) of the weeds ranged from 30% in Horehound to only 5% in Iceplant.

## Post flowering:

With maturity came a dramatic decrease in CP across all weeds. Wards weed and mustard maintained a level of protein (16%) required by growing weaners but Onion weed fell low enough to render it inadequate for maintaining sheep body weight. All weeds fell below the 8 MJ/kg DM of ME needed for maintaining body condition, except for Iceplant. Digestibility fell to 55% or lower in all weeds excluding Iceplant. Fibre remained low in Iceplant only with all other species increasing to over 50%.

## What does it mean?

The survey shows that none of the weeds sampled are capable of providing adequate nutrition to livestock for the entire period from pre flowering stage through to post flowering. The basic nutritional analysis indicates that some species could carry dry ewes (low nutritional demand) or even weaner lambs (high demand) for brief periods of time.

The weeds sampled pre flowering and at full flowering generally had very high protein (above 18%) and high energy levels (above 11 MJ/kg

DM). Fibre levels were generally below the recommended 30% at pre and full flowering which is not ideal for livestock as low fibre occurred when protein and energy are at their highest. The feed is rich and the stock can consume large quantities as digestibility is also high, so it's possible they may become fat, scour or suffer from various health issues. Fibre content increased dramatically post flowering as the plants matured, coinciding with low protein, energy and digestibility so stock would not have been able to consume enough feed in order to perform the more demanding tasks of lactating or putting on weight and could potentially lose weight.

A diet that is 50% indigestible means that half of the animal's intake exits as waste. The animal must then double its intake in order to meet its nutritional need, which is not possible when fibre is high – imagine trying to replace half of your daily intake with cardboard.

As the weeds began to hay off post flowering, protein, energy and digestibility all dropped as fibre and dry matter content increased. The nutritional value of weeds became so poor that livestock would rapidly lose weight.

Horehound is well balanced for protein, energy and fibre at pre flowering and full flowering and all sheep classes should show positive growth. Sheep would get no value from grazing Horehound post flowering.

Iceplant is a poor stock feed and is likely to be eaten only in very small quantities. It lacks fibre and is consists largely of water, but contains a high level of energy through all growth stages.

Indian hedge mustard is a high energy, high protein feed source during pre and full flowering, slightly lacking in fibre but conducive to positive growth in weaners. As it matures and feed value decreases, mustard is only suited to maintaining body weight as the high fibre content will prevent weight gain.

Lincoln weed and Ward's weed show similar trends to Indian hedge mustard at pre and full flowering; marshmallow and long fruited turnip are similar through all three growth stages. Ward's weed maintains high protein post flowering, however fibre is also very high and digestibility drops, making it less appealing to sheep.

Onion weed, like Iceplant is very high in energy, highly digestible, low in fibre and has a high water content through flowering and would be eaten in small quantities, but as it matures, sheep are unlikely to consume and will not perform well due to lack of protein and energy.

A great deal of variation can occur in the nutritional value of weed species over the growing season and from one year to the next. Weight gain is usually the best indicator of how good the feed is, but if there's uncertainty about the nutritional value, it should be tested. Paddocks are very rarely dominated by only one weed species. There are usually other weed species or crop residues in the paddock that will offer a variation in nutritional value.

Refer to the article "Why is testing feed value important for sheep", p. 84 for why recommended nutrient levels and their function are important.

## Acknowledgements

Grain & Graze is jointly funded by Meat & Livestock Australia, Grains Research & Development Corporation, Australian Wool Innovation and Land &Water Australia.

FeedTest is a registered product of the Victorian Department of Primary Industries.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Grain & Graze

Profit through knowledge

EYRE PENINSULA

# Matching Land Capability and Pasture Production

**Liz Guerin[1] and Brett Masters[2]**
[1]Rural Solutions SA, Streaky Bay, [2]Rural Solutions SA, Port Lincoln

Research

## Key messages

- **Sowing annual pasture (including a cereal for grazing) can produce a bulk of early feed.**
- **Have a mix of pasture options in the farming system to make the most of variable rainfall.**
- **With the expense of establishing pastures (up to $200/ha) it is important to utilise all the feed produced by using appropriate paddock sizes and stocking rates.**
- **Sowing a cereal for grazing can produce high quality feed for finishing stock in a poor season and has flexibility to be harvested for grain or hay in good seasons.**
- **Perennial pasture species will establish in drier areas, however the test of successful establishment is if seedlings make it through a dry summer.**

## Why do the trial?

Pasture species for Eyre Peninsula land systems are quite limited. Investigating alternatives which perform and persist can increase farmers' grazing options.

Dry seasons and reduced margins in cropping systems are forcing farmers to rethink the mix of cropping and grazing in their farming systems. In 2006 a number of sites were set up across various land systems on Eyre Peninsula to determine the most profitable and sustainable grazing and cropping systems (EPFS Summary 2006, p. 53, EPFS Summary 2005 pp. 67–68, EPFS Summary 2004, p. 59).

## How was it done?

A number of demonstration sites across Eyre Peninsula were sown to examine possible alternative pastures for the region. Pasture species included Lucerne, phalaris, medic, Italian ryegrass and cereals.

***Lake Hamilton***

The Lake Hamilton site was a 40 ha paddock that was fenced into three separate treatments. These smaller paddocks were sown to Lucerne (13 ha), Italian ryegrass (14 ha) and oats (14 ha). The aim of this site was to compare establishment costs and production from annual pasture species (oats and Italian ryegrass) as well as to use Italian ryegrass as a weed competitor to "clean up" a paddock for Lucerne establishment in the following year. Grazing days were recorded to give an indication of comparative dry matter production between the oats and ryegrass.

**Try this yourself now**

**Location**
Lake Hamilton
Area: 40ha

**Soil type:**
Sandy loam (some ironstone) over clay

**Rainfall:**
2007 total: 250 mm

**Location**
Lipson
Area: 19 ha

**Soil type:**
Red brown earth

**Rainfall:**
2007 total: 190 mm

## What happened?

- Good opening rains allowed establishment of all treatments. The Lucerne suffered some damage from Red-legged earth mite and Lucerne flea.
- The landholder put stock into the oats and Italian ryegrass paddocks when plants were well anchored and there was sufficient dry matter to graze.
- The landholder commented on the high weight gain of hogget rams on Italian ryegrass.
- The landholder grazed the oats for a total of thirty six days with average grazing pressure of 48 DSE/ha (1728 DSE/days per ha) and the Italian ryegrass for forty seven days with average grazing pressure of 24 DSE/ha (1128 DSE/day per ha).
- Although the Lucerne was slow to establish, by mid September the plants were well anchored. The landholder was able to graze the Lucerne with 480 DSE for five days in September to clean up the volunteer cereals sprayed in August.
- The site received 18 mm of rain in early November which saw the Italian ryegrass respond with a flush of growth. After these rains the landholder got no valuable grazing from the oats and yet was able to graze 160 DSE for a further sixteen days on the ryegrass.

## What does this mean?

- Despite well below average rainfall in 2007, by sowing annual pasture for grazing the landholder was able to produce a quick bulk of dry matter for stock to graze on throughout the season.
- Oats provided more grazing than the ryegrass during winter, but due to the later maturity of Italian ryegrass, it was able to respond to spring rains and be grazed later into the season.
- Having a variety of pastures in the farming system can utilise unseasonal rainfall.
- Although Italian ryegrass can be more expensive than oats to establish, the feed produced by response to late rains can be very valuable.
- By fencing off the paddocks into manageable units and rotational grazing with high stocking pressure, the landholder was able to effectively utilise the feed that the paddock produced.
- As Lucerne is slow to establish and little grazing is to be had in the first year it advisable to ensure that other pasture paddocks produce enough feed to offset the loss of production area.

***Lipson***

The Lipson oat variety grazing demonstration site was a 19 ha paddock with half sown to Wintaroo, a CCN resistant, mid maturity hay oat. The other half of the paddock has sodicity issues and was sown to Saia oats, a late maturity hay oat with good early vigour. The aim of this site was to compare dry matter production and feed quality of the different oat varieties.

- Dry matter cuts were taken in August during the main growth period and in early November at the end of the growing season.
- Feed tests were taken in August during the main growth period.

## What happened?

- Wintaroo looked greener and had a more erect growth all season. Saia oats carried more tillers than Wintaroo. Though neither variety grew very high, the Saia plants were considerably more stunted than Wintaroo.
- Wintaroo produced more dry matter than Saia in August.
- Moisture content of Saia was 8% less than Winteroo

## What does this mean?

- Sowing an annual cereal for grazing can produce high quality feed to finish lambs.
- Given better seasonal conditions the grower would have had the option of cutting the paddock for hay or reaping grain.
- The grower had the opportunity to wean and finish lambs in a dry year.
- The preferential grazing of the Wintaroo oats may suggest differences in palatability between varieties.

***Other Sites***

Other sites were established at Penong, Streaky Bay, Mount Damper, Lock and Lipson. These sites looked at a variety of pasture species, both annual and perennials for suitability, dry matter production and persistence. Good emergence of all species was observed with many of the perennial species being much slower to establish. Due to the dry season data measurements were not taken. It is unclear whether the perennial species will recover after summer (and in sufficient densities). A measure of persistence will be taken in March 2008.


## Acknowledgements

We gratefully acknowledge funding from NLP through EP Natural Resources Management Board.

A big thank you to the following landholders: Ben Polkinghorne, Daryl Tree, Sean O'Brien, Dion Williams, Bill Nosworthy, Gerald Schlink, Richard Dutschke, Andrew Wiseman, Brenton Solly, Steven Nankivell, Andrew Ware, Des and Terry Baillie, Andrew Bates and Geoff Kroemer for their interest, cooperation and for letting us use their land.

Thanks to Ben Ward, Neil Cordon, Jon Hancock and Wade Sheppard (SARDI) for sowing and spraying the Mount Damper and Streaky Bay demonstration strips; David Davenport, Brett Masters, Daniel Schuppan, Tim Prance (Rural Solutions SA) for technical expertise and monitoring; Ali Frischke and Emma McInerney of SARDI (Grain and Graze) for cooperation and team work.


MCPA LVE, Roundup PowerMAX and Striker are registered products of Nufarm. LeMat is registered to Bayer and Pantera is registered to Chemtura.

***Establishment costs and production at Lake Hamilton, 2007***

| Pasture Species | Cost of Establishment ($/ha) | Production (kg/ha DM) |
|---|---|---|
| **Lucerne** | 170 | Establishment year |
| **Italian ryegrass** | 178 | 1128 |
| **Oats (farmer provided seed)** | 120 | 1728 |
| **Oats (purchased certified seed)** | 220 | 1728 |

Pastures

***Site management at Lake Hamilton, 2007***

| Date | Activity | Details |
|---|---|---|
| **17 May** | Sowing (Italian ryegrass) | Paddock sprayed with 1L/ha Roundup PowerMAX/LI700. Italian ryegrass (Tetila) sown at 20 kg/ha with 22:15:0 @ 75 kg/ha using main box of combine |
| **19 May** | Sowing (Lucerne) | Paddock sprayed with 1L/ha Roundup PowerMAX/LI700 and 1L/ha Treflan. Lucerne sown at @ 7.5 kg/ha (mainly SARDI 7 with ML99 in centre of paddock) with 22:15:00 @ 75 kg/ha using small seeds box on combine |
| **20 May** | Sowing (oats) | Paddock sprayed with 1L/ha Roundup PowerMAX/LI700. Oats (Echidna) sown at 75 kg/ha with 22:15:0 @ 75 kg/ha using combine |
| **6 June** | Insecticide application (Lucerne) | LeMat @ 100 mL/ha for Red-legged earth mite (RLEM). Light rain may have affected efficacy |
| **3 July** | Insecticide application (Lucerne) | LeMat @ 100 mL/ha for RLEM and Lucerne flea |
| **19 August** | Herbicide application (Lucerne) | Pantera @ 250 mL/ha for volunteer cereal and grasses |
| **20 August** | Herbicide application (Italian ryegrass) | MCPA LVE @ 400mL/ha to remove broadleaf weeds |

***Site management at Lipson, 2007***

| Date | Activity | Details |
|---|---|---|
| **25 May** | Knockdown herbicide spray | Roundup PowerMAX @ 800 mL/ha and Striker@ 75 mL/ha |
| **25 May** | Sowing | Oats sown @ 80 kg/ha on 4" tynes with 18:20:00 broadcast @ 56 kg/ha |
| **1 May** | Herbicide application | Diuron @ 400 g/ha to control three corner jack |
| **10 July** | Insecticide spray | Danadim @ 85 ml/ha to control lucerne flea |

***Dry matter production and feed test results at Lipson, 27 August 2007***

| Variety | Dry Matter (kg/ha) | Moisture (%) | Crude Protein (%) | Neutral Detergent Fibre (% of DM) | Digestabilisty (% of DM) | Metabolisable Energy (MJ/kg DM) |
|---|---|---|---|---|---|---|
| **Wintaroo** | 500 | 79 | 13 | 36.5 | 80 | 12.1 |
| **Saia** | 800 | 71 | 20 | 36.4 | 82 | 12.5 |

## References

Seymour, M. (2004) Farmnote 56/2004 "Achieving Production Targets for Prime Lambs", Department of Agriculture, Western Australia

Australian Government
Department of Agriculture, Fisheries and Forestry
National Landcare Program

Government of South Australia

Government of South Australia
Eyre Peninsula Natural Resources Management Board

LANDCARE

# Tolerance of 'Angel' to Group B Herbicides: Part I – Simulated Residues


## Jake Howie and Chris Dyson

SARDI, Waite Campus


Research

Pastures

## Key message

- **Angel was tolerant to simulated residues of four previously untested Group B herbicides:**
  - **Iodosulfuron**
  - **Sulfosulfuron**
  - **Mesosulfuron-methyl**
  - **Imazapic + imazapyr**

## Why do the trial?

This trial was conducted to test the response of Angel strand medic to simulated residues of some previously untested Group B herbicide products.

'Angel' is a chemically induced mutant variety of strand medic (*Medicago littoralis*) selected for tolerance to soil residues of certain acetolactate synthase (ALS) inhibiting herbicides including the sulfonylurea (SU) herbicides (see EPFS Summary 2003, p. 45; EPFS Summary 2005, p. 51). Although widely used, SU herbicide residues can be very persistent, particularly where alkaline soils and low rainfall significantly reduce their breakdown by microbial action and chemical hydrolysis. Regenerating annual *Medicago* spp. are generally intolerant of SU herbicide residues, resulting in stunting, reduced dry matter production, lower seed yields, poor persistence and decreased N fixation.

## How was it done?

Three SU herbicides and a mixture of two imidazolinone herbicides were applied as pre-sowing treatments to bare ground on 17 May. To simulate a range of residual herbicide levels, they were applied at five rates, corresponding to 0, 5, 10, 20 and 40% of recommended label rate (label rates are: iodosulfuron, 10 grams active ingredient per hectare; mesosulfuron-methyl, 9.9 g.a.i. ha; sulfosulfuron, 18.75 g.a.i. $ha^{-1}$ and imazapic + imazapyr, 21 + 7 g.a.i. ha respectively). Angel was subsequently sown (5 June) into the simulated herbicide residues. Dry matter production (DM) was assessed at sixteen weeks post sowing (pod and seed yields were also harvested and their analysis is pending final processing).

Trial design: randomised block, 3 replicates; plot size: 5 m x 1.2 m.

For Angel to be considered as possessing tolerance to a particular rate of chemical, its yield (dry matter) had to significantly ($p < 0.10$) exceed 75% of that of the untreated control.

## What happened?

Angel was tolerant to mesosulfuron-methyl and imazapic + imazapyr at all rates applied. It was tolerant to iodosulfuron at 5, 10 and 20% and to sulfosulfuron at the 5 and 10% rates (Table 1). At the 40% rate, dry matter production was reduced by 27% and 18% for iodosulfuron and sulfosulfuron respectively.

* Iodosulfuron, sulfosulfuron, mesosulfuron-methyl and imazapic/imazapyr are respectively the active ingredients of Hussar (registered trademark of Bayer Crop Science), Monza (Monsanto), Atlantis (Bayer Crop Science) and OnDuty (BASF).

Of the rates applied, the 10% rate is estimated to approximate typical residual SU herbicide levels experienced ten months after application in alkaline soils receiving 300 mm annual rainfall (Heap pers. comm.), but actual residual levels will vary according to environmental conditions. Despite good opening rains in 2007, the growing season rainfall at Mallala after herbicide application was low (128 mm) and may have led to reduced breakdown of herbicide, thus exacerbating any damaging effects and reducing the relative ability of Angel to respond and "grow away".

**Almost ready**

**Location**
Mallala: Peter March & Wayne Matters

**Rainfall**
Av. annual: 379 mm
Av. GSR: 282 mm
2007 total: 342 mm
2007 GSR: 217 mm
2007 GSR after May herbicide application: 128 mm

**Yield**
Potential: 6.6 t/ha (regenerating pasture)
Actual: 3.2 t/ha (sown pasture)

**Soil Type**
Sandy loam (pH 6.7) over loam (pH 8-9)

**Plot Size**
5 m x 1.2 m x 3 reps

**Yield Limiting Factors**
Frosts, early finish

*Table 1 Relative dry matter production (% nil control) of Angel in response to pre-sowing herbicides* applied at 5, 10, 20 and 40% recommended label rate at Mallala, 2007*

| Rate (%) | Iodosulfuron | Sulfosulfuron | Mesosulfuron-methyl | Imazapic/imazapyr |
|---|---|---|---|---|
| **5** | 95 | 92 | 90 | 92 |
| **10** | 87 | 95 | 88 | 84 |
| **20** | 90 | 82 | 96 | 96 |
| **40** | 73 | 82 | 98 | 95 |
| **Critical value to be exceeded** | | | **83** | |

## What does this mean?

- Angel was able to adequately tolerate (dry matter basis) simulated residues of all four ALS-inhibiting herbicide products tested at levels that would normally be expected to be damaging for intolerant medic pastures.
  ***NB*** *Seed yields are still being processed and when the overall analysis is completed, should also provide additional information.*
- Angel's relative tolerance should contribute to increased pasture productivity in situations where residues of SU herbicides exist at damaging levels.
- Additional new and untested group B herbicides will be tested in 2008.

## Acknowledgements

We gratefully acknowledge the funding by South Australian Grains Industry Trust; technical assistance from Jeff Hill, SARDI; advice from Chris Preston, University of Adelaide and collaborating farmers, Peter March and Wayne Matters, Mallala.

# Tolerance of 'Angel' to Group B Herbicides: Part II – Foliar Applied


## Jake Howie

SARDI, Waite Campus


Research



## Key messages

- **Angel strand medic was tolerant to one sulfonylurea and three imidazolinone herbicides applied as post-emergents at various rates.**
- **Herald strand medic was tolerant to two imidazolinone herbicides.**

## Why do the trial?

These trials were conducted to assess the relative response of Angel and Herald strand medic to foliar applied Group B herbicides used for post-emergence broadleaf weed control in certain crops including some legume crops, pastures and canola. Although some of the treatments are not registered (i.e. are "off-label") for annual medics, they could be potentially useful in controlling certain problem weeds including capeweed, 3 cornered jack, wireweed and silver grass.
The plant parasite, branched broomrape (*Orobanche ramosa*), is another weed that could potentially be controlled in the pasture phase with these Group B herbicides. As broomrape emerges late in the season, post-emergent applications of Group B herbicides could be used to gain greater control indirectly by controlling the weed host; systemically through the host plant; and/or directly upon the emerging broomrape plant.

## How was it done?

One sulfonylurea and three imidazolinone herbicides were applied as post-emergent herbicides to sown plots of Angel and Herald at the 8-10 leaf stage on 13 September at Mallala. The treatments are listed in Table 1.

Dry matter production was assessed at sixteen weeks post sowing (pod and seed yields were also harvested and their analysis is pending final processing).

Trial design: randomised block, 3 replicates; plot size: 5 m x 1.2 m.

## What happened?

The establishment of Herald was unaccountably poor (average 310 plants/m$^2$ cf Angel, 550 plants/m$^2$) resulting in lower overall dry matter (DM) production (Figure 1) and suggesting lower viability seed, which may have affected subsequent responses to herbicides. Treatments were applied somewhat later than ideal, held up by consistently windy conditions, and the dry finish increased experimental variability. Despite the above, the DM of Angel was relatively consistent across all the treatments, indicating adequate tolerance to the treatments applied. Herald DM was reduced by OnDuty @ 40 g/ha and Oust @ 20 g/ha, but increased by Spinnaker @ 280 g/ha.

## What does this mean?

Angel was able to adequately tolerate foliar application of all treatments including three imidazolinone products tested at typical application rates. Oust is a sulfonylurea product registered for use in commercial and industrial areas and although it was applied at only 5–10% typical label rate, the tolerance of Angel relative to Herald is interesting and may lead to work with more rates in 2008.

Herald was also tolerant of a number of the treatments including Raptor and Spinnaker. The increased Herald DM in

**Searching for answers**

**Location**
Mallala: Peter March & Wayne Matters

**Rainfall**
Av. annual: 379 mm
Av. GSR: 282 mm
2007 total: 342 mm
2007 GSR: 217 mm
2007 GSR after May herbicide application: 128 mm

**Yield**
Potential: 6.6 t/ha (regenerating pasture)
Actual: 3.2 t/ha (sown pasture)

**Soil Type**
Sandy loam (pH 6.7) over loam (pH 8-9)

**Plot Size**
5 m x 1.2 m x 3 reps

**Yield Limiting Factors**
Frosts, early finish

response to Spinnaker @ 280 g/ha is unexplained and may be an artefact of experimental variability. A duplicate trial sown at Mannum is pending final analysis and may help interpret the results. Seed yields for both sites are also still being processed and when the overall analysis is completed, should provide additional information.

The treatments above are experimental only and not recommendations.

Group B herbicides do have a higher risk of developing herbicide resistant weeds than most other herbicide groups. However, this can be minimised with productive and well managed pasture phases providing additional weed control options such as herbicide rotation, grazing, hay making, green manuring and spray-topping.

Some of these treatments will be repeated in 2008 in addition to some new and untested group B herbicides.

* Iodosulfuron, sulfosulfuron, mesosulfuron-methyl and imazapic/imazapyr are respectively the active ingredients of Hussar (registered trademark of Bayer Crop Science), Monza (Monsanto), Atlantis (Bayer Crop Science) and OnDuty (BASF).

## Acknowledgements

We gratefully acknowledge the funding by South Australian Grains Industry Trust; technical assistance from Jeff Hill, SARDI; advice from Chris Preston, University of Adelaide and collaborating farmers, Peter March and Wayne Matters, Mallala.

OnDuty, Spinnaker and Raptor are the registered trademarks of BASF and Oust is the registered trademark of DuPont.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

THE UNIVERSITY OF ADELAIDE AUSTRALIA

***Table 1 Herbicide treatments and rates, Mallala 2007****

| Herbicide and rate | Additive |
|---|---|
| Nil herbicide | nil |
| OnDuty @ 20 g/ha | Hasten @ 0.50% |
| OnDuty @ 40 g/ha | Hasten @ 0.50% |
| Oust @ 10 g/ha | BS 1000 @ 0.25% |
| Oust @ 20 g/ha | BS 1000 @ 0.25% |
| Raptor @ 45 g/ha | Hasten @ 0.50% |
| Raptor @ 50 g/ha | Hasten @ 0.50% + Boost @ 2% |
| Spinnaker @ 70 g/ha | BS 1000 @ 0.20% |
| Spinnaker @ 140 g/ha | BS 1000 @ 0.20% |
| Spinnaker @ 280 g/ha | BS 1000 @ 0.20% |

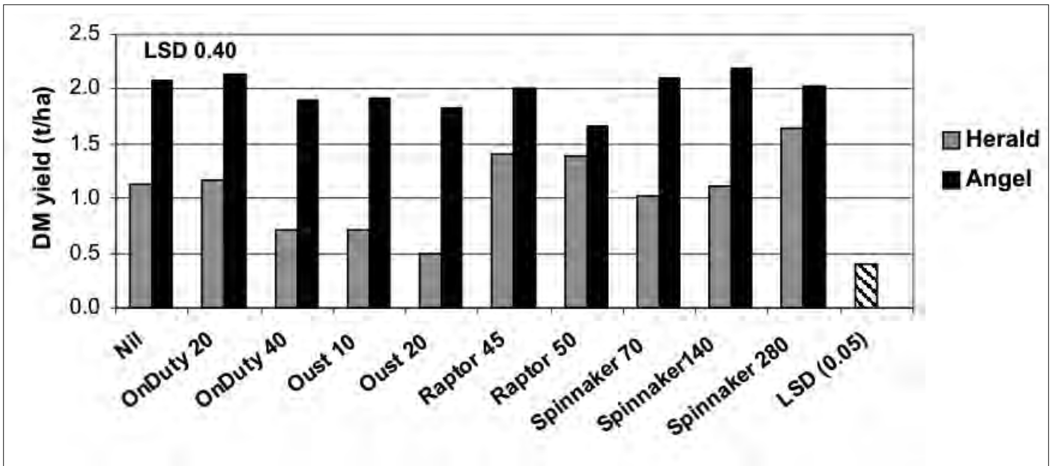



***Figure 1 Dry matter yield (t/ha) of Angel and Herald in response to foliar applied herbicides* applied at various rates at Mallala, 2007.***

# Fertilising Veldt Grass at Wharminda


## Sarah Horne

Cleve Area School


Demo



## Key message

- **The impact of fertilising Veldt grass has delivered inconclusive results and requires further work.**

## Why do the trial?

Veldt grass is typically used for grazing stock and providing cover for soils that are susceptible to wind erosion. This trial was designed to determine if applying different fertilisers at different rates to Veldt grass would increase dry matter production.

Very little research has been done on the productivity of Veldt grass and its response to fertiliser, particularly in the Wharminda district.

## How was it done?

The trial was conducted on a 30 year old stand of Veldt grass, which had been sown on a sand hill to prevent erosion. The rate and types of fertilisers were varied to determine the most effective way to increase dry matter production (Table 1). The Veldt grass did not have a recent history of fertiliser use, though soil nutrition was not measured prior to the trial. The paddock was not grazed during the previous year.

Fertiliser was applied on 30 May (Table 1) and treatments were replicated three times. The site received 66 mm rainfall over the trial period. Dry matter cuts were done on 19 August (eleven weeks after application).

## What happened?

Treatments 3, 4 and 6 showed increases in dry matter production from the control (Figure 1). Dry matter production response was completely random – there was no trend toward a particular rate of fertiliser or any component being more effective than others.

## What does this mean?

While fertiliser applications such as 150 kg/ha of urea (treatment 3) may have shown an increase in dry matter production, the results are inconclusive as the response to N was inconsistent across other treatments. The increasing trend of fertiliser prices would further deter any recommendation on the basis of these results. More trials would need to be conducted to produce reliable results.

### Searching for answers

**Location:**
Wharminda
M, J and S Horne

**Rainfall:**
Av. annual: 268 mm
Av. GSR: 206 mm
2007 total: 249 mm
2007 GSR: 162 mm

**Paddock History:**
30 year old unfertilised Veldt grass stand

**Soil Type:**
Non-wetting sand

**Plot Size:**
200 m x 1.5 m

***Table 1 Fertiliser type and rates applied to Veldt grass at Wharminda, 2007***

| Treatment | Rate (kg/ha) | Units |
|---|---|---|
| 1 | Urea @ 50 | 23 N |
| 2 | Urea @ 100 | 46 N |
| 3 | Urea @ 150 | 69 N |
| 4 | 18:20:00 @ 130 | 23 N, 26 P |
| 5 | 18:20:00 @ 255 | 46 N, 51 P |
| 6 | 18:20:00 @ 380 | 68 N, 76 P |
| 7 | 18:20:00 @ 85, SOA @ 40 | 23 N, 0.6 P, 9 S |
| 8 | nil | (control) |

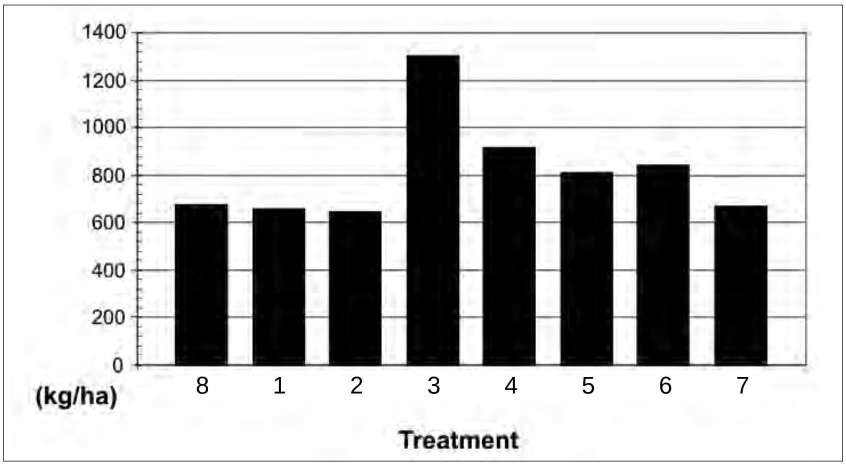



***Figure 1 Dry matter production of Veldt Grass, Wharminda, 19 August 2007.***

** Refer to Table 1 for treatments.*

## Acknowledgements

This trial was sown by Minnipa Agricultural Centre staff M. Bennet, B. Ward and D. Brands. I would like to acknowledge E. Hunt (Agricultural Consultant), E. McInerney (Minnipa Agricultural Centre) and J. Solly (Cleve Area School), for their advice and expertise and to P. DuBois (Cleve Megafert) who donated the fertiliser.

# Types of work in this publication

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

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

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Section 5

**Section editor:**
**Alison Frischke**
SARDI,
Minnipa Agricultural Centre

# Livestock

## Grazing Cereals at Minnipa


**Emma McInerney**
SARDI, Minnipa Agricultural Centre


Research

### Key messages

- **Grazing reduced grain yield but was still economically viable.**
- **Early sowing and good establishment are key elements to producing high dry matter and giving the plants time to recover for grain.**
- **Cereals provide a flexible option for feed gaps in autumn and spring.**

### Why do the trial?

Previous research has shown growing cereals for grain and grazing is high risk on upper EP and likely to result in loss of grain yield, except when grazed early in a favourable season (EPFS Summary 2006, p. 73 and 2005, p. 61). A lower risk option is to sow a cereal solely for feed and in favourable years remove livestock to capitalise on excess feed by turning it into grain production.

### How was it done?

***Variety and seeding rate evaluation***

Barque and Keel barley, Wallaroo oats, Wedgetail, Yitpi and Wyalkatchem wheat were sown at two seeding rates (district practice and high) and assessed on dry matter production (DM) at 5 leaf stage, grain yield and gross income at maturity. Wedgetail is a long growing season winter wheat used commonly in eastern states as a dual-purpose variety.

***Growth stage evaluation***

Keel, Wallaroo and Wyalkatchem were mown (to simulate grazing) at 3 leaf, early tillering and late tillering and assessed for dry matter production, grain yield and gross income.

**Trial type:** Small plot trial
**Seeding method:** direct drilled, 22 cm (9") spacing
**Seeding rate and date:** sown 16 May at district practice rates (wheat @ 60 kg/ha, barley @ 65 kg/ha and oats @ 55 kg/ha) and high seeding rates (65% higher than district practice)
**Fertiliser rate and date:** 60 kg/ha of 18:20:00 at sowing
**Mowing date and method:** cut at 3 leaf (25 June), 5 leaf (17 July), early tillering (6 August) and late tillering (28 August), mowed to 6-7 cm height
**Harvest date:** 6 November
**Chemical use:** knockdown 9 May with Sprayseed and Hammer

**Searching for answers**

**Location**
Minnipa Agricultural Centre
**Rainfall**
Av. annual: 325 mm
Av. GSR: 242 mm
Actual annual: 286 mm
Actual GSR: 141 mm
**Yield**
Potential: (W) 1.4 t/ha
Actual: 1.0 t/ha
Potential: (B) 1.8 t/ha
Actual: 1.0 t/ha
Potential: (0) 1.4 t/ha
Actual: 0.5 t/ha
**Paddock History**
2006: Medic pasture
2005: Wyalkatchem wheat
2004: Yitpi wheat
**Soil**
Sandy loam

## What Happened?

***Variety and seeding rate evaluation***

Grain yield was decreased by 0.1 t/ha by grazing compared with ungrazed cereals which averaged 0.79 t/ha. Keel, Wyalkatchem and Yitpi yielded highest, while Barque and Keel produced the most dry matter (Table 1 & Figure 1).

65% higher seeding rates had no effect on grain yield but did make a 15% overall increase to dry matter production at the 5 leaf stage, except in Wallaroo, which produced less dry matter than district practice seeding rate.

Grain quality was unchanged by grazing or seeding rate. Keel was downgraded for high screenings and Wedgetail for low test weight across all treatments (grazed and ungrazed, high and district practice seeding rates).

***Growth stage evaluation***

Another trial looked at the impact of grazing at different crop growth stages, resulting in a general decrease in grain yield after grazing. On average, ungrazed cereal yielded 0.64 t/ha, followed by late tillering 0.58 t/ha, 3 leaf at 0.52 t/ha and early tillering was the poorest yielding at 0.42 t/ha (Table 2). Grain screenings varied between varieties but there was no penalty from grazing.

## What does it mean?

2007 was a year of high grain prices, a more conservative livestock gross margin than previous years and a poor finish for grain growers, which would be expected to work against the practice of grazing cereal crops that are intended for grain harvesting.

The main difference in the 2007 trial from 2005 and 2006 (later sown) is the good start it received. This reinforces the early sowing principle for cereals sown for feed. 2007 dry matter production almost doubled last year's production and increased the grazing time available and the value of the crop, due in part to better plant establishment and deferring grazing slightly (grazed at 3-4 leaf in 2006).

For all the commonly grown varieties trialled in the variety and seeding rate evaluation in 2007, where crops were grazed at the 5 leaf stage, the bottom line of a grazed crop was similar to crops that had not been grazed. There was no benefit to grain yield from increased seeding rate on grazed or un-grazed crops.

Wedgetail has performed poorly in comparison to commonly grown wheat varieties over the last three years. Yitpi and Wyalkatchem have a shorter growing season, which has probably benefited their production in years when the season has cut off early.

Late grazing (28 August) in the growth stage evaluation trial looked to have less effect on reducing grain yield this season. This goes against previous low-medium rainfall trial results that show grazing later than the early tillering stage can decrease grain yield beyond the point where the feed value of dry matter can make up the difference.

Across both trials, gross income for crops with grazing plus grain harvest compared to grain harvest only, was very close. High grain prices may have had further impact if the crops had reached their potential grain yields, (which none did) and would have perhaps put the income from non-grazed crops ahead.

Cereals provide a secure feed source for livestock, but can also benefit the cropping system by tackling weed burdens and generating better residual ground cover than medic pastures over summer months. Favourable seasons provide the opportunity for alternate uses such as conserving fodder (cutting hay or hay freezing) or reaping the crop, but above all it provides a low risk strategy for managing feed shortages.

***Table 1 Grain yield, dry matter production and gross income at Minnipa, 2007***

| | Ungrazed | | Grazed | | | | |
|---|---|---|---|---|---|---|---|
| Treatment | Yield (t/ha) | GI grain ($) | DM (t/ha) | Yield (t/ha) | GI grain ($) | GI DM ($) | Total GI ($) |
| Barque | 0.60 | 166 | 0.69 | 0.51 | 141 | 38 | 179 |
| Keel | 1.17 | 312 | 0.60 | 0.99 | 264 | 33 | 297 |
| Wallaroo | 0.56 | 140 | 0.55 | 0.46 | 115 | 30 | 145 |
| Wedgetail | 0.43 | 163 | 0.39 | 0.37 | 140 | 21 | 162 |
| Wyalkatchem | 1.07 | 416 | 0.31 | 0.94 | 366 | 17 | 383 |
| Yitpi | 0.99 | 389 | 0.45 | 0.9 | 352 | 25 | 377 |
| Barque HS | 0.66 | 183 | 0.75 | 0.63 | 175 | 41 | 216 |
| Keel HS | 1.01 | 270 | 0.68 | 0.86 | 230 | 37 | 267 |
| Wallaroo HS | 0.57 | 143 | 0.44 | 0.49 | 123 | 24 | 147 |
| Wedgetail HS | 0.42 | 159 | 0.47 | 0.35 | 133 | 26 | 159 |
| Wyalkatchem HS | 1.06 | 413 | 0.47 | 0.91 | 353 | 26 | 379 |
| Yitpi HS | 0.96 | 377 | 0.53 | 0.88 | 345 | 29 | 374 |

*GI = gross income, DM = dry matter, HS = high seeding rate.*
*GI DM value based on 2007 Rural Solutions SA self-replacing merino flock gross margin of $20/DSE/year, assuming that 1 DSE consumes approximately 1 kg dry matter/day.*
*Grain prices as delivered Port Lincoln 14 December 2007, sourced AWB.*
*Dry matter data collected at 5 leaf stage, 17 July 2007.*

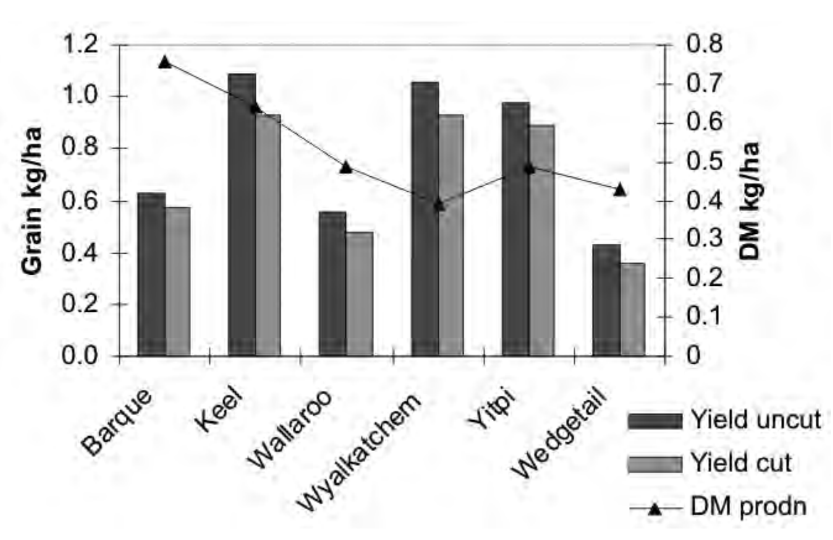



***Figure 1 Minnipa grazing cereal yields and dry matter production, 2007.***

***Table 2 Yield and dry matter effect of cereals grazed at different growth stages, Minnipa, 2007***

| Treatment | DM (t/ha) | Yield (t/ha) | GI DM ($) | GI grain ($) | Total GI ($) |
|---|---|---|---|---|---|
| Keel 3 leaf | 0.22 | 0.52 | 12 | 144 | 156 |
| Keel early tillering | 0.86 | 0.37 | 47 | 102 | 149 |
| Keel late tillering | 1.56 | 0.74 | 85 | 205 | 290 |
| Keel uncut | * | 0.71 | 0.00 | 197 | 197 |
| Wallaroo 3 leaf | 0.16 | 0.41 | 9 | 102 | 111 |
| Wallaroo early tillering | 0.78 | 0.36 | 43 | 90 | 133 |
| Wallaroo late tillering | 1.35 | 0.38 | 74 | 95 | 169 |
| Wallaroo uncut | * | 0.54 | 0 | 135 | 135 |
| Wyalkatchem 3 leaf | 0.17 | 0.62 | 9 | 240 | 249 |
| Wyalkatchem early tillering | 0.52 | 0.53 | 28 | 205 | 233 |
| Wyalkatchem late tillering | 1.02 | 0.62 | 56 | 240 | 296 |
| Wyalkatchem uncut | * | 0.68 | 0 | 263 | 263 |

*GI DM based on 2007 Rural Solutions SA self replacing merino flock gross margin of $20/DSE/year, assuming that 1 DSE consumes approximately 1 kg dry matter / day.*
*Grain prices as delivered Port Lincoln 14 December 2007, sourced AWB.*
*DM production at 3 leaf – 25 June, early tillering - 6 August, late tillering – 28 August.*

## Broadacre experience at MAC

***Why graze the barley crop?***

The paddock was sown early with the intention of carrying sheep to relieve pastures for a short spraying window while pasture paddocks were grass-freed, then the crop would be harvested for grain.

***How was it done and what happened?***

**Paddock size:** 20 ha
**Sown:** 6 May Barque barley sown @ 50 kg/ha, 18:20:00 @ 40 kg/ha, direct drilled, 30 cm (12”) spacing.

The plants were well anchored before the stock grazed for the ten days. The cereal was grazed heavily and due to the wide rows, left the paddock looking exposed in comparison to other cereals. Had the paddock been shut up for reaping at this point, it would have still produced an estimated 0.57 t/ha, however with little July-August rainfall, pastures had begun to dry out leading into spring and feed on offer was getting low, so a decision was made turn the lambs in on the maturing crop.

A distinct grazing pattern was observed during both times the sheep were on the cereal feed. The sheep would spread along the fenceline which had a trough positioned mid-way and would graze toward the opposite fence, leaving a discernable line dividing the grazed and ungrazed parts of the paddock. During the fifty six days that stock were in the paddock for the second grazing, the area around the trough began to bare out while the far corners of the paddock were not grazed.

The quality of feed was high on both occasions; sufficient to the needs of fast growing, young animals.

***Table 3 Broadacre grazing cereal paddock activity, Minnipa 2007***

| | First grazing | Second grazing | Ungrazed |
|---|---|---|---|
| **Date stock in** | 12 June | 27 September | |
| **Date stock out** | 22 June | 21 November | |
| **Grazing duration** | 10 days | 56 days | |
| **Crop growth stage** | 5 leaf / 2 tillers | Head fill | |
| **Type of stock** | Ewe hoggets | Lambs | |
| **Number and DSE** | 128 = 154 DSE | 203 = 305 DSE | |
| **Stocking rate** | 8 DSE/ha | 15 DSE/ha | |
| **Estimated intake** | 1-1.5 kg/DSE = 80-120 kg/ha | Min 1.5 kg/DSE = 1260 kg/ha | |
| **Feed on offer (FOO)** | 120 kg/ha DM | 2195 kg/ha DM | |
| **Approx. grain yield** | 0.57 t/ha (F1) | 0.1 t/ha (F2 – high screenings, low test weight) | 0.84 t/ha (F1) |
| **Grazing value** | \$6/ha | \$69/ha + \$6/ha (first graze) | |
| **Grain value** | 0.57 x \$277.4 = \$158/ha | 0.1 x \$267.40 = \$27/ha | 0.84 x \$277.4 = \$233/ha |
| **Total value** | \$164/ha | \$102/ha | \$233/ha |

*After second grazing, the header picked over the heavier looking parts of the paddock. There was plenty of feed left over and it was grazed again post harvest.*

***Table 4 Feed Test analysis of broadacre grazing cereal paddock, Minnipa, 2007***

| | First graze 12 June (5 leaf, green feed) | Second graze 27 Sept (grain in head, dry feed) |
|---|---|---|
| **Dry matter (%)** | 15.7 | 63.2 |
| **Crude protein (%)** | 33.1 | 14.7 |
| **Neutral detergent fibre (%)** | 33.6 | 39.4 |
| **Digestibility (DOMD) (%)** | 81.2 | 73.3 |
| **Metabolisable energy (MJ/kg of DM)** | 13.5 | 11.9 |

## What does it mean?

The cereal served the purpose of reducing feed pressure on the farm while pasture paddocks were being sprayed and also provided the system with flexibility when spring feed ran short. The potential cost of not having this feed available included poor recovery of over grazed medic pastures, premature sale of stock, handfeeding, condition decline in weaner lambs and potential eroding of pasture paddocks. The mature crop had an ideal mix of grain and straw of nutritional value high enough to meet the needs of weaner lambs and contributed to good liveweights at sale time.

The watering point location had a big impact on how the paddock was grazed and where sheep camped. Demand for water is low when grazing green feed and stock are encouraged to forage greater distances across the paddock to seek out feed (less feed on offer at the 5 leaf stage), discouraging traffic and camping around the trough. When the paddock was grazed in September, the feed was dry, causing stock to frequent the trough. There was also an excess of feed in September, which allowed stock to access feed while camping close to the water and as a result this area got bared out. Supplying water on the opposite side of the paddock would create a more even grazing pattern and prevent paddock damage through soil erosion.

## Acknowledgements

Technical assistance in managing the small plot trials from Ben Ward, Kay Brace, Brenton Spriggs and Trent Brace was most appreciated. Brendan Frischke, Shane Moroney, Brett McEvoy, and Marko Klante took care of the big paddock.

The Eyre Peninsula Grain & Graze project is funded by Meat & Livestock Australia, Grains Research & Development Corporation, Australian Wool Innovation and Land & Water Australia.

FeedTest is a registered product of the Victorian Department of Agriculture.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Grain & Graze
Profit through knowledge
EYRE PENINSULA

# Grazing Cereals at Edillilie

**Emma McInerney**
SARDI, Minnipa Agricultural Centre

Research



**Searching for answers**

**Location**
Edillilie

**Co-operator**
Mark Modra

**Rainfall**
Av. annual: 460 mm
Av. GSR: 370 mm
Actual annual: 475 mm
Actual GSR: 356 mm

**Yield**
Potential: (W) 5.4 t/ha
Actual: 2.4 t/ha
Potential: (B) 5.8 t/ha
Actual: 3.7 t/ha
Potential: (0) 5.4 t/ha
Actual: 3.0 t/ha

**Paddock History**
2006: Canola
2005: Cereal
2004: Cereal

**Soil**
Buckshot over clay

## Key messages

- **Grain yield was unaffected by early grazing (5-leaf stage), but declined with grazing at late tillering.**
- **Grazing a crop should cease while it is tillering, if intended for grain harvest.**

## Why do the trial?

The last two years of grazing cereals trials on lower EP have indicated that grazing cereal crops early will not decrease grain yield. Grazing at or after crop growth stage 30 (stem elongation) has decreased yields in medium – high rainfall trials across Australia. In this year's trial at Edillilie, grazing was simulated at four growth stages to determine the cut-off point for grazing cereals without decreasing yield and income.

## How was it done?

**Trial type:** replicated small plot

**Seeding method:** direct drill, 26 cm row spacing

**Seeding date and rate:** 18 May, wheat @ 88 kg/ha, barley @ 103 kg/ha, oats @ 85 kg/ha

**Fertiliser rate and date:** 75 kg/ha 18:20:00, 40 kg/ha urea at seeding, extra urea (post mowing) @ 50 kg/ha 20 July

**Cutting date and method:** 5 leaf 28 June, early tillering 5 July, late tillering 20 July, stem elongation 24 August, mowed to 6-7 cm height

**Harvest date:** 14 November, 25 November and 8 December (varied with maturity of barley, oats and wheat)

## What happened?

Grain yield was not decreased by grazing at 5 leaf and early tillering stage in Keel and Wyalkatchem (Table 1). The grain yield of Wallaroo was not decreased by grazing at 5 leaf but dropped when grazed at early tillering. All crops grazed at late tillering or at stem elongation had grain yield reduced by 0.47 t/ha (16%) or more.

Cereal variety and crop growth stage at grazing affected dry matter production (DM). Wallaroo produced the most dry matter overall (2.07 t/ha) followed by Keel (1.7 t/ha) and Wyalkatchem (1.11 t/ha). Dry matter production increased as the crop growth stage progressed (Table 1).

Time of grazing had a dramatic effect on screenings in the wheat and barley; the later it was grazed, the higher the screenings (Table 2).

## What does it mean?

A cereal sown for feed should have high dry matter production and the ability to recover for subsequent grazing. It is generally recommended that cereals are not grazed until there is 800-1000 kg/ha of dry matter available, which was achieved by Wallaroo and Keel at early tillering stage and by Wyalkatchem at late tillering. Wallaroo had produced the driest matter by growth stage 30 but other research (Early Feed Trial 2007, p. 81) has shown that Wallaroo is poor to recover from grazing.

If a cereal is sown with the intention of chasing grain yield, EP trials have shown that waiting to grow 800 kg/ha dry matter could come at the cost of grain yield, making it more critical to monitor crop growth stage to determine when stock should graze, rather than how much feed is available.

Other trials have shown that varietal choice has very little impact on livestock production. Nutritional value of cereal crops will vary more on account of the season than between varieties.

There was no difference in grain yield between the cereals that were uncut and those grazed at 5 leaf or early tillering stages, meaning that cereal crops can offer a low risk early feed option, with the potential to be reapt if stock are removed early enough. These findings confirm previous trial results which found no yield loss from grazing at 3-4 leaf stage in 2006 and great yield loss from grazing at late tillering in 2005.

Wyalkatchem and Wallaroo are safer varietal choices to avoid grain quality penalties as Keel suffered from high screenings (>15 %) after grazing at early tillering and was downgraded to F2 at the silos. However, the gross income was still higher from Keel than the wheat and oat varieties.

## Acknowledgements

Thanks to Mark Modra who generously offered a patch of paddock for the trial, Teararse (Terry Blacker) and Fluff (Ian Richter) who instrumented the seeding and harvest of the trial and Ben Ward for spraying and grazing (with mower).

A dishonourable mention for the kangaroos' attempted sabotage and inability to graze the "grazing" plots.

The Eyre Peninsula Grain & Graze project is funded by Meat & Livestock Australia, Grains Research & Development Corporation, Australian Wool Innovation and Land & Water Australia.

***Table 1 Grazing cereals production and gross income, Edillilie 2007***

| Treatment | DM** (t/ha) | GI DM ($) | Grain yield (t/ha) | GI grain ($) | Total GI ($) |
|---|---|---|---|---|---|
| **Keel 5 leaf** | 0.20 | 11 | 3.27 | 873 | 884 |
| **Keel early tillering** | 0.82 | 45 | 3.31 | 884 | 929 |
| **Keel late tillering** | 2.18 | 119 | 2.56 | 684 | 803 |
| **Keel stem elongation** | 3.61 | 198 | 0.95 | 254 | 452 |
| **Keel uncut** | | | 3.71 | 991 | 991 |
| **Wallaroo 5 leaf** | 0.21 | 12 | 2.97 | 742 | 754 |
| **Wallaroo early tillering** | 0.88 | 48 | 2.41 | 603 | 651 |
| **Wallaroo late tillering** | 1.99 | 109 | 2.29 | 573 | 682 |
| **Wallaroo stem elongation** | 5.21 | 285 | 1.01 | 253 | 538 |
| **Wallaroo uncut** | | | 2.96 | 740 | 740 |
| **Wyalkatchem 5 leaf** | 0.18 | 10 | 2.16 | 822 | 832 |
| **Wyalkatchem early tillering** | 0.59 | 32 | 2.17 | 833 | 865 |
| **Wyalkatchem late tillering** | 0.98 | 54 | 1.82 | 693 | 747 |
| **Wyalkatchem stem elongation** | 2.68 | 147 | 0.87 | 331 | 478 |
| **Wyalkatchem uncut** | | | 2.36 | 896 | 896 |
| *LSD (P=0.05)* | *0.6* | | *0.47* | | |

***DM at time of grazing*
*GI = gross income*
*GI DM value based on 2007 Rural Solutions SA self-replacing merino flock gross margin of $20/DSE/year, assuming that 1 DSE consumes approximately 1 kg dry matter/day.*
*5 leaf – 28 June, early tillering – 5 July, late tillering – 20 July, stem elongation (GS 30) – 24 August*

***Table 2 Grain screenings (%) from grazing cereals trial, Edillilie, 2007***

| | 5 leaf stage | Early tillering | Late tillering | GS30 | Uncut |
|---|---|---|---|---|---|
| **Keel** | 15 | 19.3 | 25.1 | 39.3 | 12.5 |
| **Wyalkatchem** | 1.1 | 1.2 | 1.3 | 10.4 | 1.0 |

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Grain & Graze
Profit through knowledge
EYRE PENINSULA

# Early Feed Trial, Minnipa

**Emma McInerney**
SARDI, Minnipa Agricultural Centre

Research



## Key messages

- **Seeding rate has more effect on increasing dry matter production than fertiliser rate.**
- **Sow early then graze early and repeatedly to get best dry matter production.**

## Why do the trial?

Cereals have a place in the farming system by providing feed early in the season, well before medic based pastures. A cereal is a low risk strategy that can solve early feed shortages and can also be reserved for later use by hay freezing or baling. Two trials were conducted at Minnipa in 2007 to evaluate agronomic and grazing strategies for feed production.

Grazing management influences how much dry matter can be produced by manipulating plant growth. Plants are of higher quality and grow fastest during the vegetative stage, which can be maintained by early, and regular grazing. The 2006 trial results (EPFS Summary 2006, p. 76) went against this trend and needed reviewing again in 2007. Plants that were not grazed produced more dry matter up to late tillering than repeated grazing produced, due to insufficient moisture for recovery of grazed plants. The trial assesses whether a repeat (or cell) grazing strategy would produce more feed than letting the crop get away and only grazing once when the crop is in the late tillering stage.

Dry matter production from a cereal crop is limited by plant density and fertility, which in turn are influenced by seeding rates and soil nutrition. In higher rainfall areas, increased seed and fertiliser rates have been directly related to increased plant density and therefore dry matter production. Fertiliser prices escalated at the beginning of 2007 and would have discouraged anyone from increasing fertiliser rates, particularly for feed. The second trial assessed a combination of lower fertiliser rates and increased seeding rates for the most economic and productive option in a low rainfall environment.

## How was it done?

### *1. Grazing management trial*

Six varieties (Fleet and Maritime barley, Wallaroo and Brusher oats, Rufus and Speedee triticale) sown at district practice (56 kg/ha), double (110 kg/ha) and triple rates (164 kg/ha) were mowed (to simulate grazing) at three growth stages (5 leaf, early tillering and late tillering). Dry matter production was assessed at each growth stage and combined production was compared to the dry matter production of uncut plots at late tillering stage.

### *2. Seed and fertiliser rates trial*

Seeding rates of Barque barley (district practice – 56 kg/ha, double – 110 kg/ha, triple – 164 kg/ha) and fertiliser rates (none, 30 kg/ha and 60 kg/ha of 18:20:00) were compared on dry matter production at three growth stages (5 leaf, early tillering and late tillering). The economics of increased seeding rate and decreased fertiliser rate were compared.

**Trial type:** replicated small plot

**Seeding method:** direct drill, 22.5 cm (9") row spacing.

**Searching for answers**

**Location: Minnipa**
Minnipa Agricultural Centre

**Rainfall**
Av. annual: 325 mm
Av. GSR: 236 mm
Actual annual: 233 mm
Actual GSR: 140 mm

**Paddock History**
2006: Grass-free pasture
2005: Wyalkatchem wheat
2004: Yitpi wheat

**Soil**
Loamy sand

**Seeding date and rate:** 16 May, target 160 plants/m$^2$ (district practice).

**Fertiliser rate and date:** 60 kg/ha 18:20:00 at seeding.

**Mowing date and method:** 5 leaf 9 July, early tillering 16 July, late tillering 28 August, by mower (to 6-7 cm height).

**Chemical use:** knockdown spray 9 May, Sprayseed and Hammer.

## What happened?

### *1. Grazing management trial*

Seeding rate had a significant impact on dry matter production across all varieties; triple seeding rate produced more dry matter than double seeding rate and double produced more dry matter than district practice at each growth stage. Across all varieties, the average total dry matter production (5 leaf + early tillering + late tillering) was the highest in triple seeding rates (1930 kg/ha DM); double seeding rate was second (1694 kg/ha DM) and district practice produced the least (1419 kg/ha DM).

Fleet barley produced the driest matter at each of the growth stages, while the triticale varieties produced the least (Table 1 and Figure 1). Increased dry matter was produced by repeated grazing than a one-off grazing of Brusher oats, Maritime barley, Wallaroo oats and Fleet barley (Table 1). Every variety showed rapid growth after being grazed at the 5 leaf stage. Grazing at early tillering resulted in poor recovery from Rufus, Speedee and Maritime, producing less dry matter at late tillering than at early tillering (Table 1 and Figure 1).

### *2. Seed x fertiliser rates trial*

At 5 leaf stage, triple seeding rate produced more dry matter than the district practice but was not different from double seeding rate (Table 2). There were no other production differences in the interactions between seeding and fertiliser rates, creating uncertainty about whether the effects on dry matter production is a result of altering the seed or the fertiliser rate.

The total dry matter figures indicated a difference in production of more than 1000 kg/ha between district practice + no fertiliser (2664 kg/ha) and triple seeding rate + 30 kg/ha 18:20:00 (3772 kg/ha), triple seeding rate + 60 kg/ha 18:20:00 (3671 kg/ha) and double seeding rate + 60 kg/ha (3729 kg/ha). The increased production equates to many extra grazing days and would be valuable to any system in terms of generating organic matter.

Table 2 shows that feed rarely paid for itself if only grazed at the 5 leaf stage, excluding the lowest input combinations (no fertiliser and district practice or double seeding rate), but if grazed two or three times, the input costs were more than covered.

## What does it mean?

### *1. Grazing management*

Increased seeding rate resulted in a major increase in dry matter production. Triple seeding rate produced 500 kg/ha more dry matter than district practice. If seed was valued at $200/t and district practice seeding rate was 90 kg/ha (for feed production), the cost

***Table 1** Dry matter production (kg/ha) of barley, oats and triticale grazed at 5 leaf stage, early tillering and late tillering, Minnipa 2007*

| | 5 leaf | Early tillering | Late tillering | Total DM prod.* | One off cut at late tillering |
|---|---|---|---|---|---|
| **Speedee triticale** | 397 | 557 | 396 | 1350 | 1713 |
| **Rufus triticale** | 304 | 648 | 554 | 1506 | 1599 |
| **Brusher oats** | 268 | 587 | 756 | 1611 | 1470 |
| **Maritime barley** | 394 | 635 | 633 | 1662 | 1658 |
| **Wallaroo oats** | 257 | 665 | 808 | 1731 | 1684 |
| **Fleet barley** | 425 | 726 | 1002 | 2152 | 1676 |
| *LSD (P=0.05)* | *59.8* | *84.2* | *84.2* | *198.1* | |
| | | | | *224.8* | |

**Total DM production = combined dry matter production of 5 leaf + early tillering + late tillering*

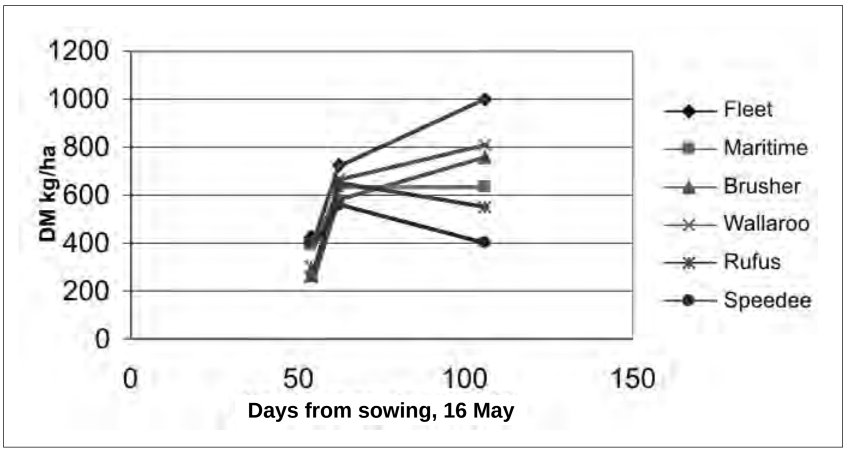



***Figure 1** Dry matter production of barley, oats and triticale grazed at 5 leaf stage, early tillering and late tillering, Minnipa 2007. 5 leaf stage – 9 July, early tillering – 16 July, late tillering 28 August.*

of tripling seed would be an extra $36/ha. The value of the additional feed would be $27/ha (based on the $20/DSE 2007 RSSA GM for SR merinos), however the value might be viewed more in the ability to carry more DSE's, not having to sell off stock, weed management or generating a source of carbon for the soil, rather than dollars alone.

The high dry matter production of Fleet at each growth stage makes it an ideal choice as an early feed variety. It recovered well from grazing unlike the triticale varieties Rufus and Speedee.

Grazing management of cereals sown early for feed has an important role in maximising the amount of grazing time a crop can provide. The barley and oat varieties were more productive under the repeat (or cell) grazing approach than letting them reach the late tillering stage before grazing. In addition, young and rapidly growing plants are much higher in nutritive value than cereals that are starting to run up. Testing the feed will determine the nutritional value for various classes of stock.

Variety and species should be selected for the impact they have in the rotation, despite the significant differences in dry matter production between varieties. If barley presents a greater risk of disease (eg. Rhizoctonia), then oats and triticale are a better option. If having triticale on the property is not an option then oats would be the best bet.

### *2. Seed x fertiliser rates*

The lack of statistical difference in dry matter production is an important finding for low rainfall farming as it reinforces low input, low risk management strategies. Increasing seeding rate would not significantly increase risk to the business and could in fact increase profit in years with abundant feed if that particular paddock did not have to be grazed and could left for grain. The trial shows that reducing/not using fertiliser on cereals sown for feed can reduce total dry matter production but would also decrease input costs and hence risk.

The practical approach to sowing cereals is unchanged – keep fertiliser low (or do not use it), select the variety to suit your rotation and sow early. A cereal paddock sown for feed increases in value the more it is utilised.

## Acknowledgements

Trial was completed with much appreciated assistance from Ben Ward, Brenton Spriggs, Ian Richter, Trent Brace, Kay Brace and Carey Moroney, Minnipa Agricultural Centre.

EP Grain & Graze is funded by Meat & Livestock Australia, Grains Research & Development Corporation, Australian Wool Innovation and Land & Water Australia.



***Table 2 Dry matter production and gross income of cereals sown with different seed and fertiliser rates, Minnipa, 2007***

| **Treatment** (Sowing rate x fertiliser rate) | DM $1^{st}$ graze (kg/ha) | DM $2^{nd}$ graze (kg/ha) | DM $3^{rd}$ graze (kg/ha) | Total DM (kg/ha) | GI** $1^{st}$ graze | GI $1^{st}$ + $2^{nd}$ graze | GI $1^{st}$ + $2^{nd}$ +$3^{rd}$ graze |
|---|---|---|---|---|---|---|---|
| District 0 | 350 | 809 | 1505 | 2664 | $7 | $51 | $133 |
| District 30 | 455 | 1101 | 1523 | 3079 | -$4 | $56 | $139 |
| District 60 | 504 | 1079 | 1819 | 3402 | -$18 | $41 | $140 |
| Double 0 | 478 | 972 | 1693 | 3143 | $1 | $55 | $147 |
| Double 30 | 498 | 1020 | 1687 | 3205 | -$14 | $42 | $134 |
| Double 60 | 622 | 1254 | 1853 | 3729 | -$24 | $45 | $146 |
| Triple 0 | 529 | 1045 | 1550 | 3124 | -$8 | $50 | $134 |
| Triple 30 | 656 | 1270 | 1846 | 3772 | -$17 | $52 | $153 |
| Triple 60 | 642 | 1097 | 1932 | 3671 | -$35 | $25 | $131 |

*Seeding rates: district practice @ 56 kg/ha, double @ 110 kg/ha, triple 164 @ kg/ha*
*18:20:00 rates = 30 kg/ha, 60 kg/ha, none*
*$1^{st}$ graze at 5 leaf, $2^{nd}$ graze at early tillering, $3^{rd}$ graze at late tillering*
*** GI = gross income/ha = DM value based on 2007 Rural Solutions SA self replacing merino flock gross margin of $20/DSE/year, assuming that 1 DSE consumes approximately 1 kg dry matter / day, less input costs (fertiliser $557/t inc freight, seed $225/t)*

# Why is Testing Feed Value Important for Sheep?

**Emma McInerney**
SARDI, Minnipa Agricultural Centre

Extension


## Key messages

- **Test feed for nutritional value to optimise animal production.**
- **Supplement cereal grains with a stocklime and salt mix.**
- **Money is wasted on supplement products if they are not needed.**

## Why test stock feed?

Poor performance in weaner growth rates can be linked to any number of health, genetic or environmental problems, but often it will come down to understanding and reacting to animal nutrition. A good deal of time can be spent speculating on various health and nutrition issues to decipher why livestock are not performing equally well in the paddock. Poor growth rates, a struggling minority in the mob who have always looked scraggly or more obvious symptoms such as lameness, scours, deaths, poor lambing percentage and ill thrift are good reasons to get feed quality right. Sending samples to a laboratory for analysis is the best way to monitor livestock nutrition.

## What does it mean?

Money invested in sampling the quality of feed is much better spent than buying supplements for problems you are not sure exist. Feed testing provides a summary on all the essential components below.

### *Metabolisable energy (ME)*

Necessary all the time but in higher levels during pregnancy, production of milk and putting on body condition. Excess energy can make livestock fat. Energy is usually the limiting factor to stock production in dry feed on EP. Grains are a good supplement to a low energy ration.

Target: 8 mega joules (MJ) of ME/kg DM for maintenance, 11 MJ/kg DM for young, quick growing lambs and for lactating ewes.

### *Digestibility (DOMD)*

Refers to the percentage of feed that is used by the animal i.e. for 1 kg of feed that is 55% digestible - 0.55 kg can be used by the animal and 0.45 kg is wasted (converted to dung).

Target: no lower than 55% for maintenance and 75% digestibility for production feeding.

### *Crude Protein (CP)*

Necessary for muscle growth and function, milk production, wool growth, growth of the lamb during late pregnancy and to develop rumen microbes. Grain protein readings at the silo are done on a "wet weight" basis, i.e. grain is not 100% dry. Silo tested protein should be multiplied by a factor of 1.1 to give protein on a dry matter basis. Excess protein is a burden to the animal, as it requires an increased energy supply in order for the body to excrete it.

Target: 8% CP for maintenance and 16% for lambs and lactating ewes.

### *Fibre (NDF)*

During rumination fibre is broken down in small particles mechanically, (chewing the cud) which stimulates saliva production (5-20 L per day for sheep and 50-200 L for cattle), aiding chemical breakdown and stimulating rumen microbes.

Target: over 30% (up to 50% for maintenance/drought feeding).

### *Calcium (Ca) and Phosphorus (P)*

Calcium is necessary for bone growth and muscle function (note: the rumen is also muscle! Ca deficiency reduces rumen ability to contract and therefore will reduce feed intake). Lactating animals have a high demand for calcium and severe deficiencies at lambing can result in 'milk fever'. As cereals are low in calcium, it is important to make sure that calcium supplies are kept up over summer to prevent deficiency at lambing time. This can be achieved by offering a stocklime supplement to compensate for low calcium and to balance the relatively high phosphorus content. It cannot be assumed that pastures on highly calcareous soils have adequate calcium, as a lot is tied up and unavailable to the animal.

Target: ideal calcium to phosphorus ratio is 2:1. Stocklime should be offered at 1.5% and salt can be added at 0.5%.

### *Dry matter (DM)*

Dry matter is the remaining component after moisture has been removed from a feed. 1 DSE requires approx 1 kg DM/day if feed is green and 1.5 kg if feed is dry. On green pasture containing 10% DM, the animal would have to consume 10 kg of green feed to intake 1 kg of DM. An animal has to work hard to process the 9 L of water and may result in scouring.

Testing nutritional value of feed will identify components of the diet that are lacking or in excess of stock requirements. Supplementing to meet specific requirements can often be complicated and may require further advice and is equally important for cattle as for sheep.

## Key points for addressing ill thrift and poor production of weaner lambs

- Nutrition of the ewe is important throughout pregnancy – target condition score 3.
- Encourage early rumen development – it takes twenty one days after birth before the rumen begins to develop. Introduce grain to the diet while lambs are still on the ewes to teach them to consume grain and also encourage development of the rumen microbes more quickly. Nutrition and rumen development in the first three months of a lamb's life directly affects the animal's production for the rest of its life – if it has a tough time, it will never recover to reach full potential.
- Meet nutritional requirements – if essential components are lacking, lamb growth will be restricted, regardless of whether it has been drenched, vaccinated or even kissed.
- Have a target weaning weight – aim to get merino lambs to a minimum of 20 kg and crossbreds to 36 kg.
- Measure weaning weights and consider splitting the mob. Lighter weight lambs are commonly twins and consequently the genetics for higher lambing percentage is slowly culled from the mob.
- What are your market options – is it profitable to finish your own lambs and if so how, or should they be sold as weaners? If buying in ewes, ask your agent about seasonal conditions at the time they were lambs, i.e. if the ewes were born in a year when feed was poor, they may have suffered during the critical first three months and affected their lifetime potential.

## Further information

MLA website - Best practice for production feeding of lambs: A review of the literature.

http://www.mla.com.au/TopicHierarchy/InformationCentre/AnimalProduction/Lamb+Finishing.htm

Feeding and Managing Sheep in Dry Times, available from your PIRSA office

Nutrient Requirements of Domesticated Ruminants, CSIRO Publishing


## Acknowledgements

San Jolly, Productive Nutrition P/L and Tim Prance, Rural Solutions SA for providing technical advice.

Eyre Peninsula Grain & Graze is jointly funded by Grains Research & Development Corporation, Meat & Livestock Australia, Australian Wool Innovation and Land & Water Australia.

No animals were harmed in the production of this article.


SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Grain & Graze
Profit through knowledge
EYRE PENINSULA

# Farmer Experiences from the 2006 Drought

**Brian Ashton**
Rural Solutions SA, Pt Lincoln

Survey
Extension

**Try this yourself now**

## Key messages

- **Make summer livestock feeding plans early – it reduces stress and saves money.**
- **Condition score your stock. Fat stock have a "feed reserve" on their backs.**
- **It is well worth retaining ewes in a widespread drought.**
- **Confinement feeding is not difficult, was very successful, and was done primarily to reduce the risk of erosion.**

## What was done?

2006 was a severe drought - even in high rainfall areas of the state. Because of the current good returns from sheep, and the widespread nature of the drought, most people wanted to keep as many of their breeding ewes as possible. They also wanted to avoid increased risk of erosion.

Meetings were held and articles written to help people work through the issues. Much of the information given comes from farmer's experiences on Eyre Peninsula since 1982.

After the drought five meetings were held to review how it went. A survey was also conducted to document the experiences of confinement feeding sheep. Below is a summary of the key findings. A full report (14 pages), called 'Farmer experiences – what was learnt by sheep and cattle managers in the 2006 drought', is available on request.

## Feed

A feed test (approx $50) should be used more to determine energy, protein and dry matter content of pasture and fodder. Feed quality was very high and people who did not test were unsure of the correct ration to feed (many fed more than was necessary).

Feed your lowest quality feed once the stock are into the feeding routine. Save the good feed for late pregnancy and at the break of the season - this is when stock losses can occur.

Hay is hard to get and expensive in droughts. It is best to feed less hay in the paddock and more once the stock have settled in the containment area. It is essential to save some good roughage for late pregnancy, when the stock are released, and at the break of the season. Last autumn, once green feed became available, there was a problem with bloat due to lack of roughage. Stock in poorer condition will tend to eat more when put onto green feed as they make "compensatory growth". This predisposes them to health issues, eg. bloat and nitrate poisoning.

Stock lime is essential and cheap - if purchased in "bulk bags". After the drought there was an increased incidence of milk fever (calcium deficiency) in lambing ewes.

Dry pastures were very high quality over the summer. People learnt that with feed budgeting and rotational grazing, good dry feed can stretch a long way.

Water supply is critical in droughts and could be improved in all years. This would enable more use of paddock feed.

Good use of unusual feeds was made especially as a source of roughage, eg straw, grape marc and almond hulls. However, the quality of these by-products varies greatly and it is important to feed test them (or feed more than the minimum).

Canola hay was used with success - as long as it was not fed to hungry stock.

## Stock management

Grain poisoning is still the major cause of deaths. You cannot be too careful. Problems occurred when farmers were; increasing the ration at the start, first putting them into a containment area, increasing grain in late pregnancy, changing grain type and when the nut manufacturer changed grain type and did not advise people.

However, one producer said that this year he "followed the book" and had less trouble with grain than in other years.

Feeding the grain only twice a week reduces labour and ensures the "gutses" cannot eat too much. However, if grain is fed three times a week, or even every second day, there is less chance of grain poisoning as less grain is fed each time. If this approach is taken, ensure there is plenty of trough length (at least 20 cm a sheep of double sided trough each) so the shy sheep always get a feed.

Draft young stock off and feed them a good quality ration (higher protein and energy).

Draft stock into mobs on their condition score. This saves on feed if the good stock can be fed less. It also makes sure poorer animals are able to get their share.

More stock weighing could be done (in conjunction with condition scoring) as a method of monitoring.

Stock can be allowed to fall in condition score if management is good. The ideal condition score, even when feed prices are extreme, is about score 3 (from the Lifetime Wool project). However, if feed or finances are very short they can be fed a "survival" ration and the sheep can slowly drop to score 2 if they are in good condition at the start, and they are managed very carefully. Do not allow the sheep to drop in condition and then try to build them up – it is uneconomic.

Feed roughage before grain so that all the stock have some fibre in their rumens.

Creep feeding, a physical barrier that allows lambs and calves access to feed before weaning but prevents adult animals access, could be used more.

Early weaning was good if the calves or lambs could be put onto a high protein, high energy ration.

## Containment feeding

Containment feeding can save time once the area is built.

Dust in containment areas did worry farmers. It is probably of minor economic importance but it is important not to locate the area up wind of the house or work areas. Ways to reduce the dust need to be established. Containment areas down to 2.5 $m^2$ a sheep were used with success and these tended to pack down more quickly.

Some people spent a lot of money setting up containment areas while others did it quite cheaply.

In containment areas shorter water trough length than recommended appeared to work if the flow rate was good. One farmer used a 2.4 m trough for 2000 sheep.

People held up to 2500 sheep in one containment area. If management was good (such a big mob makes this a bit more challenging) this appeared to be very successful.

A break-in-the-wool was rarely experienced which indicated the transitions onto grain, and onto green, were both well done. The minimum survival ration was rarely used which helped.

Instead of grain troughs, one farmer used a strip of rubble laid down, crowned and compacted. This seemed the best cheap form of 'trough'. The other one was second hand conveyer belt laid flat. Shade cloth strung between wires also worked well although it does have problems (sheep can get in and damage it, and additives can fall through).

Sheep mate very well in containment areas. The conception rates will depend on their condition.

Have a "sick pen". Also have small paddocks near the containment area so that sheep can be released but still fed the same ration if the area gets too wet. This is also useful to get the stock used to green feed at the end.

## More information

The full report, 'Farmer experiences – what was learnt by sheep and cattle managers in the 2006 drought'. The book 'Feeding and managing sheep in dry times' provides technical information. Both are available from PIRSA.

## Acknowledgements

The SA Government Drought Response and the EP Grain & Graze project funded the work.

DROUGHT RESPONSE SOUTH AUSTRALIA

Grain & Graze
Profit through knowledge
EYRE PENINSULA

# Sheep Production Analysis

**Brian Ashton**
Rural Solutions SA, Pt Lincoln

Survey

Extension


## Key messages

- **Key profit drivers of your sheep enterprise should be calculated every year.**
- **Many people could lift their production and profit dramatically.**

Sheep now have a major role in increasing profit and reducing the risk on many Eyre Peninsula farms. However, there is a huge range in the productivity of sheep flocks.

The Eyre Peninsula Grain & Graze Project has attempted to create some guidelines that will help people evaluate their own sheep enterprise. It is a very simple analysis that you can easily do using your tax returns each year. Because the questions are not detailed, the figures should be used as a guide only.

Last year the results of data collected from twenty nine farms were summarised (EPFS Summary 2006, p. 65). Data was collected from a further seventeen farms last year making enough farms to draw some useful production guidelines. We can assume that the people who took the effort in completing the record sheet are some of the better sheep producers - as indicated by their average lambing percent (99%).

It must be remembered that farmers have very different objectives. Some may focus on having a very productive sheep flock while others may consider them secondary to their crops. Farms also have very different resources available to them – such as infrastructure, soil type and labour. There may be a very good reason why you have a low figure.

The results (from two drought years) have been split into four different rainfall districts for ease of comparison (Table 1).

## How to work out the figures for yourself

### *Pasture area*

This is the arable area that is not cropped or cut for hay i.e. the winter grazing area. Add what you think is a reasonable proportion of non-arable land (e.g. 30%). If the farm has other stock (e.g. cattle) the proportion of area used by other stock is removed (calculated as a proportion of the DSE's).

### *Sheep income*

Usually this is just wool sales plus sheep and lamb sales. However, we also take account of what is called "sheep trading profit". If there is a change in the number of sheep carried, we value them at $60 each.

- Income from sheep = Wool income
- + Income from sheep and lamb sales
- + Value of extra sheep carried (if sheep numbers increase)
- - Value of decreased sheep carried (if sheep numbers decrease)
- - Cost of sheep purchased (other than rams)

### *Sheep income per pasture hectare*

This is the income from sheep (as above) divided by the pasture area used by the sheep.

### *Sheep variable costs*

These are the direct costs of running sheep. Do not include overhead costs, or capital costs. Include shearing, crutching, freight, agistment, water, fodder, animal health, levies, rams, dog, vermin control, mulesing, etc.

### *Stocking Rate*

The sheep numbers at 1 July (not including lambs). The sheep numbers are multiplied by a Dry Sheep Equivalent (DSE) rating. Ewes are 1.7 DSE, weaners or hoggets are 1.3 DSE, wethers are 1 DSE, rams are 2 DSE and any others are 1 DSE. Other types of stock, e.g. cattle, are also given a DSE value.

The stocking rate is the total stock DSE number divided by the total pasture area.

### *Gross Margin*

The income from sheep less the variable costs.

## How good is your sheep enterprise?

Calculate your own figures then compare them to the table below. There may be good reasons for a low figure but it may also alert you to an area that you could improve. This may identify a good

*Table 1 Survey results, 2006 and 2007*

| Productivity measure | Rainfall district (mm of average annual rain) | Top | Average | Bottom |
|---|---|---|---|---|
| **Sheep Income per pasture ha** | 263 to 299 | $114 | $75 | $25 |
| | 300 to 349 | $258 | $121 | $23 |
| | 350 to 399 | $354 | $144 | $25 |
| | 400 to 485 | $506 | $293 | $115 |
| **Sheep Gross Margin per pasture ha** | 263 to 299 | $72 | $51 | $14 |
| | 300 to 349 | $216 | $89 | $12 |
| | 350 to 399 | $313 | $114 | $18 |
| | 400 to 485 | $392 | $232 | $86 |
| **Gross Margin per DSE** | 263 to 299 | $35 | $26 | $18 |
| | 300 to 349 | $51 | $30 | $7 |
| | 350 to 399 | $48 | $32 | $14 |
| | 400 to 485 | $53 | $26 | $15 |
| **Stocking Rate per pasture ha (DSE)** | 263 to 299 | 3.5 | 2.0 | 0.7 |
| | 300 to 349 | 6.1 | 2.9 | 0.7 |
| | 350 to 399 | 7.3 | 3.5 | 0.5 |
| | 400 to 485 | 20.5 | 9.6 | 4.3 |
| **Wool cut per pasture ha (kg)** | 263 to 299 | 22 | 11 | 3 |
| | 300 to 349 | 23 | 12 | 3 |
| | 350 to 399 | 24 | 13 | 7 |
| | 400 to 485 | 43 | 31 | 13 |

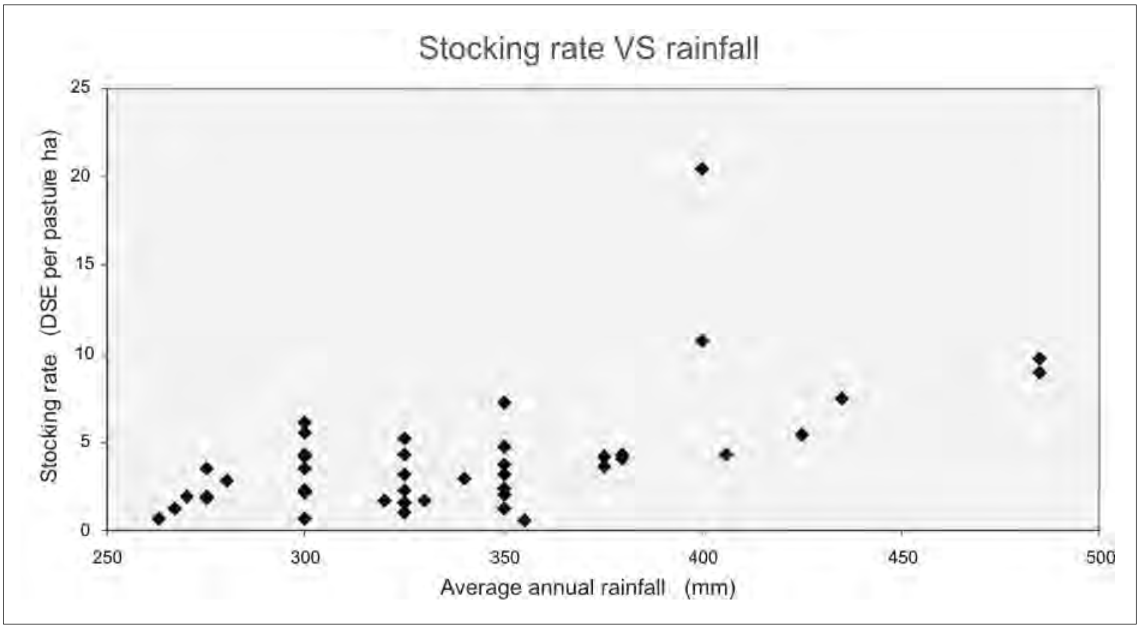



***Figure 1 Annual rainfall vs. sheep stocking rate, Eyre Peninsula 2005 – 2007.***

Livestock

opportunity to improve your profit and reduce your risk.

## What can you do?

Farmers need to have an idea of the strengths and weaknesses of their business. You should calculate these figures every year and compare them with your friends (and maybe even your enemies). It will help you identify areas to focus on.

If you need help, contact a consultant or attend an MLA 'Cost of Production' workshop. Contact Brian Ashton if you want a copy of an EXCEL spreadsheet that records and calculates the key profit drivers.

## Acknowledgements

The Eyre Peninsula Grain & Graze project funded this work.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Grain & Graze
Profit through knowledge
EYRE PENINSULA

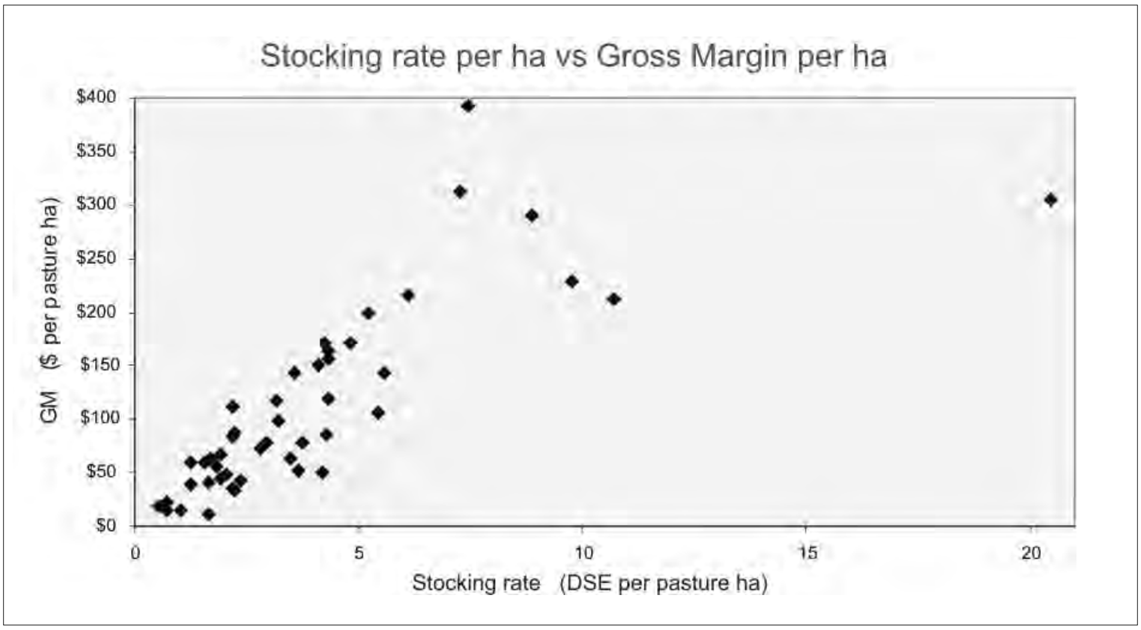



***Figure 2 Sheep stocking rate vs. gross margin/ha, Eyre Peninsula 2005 – 2007.***

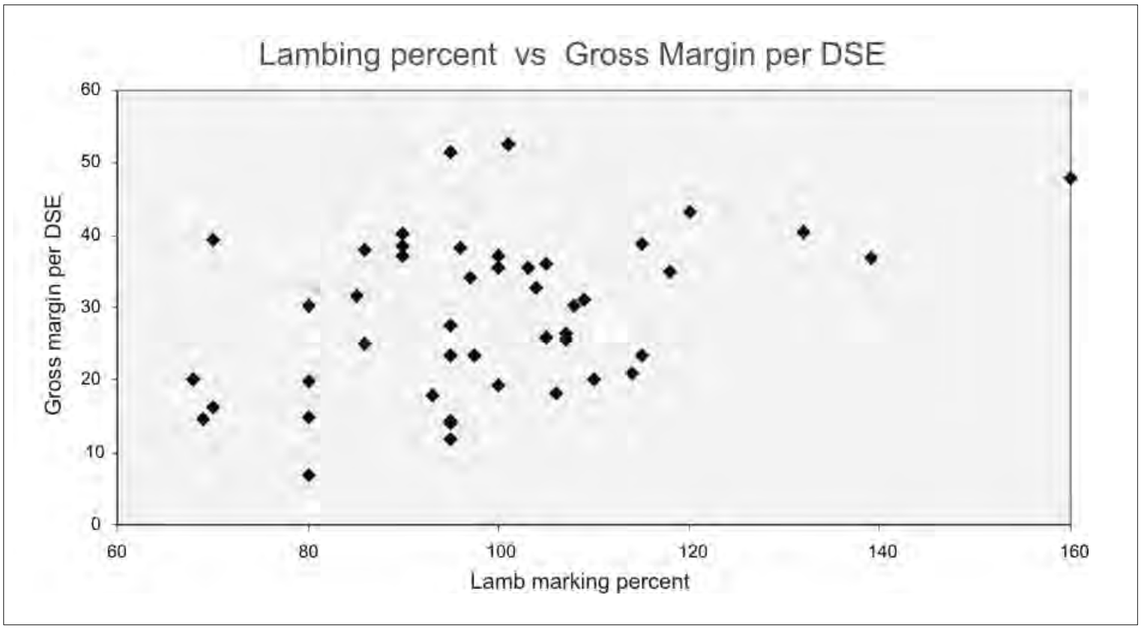



***Figure 3 Lamb marking percentage vs. gross margin/DSE, Eyre Peninsula 2005 - 2007.***

# Mineral Deficiencies Hold Sheep Back

**Brian Ashton**

Rural Solutions SA, Pt Lincoln

Extension

## Key messages

- **Mineral deficiencies are still holding back sheep on some EP farms.**
- **Highly calcareous soils are most at risk.**
- **Cobalt is the most likely deficiency.**

We have known for many years that on coastal areas of EP, particularly calcareous country, sheep do not grow as well as on heavy country. One reason is due to cobalt and/or copper deficiency. However, farmers have been struggling to come up with simple, reliable ways to overcome the problem.

Work done by the Streaky Bay and Elliston Sheep Groups has now found some clear guidelines.

## Cobalt

In coastal country, where sheep do not thrive, the essential cobalt treatment is a Vitamin B12 injection at marking, and ***every 6 weeks*** until the lambs are big enough to be given a cobalt bullet - which should last until they are sold.

On calcareous country we twice recorded severe deficiency in lambs 8 weeks after a B12 injection.

We also twice recorded severe deficiency in lambs at lamb marking. For this reason ewe lambs that will be retained must have a cobalt bullet so that they pass B12 on to their lambs. We tested ewes at 5.5 years old and their bullet was still working. In bad areas, ewes could be given a B12 before lambing (with the 3 in 1 vaccine) so some extra B12 is passed onto the lamb. This is optional but ***the bullet is essential.***

Some sheep may lose their bullets or the bullet runs out after three years. Poor sheep in an adult mob could be given another bullet.

## Copper

The ideal treatment for copper deficiency is to use copper fertiliser. The only time that copper fertiliser is not the best long term solution is when molybdenum is high and it ties up the copper.

We only found copper deficiency on two properties however, blood tests are less reliable for copper as they only show up severe deficiencies, and only in winter.

If you are in calcareous country and your young sheep do not do well, even with full cobalt treatment, you have two choices;

- treat 15 lambs ***each year***, identify them at marking with an extra ear tag, and see how they go, or
- arrange for a liver test for copper when you kill young ration sheep in winter or spring.

Recommended treatments for copper are a copper sulphate drench every 6 weeks until they are big enough for a Permatrace Copper pellet (at least 2 months old). The pellet should be given every year, although every second year may work if the bullet is given early in winter.

More information on copper can be found in the Eyre Peninsula Farming Systems Summary 2005, p. 108.

## Calcium

Sheep can become calcium deficient (even in calcareous country). The most likely deficiency occurs when sheep have been fed cereal grain and not given stock

**Try this yourself now**

Streaky Bay and Elliston sheep groups

Livestock

lime. The other time is when they are grazing green cereal crops.

Always give stock lime when feeding over 1 kg a week of cereal grain for over a month. It can be mixed with the feed or just put in a drum with salt (e.g. 80:20 stock lime:salt).

When grazing green cereal crops also give the above mixture in a drum.

## Magnesium

Work in the eastern states of Australia has shown that magnesium can be deficient when sheep graze green cereal crops. If the stock are not performing well, test the pasture for magnesium levels so that it can be mixed with the stock lime and salt if necessary.


## Acknowledgements

The Meat & Livestock Australia PIRD program funded the Streaky Bay and Elliston sheep groups.

Eyre Peninsula Grain and Graze project funded blood sampling and data collection, collation and promotion.

Eyre Peninsula Grain & Graze is funded by Meat & Livestock Australia, Grains Research & Development Corporation, Australian Wool Innovation and Land & Water Australia.

Permatrace is a Registered product.


# Types of work in this publication

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

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

# Lambing Percent – Where Do You Sit?

Survey

**Brian Ashton**

Rural Solutions SA, Pt Lincoln

Livestock

## Key messages

- **Lambing percent has improved greatly over the last 10 years – presumably reflecting an improvement in sheep management.**
- **There is still a big range in lambing percentage on Eyre Peninsula - many people could still lift their lambing percentage and profitability.**

In last year's EPFS Summary, p. 67, ideas were given on how they could increase their lamb marking percentage. I often wonder how many people actually change their management and how it goes. Evidence has been received that shows most farmers are improving their management and getting good results.

## Streaky Bay Sheep Group

Over four years the group had a number of meetings (including a "Wean more lambs" workshop) and collected data. At the end of the project nine members collected their lambing percentage over the last 10 years.

It shows that their average lamb marking percentage has increased from 82 to 89% over 10 years.


## Integrated Pest Management (IPM) landholder surveys

Each year the EP Natural Resources Management Board conducts surveys of producers on upper EP to determine the effectiveness of fox baiting programs in the IPM project. Since the year 2000 over 80 people have given their lambing percentage data in this survey. This survey is only of people who are part of the fox baiting program and could reflect the success of baiting. However, it is another indication of improving lambing percent on Eyre Peninsula.

The survey indicates that average lambing percentage has increased from about 78 to 93% in 10 years (Figure 1).

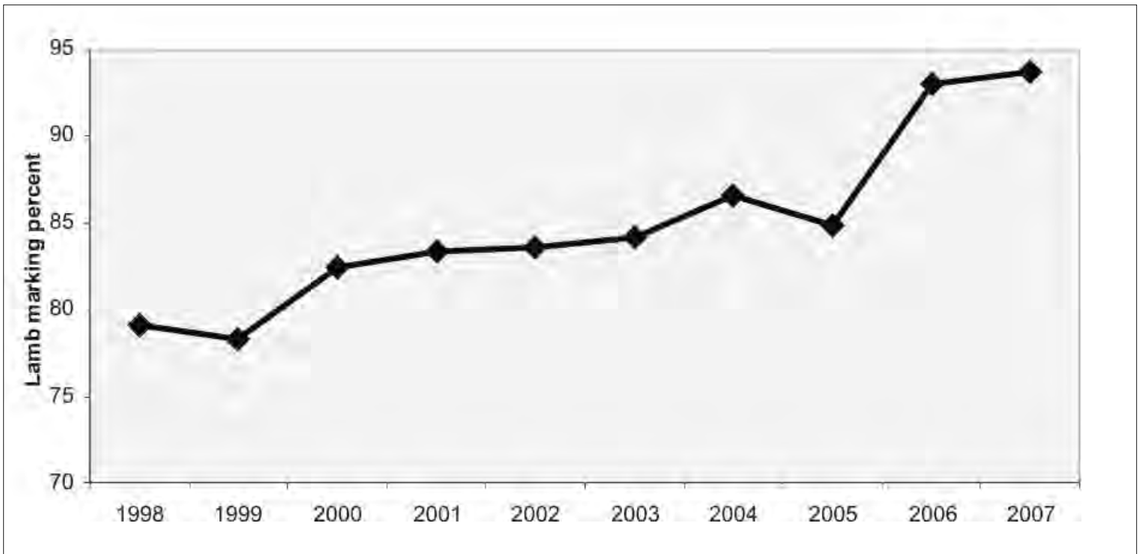



***Figure 1** Change in lambing percentage on upper EP from 1997 to 2007.*

## Sheep production records

There were 47 people who filled out a production record sheet over the last two years (see article "Farmer Experiences from the 2006 Drought" on p.86). The average lambing percentage was 99% but the range was 68 to 139% (and a farmer with Crossbred ewes who got 160%).

These three examples, while only an indication, are a credit to all those involved. It shows that people are managing their sheep better and getting results.

## The problem

These surveys show that there is still the same range in results as there was 10 years ago. The high performers have improved just as much as the low performers. There are now almost a third of farmers getting over 100% lambing. In the 2006 IPM survey, 14% of farmers (that is 1 in 7) got over 110% – a very good result. However, there are still 16% who get less than 80%. Unless these low performers are fully stocked up in most years (very unlikely) they could easily increase their profit by some of the management changes outlined in 'Increasing Lambing Percent – What is Economic?' EPFS Summary 2006, p. 67.

## More information

Contact us for a copy of 'Wean More Lambs', 'Ewe Management Handbook', 'Lambing Planner' booklets or to run a 'Wean More Lambs' workshop.

## Acknowledgements

Meat & Livestock Australia and Australian Wool Innovations supply the publications.

The Streaky Bay Sheep Group was funded by the MLA PIRD program.

The Natural Heritage Trust, Australian Government, funds the West Coast IPM Program.

Eyre Peninsula Grain & Graze funds the data collection, collation and promotion.

Eyre Peninsula Grain & Graze is funded by Meat & Livestock Australia, Grains Research and Development Corporation, Australian Wool Innovation and Land & Water Australia.

*Competition Paddock Teams 2007: Researchers, Farmers and Consultants.*

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE



Section editor:
**Liz Guerin**
Rural Solutions SA,
Streaky Bay

# Farming Systems

Research

## Predicting the Potential Yield of Wheat with APSIM

**Anthony Whitbread[1] and Jon Hancock[2]**
[1]CSIRO Sustainable Ecosystems, Waite, [2]SARDI, Minnipa Agricultural Centre

### Key messages

- **Simple relationships between rainfall and potential yield ignore the fact that interactions between soil type, plant available soil water and crop growth are largely determined by the amount and distribution of rainfall.**
- **In low rainfall wheat growing regions like EP, the French and Schultz calculation is not a reliable predictor of potential yield. In order to accurately model the system (eg. grain yield) and be relevant to developing lower risk and responsive farming systems, there is a minimum amount of system complexity that a model must be able to represent. APSIM strikes this balance.**
- **In experimental trials in various season, sites and soil types, APSIM accurately predicted grain yield and was able to model the differential effect that dry finishes have on heavy soils compared with less constrained loams. The simulations were most accurate where the sites were characterised for water holding capacity, rooting depth and chemical or physical constraints, and information was known about crop variety, planting time, fertiliser application and management and daily climate.**

### Why do the trial?

The aim of this work was to collate historically measured wheat yield data from MAC and data from recent experimental work and compare them to the predictions of the French and Schultz potential yield calculation and the predictions made by the systems simulation model APSIM (Agricultural Production Systems sIMulator). Understanding the complex interactions between soil type, rainfall distribution and management are essential for developing lower risk farming systems for EP and models are used to help achieve this.

The French and Schultz (F&S) potential yield calculation is a

**Almost ready**

**Location: Minnipa**
Minnipa Agricultural Centre
**Rainfall**
Av. annual: 325 mm
Av. GSR: 242 mm
2006 total: 236 mm
2006 GSR: 111 mm
2005 total: 327 mm
2005 GSR: 267 mm
**Yield**
Potential 2006: 1.01 t/ha
Actual 2006: up to 0.59 t/ha
Potential 2005: 3.14 t/ha
Actual 2005: up to 2.53 t/ha
**Soil Type**
Sandy loam / red clay loam
**Plot size**
10 m x 1.5 m x 4 replications

**Location: Mudamuckla**
Peter Kuhlmann
**Rainfall**
Av. annual: 293 mm
Av. GSR: 219 mm
2006 total: 203 mm
2006 GSR: 102 mm
2005 total: 301 mm
2005 GSR: 239 mm
**Yield**
Potential 2006: 0.92 t/ha
Actual 2006: up to 0.88 t/ha
Potential 2005: 2.58 t/ha

continues

simple and widely used method for predicting potential grain yield. It is based on a collection of data (French and Schultz 1984) that defined the relationship between the efficiency of water transpired (20 kg/ha/mm for wheat grain) and April to October rainfall less evaporation (estimated to be 110 mm). The main criticisms of the F&S approach in the literature have been:

- not accounting for the timing of in-season rain,
- not considering runoff or drainage or out of growing season rainfall on the water budget and
- assuming constant seasonal evaporation.

Despite these criticisms, the F&S approach remains popular. Many modifications have been made to this method to extend its applicability from the 275 to 450 mm average annual rainfall zone where it was derived, as well as attempts to improve accuracy. The model has been modified (EPFS Summary 2006 p. 87) to include some summer stored rainfall in growing season with April to October rainfall >200 mm, or in the case of April to October rainfall being <200 mm, decreased the assumed evaporation rate of 110 mm by an evaporation factor. In this paper, predictions of water limited grain yield using the original and modified F&S approaches were compared with historical datasets from MAC and its surrounds.

A more complex approach to predicting crop performance is the use of APSIM, a systems model that simulates the major processes that occur while growing crops and pastures. These include the nitrogen and carbon dynamics in soil, soil water balance (including drainage, leaching and runoff) and crop growth and interactions with daily temperature, radiation and rainfall. APSIM requires accurate information about soil type (water holding capacity, rooting depth, chemical or physical constraints, carbon and nitrogen content), information about crop variety, planting time, fertiliser application and management and daily climate.

## How was it done?

Historical wheat yield data from MAC and information from more recent on-and off-station experimental work were collated as follows:

The MAC annual average grain yield of all paddocks that were sown to wheat for the seasons between 1972 and 2007. This includes paddocks that have been in long-term cereal or other rotations as well as paddocks coming out of pasture rotation. No management information about variety, planting date, fertiliser or stage of rotation was available.

Measured grain yields for wheat grown in the MAC paddock N1 during the seasons of 1977, 1986, 1990, 1995, 1998, 2000, 2002, 2006 and 2007. Information such as planting date, cultivar and fertiliser application was available.

Wheat trials were conducted separately on heavy and loam soil types in 2005 and 2006 at MAC, Tuckey and Mudamuckla. Information on planting date, cultivar and fertiliser application was available as well as soil moisture and mineral N at sowing. The two soil types at each site were characterised for the drained upper limit (DUL), crop lower limit (CLL), rooting depth, bulk density, organic carbon and chemical constraints.

For each of the sites and seasons, potential yield was calculated using the modified French and Schultz approach (EPFS Summary 2006 p. 87). The systems simulation model APSIM was also parameterised to utilise the available information and simulate wheat growth as follows:

MAC annual average: APSIM was used to simulate the growth of wheat and its interaction with soil water, nitrogen and climate for heavy and a loam soils that were characterised at MAC. The heavy soil had a rooting depth restricted to 40 cm and plant available water capacity (PAWC) of 38 mm. The loam had a rooting depth of approximately 60 cm and PAWC of 108 mm. Daily weather records recorded at MAC were obtained from SILO (weather tracking program). Other assumptions about the management of the wheat crops were:

Wheat cultivar Yitpi sown at 150 plants/$m^2$ in a sowing window that opened 15 May and closed 30 June. Sowing took place during this window if 10 mm of rainfall was received over 3 days and 20 mm of plant available water was in the soil profile.

Based on the measurement of mineral N made in 2006, the soil profile was assumed to contain 167 kg/ha of mineral N in the loam and 228 kg/ha in the heavy soil and this amount was reset yearly. While some of this N is below the rooting zone, it is common to measure large amounts of mineral N pre-sowing in these soil types, particularly after medic pasture. An additional 30 kg N/ha was applied at sowing.

**Soil Type**
Grey calcareous sandy loam / calcareous loam

**Plot size**
10 m x 1.5 m x 4 replications

**Location: Tuckey**
Jason Burton

**Rainfall**
Av. annual: 324 mm
Av. GSR: 241 mm
2006 total: 240 mm
2006 GSR: 94 mm
2005 total: 313 mm
2005 GSR: 281 mm

**Yield**
Potential 2006: 0.68 t/ha
Actual 2006: up to 0.88 t/ha
Potential 2005: 3.42 t/ha
Actual 2005: up to 2.14 t/ha

**Soil Type**
Sandy loam/red clay loam

**Plot size**
10 m x 1.5 m x 4 replications

MAC paddock N1: The grain yield was simulated as for data set 1, but with actual planting dates and fertiliser application.

(In order to calculate a predicted wheat yield for both of the measured datasets at MAC, it was assumed that one-third of the cropping country was on the heavy soil type and two thirds was loam. This assumption was based on the interpretation of an EM map for paddock N1.)

The APSIM simulations were setup using all of the available information with separate simulations for the two soil types.

## What happened?

*Simulating the datasets 1 & 2 with limited soils and management information*

Using the MAC annual average dataset for the seasons between 1972 and 2007, yield predictions made using the modified F&S approach or simulating the individual seasons with APSIM were plotted against April to October rainfall (Figure 1). The MAC average yield reaches a maximum of about 2.9 t/ha with 287 mm April to October rainfall. In the seasons where rainfall exceeded this, wheat yield plateaus at about 2 t/ha, presumably due to other constraints such as N, which may leach in years of high rainfall. Predictions of grain yield based on the F&S and modified F&S approach are linearly related to April to October rainfall and over predict grain yield in most seasons. A regression of the predicted against observed yields result in an R2 = 0.62 and a slope of 1.45 (Figure 2a).

Predictions of grain yield using APSIM are more closely matched to the measured data for April to October rainfall up to 300 mm, but in seasons where rainfall exceeds this amount, APSIM over predicts yield. A regression of the predicted against observed yields result in an R2 = 0.66 and a slope of 1.22 (Figure 2a). Using APSIM to simulate a subset of seasons for MAC paddock N1 where planting date, cultivar and fertiliser application were available to initialise the model substantially improved the regression between predicted and observed (Figure 2b).

At each of the sites, trials were undertaken on a fully characterised heavy textured and loam textured soil. The heavy soils are typically higher in clay content, and subsoil constraints, particularly boron toxicity and high salt concentrations, limit rooting depth and therefore reduced plant available water capacity (PAWC) (Table 1). The loam soils are not constrained by sub-soil salts or boron, and potential rooting depth is deeper. The interaction between crop growth and available soil water is largely determined by the amount and distribution of rainfall.

On heavy soils, PAWC is small, plant uptake of water is limited to shallow layers, and so available water can be rapidly depleted resulting in water stress limiting plant growth. On the loam soils, PAWC is typically larger because the potential depth of rooting is further; therefore the period that plants can access available soil water is longer. In the trials conducted during 2005 (growing season rainfall of 281, 239 and 267 mm at Tuckey, Mudamuckla and MAC respectively) and 2006 (growing season rainfall of 94, 102 and 111 mm at Tuckey, Mudamuckla and MAC respectively), wheat grown on the loam soils out-yielded wheat grown on the heavy soils in all cases, with the exception of Tuckey in 2005 (Table 1)(EPFS Summary 2005, pp. 25-26, EPFS Summary 2006, pp. 91-92). It is not uncommon to see "flip-flops" for different seasons where some parts of the paddock perform the best in dry years (i.e. the lighter parts) while other parts of the paddock can perform better in the wetter years (the heavier ground with subsoil constraints). By carefully characterising the water holding characteristics of these soils, APSIM was able to simulate the effect of rainfall amount and distribution on available soil water and its

***Table 1 Plant available water capacity (PAWC) and rooting depth of heavy and loam soils at 4 sites on upper Eyre Peninsula and observed and APSIM predicted wheat grain yield (t/ha) for 2005 and 2006***

| Site | Soil | PAWC (mm) | Rooting depth (cm) | 2005 Grain Yield (t/ha) | | 2006 Grain Yield (t/ha) | |
|---|---|---|---|---|---|---|---|
| | | | | Observed | Predicted | Observed | Predicted |
| Tuckey | Heavy | 76 | 40 | 2.17 | 2.22 | 0.28 | 0.31 |
| | Loam | 70 | 70 | 1.88 | 2.42 | 0.79 | 0.31 |
| Mudamuckla | Heavy | 29 | 30 | 1.12 | 1.10 | 0.36 | 0.44 |
| | Loam | 114 | 100 | 1.26 | 1.73 | 0.85 | 0.45 |
| Minnipa cv. W | Heavy | 33 | 40 | 1.21 | 1.37 | 0.29 | 0.43 |
| | Loam | 163 | 120 | 2.01 | 1.94 | 0.56 | 0.63 |
| Minnipa cv. Y | Heavy | 33 | 40 | 1.52 | 1.59 | 0.22 | 0.36 |
| | Loam | 163 | 120 | 2.32 | 1.98 | 0.48 | 0.57 |

*Nb. Cv. W and Y refer to wheat cultivars Wyalkatchem and Yitpi.*

interactions with crop growth resulting in a good prediction of grain yield (y = 0.995+39, R2 = 0.88). Most importantly, the effects of soil type difference and season interactions could be modelled.

## What does this mean?

The interaction between soil type, available soil water and crop growth is largely determined by the amount and distribution of rainfall. Models such as the F&S approach that ignore this interaction have limited ability for predicting grain yield in low rainfall regions like the Eyre Peninsula where soil variation and sub-soil constraints are so common. While APSIM is a seemingly complex model requiring substantial investment in soil characterisation and the collation of management and climatic information, we believe it is the minimum amount of complexity to actually represent the system and its interactions. Once this investment is made, the model can be applied to a range of tasks that can help farmers manage risk.

To make APSIM more relevant to the EP farming systems, a co-ordinated effort should be undertaken to characterise a wide range of soils, parameterise and validate crop types and varieties (eg. growth, phenology), and better understand the dynamics of rainfall, evaporation, soil type and management. In the absence of key soil and management information, predictions made by APSIM are not substantially better than F&S.

While APSIM is essentially a tool for researchers to use, Yield Prophet (www.yieldprophet.com.au) is a well developed web-based interface to APSIM that allows consultants and farmers to access real time crop performance and yield predictions.

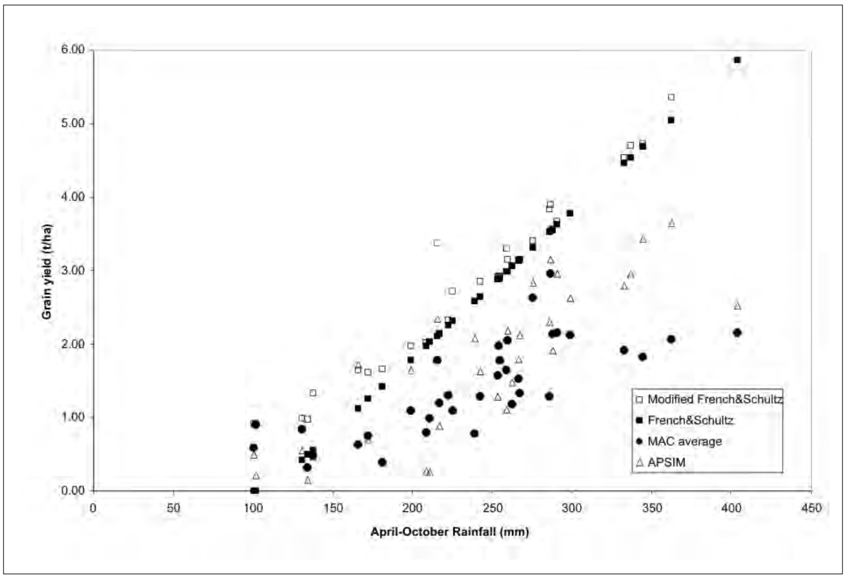



***Figure 1** The yearly average MAC wheat yield, the predicted grain yields using the French and Schultz and APSIM approaches plotted against the April to October rainfall in each season 1972 to 2006.*

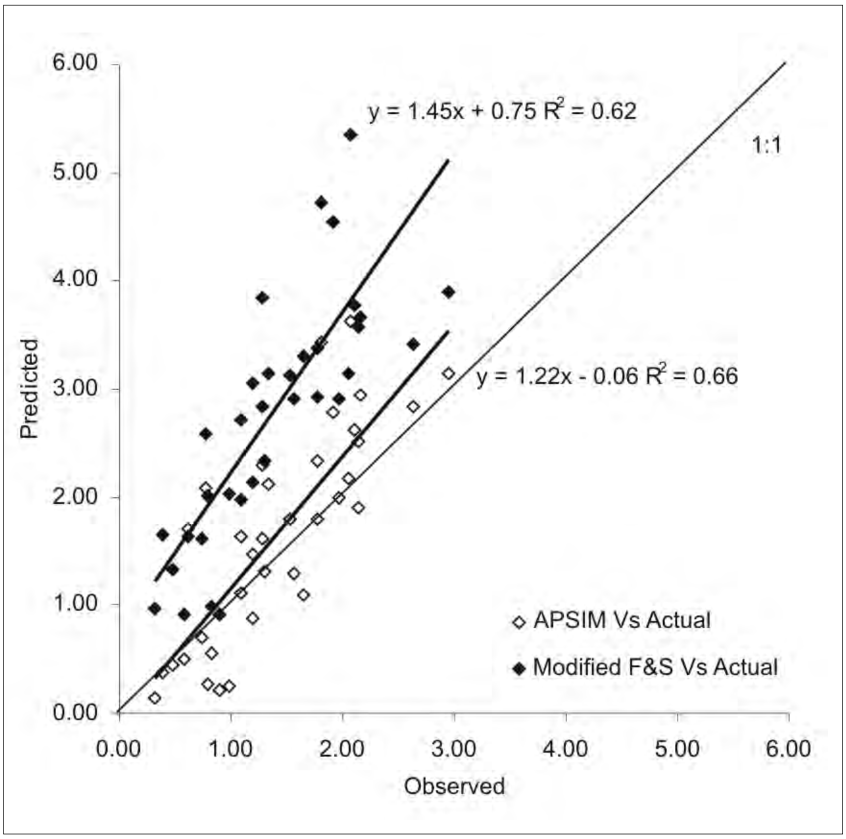



***Figure 2a** Modified French and Schultz and APSIM predicted grain yields (t/ha) plotted against observed average MAC wheat yield for seasons between 1972 and 2006.*

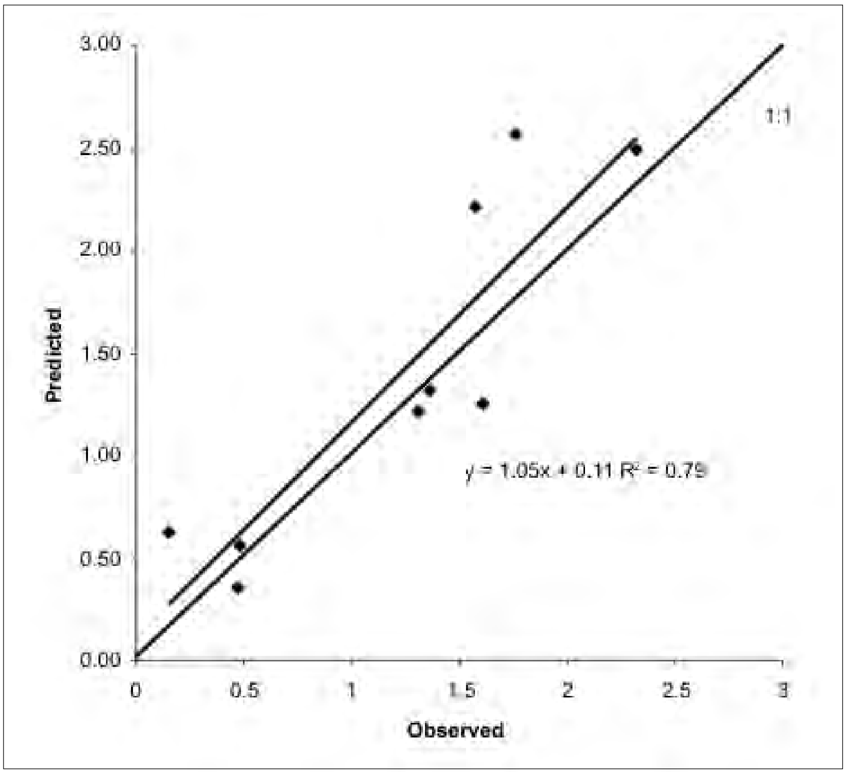



***Figure 2b** Observed grain yields for wheat grown in the MAC paddock N1 during the seasons of 1977, 1986, 1990, 1995, 1998, 2000, 2002, 2006 and 2007 plotted against APSIM prediction yield using planting date, cultivar and fertiliser application for those seasons.*


## Acknowledgements

We would like to thank Peter Kuhlmann and Jason Burton for providing the trial sites and Wade Shepperd, Kay Brace and Trent Brace for technical support.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

CSIRO




# Row Direction, Row Spacing and Stubble Effects in Wheat and Barley

**Jon Hancock, Alison Frischke and Amanda Cook**
SARDI, Minnipa Agricultural Centre

Research

**Try this yourself now**

**Location: MAC**
Minnipa Agricultural Centre
**Rainfall**
Av. annual: 325 mm
Av. GSR: 242 mm
2007 total: 286 mm
2007 GSR: 141 mm
**Yield**
Potential: (B) 1.83 t/ha
Actual: up to 1.32 t/ha
**Paddock History**
2006: Wheat
2005: Wheat
**Soil**
Red sandy loam

**Location: Lock**
**Rainfall**
Av. annual: 347 mm
Av. GSR: 259 mm
2007 total: 318 mm
2007 GSR: 191 mm
**Yield**
Potential: (W) 2.05 t/ha
Actual: up to 1.28 t/ha
**Paddock History**
2006: Pasture
2005: Barley
**Soil**
Grey sandy loam

## Key messages

- **Wheat and barley yield improved with stubble retention and narrower row spacings.**
- **Stubble retention aided disease suppression and reduced the incidence of *Rhizoctonia*.**
- **Row direction did not affect grain yield in 2007.**

## Why do the trial?

During 2005 and 2006, trials investigating the effects of row direction, row spacing and stubble cover on grain yield and quality of wheat showed that north-south sowing had a yield advantage over east-west sowing. North-south sowing improved grain yields by 5 and 17% for the 2005 and 2006 seasons respectively. Trials were sown in 2007 to determine if the yield advantage of north-south sowing could be maintained for yet another season, investigate why sowing direction could affect grain yield and determine if this benefit exists in different environments. Previous results are published in the EPFS Summary 2005, pp. 131-132 and the EPFS Summary 2006, pp. 165-166.

## How was it done?

A trial was set up at Minnipa Agricultural Centre in 2005 and was re-sown with identical treatments in 2006 and 2007. Prior to each seeding, the stubble was removed from the appropriate plots by burning. In 2007, the trial was sown on 16 May after an application of Roundup Powermax @ 1.2 L/ha and TriflurX @ 1.2 L/ha to Maritime barley sown @ 60 kg/ha with 18:20:00 @ 60 kg/ha at 18, 23 and 30 cm row spacings in north-south and east-west directions.

A similar trial was also set up at Lock in 2007. This trial was sown into sparse remnant pasture stubble and had no burning treatments applied prior to sowing. The trial was sown on 21 May after an application of Roundup Powermax @ 1.2 L/ha and TriflurX @ 1.2 L/ha to Correll wheat sown @ 60 kg/ha with 18:20:00 @ 60 kg/ha at 18, 23 and 30 cm row spacings in north-south and east-west directions.

Plots at Minnipa were sampled for the disease suppression bioassay on 15 May and scored for visual *Rhizoctonia* patch on 24 August when the crop was just starting to boot. Also at this site, pan evaporation at the soil surface was measured in-row and inter-row for stubble-retained treatments from anthesis to maturity.

At both sites, quadrat cuts and soil cores were taken at anthesis and maturity to compare dry matter, harvest indices, yield components and soil water. All plots were harvested at maturity and grain samples were retained for quality analysis.

## What happened?

At Minnipa, there was an interaction between stubble and row spacing on grain yield and grain protein (Table 1). In the presence of stubble, grain yield was higher at 18 and 23 cm row spacings, however where stubble was burnt, there was no yield difference between row spacings. Crop biomass through the season was also higher where stubble was retained (Table 2). Grain screenings averaged 1.1% and were unaffected by treatment.

Part of the explanation for higher crop growth and yields where stubble was retained is due to *Rhizoctonia* suppression. The assessment of *Rhizoctonia* 'patch' during the growing season, which was given a score from 0 to 5 (where 0 = no patch and 5 = severe rhizoctonia patch), showed that the incidence of rhizoctonia was much lower where stubble was retained (Table 3) and was also lower at the 30 cm row spacing (Table 4).

Typically, narrow rows have the advantage of reduced crop competition, allowing for more fertile heads and subsequently grains per unit area to benefit grain yield, however in the situation of removed stubble, the extra disease pressure in treatments with narrow rows negated any benefit from crop competition.

The disease suppression bioassay (for methodology refer to 'EP Disease Suppression Bioassay and Survey' article on p. 130) carried out on soil collected from burnt and unburnt treatments prior to sowing, showed that soil from the burnt areas did not have the ability to suppress disease as much as soil from the areas where stubble was retained. Organic carbon, also measured on these soil samples was higher where stubble was retained (1.02%), compared to where stubble was burnt for three consecutive seasons (0.88%). The removal of carbon, the main food source for microbes by burning severely reduced the microbial activity of this soil and consequently it's ability to suppress root diseases.

At Minnipa, pan evaporation at the soil surface from anthesis to maturity was not influenced by row direction or spacing. There was no effect of any treatment on soil water at anthesis or maturity at either site.

At Lock, treatments sown on 18 cm row spacing had more total biomass and higher grain yields than those sown on 23 or 30 cm row spacing, though grain protein was lower (Table 5). The yield advantage of the narrow row spacing was due to a higher density of fertile tillers, which resulted in more grains per unit area with no difference in kernel weight between treatments (data not shown). Grain screenings averaged 2.2% and were unaffected by treatment.

In 2007, there was no difference in yield due to sowing direction at either site.

## What does this mean?

Row spacings at 30 cm compromised grain yield at both sites. Grain yield was maximised with row spacings of 18 cm at Lock and 18 or 23 cm at Minnipa when sown into retained stubble. This is a direct function of reduced crop competition within narrower rows. Where the stubble was burnt in the Minnipa trial, the extra disease burden in the plots with narrower row spacings negated any crop competition benefits.

Stubble retention has proved to be a valuable tool for disease management in the trial at

***Table 1** Effect of row spacing and stubble on grain yield (t/ha) and grain protein (%) of barley at Minnipa, 2007*

| Row Spacing (cm) | Grain Yield (t/ha) | | Grain Protein (%) | |
|---|---|---|---|---|
| | Burnt Stubble | Stubble Retained | Burnt Stubble | Stubble Retained |
| **18** | 1.13 a | 1.32 b | 11.1 a | 10.6 b |
| **23** | 1.14 a | 1.30 b | 11.0 a | 10.4 b |
| **30** | 1.15 a | 1.20 a | 10.8 a | 10.9 a |
| *LSD (P=0.05)* | *0.10* | | *0.7* | |

***Table 2** Effect of stubble retention on biomass production (t/ha) of barley at Minnipa, 2007*

| Stubble | Anthesis Dry Matter (t/ha) | Maturity Dry Matter (t/ha) |
|---|---|---|
| **Burnt** | 3.34 a | 3.66 a |
| **Retained** | 3.76 b | 4.09 b |
| *LSD (P=0.05)* | *0.10* | *0.43* |

***Table 3** Effect of stubble retention on Rhizoctonia patch in barley at Minnipa, 2007*

| Stubble | *Rhizoctonia* Patch Score* |
|---|---|
| **Burnt** | 1.95 a |
| **Retained** | 1.26 b |
| *LSD (P=0.05)* | *0.47* |

**Scored from 0 to 5, where 0 = no patch and 5 = severe rhizoctonia patch*

***Table 4** Effect of row spacing on Rhizoctonia patch in barley at Minnipa, 2007*

| Row Spacing (cm) | *Rhizoctonia* Patch Score* |
|---|---|
| **18** | 2.00 a |
| **23** | 1.74 a |
| **30** | 1.07 b |
| *LSD (P=0.05)* | *0.31* |

**Scored from 0 to 5, where 0 = no patch and 5 = severe rhizoctonia patch*

***Table 5 Effect of row spacing on biomass production (t/ha), grain yield (t/ha) and grain protein (%) of wheat at Lock, 2007***

| Row Spacing (cm) | Anthesis Dry Matter (t/ha) | Maturity Dry Matter (t/ha) | Grain Yield (t/ha) | Grain Protein (%) |
|---|---|---|---|---|
| **18** | 4.48 a | 4.67 a | 1.28 a | 13.2 a |
| **23** | 3.57 b | 3.70 b | 1.02 b | 13.8 b |
| **30** | 3.57 b | 3.69 b | 1.04 b | 13.6 b |
| *LSD (P=0.05)* | *0.32* | *0.74* | *0.06* | *0.4* |

Minnipa. Though the stubble has only been burned for the last three seasons, this has had a substantial impact on the soil's organic carbon level, microbial activity and ability to suppress root diseases.

Data from the 2007 season did not show a yield advantage from sowing in a north-south direction as the results from the 2005 and 2006 seasons did. The reason for this difference is not clear but possibly related to differences in rainfall and wind patterns of the different seasons. Measurements showed that row direction and spacing did not affect soil water evaporation rates late in the 2007 season. Previous results have found north-south sowing to be advantageous to yield but further work is required to substantiate the influence of sowing direction over a range of seasons and environments.

## Acknowledgements

We would like to thank Andrew, Lynne and Stuart Henstchke for providing the trial site at Lock and thank Wade Shepperd, Brenton Spriggs, Kaye Brace and Trent Brace for technical assistance. Roundup Powermax is a registered product of Monsanto and TriflurX is a registered product of Nufarm.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

GRDC Grains Research & Development Corporation

# Improving Wheat Performance through Genetic Manipulation of Tillering

**Jon Hancock[1], Greg Rebetzke[2] and Richard Richards[2]**

[1]SARDI, Minnipa Agricultural Centre, [2]CSIRO Plant Industry, Canberra

Research

## Key messages

- **A gene for reduced-tillering *(tin)* has been identified and molecular markers linked to this gene used in selection of reduced-tillering sister-lines across a range of genetic backgrounds.**
- **Lines containing the *tin* gene were grown at Minnipa in 2007 and found to be associated with a higher proportion of fertile tillers particularly on shallow soils.**
- **Grain yields and grain size were generally larger for the reduced-tillering wheats – the advantage of reduced-tillering being greatest on shallow, heavy soils with reduced yield potential.**
- **South Australian-adapted, reduced-tillering lines derived from Camm, Wyalkatchem and Yitpi are currently being developed for release to commercial breeders.**

## Why do the trials?

The aim of this experiment was to evaluate tillering, grain yield and size for related wheats varying for presence of a reduced-tillering gene.

All current wheat cultivars produce more tillers than they can sustain to grain maturity. That is, many tillers are produced that eventually die. This represents a waste of resources (water and nutrients) used for the growth of these sterile tillers that could otherwise have been invested in fertile heads to increase grain yield. We have identified a single gene that inhibits tillering. This tillering inhibition is not always complete and so it is possible to genetically manipulate the crop with this gene such that fewer wasteful tillers are produced. This gene has been backcrossed into a set of commercial wheats, and preliminary evaluation in NSW and QLD has shown yields to be similar to, or greater than, the commercial parents. In all cases the grain weight has been larger and screenings percentage smaller for reduced-tillering wheats.

## How was it done?

Two small plot trials were sown on two contrasting soil types within the same paddock: a heavy flat (heavy) and a sandy loam (light) at Minnipa on 1 June. Each trial contained 95 lines that were selected for presence (+) or absence (-) of the *tin* gene for reduced tiller number. This gene was selected across a range of genetic backgrounds, including a large set derived from the commercial parents Brookton, Chara and Silverstar. Lines were sown at a rate of 60 kg/ha with 60 kg/ha of 18:20:00. Due to limited seed quantity, the trials were not replicated. However, plots of Correll and selected check varieties were included throughout each trial to account for spatial variation. At maturity, quadrats were hand-harvested to determine plant density, tiller density, dry matter production and yield components. The trials were harvested with a small plot header for grain yield determination.

## What happened?

### *Soil types*

Grain yields and grain size were low reflecting the lower in-season rainfall (141 mm) during 2007.

**Try this yourself now**

**Location: Minnipa**
Minnipa Agricultural Centre

**Rainfall**
Av. annual: 325 mm
Av. GSR: 242 mm
2007 total: 286 mm
2007 GSR: 141 mm

**Yield**
Potential: (W) 1.43 t/ha
Actual: up to 0.6 t/ha

**Paddock History**
2006: Pasture (grass-free)
2005: Wheat
2004: Wheat

**Soil Type**
Red sandy loam, heavy red flat

**Plot size**
1.5 m x 5 m

The different soil types produced contrasting tillering responses to affect grain yield and grain size (Table 1). The favourable conditions associated with the lighter soil produced greater tillering and a higher proportion of fertile tillers to increase grain yields and produce larger grain size. In contrast, the less favourable conditions characteristic of the heavier soil reduced total tiller numbers and reduced the frequency of fertile tillers to decrease grain yields and reduce grain size for all lines tested.

### *Breeding lines*

Breeding lines were divided into maturity class based on the frequency of green heads assessed late in the season (Table 1). Brookton derivatives were slowest to mature; Chara was intermediate, and Silverstar the quickest. Maturity had little effect on tiller number, grain yield or grain size although earlier lines tended to produce a higher percentage of fertile tillers. Grain yields were similar across all backgrounds. The smaller grain size of the Silverstar lines indicated production of a larger number of kernels than for Brookton or Chara lines.

Presence of the reduced-tillering, tin gene was associated with an average 5-20% reduction in tiller number in the more favourable lighter soils. Numbers of fertile tillers were similar for +*tin* and –*tin* sister-lines reflecting the higher frequency of fertile tillers associated with presence of the reduced-tillering gene. In turn, grain yields were similar for reduced - and free-tillering lines in all three backgrounds. Grain size was equal to, or larger for the reduced-tillering lines grown in the lighter soils.

In the less-favourable, heavy soils, presence of the reduced-tillering gene was associated with a greater frequency of fertile tillers to increase grain yield in some backgrounds. Grain size was as large or larger for the reduced-tillering lines and particularly for the Silverstar background in the heavier soils.

It is noteworthy that performance of the very free-tillering check variety Silverstar was consistent with performance of the free-tillering Silverstar derivative lines (Table 1). This confirms the success in recovery of the 'Silverstar-type' when selecting among lines. Importantly, the high tillering and reduced grain size of Silverstar seen in this study was typical of its performance elsewhere.

Some reduced-tillering lines established poorly which reduced tiller number and decreased grain yield (data not shown). Overall, the results from 2007 mirrored the greater grain yield and grain size associated with lines containing the reduced-tillering, *tin* gene evaluated under severe drought at Minnipa in 2006 (data not shown).

***Table 1 Assessment of varieties carrying reduced-tillering gene (tin), Minnipa 2007***

| Background/ Soil-type | Tillering gene presence | Maturity (as % green heads) | Total number tillers ($m^{-2}$) | Number fertile tillers ($m^{-2}$) | Percent fertile tillers (%) | Harvest index (%) | Grain yield ($kg.ha^{-1}$) | 1000-grain weight (g) |
|---|---|---|---|---|---|---|---|---|
| ***Brookton*** | | | | | | | | |
| a) Light | +tin | 21 | 182 | 139 | 76 | 36 | 568 | 29.6 |
| | -tin | 16 | 191 | 141 | 74 | 36 | 603 | 28.8 |
| b) Heavy | +tin | 35 | 158 | 115 | 73 | 32 | 167 | 26.2 |
| | -tin | 33 | 139 | 87 | 62 | 32 | 113 | 25.2 |
| ***Chara*** | | | | | | | | |
| a) Light | +tin | 12 | 166 | 128 | 78 | 33 | 554 | 30.3 |
| | -tin | 13 | 194 | 139 | 71 | 33 | 548 | 28.6 |
| b) Heavy | +tin | 32 | 164 | 126 | 76 | 32 | 147 | 27.2 |
| | -tin | 33 | 148 | 90 | 61 | 32 | 168 | 25.6 |
| ***Silverstar*** | | | | | | | | |
| a) Light | +tin | 3 | 171 | 139 | 81 | 37 | 589 | 26.2 |
| | -tin | 4 | 189 | 142 | 75 | 37 | 554 | 26.5 |
| b) Heavy | +tin | 6 | 149 | 122 | 82 | 38 | 198 | 25.3 |
| | -tin | 9 | 168 | 128 | 76 | 37 | 181 | 24.1 |
| ***Silverstar (variety)*** | | | | | | | | |
| a) Light | | 3 | 182 | 126 | 69 | 35 | 512 | 26.2 |
| b) Heavy | | 2 | 147 | 113 | 76 | 34 | 126 | 24.2 |
| *LSD (P = 0.05)* | | *3* | *13* | *11* | *5* | *3* | *24* | *0.4* |

*Grain yield, harvest index, tiller number, percentage fertile tillers and grain weight for Brookton (slow maturity), Chara (intermediate maturity) and Silverstar (quick maturity) sister-lines with (+tin) and without (-tin) the reduced-tillering gene, and the check variety Silverstar when grown on light and heavy soils.*

## What does this mean?

This trial work has shown that genetic control of tillering can benefit grain yield and grain size with the greatest benefit on the shallow, heavy soil types. These soils typically hay-off in seasons with a harsh finish, but the ability to restrict crop biomass and increase tiller fertility through restricted tillering offers the opportunity to conserve soil water for grain-filling and maximise yield potential and grain size.

Restricted-tillering associated with the *tin* gene will reduce the capacity of poorly established crops to recover. Thus seed quality, sowing density and conditions at sowing must be suitable to avoid problems with early growth and reduced yield potential. Any efforts to genetically reduce the excessive production of tillers must compliment good agronomy.

Reduced tillering lines are currently being developed from common South Australian varieties (Camm, Wyalkatchem and Yitpi) for evaluation and release to commercial breeders.

## Acknowledgements

We would like to thank Wade Shepperd, Kay Brace and Carey Moroney of Minnipa Agricultural Centre for technical assistance.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

CSIRO

GRDC Grains Research & Development Corporation



# Types of work in this publication

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

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

# Variable Rate Technology at Minnipa and Mudamuckla – Is It Worthwhile?

Research

**Jon Hancock[1] and Peter Kuhlmann[2]**

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

**Almost ready – we know the basics, just fine tuning the edges**

**Location: Minnipa**
Minnipa Agricultural Centre

**Rainfall**
Av. annual: 325 mm
Av. GSR: 242 mm
2007 total: 286 mm
2007 GSR: 141 mm

**Yield**
Potential: (W) 1.43 t/ha
Actual: up to 0.75 t/ha

**Paddock History**
2006: Pasture (grass free)
2005: Wheat (Wyalkatchem)
2004: Wheat (Yitpi)

**Soil Type**
Red loam

**Location: Mudamuckla**

**Rainfall**
Av. annual: 293 mm
Av. GSR: 219 mm
2007 total: 302 mm
2007 GSR: 122 mm

**Yield**
Potential: (W) 1.06 t/ha
Actual: up to 0.61 t/ha (Paddock 2), up to 0.69 (Paddock 41)

**Paddock History (Paddock 2)**
2006: Pasture (grass free)
2005: Wheat (Krichauff)
2004: Wheat (Krichauff)

**Paddock History (Paddock 41)**
2006: Wheat (Yitpi)
2005: Oats (Euro – grazed /sprayed out)
2004: Wheat (Clearfield JNZ)

**Soil Type**
Grey calcareous sandy loam

## Key messages

- **Farming to soil type using VRT is achievable on the broad scale and appears to be worthwhile for reducing input costs.**
- **The profitability of VRT was very similar to standard practice in 2007 (very dry late winter and spring and there was minimal response to fertiliser).**
- **The financial merits of adopting VRT to farm according to soil type rather than a standard approach across the paddock is yet to be proven.**
- **In a season with better rainfall and yields it is expected that there will be economic nutrition responses and the benefits of VRT would be greater.**

## Why do the trials?

Farmers are continually looking for ways to improve their bottom line by getting maximum return from minimum inputs. Variable Rate Technology (VRT) is the technology on a farmer's seeding machinery to adjust seed and fertiliser rates on the go during the seeding process. This provides the opportunity to change agronomic inputs according to the production capability of different paddock zones or soil types. Replicated field trials, investigating how crop canopy size affects crop growth and yield on different soil types, have shown that in a good season (2005), reduced canopy size reduced yield across all soil types. However, in a poor season (2006), reduced crop canopy on the heavy/shallow soil types increased grain yield (EPFS Summary 2005 pp. 25-26, EPFS Summary 2006 pp. 91-92). These soils are those that traditionally show crop water stress first in times of drying hot north winds.

Broadacre trials were set up to determine if VRT can improve farm profitability on upper EP.

## How was it done?

A paddock at Minnipa (N2) and two paddocks at Mudamuckla (2 and 41) were zoned using combinations of yield, EM38 and elevation maps which resulted in the segregation of distinct production zones within each paddock (Table 1). Inputs (seed and fertiliser) were tailored for each zone and applied using existing broadacre seeding machinery equipped with VRT. Standard practice strips were included for comparison. The paddock at Minnipa was sown to Correll on 15 May and included all input treatments in alternating strips across the whole paddock. This allowed comparison of all treatments in each paddock zone. A commercial prescription for this paddock would have had high input on the good ground, standard input on the medium ground and low input on the poor ground. Paddock 41 at Mudamuckla was sown to Wyalkatchem on 11 May and paddock 2 was sown to Yitpi on 18 May. The high seeding rate on sand in paddock 2 was to increase the plant population to minimise the risk of wind erosion, which was successful.

*Table 1 Sowing inputs, grain yield, grain quality and gross income for treatments in N2 at Minnipa, 2007*

| Paddock Zone | Paddock Area (%) | Treatment | Seed Rate (kg/ha) | P Rate (kg/ha) | N Rate (kg/ha) | Grain Yield (t/ha) | Protein (%) | Screenings (%) | Gross Income[1] ($/ha) |
|---|---|---|---|---|---|---|---|---|---|
| Good | 41 | High Input | 50 | 12 | 33.8 | 0.63 | 13.9 | 8.2 | 170 |
| | | Standard | 50 | 12 | 10.8 | 0.75 | 13.7 | 6.4 | 250 |
| | | Low Input | 35 | 8 | 7.2 | 0.72 | 13.7 | 6.6 | 251 |
| Medium | 37 | High Input | 50 | 12 | 33.8 | 0.48 | 14.3 | 7.7 | 114 |
| | | Standard | 50 | 12 | 10.8 | 0.60 | 15.2 | 6.3 | 191 |
| | | Low Input | 35 | 8 | 7.2 | 0.51 | 14.6 | 6.6 | 170 |
| Poor | 22 | High Input | 50 | 12 | 33.8 | 0.31 | 13.6 | 15.5 | 43 |
| | | Standard | 50 | 12 | 10.8 | 0.41 | 14.1 | 9.3 | 113 |
| | | Low Input | 35 | 8 | 7.2 | 0.37 | 13.8 | 14.8 | 105 |

*[1]Gross Income is yield x price (with quality adjustments) less seed and fertiliser costs delivered to No. 1 pool at Minnipa, 2007.*

*Table 2 Sowing inputs, grain yield, grain quality and gross income for treatments in paddock 2 at Mudamuckla, 2007*

| Paddock Zone | Paddock Area (%) | Treatment | Seed Rate (kg/ha) | P Rate (kg/ha) | N Rate (kg/ha) | Grain Yield1 (t/ha) | Protein (%) | Screenings (%) | Gross Income[2] ($/ha) |
|---|---|---|---|---|---|---|---|---|---|
| Good | 44 | Prescription | 60 | 6 | 9.2 | 0.54 | 14.1 | 1.0 | 182 |
| | | Standard | 60 | 4.7 | 6.9 | 0.55 | 14.0 | 1.0 | 192 |
| Medium (Grey) | 24 | Prescription | 60 | 4 | 5.5 | 0.47 | 14.5 | 0.9 | 163 |
| | | Standard | 60 | 4.7 | 6.9 | 0.48 | 14.7 | 1.1 | 162 |
| Medium (Sand) | 24 | Prescription | 80 | 4 | 5.5 | 0.60 | 13.5 | 1.2 | 214 |
| | | Standard | 60 | 4.7 | 6.9 | 0.61 | 12.5 | 1.1 | 217 |
| Poor | 8 | Prescription | 40 | 0 | 0 | 0.17 | 14.4 | 0.9 | 62 |
| | | Standard | 60 | 4.7 | 6.9 | 0.16 | 13.5 | 1.1 | 26 |

*[1]Grain yields for poor paddock zone estimated from hand harvests, adjusted for harvesting losses.*
*[2]Gross Income is yield x price (with quality adjustments) less seed and fertiliser costs delivered to No. 1 pool at Thevenard.*

*Table 3 Sowing inputs, grain yield, grain quality and gross income for treatments in paddock 41 at Mudamuckla, 2007*

| Paddock Zone | Paddock Area (%) | Treatment | Seed Rate (kg/ha) | P Rate (kg/ha) | N Rate (kg/ha) | Grain Yield1 (t/ha) | Protein (%) | Screenings (%) | Gross Income[2] ($/ha) |
|---|---|---|---|---|---|---|---|---|---|
| Good | 40 | Prescription | 60 | 6 | 9.2 | 0.69 | 12.2 | 1.2 | 241 |
| | | Standard | 60 | 4.7 | 6.9 | 0.66 | 11.9 | 1.0 | 238 |
| Medium | 50 | Prescription | 60 | 4 | 5.5 | 0.61 | 12.5 | 2.2 | 220 |
| | | Standard | 60 | 4.7 | 6.9 | 0.62 | 12.0 | 1.9 | 218 |
| Poor | 10 | Prescription | 40 | 0 | 0 | 0.49 | 12.6 | 3.2 | 194 |
| | | Standard | 60 | 4.7 | 6.9 | 0.45 | 13.4 | 2.6 | 149 |

*[1]Grain yields for poor paddock zone estimated from hand harvests, adjusted for harvesting losses.*
*[2]Gross Income is yield x price (with quality adjustments) less seed and fertiliser costs delivered to No. 1 pool at Thevenard.*

Crop growth and soil water measurements were taken at early grain fill and at maturity. The paddocks were harvested with broadacre machines and yield data was recorded via the yield monitor on the harvester. Grain samples were collected and analysed for quality.

## What happened?

Grain yield, quality and economic returns are listed in Tables 1-3. At all sites, the main differences in grain yields were between paddock zones, with higher grain yields on the better, lighter soils of the paddocks. This highlights the strong influence of soil type on plant available water and crop production. At Minnipa, grain yield was compromised both by the extra urea of the high input treatment and the reduced fertiliser and seeding rate of the low input treatment across all paddock zones. The loss of yield combined with higher input costs substantially reduced the gross income of this treatment. The smaller reduction in yield of the low input treatment in this paddock was also offset by reduced input costs, so the gross income was similar to standard practice.

At Mudamuckla, grain yields in the 'poor' zones of both paddocks were too low for accurate detection by the yield monitoring equipment in the harvesters, and most of these areas had no yield data on the original yield maps. As this was not the case in reality, but a limitation with the technology, grain yields in these zones were estimated from hand harvests and adjusted for harvesting losses.

The main benefits of VRT in 2007 were on the poorer soils of the paddocks, where lower inputs reduced costs without compromising grain yield, but this was only over a small proportion of the paddocks. These areas "hung on" much better because the crop was unfertilised and thinner. On the better soil types, the response to extra nutrition was small but varied between paddocks. Overall, the extra nutrition didn't lead to any substantial economic benefits in such a dry season. Input rates tended to have little effect on grain quality. When extrapolated to a whole paddock basis, there was little difference between the profitability of VRT versus a standard blanket approach (Table 4).

## What does this mean?

In the dry season of 2007, the profitability of farming to soil type through VRT was no better than for a standard blanket approach. While reducing inputs in the low production areas of paddocks reduced costs and often improved the profitability of these zones, this was traded off against poorer returns in the good areas due to the higher cost of inputs with little or no yield benefits. As the poor areas of the paddocks constitute a relatively small proportion of each paddock, gains in this area were offset by losses in the good areas. Further work is required to determine if increasing inputs on the better parts of paddocks is profitable over the long term.

## Acknowledgements

Thanks to Peter Kuhlmann for the opportunity to monitor VRT on his property, 'Jock' Rhynne, Andre Eylward, Brett McEvoy and 'Desi' Moroney for sowing and harvesting the trials, Wade Shepperd, Kay Brace and Trent Brace for technical assistance and Ed Cay and Brendan Frischke of GPS-Ag for assistance with paddock zoning and yield data.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

***Table 4 Comparison of the Gross Income ($/ha) of VRT versus standard practice across whole paddocks at Minnipa and Mudamuckla, 2007***

| Site | Prescription Rates | Standard Rates |
|---|---|---|
| **Minnipa N2** | 164 | 198 |
| **Mudamuckla Paddock 2** | 175 | 178 |
| **Mudamuckla Paddock 41** | 226 | 219 |

# Minnipa Farming Systems Competition – Proudly sponsored by AWB

**Michael Bennet[1], Neil Cordon[2] and Bruce Heddle[3]**

[1]SARDI, Minnipa Agricultural Centre, [2]SARDI, Minnipa Agricultural Centre (defected to Consultants team because they were winning!), [3]Farmer, Minnipa

Demo

**Best practice**

**Location: Minnipa**
Minnipa Agricultural Centre

**Rainfall**
Av. annual: 325 mm
Av. GSR: 242 mm
2007 total: 286 mm
2007 GSR: 140 mm

**Yield**
Potential: 1.44 t/ha
Actual: 1.22 t/ha

**Soil Type**
Red clay loam

**Diseases**
Crown rot

**Plot size**
2.5 ha

**Yield Limiting Factors**
Frost, snails, early finish, late sowing, hot dry spring, no rain!

## Key messages

- **Consultants storm home with a mighty victory over their opposition.**
- **Early sowing pays off. Farmers $141/ha better off than District Practice by sowing 19 days earlier.**
- **If you think break crops are risky, try growing certified medic seed.**
- **Following the researcher's agronomic example could be harmful to your wealth.**
- **The researchers have gone back to research; at least we actually make money that way.**

## Why do the trial?

The farming systems competition was inaugurated in 2000 to compare the impact of four different management strategies on production, profitability and sustainability at MAC.

## How was it done?

The competition is between four separate teams. The teams are: Local Farmers, Local Consultants, District Practice and keeping a very low profile are the Local Researchers. Each team is allocated a 2.5 ha paddock to provide their input for management decisions.

## What happened?

In 2006, the first comment in this section was exactly that… "What happened? "This year was no exception.

In 2007 the Farmers and Consultants leapt even further away from the Researchers, but the Consultants snatched the lead from the Farmers. Now that they are in front, the Consultants are brave enough to make noises about charging the Farmers for their agronomic expertise.

In many ways 2007 was similar to 2006; a good early break, fantastic subsoil moisture, a dry winter and a terrible finish to the season. The main difference was the wheat prices (thank goodness). This enabled the farmer's 0.86 t/ha crop to make a gross margin of $209/ha, compared to the 2006 Consultant's 0.81 t/ha crop with a gross margin of only $22/ha.

The Farmers, Consultants and District Practice paddocks were all sown to Wyalkatchem wheat. The Farmers and Consultants capitalised on the early break and sowed on 30 April, which was an excellent decision in hindsight. The District Practice paddock was sown nineteen days later than the Farmers, with similar conservative input levels and final yields of 0.52 and 0.86 t/ha respectively. The additional 340 kg/ha courtesy of early sowing made for an extra $141/ha gross margin for the Farmer team.

Not much time will be spent dwelling on the result of the consultants, as they themselves cannot pin down what actually happened to achieve their excellent result except that it was "all a combination of their good management skills". Good on them, a fantastic result given the season.

Let's not leave out the researchers, who in 2007 left their paddock to regenerate certified Angel medic AGAIN with no income for the season.

With the Consultant team having a victory over the Farmers, it is important to recognise them as such. So the Farmers have lost their title of "cocky" and have awarded it to the very deserving Cocky Consultants.

## What did we learn last year?

### *Team 1*

**The Farmers**
(Not Too Cocky Cockies)

**Team Motto:** To farm profitably today while giving our kids the chance to do the same tomorrow.

Call it drought, bad farming strategy, subsoil constraints, fate or just the inevitable consequence of overconfidence, season 2007 bought the Cockies well and truly undone. The team chose to sow a crop of Wyalkatchem wheat quite early, and with the early to mid part of the season favourable at Minnipa, felt reasonably confident of the chances.

The team stuck with their modest input strategy and pragmatic approach to tillage (seeding was with a sweep and no knockdown); the one management strategy change was to increase the sowing rate from 40 kg/ha to 50kg/ha. This was done for a few reasons –

1. To make up for the lack of early season vigour that Wyalkatchem often displays
2. To provide at least some competition for the barley grass
3. Thought that after 6 cereal crops in seven seasons, N supply might be starting to moderate, even considering the extreme drought of 2006. Had this been the case, tillering would have been somewhat moderated – it was not.

The result was that the team went into July with about 25% higher tiller numbers per metre than the consultants, and into September with about 15% more heads per metre. That is when Crown rot started to appear and the team's confidence started to wane. Maybe the lower plant available water in the paddock made it harder to finish what may have been higher yield potential. *(There were quite high levels of salt and boron at 400 mm, rather than much lower levels at 500 mm further up the rise on consultant real estate – refer EPFS Summary 2003, pp. 62 & 63.)* Whatever the reason, the header found not enough grain and too many screenings.

## 2008 Plans

Where next? Another cereal crop? Why stop? Nutrition will not limit the options, weeds are at modest levels, most of the diseases seem to be at a low level and managing Crown rot seems like a lottery. Above all, grain prices are high. But then, maybe it is time to show some imagination and courage again – what about some Angel medic for certified seed or skipping the winter crop to grow sorghum next summer. Time will tell.

### *Team 2*

**The Consultants**
(De$parately $eeking $olutions)

**Team Motto:** If we get trounced, please blame Ed Hunt (or Fish!).

## What did we learn last year?

Going into 2007 the team was confident that the weed management strategy of a high rate (30 g) of Logran in 2006 would give two years weed control which meant the team was able to get away with a pre-sowing knockdown only. The Wyalkatchem on Wyalkatchem stubble was a safe option due to its moderate resistance to yellow leaf spot, however the team applied a little extra nitrogen and increased the seeding rate to 70 kg/ha.

Throughout the year the paddock looked good and then nature took hold with Crown rot showing up at significant levels.

The team wishes to bring to everyone's attention the results in Table 1, which shows that the team achieved the highest gross margin, lowest screenings, highest grain weights, highest yields and 13.5% grain protein. Some would consider that the good grain quality was in conflict to using higher seeding rates and extra nitrogen. Maybe the rotation and the system were right for a change.

## 2008 Plans

The team has had approaches from the Researchers to generate some off farm income by fee for service advice to them. This is under consideration, however knowing their track record it would need to be a cleared cheque before delivery.

To differentiate the team from the norm, we are considering sowing canola for hay production, firstly to see how it would go and secondly to get a feel for its feed quality in this environment.

### *Team 3*

**The Researchers**
(Starship Enterprise)

**Team Motto:** Boldly going where no man has gone before.

## What did we learn last year?

The researchers are not forthcoming with making decisions on their competition paddock, however in 2007, the team was pushed along by the season. After the significant rainfall event in late March, our medic started to germinate, which enabled it to have a long enough growing season to go through to set enough seed to keep our loss-making venture going for a few more years.

Having two years of medic in the system is quite often a good move for many growers on upper Eyre Peninsula, however it seems to have been the downfall of the researcher team. All is not lost however, the enterprising researchers plan to take advantage of the coming season to capitalise on the "investment" in the little paddock and come out in front in the long term.

## 2008 Plans

Grow a paddock of knee high medic, harvest a tonne/hectare medic seed crop, and go on holidays.

*Table1 Farming Systems Competition Summary 2001-2007*

| Year | Date | Farmers | Consultants | Researchers | District practice |
|---|---|---|---|---|---|
| 2001 | | Yitpi wheat<br>Yield: 2.75 t/ha<br>GM = $600/ha | Yitpi wheat<br>Yield: 2.77 t/ha<br>GM = $572/ha | Frame wheat<br>Cut for hay<br>GM = $207/ha | Yitpi wheat<br>Yield: 2.79 t/ha<br>GM = $575/ha |
| 2002 | | Krichauff wheat<br>Yield: 1.48 t/ha,<br>GM = $316/ha | Krichauff wheat<br>Yield: 1.25 t/ha<br>GM = $231/ha | Barque barley<br>Yield: 1.36 t/ha<br>GM = $195/ha | Grazed pasture<br>GM = -$4/ha |
| 2003 | | Krichauff wheat<br>Yield: 1.21 t/ha<br>GM = $163/ha | Krichauff wheat<br>Yield: 0.99 t/ha<br>GM = $118/ha | Rivette canola<br>Yield: 0.50 t/ha,<br>GM = $90/ha | Yitpi wheat<br>Yield: 0.85 t/ha,<br>GM = $117/ha |
| 2004 | | Wyalkatchem wheat<br>Yield: 1.01 t/ha<br>GM = $84/ha | Keel barley<br>Yield: 1.35 t/ha<br>GM = $67/ha | Yitpi wheat<br>Yield: 1.25 t/ha<br>GM = $132/ha | Krichauff wheat<br>Yield: 0.82 t/ha<br>GM = $41/ha |
| 2005 | | Toreador medic<br>793 grazing days<br>GM = $11/ha | Kaspa peas<br>Yield: 1.57t/ha,<br>GM = $83/ha | Wyalkatchem wheat<br>Yield: 1.98 t/ha,<br>GM = $108/ha | Regenerated pasture<br>764 grazing days<br>GM = $53/ha |
| 2006 | | Wyalkatchem wheat<br>Yield: 0.71 t/ha<br>GM = $26/ha | Wyalkatchem wheat<br>Yield: 0.81 t/ha<br>GM = $22/ha | Angel<br>GM = -$166/ha | Wyalkatchem wheat<br>Yield: 0.60 t/ha<br>GM = $1/ha |
| **Running gross margin after 2006** | | **$ 1143** ☺ | **$ 1071** ☺ | **$ 553** | **$773** |
| | 19 Apr | Roundup Max @ 0.5 L/ha | | Prickle Chained + Rolled | |
| | 30 Apr | TriflurX @ 0.8 L/ha | Sprayseed @ 1 L/ha | | |
| | 30 Apr | Wyalkatchem @ 50 kg/ha + 18:20 @ 40 kg/ha | Wyalkatchem @ 70 kg/ha + 18:20 @ 40 kg/ha + Urea @ 25 kg/ha | | |
| | 18 May | | | | Sprayseed @ 1 L/ha |
| | 18 May | | | Broadstrike @ 25 g/ha + Uptake | Wyalkatchem @ 50 kg/ha + 18:20 @ 40 kg/ha |
| | 4 June | Copper Sulphate @ 0.25 kg/ha +<br>Zinc Sulphate @ 1.25 kg/ha | | Targa @ 350 ml/ha + Ammonium Sulphate + BS1000 | |
| | 17 Oct | 80 grazing days<br>Wyalkatchem wheat<br>Yield: 0.86 t/ha,<br>Protein: 14.0%,<br>Scrn: 5.8%, TW: 77.8,<br>GM = $215/ha | 100 grazing days<br>Wyalkatchem wheat<br>Yield: 1.22 t/ha,<br>Protein: 13.5%,<br>Scrn: 1.5%, TW: 81.6,<br>GM = $345/ha | 700 grazing days<br>Angel Medic<br>GM = $0 | 120 grazing days<br>Wyalkatchem wheat<br>Yield: 0.52 t/ha,<br>Protein: 14.2%,<br>Scrn: 9.8%, TW: 76.2,<br>GM = $78/ha |
| **Running gross margin after 2007** | | **$ 1358** ☺ | **$ 1416** ☺ | **$ 553** | **$851** |

## Acknowledgements

AWB is appreciated for its continued long term support of the MAC Farming Systems Competition. The competition would not be possible without the support of the MAC broadacre team, Mark Klante, Brett McEvoy and Shane Moroney. Special thanks to Fox Frischke for his patience with the various teams earlier last season.

AWB
LIMITED

# Smarter Invertebrate Pest Management

**Ken Henry and Judy Bellati**
SARDI Entomology Unit, Waite

Extension


## Key messages

- **Chemical resistance of pests is an emerging threat to the grains industry.**
- **Different pest species have different pesticide susceptibility and require different management strategies.**
- **Accurate identification and monitoring is the key to effective control and a successful integrated management systems approach.**

## Why we need to be smarter

The important factors to be considered in why chemical resistance problems keep emerging are chemical usage, how species respond to variable climatic conditions and natural tolerance of pest species to insecticide groups.

Heavy reliance on chemicals alone for pest problems in field crops is not a long-term solution. The development of chemical resistance to various insecticide groups is already occurring in Diamondback moth, some crop aphids and corn earworm (cotton bollworm). The recent evolution of chemical resistance in Red-legged earth mite (RLEM) highlights the need for alternative control options and integrated pest management strategies. Studies conducted by the Centre for Environmental Stress and Adaptation Research (CESAR) showed that resistance in RLEM is heritable rather than environmentally induced. These findings should cause growers and researchers to re-think strategies currently used to control RLEM.

Chemical resistance has become a real concern for the grain industry and emphasises the need to shift away from prophylactic and routine use of broad-spectrum pesticides to more selective products and timing of applications to better target the pests of concern.

Chemical resistance can be generated by a few individuals in any pest population that have genetic traits that allow them to survive exposure to a particular insecticide. These individuals then pass the resistance traits on to their offspring. If the same insecticide group is sprayed on each generation of the pest, the number of resistant individuals will increase in the population. Eventually the pest population will consist mostly of resistant individuals to the insecticide, which will fail to control the pests.

Changes in weather patterns, seasonal conditions and temperature affect changes in developmental rates and population levels of different insects. Increasing our understanding of invertebrates' lifecycles, biology and ecology is of paramount importance in achieving more effective and sustainable control measures that combat control failure problems and emerging threats such as chemical resistance.

Chemical control difficulties do not always indicate chemical resistance. There may be chemical application problems such as sufficient spray coverage, which can mimic resistance problems. Some key elements that need to be considered to ensure good spray coverage include correct nozzle selection and spray pressure, choosing the best weather conditions for spray application and the right surfactant or wetting agents. Assessing spray application for its effectiveness of coverage is essential.

Some species show natural tolerance to insecticides, for example there are significant differences in tolerance levels between mite pest species. Blue oat mites are generally more tolerant to chemicals than RLEM. Balaustium mites have a high tolerance level to a large range of pesticides compared to RLEM, therefore standard RLEM rates will not be effective on Balaustium mites. Balaustium mites also have an extended season compared with other pest mites and can be found in very high numbers in many cropping environments.

Bryobia mites have a high level of tolerance to synthetic pyrethroids. Therefore, growers are encouraged to control Bryobia mites with organophosphate pesticides, such as omethoate, when spraying is necessary. Bryobia mites appear to be a sporadic pest, common in autumn and spring, but rarely found in winter.

## Thinking Smarter – the basics for getting started

Identifying and managing crop pests correctly is important for effective control and preventing future insecticide resistance. The fundamental keys to any successful management strategy are prompt and accurate pest and natural enemy identification and monitoring.

Correct identification is critical before deciding on the most effective control program. For example earth mites differ in their response to commonly used chemical sprays, therefore, to avoid costs associated with crop failure and increases in pesticide use (or incorrect pesticide applications) earth mites must be identified correctly.

Monitoring pest and beneficial populations is the key in any management decision to decide whether action should be taken. Understanding the effects of pest damage on crop quality, and quantifying whether the economic impact of the pest justifies chemical application is necessary. Standardised monitoring, sampling and reporting practises and techniques need to be developed and achieved to improve and ensure good quality data to make sound management decisions.

### *What is Integrated Pest Management (IPM)?*

IPM is a term used for a wide range of tactics to prevent pests (invertebrate, vertebrate, disease or weed) from reaching damaging levels in crops. The integration of a range of more effective and sustainable pest management tactics and strategies to deal with pests will replace the reliance on any single method of control in the future.

IPM tactics generally fall into the following categories:

- Biological – protection or release of natural enemies (predators, parasites and pathogens)
- Cultural – weed control, crop rotations, cultivation, time of planting
- Chemical – 'soft' chemicals, seed dressings
- Physical /mechanical – barriers, wind breaks
- Genetic – resistant crop varieties

IPM does not necessarily mean the abandonment of pesticides but IPM aims to reduce the frequency of pesticide applications.

Some of the benefits of using an IPM approach include early detection of potential problems from regular crop monitoring, maintaining chemical effectiveness by delaying the onset of resistance, encouraging natural enemies to help maintain pests and the development of more robust cropping systems by using a range of control options. One disadvantage of an IPM approach is that it is rather more complex than chemical control alone and requires a greater understanding of pests and beneficials and the interactions between them, as well as chemical effects. A knowledge of how different pest control measures will affect the pests and natural enemies is required.

### *Start to look for beneficial species (natural enemies)*

Naturally occurring beneficial species (natural enemies) play a vital, often unseen, natural biological control role in cropping systems. Most are highly mobile and will move from crop to crop if left unsprayed. They are able to help keep pest populations under control. The degree to which natural enemies can be used will vary from crop to crop, area and time of year.

Beneficial classifications include:

- Predators: generalist; consume a wide range of prey; free living
- Parasites: specialised and target species; feed on or in the body of its host
- Diseases: insect fungal, viral and bacterial infections

Common beneficial invertebrates likely to be encountered include predatory mites, lacewings, hoverflies, ladybird beetles, carabid beetles, damsel bugs, spiders and parasitic wasps.

Whilst there are organisations that breed beneficial insects and mites for release, the most effective strategy is likely to be the preservation of those already in the system. Broad-spectrum insecticides have some very harmful effects on most beneficial invertebrate populations. Other factors involved in supporting beneficial invertebrates in the system include alternate food sources (eg. nectar sources, non-pest hosts) and refuge habitat (eg. remnant vegetation, trap crops).

### *Start to think about 'softer' chemical options*

The strategic use of selective 'softer' insecticides (eg. active constituent pirimicarb for aphids) is extremely effective in reducing the targeted pests whilst facilitating the preservation of important natural enemies in the system by minimizing the adverse effects of broad-spectrum sprays. Unfortunately 'soft' chemical control options are not available for all pests (and can be expensive) however, spot spraying may be possible rather than widespread spraying.

Seed dressings may also be an alternative control option and will delay applications of foliar sprays giving beneficial invertebrates time to build up in numbers. Seed dressings need some thought process about potential pest pressures prior to sowing, as many different dressings are available. Seed germinating baits are a quick and effective monitoring method to assess potential soil inhabiting pests that attack seeds and seedlings.

### *Other important factors to remember:*

- Chemical rotation of insecticide groups will reduce the speed of resistance onset to chemical groups.

- Do not mix insecticide families at the same time to control a particular pest.
- The use of higher rates speeds up the development of resistance and may lead to dangerous levels of residues.
- Can you get away with a border spray or spot/targeted spraying?
- Employ other control practices (cultural, genetic etc) that will assist in effective management.

Start to take a whole systems approach, get know your pests and beneficial invertebrates and the role they play. Start to change your tactics, have a closer look at alternative control strategies, choose your chemicals wisely and don't always go for the quick fix.

Ed's Note: The "Biodiversity in Grain & Graze" project has been collecting insect samples for the past two years on nine farms across EP. Watch this space as we intend to work out some IPM opportunities and have a go at it (Biodiversity in Grain and Graze on EP, p. 197).


## Acknowledgements

Paul Umina, Centre for Environmental Stress and Adaptation Research (CESAR)

SARDI Entomology Unit


SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Government of South Australia

*EPARF Cereal Root Disease field day, Minnipa 2007.*

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

# Section 7

**Section editor:**
**Jonathan Hancock**
SARDI,
Minnipa Agricultural Centre

# Risk Management

## Farm Financial Performance on Eyre Peninsula

Survey

Extension

Best practice

**Mike Krause**
Applied Economic Solutions P/L, Adelaide

### Key message

- **Maximum fertiliser and chemical input did not lead to the best financial performance (return on capital).**

### Introduction

The Eyre Peninsula Grain and Graze and EP Farming Systems projects, among other issues, have concentrated on looking at the effect enterprise mix has on farm profitability. The aim is to see which enterprise mix provides the best farm profits. The full answer to this question is very complex for a number of reasons: commodity prices can change quite dramatically, as was experienced last season; seasons vary affecting livestock and cropping enterprises differently; and, management skills and preferences also vary widely between farms.

To help look at the effects of enterprise mix, a series of farmer workshops were conducted during the autumn and winter of 2007. As a result, twenty six farmers on Eyre Peninsula provided their business data, given their average season and price expectations. A software program called 'Plan to Profit' (P2P) was used to collect and analyse farm business data. This data provided a greater insight into the current financial health and make-up of these farms. By assessing this data, it is possible to have a greater insight into to what farm enterprise mix is providing the current financial performance of these farms on Eyre Peninsula.

### The Data Collection Processes

A series of two-day farmer workshops were held at Tumby Bay, Cleve, Minnipa and Streaky Bay with the assistance of the EP Grain and Graze and Farming Systems teams, as well as Ed Hunt, Brenton Lynch and Mike Krause. Farmers were introduced to the various financial terms and concepts, and then entered their business data in P2P. The data was subsequently checked (validated) at the second workshop and results were then compiled. The results are summarized in this paper. The database consists of twenty six farmers which is seen to be a significant sample of farmers, but as they were not randomly selected, may not be fully representative of all farmers on the Eyre Peninsula. However, the results are seen as significant.

P2P aims to produce a management profit/loss statement, a series of financial benchmarks and an estimated balance sheet.

### The results

The results have been presented as a series of questions put to the database of farmer results and then a brief discussion of the answers emerging from the results.

#### *1) Is there a relationship between enterprise mix and return on capital?*

Figure 1 indicates that most farmers had 75%, or greater, of their gross income coming from crop production. Livestock income was only significant to two of these businesses. However, there also appears to be little relationship between the return on capital (an indicator of profitability) and the percentage of the enterprise mix. That is, return on capital did not appear to go higher or lower purely on the proportion of cropping being undertaken on the farm.

#### *2) Is the cost of wheat production important to return on capital?*

Figure 2 indicates that the cost of wheat production per tonne does have an influence on return on capital. This may be a logical observation but it is interesting to see that this observation is reflected in the data collected from the farmers. So concentrating on minimising the cost of production is a good strategy to achieve improved returns.

### 3) Does the cost of fertiliser input affect the return on capital?

Figure 3 indicates that the cost of fertiliser input can have an influence on return on capital. An observation form the FM500 FAST set of benchmarks indicated that if fertiliser made up more than 12% of the cost in the farming business, then profits could be negatively affected. This trend seems to be reflected with the Eyre Peninsula farmers. Figure 3 indicates that the poorest financially performing farmers tended to have a proportion of fertiliser costs greater than 12% of the total farm costs. So, fertiliser costs were a significant factor when it came to farm financial performance.

### 4) Does the cost of chemical input affect the return on capital?

Figure 4 indicates that the cost of chemical input can have an influence on return. Again the FM500 FAST set of benchmarks indicate that if chemical costs were greater than 10% of the farm's costs, then financial performance can be negatively affected. Again, the result for the Eyre Peninsula farmers indicated that the better financial performing farmers tended to have a lower percentage of their farm costs being spent on chemicals.

### 5) Does the value of farm machinery affect the farm financial performance?

Ed Hunt and Brenton Lynch have developed a machinery ownership benchmark which states that the total market value of the farm's machinery divided by the total grain produced should not exceed $260/t. Figure 5 indicates that most of the farms surveyed were below this benchmark, but more of the poorer financial performers did have a ratio which was above this benchmark. So, the cost of machinery value is important.

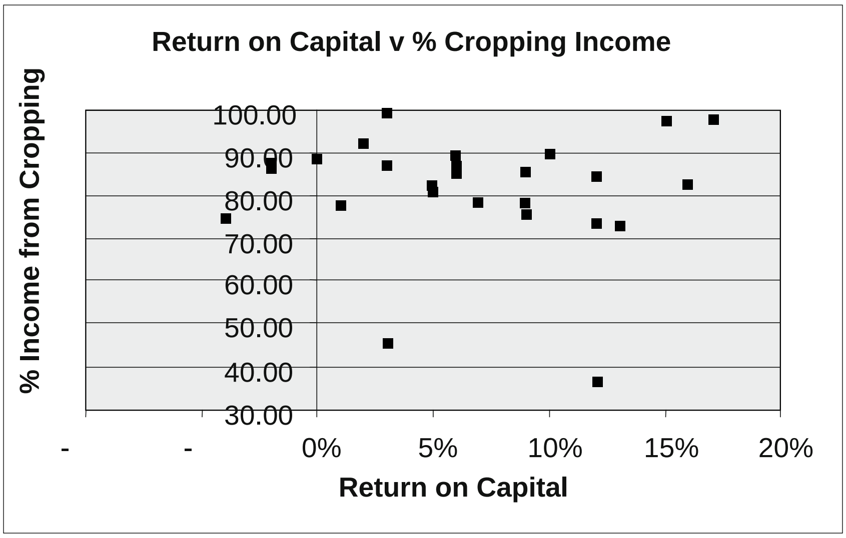



*Figure 1 Proportion of gross income from cropping.*

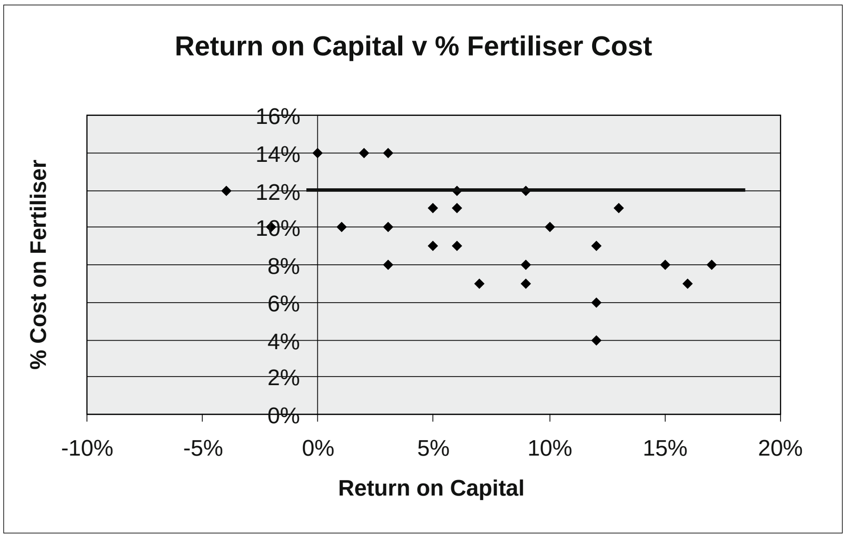



*Figure 2 Wheat cost of production.*

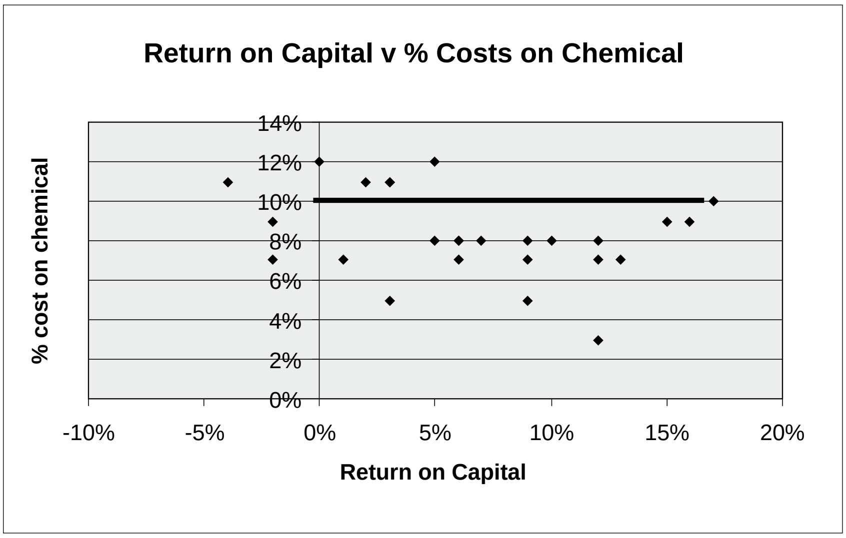



*Figure 3 Effect on fertiliser input.*

### 6) Does the farm with the higher proportion of income coming from cropping mean that they have a lower cost of production?

Figure 6 indicates that most of the farms surveyed have a high proportion of gross income coming from cropping, but it also indicated that those farms with more livestock could still have relatively good cost of production for wheat. So, those farms with higher reliance on livestock income could also be efficient wheat producers.

## The conclusions

It is difficult to observe from a group of farmers' financial data which enterprise mix provides the best farm financial performance. However, the following observations have been made:

Most farms observed had at least 75% of their gross income coming from cropping and most of these farms were viable (had a return on capital greater than 0%). Two of the farms had less than 50% of their gross income coming from cropping and these were both viable.

The cost of producing grain is important to the financial performance of a farming business and this study indicated that the cost of fertiliser, chemicals and machinery are important. This study clearly indicated that maximum fertiliser and chemical input did not lead to the best financial performance (return on capital).

The more the farm was dependant on cropping income did not mean it had the lowest cost of production per tonne of grain produced. This indicates that farmers need to focus on their input costs to generate their best financial performance, not just on the specialisation of cropping in their farming business.

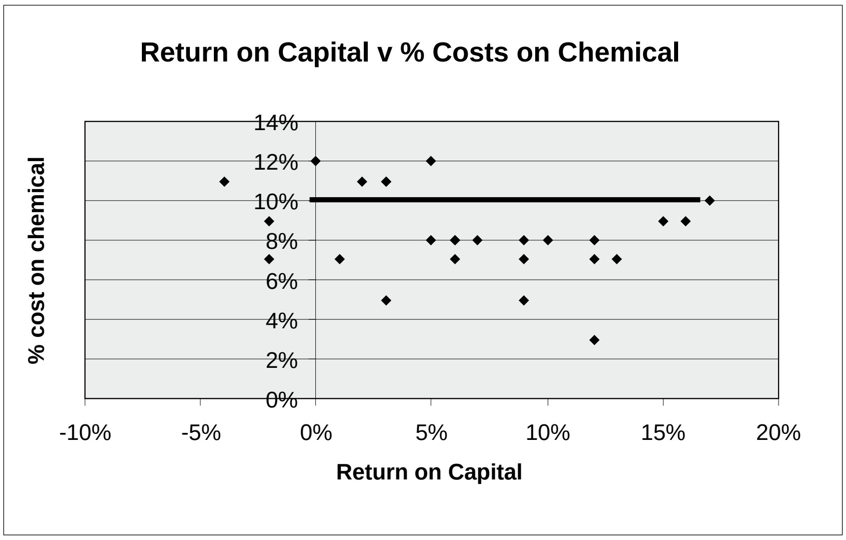



*Figure 4  Effect on chemical cost.*

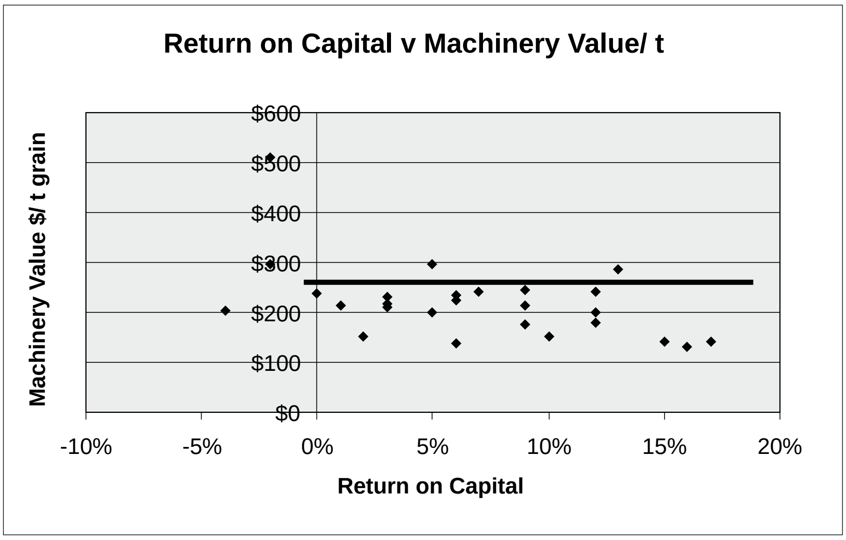



*Figure 5  Machinery value per tonne of grain produced.*

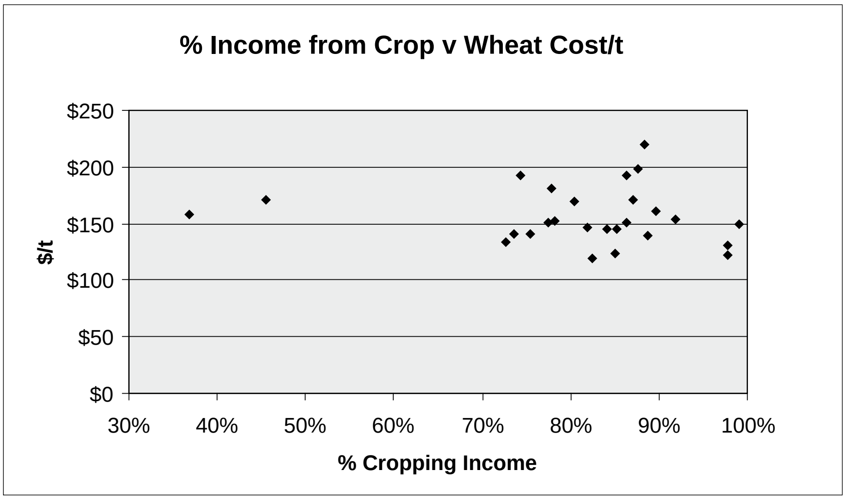



*Figure 6  Wheat cost of production.*

Grains Research & Development Corporation

# Cropping to Stock Ratios – Central and Western Eyre Peninsula

**Brenton Lynch**
Lynch Farm Monitoring, Streaky Bay

Extension

Information

## Key messages

- **In average yield/price situations, intensively cropped farms can swing 20-25% of crop area into livestock and maintain profit at similar levels with less risk.**
- **The higher risks of cropping in Western/Central Eyre Peninsula zones, along with rising fuel, fertiliser and machinery prices has led farmers to question the profitability/risk of intensive cropping over the longer term.**
- **EP Grain & Graze and EP Farming Systems Farm Profitability workshops have and will in future, allow farmers to "do the sums" on their own farm situation, to test the effect of changes to the crop/stock mix.**

## Why was it done?

Workshops were designed as a result of a bottom up approach from farmers attending annual Eyre Peninsula Farming Systems farmer workshops in 2006. This is a good example of farmer driven research/ extension.

A run of poor financial returns from cropping of the last four seasons (drought in 2004, good yields but break even financial result in 2005, drought in 2006 and again in 2007) led farmers to question the risk versus profitability of crop versus stock in Central and Western Eyre Peninsula.

Increasing crop input costs, especially fuel and fertiliser also impacted on crop profitability 2006 and 2007 (and certainly again for 2008).

A general concern among farmers at the rising costs of farm machinery associated with cropping.

## How was it done?

- Case study farms were identified in each of the Lower EP, Eastern EP and Central/Western EP. Two farms were chosen in each zone, one with continual crop and the other with a mixed cereal sheep operation.
- A Grain & Graze survey in 2005 showed that 87% (33 of 38 farmers surveyed) in Central/Western EP had a sheep enterprise as part of the business. On average across these farms, sheep provided 24% of the average total farm income.
- Analysis was conducted on two Central/Western EP farms in 2006 by Brenton Lynch and the two farm families involved, to check the effect on farm risk and profitability by varying the percentage farm area to crop and livestock, for each farm. This was done over a range of rainfall seasons, stock/wool prices and grain prices.
- This individual farm analysis was extended to farmers in the Central/Western EP area, to "road test" the variation of crop/stock area on their own farms. Applying the analysis to a farmers own situation is much more meaningful than case studies alone. In the two day workshops, farmers dealt with risk as it applies on Central/ Western EP and strategies to manage it; varying the crop/ stock ratio and measuring changes to risk, profitability, management, economic and environmental sustainability over time.
- The two day workshops have been conducted in 2007 with more planned for 2008. Feedback from those attending was very positive, with the majority of participants recommending the workshop to other farmers in the region.

## What happened?

**1. The crop/stock risk balance**

A key finding for workshop participants was that the crop area on intensively cropped farms can be reduced by 20-25% and replaced by stock in an average rainfall/yield/commodity price situation without any great change to farm profitability but with less risk.

It also stands to reason that if this is done and you experience good yields/grain prices, profit will be less (but so will risk). If the farm experiences poor yields/ grain prices, the loss will be less (and the risk less).

This gave workshop participants the confidence to manipulate/ revise/rethink the enterprise balance for their own farms, in line with business and family goals.

**2. Financial benchmarks/ indicators**

Data from farms involved in the workshops along with data generated from Brenton Lynch's and Ed Hunt's client bases indicated that:

Machinery investment/tonne grain produced:

- The market value of farm machinery divided by the average tonnage of grain produced for Central/Western EP farms is around $275/t (machinery investment per tonne). NOTE this is not recommended necessarily, it is simply the average. There may well be good reasons for individual farms to sit above or below this level.

Farm business equity (assets minus liabilities, divided by assets, multiplied by 100, equals equity percentage)

80-100% Generally sound business, able to withstand two to three years of poor trading result

65-80% Business at risk in a poor trading season

- 50 - 65% Business extremely exposed to financial downturn. Urgent action needed. (Farm business equity measured after harvest each year.)
- Equity in land (land value minus land secured borrowings such as loans and overdraft limit, divided by land value multiplied by 100, equals equity in land percentage). Most banks prefer a minimum of 60%.
- Debt servicing/tonne grain produced (on average). All loan, interest, hire purchase, lease commitments divided by tonnes grain produced on average. Generally allocate percentage debt servicing to crop in the same ratio as percentage crop income is of total gross income. (e.g. if 80% of total gross income is crop, allocate 80% of total debt servicing). A recommended figure for "safe" long term debt servicing is $40/t maximum.
- Gross margin/dry sheep equivalent (DSE). Suggested $30 to $50/ DSE is reasonable.
- Interest as a percentage of gross income. Greater than 25% is too high to service long term and less than 10% is usually a safe level.

Other indicators are also used in the workshops but those above are quite easy to calculate and useful for decision making.

With the margins becoming tighter and the decision making more critical, workshops and processes such as these covered in the "EP Farm Profitability workshops" are helping farm families and businesses to manage the tough times and be ready for the better times.

Call Naomi Scholz at Minnipa Agricultural Centre if you are interested in attending a workshop in your area.

## Acknowledgements

Mike Krause, Applied Economic Solutions for assistance with data collection and workshop presentation.

Farmer case study businesses.

EP Grain & Graze and EP Farming Systems program for funding/ facilitation of workshops.

Grain & Graze
Profit through knowledge
EYRE PENINSULA

GRDC Grains Research & Development Corporation

# Have You Looked in the Mirror Lately?

**Ken Solly**
Solly Business Services, Naracoorte

Information

## Background

Ken Solly has been contracted by Meat and Livestock Australia to deliver 'Cost of Production' workshops for both Lamb and Beef Producers. Since mid 2006 Ken has delivered this training to 1200 producers and agents across Australia. In August 2007 Ken trained 70 farmers and agents on how to calculate their cost of producing a kilogram of carcase weight lamb. In the opening session of these workshops Ken presented the ultimate challenge "What is the number one profit driver in your lamb business?" Very few knew the answer.

Stocking rate, lambing percentage, kilograms per hectare and price are constantly given as the key profit drivers in conducting a profitable lamb production business, but they are only secondary to the number one profit driver. When the answer is not forthcoming Ken holds up a mirror and says, "there it is" as he revolves the mirror around the group of producers and agents. Most still fail to see what the key profit driver is until such time as one says "I can see myself, so it must be me". "You have hit the nail on the head" Ken says and whilst he admits that stocking rate, lambing percentage and kilograms per hectare are key drivers they are only an expression of the talents of the key profit driver, the key decision maker, the enterprise manager.

Ken sees the biggest problem in farming to be the way in which producers enter the industry. Inheritance brings with it a lot of baggage, not only do we inherit the land we inherit the attitudes towards managing the business. Conservative approaches and decisions and a tendency to apportion too much of the decision outcome to poorer seasons and prices comes, but it more so comes with the inheritance package. Ken constantly witnesses neighbouring farmers outperforming their counterparts by 50% or more in the same seasons so the reasons given for the lower performance are just a cop out for poor management.

The best thing most producers could do is to analyse the characteristics or attributes of the top producers and in doing so identify the key areas of their own deficiency and then do something about them.

## What are the main characteristics of being a key profit driver?

- Enjoy the business and have it "in their guts"
- Have a good work ethic
- Understands the key drivers in the business
- They Measure, Measure, Measure
- Do not worry about what others might think
- Have great personal discipline
- Allocate resources well
- Have a support team around him/her
- Keep his/her eyes firmly on the ball – main game
- Possess good planning, monitoring and analysis skills
- Synthesise information well

Most farmers are producing a commodity that is an undifferentiated product, therefore the same or very similar to what everyone in the district is producing. Commodity producers must keep their focus on two key elements, producing more and doing it more efficiently. This later point is what makes the Cost of Production so important in producing lamb, grain, beef or whatever you like. The income of any agricultural business becomes a factor of price, yield (kgs/ha) and size. The expenses are made up of enterprise cost, overheads and labour. Deducting one from the other we establish a margin that is used to pay interest, tax and have money for capital expenditure and lifestyle. The margin on most farms needs to be a least $1 per kilogram carcase weight for lamb, this should ensure viability and some growth options for the business.

## Other main characteristics of the key profit driver?

- They recognise their own weaknesses and do something about them
- Have self respect
- Lets him/herself out of jail – get off the farm regularly to create networks and new ideas
- Remains abreast of new technology
- Uses debt as a means not an end
- Always has a best alternative and uses it to drive the main strategy
- Works on tomorrow today
- Uses forceful assertiveness wisely and sparingly
- Understands the importance of the stimulus - response - reward process (see below)
- Realises that life is a two way street – they know they must first give then receive

Most businesses are over managed and under led. Leadership is just as important in a one person farming business as it is in a corporate organisation. Good leadership brings with it higher levels of motivation, positive change and calculated risk taking. It is within the risk that the gain is to be made.

Many primary producers do not capitalise on the stimulus, response, reward cycle - one step follows the other. Farmers tend to be poor at the reward part of the cycle. You must reward yourself if the next stimulus is to arrive. It is seen time and time again, where farmers who are tight and miserable with money wonder why they continue to struggle to get ahead. Because they have not rewarded themselves appropriately they fail to receive the next stimulus to do something better. Rewards need not always be monetary, top performing dogs have had much of their training based on rewards, small and well timed, and I cannot see why farmers should not follow suit.

## More characteristics of the key profit driver?

- Handle the pressure well
- Head rules the heart
- They extract every bit of learning from a mistake –it's not a mistake the first time it's a learning opportunity
- Always conducting their own applied on farm research
- Have the courage when it comes to the tough stuff
- Develops good negotiation skills
- Time their run
- Knows something is wrong at the earliest stage
- Realise that standing still is going backwards
- Feeds off their own energy and that of others – mixes with positive people
- Realises that being average is a license to go out of business

In bringing about improvement to farming businesses the starting point is the people, the performance of the business is a direct reflection of the people driving it. Options are critical, action is paramount and you need both, so going to the bathroom and having a darn good look at ourselves in the mirror is most likely to be the best starting point, not whingeing about the weather and prices down at the pub. If at any stage whilst you were reading this article you became a little angry or defensive with the author then you on the way to making a better decision and a better lifestyle.



# Farming to Manage Risk – Securing a Better Bottom Line

**Rachel May**
Rural Solutions SA, Lenswood


## Key message

Following several seasons of little or no financial return, many farmers are now accepting that the future holds a greater level of uncertainty than previously and that they need to plan accordingly. The Advisory Board of Agriculture's "Farming to Manage Risk" project aims to provide farmers with tools to better plan and manage on farm risk while maintaining sustainable management of the natural resource base.

## Project aim

The "Farming to Manage Risk" project is an initiative of the Advisory Board of Agriculture and has been funded by the National Landcare Program. The project is a pilot working with six groups of farmers to identify the most practical tools to minimise risk and incorporate these into a farm planning framework.

In lower rainfall areas, dry seasons pose a high financial risk to intensive cropping systems. Conversely farming systems with higher levels of livestock have a lower risk exposure but may not deliver the level of profit in a good season. The project will provide opportunities for farmers to identify their level of risk under their current farming system and compare the risk of different systems.

## The project will:

- Identify, trial and assess newly developed tools and protocols to support improved risk management. The issues addressed will include; financial implications, enterprise mix and next generation property management systems.
- Incorporate risk management tools into a farm planning structure based on land capability.
- Assess landholder adoption through working with a number of grower groups on Eyre Peninsula and the Northern and Yorke Regions.

This will be achieved through a combination of group workshops and individual farm assessments. Specialists in risk management will support farmers to gain skills and knowledge of risk management tools. Once key areas of risk have been identified and assessed, technical specialists will provide support to plan and deliver strategies that reduce risk and match land capability.

## Outcomes will include:

Lower risk farming systems offering:

- greater profitability over the long term;
- greater flexibility to cope with environmental and market driven challenges;
- improved management of farm natural resources.

## How will the project be delivered?

During 2008 groups of farmers from Eyre Peninsula and Northern and Yorke regions will work through a series of modules relating to the management of farm risk. The format includes:

***1. A half day planning workshop***

- Identification and prioritisation of key business risks (economic, business and environmental).
- Identify high, medium and low production areas across the property, based on soil type.
- Develop production capability maps using aerial photographs.

***2. Risk analysis assessment – one-on-one meeting with a risk management expert to assess individual situations.***

- Each participant's property data will be assessed and comparisons will be made on the individual's level of risk under different farming systems and in relation to rainfall deciles.

***3. Production capability assessment workshop – a technical workshop enabling the landholder to assess alternative options to reduce risk based on land capability.***

- Identify the group's averages to assist in future benchmarking.
- Analyse different options for change within the district.
- Relevant technical experts will be on hand to discuss the key issues, as identified by the group.

***4. Implementing change – technical support will be provided on an individual farm basis to deliver changes determined through the risk assessment and productivity assessment process. The end result will be a realistic 'action plan' delivering a lower risk farming system. The plan will prioritise strategies in the order of likely implementation.***

## The final outcome

Through this project, farmers will develop their risk management skills and make changes to their farming systems to reduce risk and increase profit. Changes are expected to include an improved balance of livestock and cropping, better pasture and grazing management and cropping systems with less up-front inputs to reduce losses in dry seasons. The project will promote long-term sustainability and protection of natural resource assets on the farm. It is envisaged that the initial project will be a pilot for a similar program to be rolled out for the rest of the state.

## For more information

For more information on this project contact Brett Masters, Rural Solutions SA, Port Lincoln.

## Acknowledgements

Thanks to the Advisory Board of Agriculture steering committee and Ed Hunt for your feedback and support with the development of the project.

Australian Government
Department of Agriculture, Fisheries and Forestry
National Landcare Program

Government of South Australia

**Eyre Peninsula Natural Resources Management Board**

**Northern and Yorke Natural Resources Management Board**

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

# Section 8

**Section editor:**
**Alison Frischke**
SARDI, Minnipa Agricultural Centre

# Disease

## Fungicides in the Farming System

Research


**Neil Cordon**
SARDI, Minnipa Agriculture Centre


## 1. Seed and Fertiliser Fungicide Trial

### Key messages

- **Two years of trial work has yet to identify a fungicide, which will consistently control *Rhizoctonia* and provide economic production improvements.**
- **Use fungicides to control and protect crops from cereal diseases according to label recommendations.**

### Why do the trial?

Research work conducted in 2006 showed that there was no fungicide "silver bullet" to control or protect cereal crops from *Rhizoctonia* and that some fungicides can adversely effect crop emergence (EPFS Summary 2006, pp. 128-130 and 131-132).

This work did not evaluate the fungicide called Dividend. Feedback from farmers identified that the trials should be repeated in 2007 and include Dividend as a treatment. The main focus is to investigate if some fungicides will reduce the impact of root diseases, especially *Rhizoctonia* on crop growth and yield as they annually cost farmers approximately $65 million on upper and eastern Eyre Peninsula.

### How was it done?

Three sites were selected on the likelihood they would incur a root disease problem, which was verified by a pre-sowing root disease soil test.

Management strategies to enhance root diseases were practised such as no tillage, maintaining green growth up to sowing, no zinc fertilisers and using SU herbicides pre sowing. Wyalkatchem wheat was sown at 60 kg/ha with 18:20:00 @ 60 kg/ha at all sites. Sowing dates for Lock, Elliston and Poochera were15, 17 and 31 May respectively.

The control had no seed dressing and Raxil was applied to all treatments except Jockey (Fluquinconazloe) and Dividend (Difenoconazole + Metalaxyl) treatments. Fungicides were applied to the seed or the fertiliser or through a fluid delivery system. A foliar fungicide (Propiconazole) treatment was applied twice to ensure that we could identify if any yield responses came from root disease or leaf disease control. In 2006 two bio-control treatments were evaluated, however they were not included in 2007 due to a statewide specific research program evaluation of these agents.

**Best Practice**

**Location: Lock**
Michael Zacher
Lock/ Murdinga Farmers Group

**Rainfall**
Av annual: 333mm
Av GSR: 254mm
2007 total: 277mm
2007 GSR: 179mm

**Yield**
Potential: (W) 1.8 t/ha

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

**Soil Type**
Non-wetting sand over clay

**Plot size**
40 m x 1.5 m x 4 reps

---

**Location: Elliston**
Larry & Vinnie Honner
Elliston & Districts Farmers

**Rainfall**
Av annual: 370mm
Av GSR: 295mm
2007 total: 349mm
2007 GSR: 278mm

continues

Measurements: Pre-sowing and in-crop disease inoculum analysis, post emergent root disease scores, emergence and vigour counts, grain yield and quality.

## What happened?

### *Plant establishment and crop vigour*

Crop establishment and growth at Lock and Elliston was good, however at Poochera the later sowing date and earlier effects of *Rhizoctonia* damage affected early vigour across the trial. There was no difference in plant establishment or visual appearance between treatments at any of the sites.

### *Root Disease*

Pre-sowing root disease analysis (RDTS) indicated a medium to high risk of *Rhizoctonia*, with low risk of the other root diseases. At Lock there was a medium level of cereal cyst nematode (CCN).

In-crop root scoring however, identified that *Rhizoctonia* was the predominant disease at all sites effecting root and plant growth, with no difference between treatments. Low levels of Take-all, CCN and *Pratylenchus neglectus* were seen during root scoring, however there was no apparent treatment trend.

In-crop RDTS supported the visual root scores with high inoculum levels of *Rhizoctonia* identified at all sites over all treatments. Visually, the disease patches were easier to identify at the Poochera site compared to Elliston and Lock where there was less patchiness. At Elliston there was a difference between treatments in visual patch score, with Triadimefon at 800 mL/ha with the seed delivered via a fluid system better than the control.

### *Grain Quality*

Fungicide treatments had no effect on grain quality.

### *Grain Yield*

The only site to obtain a difference between treatments for grain yield was at Elliston (Table 1) where Triadimefon as a fluid delivered with the seed was better than all other treatments. An exception was the Triadimefon at 2 L/ha below the seed. It is interesting

**Paddock History**
2006: Wheat
2005: Pasture
2004: Pasture

**Soil Type**
Grey alkaline calcareous sand

**Plot Size**
40 m x 1.5 m x 4 reps

**Location: Poochera**
Ian Gosling
Poochera - Minnipa Ag Bureau

**Rainfall**
Av annual: 324mm
Av GSR: 245mm
2007 total: 283mm
2007 GSR: 143mm

**Yield**
Potential: (W) 1.6 t/ha

**Paddock history**
2006: Wheat
2005: Grass free pasture

**Soil Type**
Grey brown calcareous sandy loam

**Plot Size**
40 m x 1.5 m x 4 reps

***Table 1 Grain yield and treatment cost of Wyalkatchem wheat at Elliston, Lock and Poochera with different fungicide treatments 2007***

| Treatment | Treatment Costs ($/ha) | Grain Yield (t/ha) | | |
|---|---|---|---|---|
| | | Lock | Elliston | Poochera |
| Control | - | 1.33 | 2.04 | 0.43 |
| Raxil @ 100 mL/100 kg of seed | 1.60 | 1.35 | 2.08 | 0.47 |
| Jockey @ 300 mL/100 kg of seed | 13.10 | 1.33 | 2.08 | 0.42 |
| Jockey @ 450 mL/100 kg of seed | 19.60 | 1.34 | 2.07 | 0.40 |
| Intake @ 200 mL/ha on fertiliser | 11.10 | 1.34 | 1.99 | 0.44 |
| Intake @ 400 mL/ha on fertiliser | 20.60 | 1.35 | 2.01 | 0.46 |
| Triadimefon @ 800 mL/ha on fertiliser | 7.20 | 1.35 | 2.06 | 0.46 |
| *Triadimefon @ 800 mL/ha with seed | 7.20 | 1.42 | 2.19 | NH |
| *Triadimefon @ 2.0 L/ha below seed | 15.60 | 1.39 | 2.16 | NH |
| Dividend @ 130 mL/100 kg of seed | 2.90 | 1.27 | 2.07 | 0.42 |
| Dividend @ 260 mL/100 kg of seed | 5.90 | 1.30 | 2.08 | 0.44 |
| Two foliar sprays/Bumper @ 500 mL/ha | 38.00 | 1.39 | 2.05 | 0.39 |
| *LSD (P = 0.05)* | | *ns* | *0.10* | *ns* |

** Fungicide applied as a fluid through a fluid delivery system.*
*NH – not harvested due to sowing malfunction.*

to note that at no site did the fungicide Dividend (260 mL/100kg seed) yield better than the control treatment in the presence of high *Rhizoctonia* levels.

Two foliar spays with Bumper did not influence grain yields which indicates that leaf and stem diseases were not present at any site. Treatments yielded up to 79%, 65% and 29% of the potential at Lock, Elliston and Poochera respectively. Factors limiting yield were *Rhizoctonia* and poor moisture during grain production.

## What does this mean?

This work supports the 2006 trial program that in the absence of rust and a particular root disease (Take-all) that yield increases due to *Rhizoctonia* control using a fungicide are limited. Yield differences between control and Raxil is not expected as there was no smut present and seed dressing for smut protection is a proven long-term management strategy.

One site (Elliston) over the last two years has shown a yield increase using Triadimefon delivered as a fluid, however the recommended fertilizer application technique shows no advantage over other treatments. The Dividend label suggests that its use at 260 mL/100 kg of seed will lead to suppression of *Rhizoctonia,* however this is not supported by this data and other work shown on p. 127 in this book.

## Acknowledgements

Thanks to Ben Ward and Wade Sheppard for assisting sowing and managing the trials, and Larry Honner, Michael Zacher and Ian Gosling for provision of the trial sites.

Jockey and Raxil are registered trademarks of Bayer Crop Science, Intake in Furrow are registered trademarks of Crop Care, Bumper is a registered trademark of Nufarm and Dividend is a registered trademark of Syngenta Crop Protection.

# 2. Triadimefon Demonstration

Demo

## Key messages

- **Triadimefon had no effect on controlling root diseases in 2007.**
- **Replicated research has supported demonstrations that showed no control of *Rhizoctonia* from using fungicides.**

## Why do the demo?

Last year Michael Zacher conducted a demo to evaluate the influence fungicide Triadimefon on crop growth and grain yield (EPFS Summary 2006, p. 131). There was no yield increase using this fungicide (in the absence of stripe rust) over a traditional seed dressing. Michael decided to investigate it again during 2007 with the EP Farming Systems project monitoring the area.

## How was it done?

Demonstration strips were sown at Lock with Triadimefon coated fertilizer (800 mL/ha) and compared with the seed dressing Vitaflo (125 mL/100 kg of seed).

Fertiliser (18:20:00) was applied at 85 kg/ha with Krichauff wheat sown at 80 kg/ha on 4 June.

Measurements: Grain yield and quality, in-crop root disease analysis.

## What happened?

Visual observations throughout the year showed little difference between the treatments in vegetative growth or disease patches. Root scoring showed medium levels of *Rhizoctonia* on plants from both treatments, which was supported by the high-risk levels from the in-crop RDTS analysis (Table 2).

The Triadimefon treatment did not provide a grain yield or quality advantage over the Vitaflo treatment (Table 3).

## What does this mean?

Fungicides have a role as a risk management strategy to control and protect cereal crops against a range of leaf diseases, especially smuts and rusts. Using fungicides to protect crops from root diseases (unless stated on label) is not warranted and is a waste of money.

Seed dressings have been widely adopted in SA as protection against cereal smuts with great effect. Farmers can justify that cost as smut infection can lead to silo rejection of grain.

## Acknowledgements

Special thanks to Michael Zacher for making the effort to plan and manage this demonstration.

Vitoflo is a registered trademark of Chemtura.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

GRDC Grains Research & Development Corporation

*Table 1 In-crop RDTS levels at Lock, 2007*

| Disease | Triadimefon | Vitaflo |
|---|---|---|
| **Cereal cyst nematode (CCN)** | BDL* | BDL |
| **Take-all** | Low | Low |
| ***Rhizoctonia*** | High | High |
| **P. neglectus** | Low | Low |
| **P. thornei** | Low | Low |
| **Crown rot** | Low | Low |
| **Common root rot** | Low | Low |
| **Pythium** | Low | Low |

* *BDL: below detection level.*

*Table 2 Grain yield, quality and treatment cost of fungicides in Krichauff wheat at Lock, 2007*

| Treatment | Treatment costs ($/ha) | Protein (%) | Screenings (%) | Test weight (kg/hL) | Grain yield (t/ha) |
|---|---|---|---|---|---|
| **Vitaflo** | 3.10 | 16.3 | 2.4 | 75 | 0.60 |
| **Triadimefon** | 8.70 | 15.4 | 2.5 | 76 | 0.61 |

# Types of work in this publication

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

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

# EP Dividend Research

**Neil Cordon**
SARDI, Minnipa Agriculture Centre

Research

## Key messages

- ***Rhizoctonia solani*** **is still a major root disease affecting farming systems with strategies to minimise its impact at best inconsistent.**
- **Dividend at 260 mL/100 kg of seed is registered to suppress *Rhizoctonia*. However, the level of suppression may not be large enough to produce economic yield increases.**

## Why do the trial?

Syngenta Crop Protection Pty Ltd released their seed dressing Dividend in 2004. It is registered to control Flag Smut, Pythium and Loose Smut in wheat and seed borne Net blotch, Covered Smut and Loose Smut in barley. In 2006 product labels included the suppression of *Rhizoctonia* at a rate of 260ml/100kg of seed. The active ingredients of Dividend are Difenoconazole and Metalaxyl-M.

Previous work (EPFS Summary 2004, p. 78 and EPFS Summary 2005, pp. 81-82 & 83) suggested that yield improvements due to Dividend were inconsistent. Unreplicated demonstration plots were the basis of the data. Farmers requested that a wider replicated research program be conducted to economically quantify the degree of suppression of *Rhizoctonia* from using Dividend as indicated by grain yield.

## How was it done?

Sites were selected alongside the NVT sites at Cowell, Streaky Bay, Piednippie, Warramboo, Wharminda and Wanilla and were complemented by similar treatments that were included in other fungicide trials at Elliston, Poochera and Lock and reported in this year's EPFS Summary p. 123 Measurements: pre-sowing and post-emergent DNA root disease analysis, plant establishment, grain yields and quality. The Cowell site was not harvested due to drought conditions.

Treatments: Two rates of Dividend @ 130 mL and 260 mL/100 kg of seed, Raxil @ 100 mL/100 kg of seed and a control (no seed dressing). Seed coverage checks by Lyndon May (Syngenta) on the Dividend treatments verified that our pickling process had adequate levels of Dividend on the seed.

## What happened?

Early crop establishment was good, however warm drying weather with below average rainfall from July to maturity reduced yields. An exception was the Wanilla site where average yields were obtained.

The effect of treatments on disease levels, plant establishment, grain quality and yield are summarised below.

### *Root Disease*

Initial pre-sowing root disease tests (RDTS) (Table 2) showed the Streaky Bay site had the highest risk of root disease, especially *Rhizoctonia* and *P. neglectus*. Wanilla and Warramboo generally had the lowest overall root disease inoculum present. Throughout the year the Wanilla and Warramboo sites did not show visual disease patches.

In-crop root disease tests (RDTS) showed medium to high levels of *Rhizoctonia* (Table 3) at all sites across all the treatments except for the high rate of Dividend at

**Best Practice**

**Location: Streaky Bay**
Williams Family
Streaky Bay Ag Bureau

**Rainfall**
Av. annual: 300 mm
Av. GSR: 243 mm
2007 total: 236 mm
2007 GSR: 160 mm

**Yield**
Potential: (B) 1.70t/ha

**Paddock History**
2006: Pasture
2005: Pasture
2004: Pasture

**Soil Type**
Grey calcareous sand

**Plot Size**
10 m x 1.6 m x 3 reps

**Location: Piednippie**
Simon Patterson
Streaky Bay Ag Bureau

**Rainfall**
Av. annual: 305 mm
Av. GSR: 267 mm
2007 total: 249 mm
2007 GSR: 174 mm

**Yield**
Potential: (W) 1.5 t/ha

**Paddock History**
2006: Pasture
2005: Wheat
2004: Pasture

**Soil Type**
Grey calcareous sandy loam

**Plot Size**
10 m x 1.6 m x 3 reps

continues

Wanilla. Other root diseases were either below detection or in low risk categories with no difference between treatments.

There was no difference between treatments for plant establishment, grain yield (Table 4) or grain quality at any sites (NB plant establishment was not measured at Wharminda).

**Location: Warramboo**
David Murphy
**Rainfall**
Av. annual: 325 mm
Av. GSR: 235 mm
2007 GSR: 148 mm
**Yield**
Potential: (W) 1.6 t/ha
**Soil Type**
Brown sandy loam
**Paddock history**
2006: Medic pasture
2005: Barley
2004: Wheat
**Plot size**
10 m x 1.6 m x 3 reps

**Location: Wharminda**
Peter Forrest
Wharminda Ag Bureau
**Rainfall**
2007 total: 238 mm
2007 GSR: 147 mm
**Yield**
Potential: (B) 1.5 t/ha
**Paddock History**
2006: Wheat
2005: Grassy pasture
2004: Barley
**Soil Type**
Siliceous sand over clay
**Plot size**
10 m x 1.6 m x 3 reps

**Location: Wanilla**
David Giddings
Wanilla Ag Bureau
**Rainfall**
2007 total: 334 mm
2007 GSR: 250 mm
**Yield**
Potential: (B) 3.2 t/ha
**Paddock History**
2006: Canola
2005: Lupins
2004: Wheat
**Soil Type**
Acidic non-wetting sand over clay
**Plot Size**
10 m x 1.6 m x 3 reps

***Table 1 Crop management details of Dividend sites 2007***

| Site | Sowing Date | Sowing Rate (kg/ha) | Fertiliser Rate (kg/ha) | Variety |
|---|---|---|---|---|
| **Streaky Bay** | 18 May | 72 | 14:16:00 Mn 6% @ 70 | Flagship |
| **Piednippie** | 18 May | 67 | 18:20:00 @ 70 | Wyalkatchem |
| **Warramboo** | 6 May | 67 | 17:19:00 Zn 2.5% @ 90 | Wyalkatchem |
| **Wharminda** | 8 May | 72 | 23:16:00 @ 100 | Flagship |
| **Wanilla** | 10 May | 72 | 18:20:00 @100 | Flagship |

***Table 2 Pre-sowing root disease inoculum levels (RDTS) at Streaky Bay, Piednippie, Warramboo, Wharminda and Wanilla sites, 2007***

| Disease | Streaky Bay Risk | Piednippie Risk | Warramboo Risk | Wharminda Risk | Wanilla Risk |
|---|---|---|---|---|---|
| ***Rhizoctonia*** | High | Low | BDL | Low | Low |
| **Take-all** | BDL | BDL | BDL | Low | Low |
| **CCN** | BDL | Low | BDL | BDL | BDL |
| **P. neglectus** | High | Medium | Low | Medium | BDL |
| **Pythium** | BDL | Low | BDL | BDL | BDL |
| **Crown Rot** | Medium | BDL | BDL | BDL | BDL |
| **Common Root Rot** | Low | Low | BDL | BDL | BDL |

*BDL: below detection levels*

***Table 3 Post emergence Rhizoctonia levels (RDTS) at Streaky Bay, Piednippie, Warramboo, Wharminda and Wanilla, 2007***

| Treatment | Streaky Bay | Piednippie | Warramboo | Wharminda | Wanilla |
|---|---|---|---|---|---|
| **Control** | High | Medium | High | High | High |
| **Raxil 100 mL/ 100 kg seed** | High | Medium | High | High | Medium |
| **Dividend 130 mL/ 100 kg seed** | High | High | High | High | High |
| **Dividend 260 mL/ 100 kg seed** | High | Medium | High | High | BDL |

*Table 4 Grain yield and treatment costs at Streaky Bay, Piednippie, Warramboo, Wharminda and Wanilla, 2007*

| Treatment | *Treatment Costs ($/ha) | Streaky Bay (t/ha) | Piednippie (t/ha) | Wharminda (t/ha) | Warramboo (t/ha) | Wanilla (t/ha) |
|---|---|---|---|---|---|---|
| **Control** | - | 0.53 | 0.31 | 0.72 | 0.88 | 4.12 |
| **Raxil** | 1.60 | 0.50 | 0.35 | 0.69 | 0.90 | 4.22 |
| **Dividend 130** | 2.90 | 0.54 | 0.32 | 0.76 | 0.94 | 4.18 |
| **Dividend 260** | 5.90 | 0.47 | 0.34 | 0.68 | 0.91 | 4.03 |
| *LSD (P=0.05)* | | *ns* | *ns* | *ns* | *ns* | *ns* |

** Costs for seeding rate of 60 kg/ha*

## What does this mean?

Independent replicated research conducted this season has shown that Dividend treated seed at a label rate required to suppress *Rhizoctonia* did not produce yield increases above a nil treatment in the presence of *Rhizoctonia*.

This conclusion is similar to the research reported on p. 125 of this Summary and similar work in previous publications (EPFS Summaries 2004 & 2005).

The effectiveness and reliability of Dividend seed dressing as a suppression strategy for *Rhizoctonia* in cereals remains to be shown. Farmers should initially utilise other management strategies to reduce the influence of *Rhizoctonia* on crop yields, as Dividend does not appear to offer consistent large yield advantages in a farming system where *Rhizoctonia* is a major root disease.

## Acknowledgements

Thanks to Jo Crouch (SARDI Port Lincoln) and Leigh Davis (SARDI Minnipa) for conducting and managing these trials, and Lyndon May of Syngenta Crop Protection for doing the seed coverage analysis. Thanks also to Nigel May, Peter Forrest, David Giddings, Ken Williams and Simon Patterson for making their land available for these trials.

Dividend is a registered trademark of Syngenta Crop Protection Pty Ltd. Raxil is a registered trademark of Bayer Crop Science.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

GRDC Grains Research & Development Corporation

Disease

# EP Disease Suppression Bioassay and Survey

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

Research


## Key message

- **Due to the complexity of the disease suppression survey and the amount of data collected, more time and discussion is needed to finalise conclusions from this work.**

## Why do the research?

Soil microbes play a very important role within our farming systems. They break down stubble, change nutrients into plant available forms, compete with pathogens for resources, breakdown herbicides and pesticides and improve soil structure through aggregate or glue formation. These glues hold soil together and improve soil stability and properties such as water infiltration.

Soil microbes can also help to control soil-borne diseases. Disease suppression is the ability of the soil microbial population to compete with and inhibit plant pathogens such as *Rhizoctonia* and *Gaeumannomyces graminis* (the Take-all fungus). The disease suppressive activity of a soil depends on the microbial community structure; the numbers of microbes as well as their activities.

Trials by David Roget and V Gupta (CSIRO) at Avon showed that the level of disease suppression can be altered by management practices (Roget and Gupta, GRDC Update 2005, Southern Region). Management practices that may increase disease suppression include full stubble retention, limited grazing and higher nutrient inputs to meet crop demand (which increases plant water use efficiency). These management practices increase carbon (C) inputs into the soil, which are the food sources for the microbes, creating a shift in the activity and composition of the microbial population.

A survey commenced in 2006 to estimate the level of disease suppression in EP soils. Soil was collected from paddocks across EP, as well as the paddock history data to see if management influenced the level of suppression present. Potential suppression was estimated in a pot bioassay developed by CSIRO (CSIRO Disease Potential Test for Suppressiveness of Soils).

## How was it done?

A total of 150 soils have now been through the bioassay. The bioassays involved taking the topsoil (0-10 cm) from each paddock and placing it into containers with three treatments, (Nil, added *Rhizoctonia*, and added *Rhizoctonia* plus a C source (sugar)). These pots were then watered and kept at 10-12°C, with a 12-hour light/dark regime for six weeks in total. Five wheat seedlings were planted in each pot after the second week of incubation and watered at weekly intervals for the remaining four weeks, after which their roots were washed and scored for root disease. This bioassay estimates the potential of the microbial population in the soil to respond to added C and compete with the pathogen. This competition lowers the level of *Rhizoctonia* disease on the seedlings.

All soil samples were analysed for fertility, chemical characteristics and microbial activity.

Seventy of the sampled paddocks were sown to cereals in the 2007 season, which were visually scored for *Rhizoctonia* patches early in the growing season.

## What happened?

N12 (a continuously cropped paddock with red loam soil at Minnipa Agricultural Centre) has potential suppression and is being used as the control or benchmark soil for all bioassays. When *Rhizoctonia* inoculum is added to soils, the level of root disease on seedlings increases since there is more pathogen in the soil. However, if a carbon source (e.g. sugar) is added with the *Rhizoctonia* inoculum, the level of disease on the seedling (compared to that without added C) can decrease, depending on the type and numbers of microbes present in the soil. If this reduction in disease is large, then the soil is considered to be suppressive. Since this assay is conducted under artificial conditions we regard the suppression as being potential, or an estimate of what might happen under field conditions.

The data which has been collected during the survey includes many soil properties (nitrate, ammonia, total N, organic C%, % C as CaCO3, texture and pH), root disease DNA levels (RDTS) and nutritional analysis of plants in paddocks surveyed for *Rhizoctonia* during the cropping season. Total microbial activity measurements are also being completed for all soils.

Paddock management records were collected on the soil type, % of cereal crop in the rotation, average grain production, % of medic pasture in the rotation, chemical applications, grazing management and average P, N and TE applications.

The in-crop disease survey of seventy paddocks in cereal rotation in the 2007 season showed that plants from all paddocks (including N12) had some level of *Rhizoctonia* present on their roots. The expression of the disease as patches was only present with severe infection and a plant root score of greater than three. Barley crops exhibited greater *Rhizoctonia* symptoms than wheat, which was expected.

There are differences in responses between the red and grey soil types, but due to the complexity of the survey more time is needed to analyse the data and draw conclusions as nothing is showing tight and clear relationships, which is part of the reason why *Rhizoctonia* is still a major problem in our farming systems.

The farm management data shows that for similar rainfall, the average grain production is higher on the red soil types than the grey soils, while fertiliser management is similar.

## What does this mean?

The survey showed *Rhizoctonia* is present in most paddocks and is causing some root damage, and paddocks with visible disease symptoms have severe infection.

Initial results indicate there are paddocks on EP which are at least as suppressive to *Rhizoctonia* in the bioassay as MAC N12. Some of these paddocks were sown to cereal in 2007 and had only low levels of disease, but this was during only one cropping season and not all paddocks behaved this way. Other factors such as time of sowing, weed control and previous rotation all affect *Rhizoctonia* inoculum levels and the development of the disease in-crop, so further monitoring of these paddocks for disease is necessary.

## Acknowledgements

Thank you to SAGIT for funding this project. Thanks to Annie McNeill, Sjaan Davey, Steve Barnett, David Roget and Alan McKay for advice with this project. And big thanks to the farmers who allowed us to collect soils and gave us their paddock records.

SAGIT

GRDC Grains Research & Development Corporation

Disease

# Drivers of Soil-borne Suppression to *Rhizoctonia* Root Rot

**Sjaan Davey[1], Annie McNeill[1], Steve Barnett[2] and Amanda Cook[3]**

[1]University of Adelaide, Waite; [2]SARDI, Waite; [3]SARDI, Minnipa Agricultural Centre

Research

Searching for answers

## Key message

- **Soil-borne disease suppression is driven by abiotic (physical) and biotic (biological) soil characteristics.**

## Why do the experiment?

Soil-borne disease suppression is the ability of a soil to host a pathogen but not necessarily cause disease in crop. An example of this occurred at Avon in the lower north of SA. This soil became suppressive to soil-borne diseases after long term (ten years) retention of crop residues (Roget 1995; Wiseman et al. 1996). Many Eyre Peninsula soils have constraints which could inhibit the development of soil-borne disease suppression, but there is little information on this. The first aim of this experiment was to evaluate whether a known suppressive suite of micro-organisms (from the suppressive Avon site) could be transferred successfully into Eyre Peninsula soils. The second aim was to test whether a selection of Eyre Peninsula soils had their own suite of suppressive micro-organisms, which were able to function in the Avon soil. Results from these two experiments will suggest whether it is the soil or the micro-organisms which are important to the development of suppression.

## How was it done?

The suppressive Avon soil and three soils from the Eyre Peninsula were compared. Soils from each site were collected from the top 10 cm. The experiments were conducted in pots under controlled environment conditions. Field soils were sterilised by autoclaving and then rhizobiota (microbes which live in the zone around the roots/rhizosphere) from each of the four soils plus *Rhizoctonia solani* inoculum added separately into each soil. The disease control treatment was a pot of autoclaved (sterile) soil with *Rhizoctonia* solani added but with no added rhizobiota and represented the theoretical maximum level of disease in each soil. Table 1 lists the treatment combinations.

Four replicates of each treatment combination were placed into a growth room for fourteen days incubation to allow the pathogen and biota to colonise the soil.

Five wheat seedlings were then grown in each pot and after four weeks, roots washed for disease measurements. After scoring, all plant material was oven dried and weighed. Disease was measured as percentage infection of the seminal roots.

## What happened?

When each autoclaved soil was inoculated with its own rhizobiota the Avon soil (soil Aa) was the only soil with a large decrease in disease incidence (Figure 1). These results suggest that the Avon soil system has a disease suppressive suite of organisms that function well in its native soil matrix. However, the Eyre Peninsula soils might have either a non-suppressive suite of organisms or may have an abiotic matrix (autoclaved soil) that prevents a potentially

***Table 1** Treatment combinations used for soils A (Avon), B (Eyre Peninsula red soil), C and D (Eyre Peninsula grey soils), where a capital letter represents that soil abiotic matrix (autoclaved soil) and a small letter represents that soil's rhizobiota inoculum*

| Autoclaved soil | Rhizobiological inoculum | | Autoclaved soil | Rhizobiological inoculum |
|---|---|---|---|---|
| A | a | | C | a |
| A | b | | C | b |
| A | c | | C | c |
| A | d | | C | d |
| A | Nil (disease control) | | C | Nil (disease control) |
| B | a | | D | a |
| B | b | | D | b |
| B | c | | D | c |
| B | d | | D | d |
| B | Nil (disease control) | | D | Nil (disease control) |

disease suppressive suite of organisms from exhibiting disease suppressive functions.

To test whether the selected Eyre Peninsula soils have a disease suppressive suite of organisms, rhizobiological inoculum from each soil was transferred into autoclaved Avon soil (A) that is known to support suppression. Figure 2 shows that the transfer of Avon soil rhizobiota into the autoclaved Avon soil (Treatment Aa) was successful in decreasing disease. Only one of the Eyre Peninsula soils (D) showed a similar decrease in disease incidence to that of the treatment Aa (Avon biota in Avon soil matrix) when its rhizobiota were transferred into autoclaved Avon soil (treatment Ad). This suggests that soil D has a suppressive suite of organisms that are able to function in the Avon soil matrix but not in their native soil matrix (Figure 1, Dd) whereas, rhizobiota b and c did not decrease disease in autoclaved Avon soil. This suggests that either these soils do not have suppressive organisms, that the organisms are not in sufficient numbers to suppress disease or that despite a suppressive suite of organisms they are unable to function in the Avon soil matrix.

One reason why Eyre Peninsula soils might prevent disease suppressive organisms from either developing or functioning is that the matrices are hostile (Coventry et al. 1998). This theory was tested by transferring the suppressive rhizobiota from the Avon soil into the autoclaved Eyre Peninsula soils. Results for disease incidence shown in Figure 3 suggest that these transfers were not successful. This result implies that these Eyre Peninsula soils might have abiotic constraints which prevent the function of a suppressive suite of organisms.

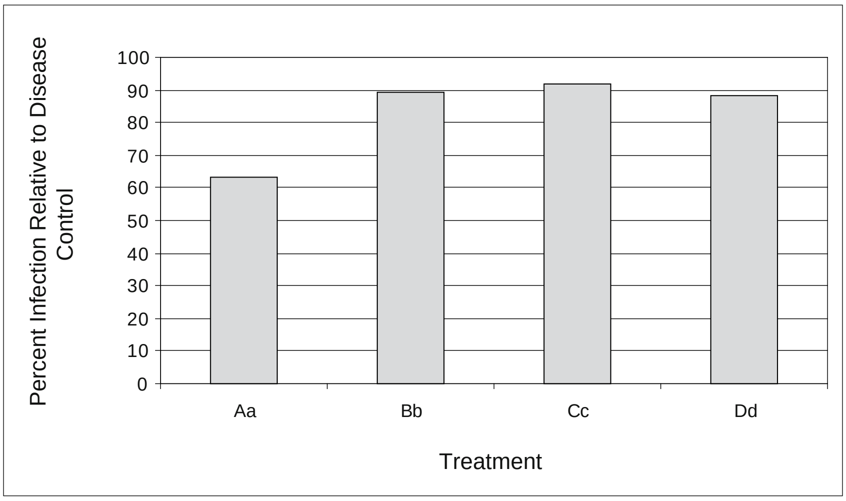



***Figure 1 Percentage infection of the soil systems (autoclaved soil inoculated with its own rhizobiota) relative to each soil's disease control. A = Avon soil, B = Eyre Peninsula red soil, C and D = Eyre Peninsula grey soils: a = Avon rhizobiota, b, c, d = rhizobiota from 3 Eyre Peninsula soils. Data is expressed relative to disease control for each soil with no rhizobiota.***

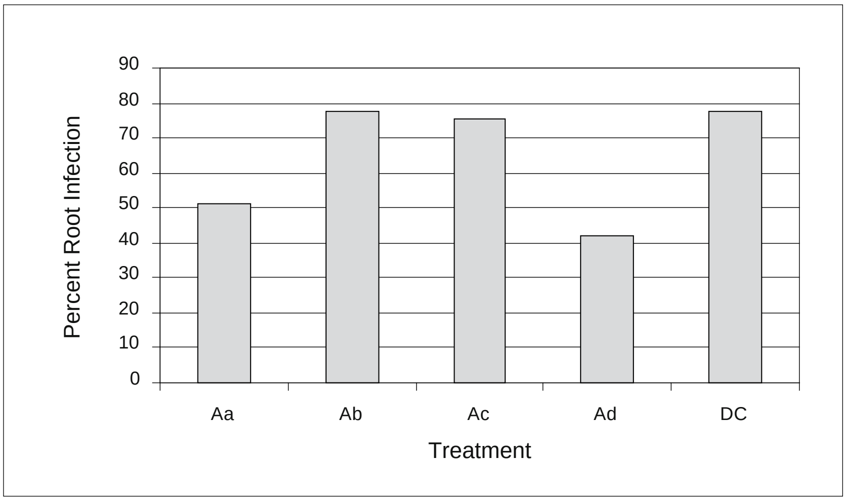



***Figure 2 Percentage root infection for autoclaved Avon soil (A) with rhizobiota from Avon soil (a) and 3 Eyre Peninsula soils (b=red soil, c and d = grey soils) and the disease control for Avon soil (DC) with the maximum level of disease.***

## What does this mean?

Avon suppressive rhizobiota were not transferable to Eyre Peninsula soils and this poses many questions. For example, what exactly is it that is hindering development of biological disease suppression within these soils? Furthermore, was the incubation period of fourteen days enough time to allow the suppressive biological communities to adapt to their new soil environments?

Suppressive rhizobiota from Eyre Peninsula soils were not transferable to the Avon soil matrix except for possibly one of the soils. Which again raises more questions, for example what do the biological community structures look like? Are those from the Avon soil similar to those found in soil D?

Overall these results so far highlight how little is known about the complex interactions between soil abiotic matrix (physical) and soil biology despite their importance. Our work now is focussed on answering these questions.

Disease

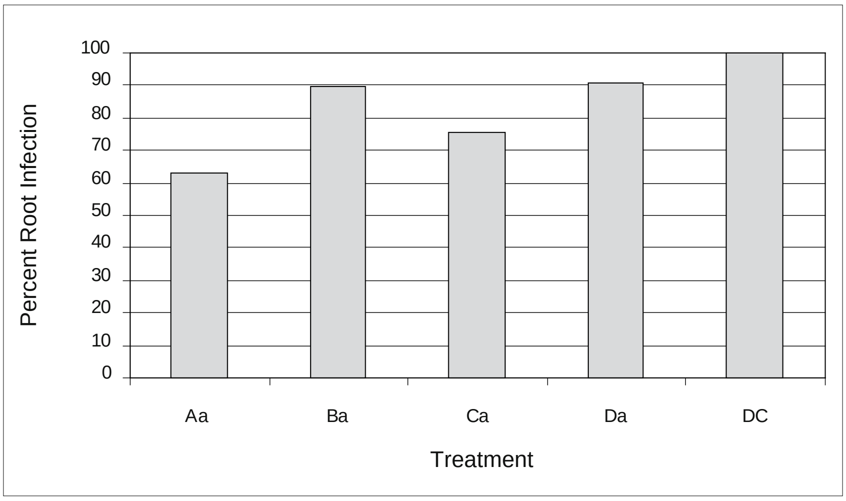



***Figure 3 Percent root infection relative to the Avon disease control of the Avon rhizobiota (a) in autoclaved Avon soil (A) and Eyre Peninsula soils (B =Eyre Peninsula red soil, C and D = Eyre Peninsula grey soils). Results for each soil are expressed relative to the disease control for each soil.***

## Acknowledgements

Thank you to EPFS, SAGIT and GRDC for funding my scholarship and research. Thank you to Mandy Cook for the use of her data, Wade Shepperd for collecting all the soil and Simon Anstis for the *Rhizoctonia*. Thank you also to Nigel Wilhelm, Ken Clarke and Rohan Dent for their support, discussions and advice and finally, thank you to Carol Sigston for all her help in the lab and growth room.

## References

Coventry, D. R., R. E. Holloway, et al. (1998). Farming fragile environments: low rainfall and difficult soils in South Australia. 9th Australian Agronomy Conference, Wagga Wagga, Australia.

Roget, D. K. (1995). "Decline in root rot (*Rhizoctonia solani* AG-8) in wheat in a tillage and rotation experiment at Avon, South Australia." Australian Journal of Experimental Agriculture 35(7): 1009-1013.

Wiseman, B. M., S. M. Neate, et al. (1996). "Suppression of *Rhizoctonia solani anastomosis* group 8 in Australia and its biological nature." Soil Biology and Biochemistry 28(6): 727-732.

Grains Research & Development Corporation

# Brassicas and *Rhizoctonia* trials

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

Research

## Key messages

- **Weed control of the green bridge reduced *Rhizoctonia*, highlighting the importance of systems with better weed control options.**
- **Part of the yield response from the chemical fallow and vetch treatments may have been due to increased stored soil water, but further research is required.**

## Why do the trial?

This ongoing work is being conducted to investigate the role of Brassica species on the incidence of *Rhizoctonia* in an environment where root disease is a major constraint. Broad scale monitoring at Miltaburra in 2004 (EPFS Summary 2004, p. 75) strongly suggested that canola or forage brassicas in the rotation markedly reduce *Rhizoctonia* inoculum levels. These results were supported by trial and paddock monitoring in 2005 and 2006 (EPFS Summary 2005, pp. 85-87, EPFS Summary 2006, pp. 123-124). These observations are being investigated with field trials over a number of years to test the impact of Brassica options, varieties and management on root disease levels, especially *Rhizoctonia*, in the following cereal crop.

## How was it done?

Brassica variety and management trials were established in 2005, 2006 and 2007. Each trial has been oversown (or will be) the following season with barley. Barley is very susceptible to *Rhizoctonia*, hence will display rhizoctonia patches readily.

### Brassica *Variety Trials*

A large selection of Brassica varieties were chosen with treatments including high and low glucosinolate mustards, canola varieties (Stubby, Rivette and Eyre), vetch, wheat and chemical fallow.

### Brassica *Management Trials*

The management options in canola (Triazine Resistant (ATR)-Stubby) included early and late removal of grasses; no grass control; and Terrachlor, Apron and Maxim XL seed dressings. Granular and fluid fertiliser treatments were also applied. All granular plots received 19:13 @ 70 kg/ha and urea @ 15 kg/ha in 2005. The fluid fertiliser treatments were applied at the same nutrient rates as the granular with 9.1 kg P/ha as APP, 20.2 kg N/ha as UAN (and APP) and 6.3 kg S/ha as ATS. A trace element treatment had granular 19:13 @ 70 kg/ha and urea @ 15 kg/ha with 1 kg Zn/ha, 1.5 kg Mn/ha and 0.5 kg Cu/ha as fluid sulphates. An additional fluid fertiliser treatment, at the same cost as the granular treatment, used equivalent rates of cheaper products - phosphoric acid (81%) and granular sulphate forms of the trace elements.

The brassica variety and management trials from 2006 at Miltaburra were sown on 9 May with Barque barley @ 50 kg/ha with 50 kg/ha of 18:20:00. The site received a knock down spray pre-seeding and a broad leaf spray using Tigrex @ 750 mL/ha and Lontrel @ 75 mL/ha. Unfortunately this site had high Ward's weed numbers due to a late germination on the variety trial (neither trifluralin nor simazine could be used due to susceptible lines in the trial). The same treatments were

**Searching for answers**

**Location**
Closest town: Miltaburra
Cooperator: L, M, C & D Mudge

**Rainfall**
Av. annual: 306 mm
Av. GSR: 212 mm
2007 total: 199 mm
2007 GSR: 130 mm

**Yield**
Potential: (B) 1.5 t/ha
Actual: 0.2 t/ha

**Paddock History**
2007: Barque barley
2006: Canola trial

**Soil**
Grey highly calcareous sandy loam

**Plot size**
12 m x 4 reps

**Location**
Closest town: Poochera
Cooperator: I & J Gosling

**Rainfall**
Av. annual: 324 mm
Av. GSR: 245 mm
2007 total: 283 mm
2007 GSR: 143 mm

**Yield**
Potential: (C) 0. 8 t/ha
Actual: 0.3 t/ha

**Paddock History**
2007: Canola trial/oats
2006: Yitpi wheat
2005: Pasture

**Soil**
Grey calcareous loam

**Plot size**
12 m x 4 reps

also re-established at Miltaburra in 2007 to be oversown in 2008.

An identical trial was also established at Poochera in 2007 to determine if the effect was similar on another grey soil.

Root disease inoculum levels were estimated by DNA-based bioassay over the 06/07 summer. *Rhizoctonia* infection was scored mid season, dry matter measured twice during the season and final yield data was collected at maturity.

Soil water data was collected in February and November 2007. Soil was collected at increments of 0–10 cm, 10–20 cm, 20–40 cm, 40–60 cm and deeper if possible. On both trials 60 cm was the mean depth measured down to, with calcrete present below this layer.

## What happened?

### *Variety and Management Trials, Miltaburra 2006*

Barley emergence in 2007 was the same regardless of treatments and the crop struggled all year due to low rainfall and dry conditions (Table 1). The canola treatments in 2006 had very poor growth and the trial was not harvested at maturity. The root disease inoculum test (RDTS) at the start of the 2007 season showed that there was little root disease inoculum present except for *Rhizoctonia* which differed markedly between the variety and management trials (Table 1). The *Rhizoctonia* inoculum level was much higher in the variety trial except for the vetch and oats treatments.

The difference between the two trials was weed control, mainly Ward's weed, which was apparently acting as a host for *Rhizoctonia*. The management trial had much lower levels of Ward's weed due to better control using simazine, and generally lower *Rhizoctonia* inoculum levels, however the rhizoctonia root scores were still high for some treatments in the management trial despite the low disease inoculum level. Late shoot dry matter was higher for the fluid treatment with trace elements indicating a response to possible nutrient deficiencies, but this did not convert to a yield benefit. The highest yield was again obtained in the chemical fallow treatments of both trials.

### *Variety and Management Trials, Miltaburra and Poochera 2007*

The canola trials established in 2007 resulted in the control plots (granular fertiliser with ATR-Stubby) yielding 0.17 t/ha at Miltaburra and 0.34 t/ha at Poochera. The Juncea canola yielded higher than the canola varieties in the trial, although newer canola varieties may now perform better, but to compare trial results over several seasons the same varieties need to be sown.

In February at Miltaburra, there were no differences in soil water measured after the different crops in the variety trial. However, by the end of the growing season (November), the 2006 chemical fallow and vetch treatments had higher soil water which suggests some of the barley yield responses seen under these treatments may have also been due to extra soil water. There were no soil water differences between the Year 1 treatments at Poochera. Further soil sampling is required in 2008.

## What does this mean?

The results obtained this season highlight the importance of controlling weed species, which can also act as a green bridge to increase the level of *Rhizoctonia* inoculum present, and the importance of systems with better weed control options. The results from the management trial, which had better control of Ward's weed due to the use of simazine within the canola cropping rotation, support previous results that suggest that canola in the rotation can reduce *Rhizoctonia* inoculum levels compared to a cereal crop.

Soil water measurements indicate that at least part of the barley yield response to the chemical fallow and vetch treatments may be due to increased stored soil water.

*Table 1 Results from the 2006 Miltaburra variety and management trials oversown with barley in 2007*

| 2006 Treatment | RDTS rating for *Rhizoctonia* | *Rhizoctonia* Root Score (0=none, 5=severe) | Early Shoot DM (mg/plant) | Early Root DM (mg/plant) | Late Shoot DM (mg/plant) | Late Root DM (mg/plant) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|
| **Variety** | | | | | | | |
| **Cereal** | Medium (65) | 2.7 | 25 | 23 | 110 | 79 | 0.24 |
| **Chemical Fallow** | Medium (65) | 1.6 | 30 | 23 | 150 | 93 | 0.31 |
| **ATR – Eyre** | Medium (68) | 1.9 | 30 | 25 | 90 | 79 | 0.23 |
| **ATR – Stubby** | High (98) | 1.6 | 31 | 26 | 120 | 81 | 0.24 |
| **Rivette** | High (94) | 2.2 | 26 | 23 | 110 | 78 | 0.25 |
| **Juncea Canola** | Medium (54) | 1.9 | 29 | 26 | 110 | 70 | 0.24 |
| **Low glucosinol** | Medium (42) | 1.3 | 27 | 24 | 90 | 75 | 0.19 |
| **High glucosinol - ATR variety** | High (96) | 2.3 | 32 | 24 | 130 | 83 | 0.28 |
| **Biofumigant mustard** | Medium (47) | 1.9 | 28 | 25 | 110 | 73 | 0.20 |
| **Saia Oats** | Low (34) | 2.4 | 28 | 25 | 100 | 83 | 0.26 |
| **Vetch** | Low (37) | 1.4 | 25 | 25 | 100 | 67 | 0.24 |
| *LSD (P=0.05)* | *73* | *0.8* | *NS* | *NS* | *NS* | *NS* | *0.06* |
| **Management** | | | | | | | |
| **Granular Fertiliser – Control** | BDL (<19.5) | 1.6 | 33 | 28 | 100 | 110 | 0.21 |
| **Chemical Fallow** | BDL (<19.5) | 1.1 | 31 | 27 | 150 | 80 | 0.30 |
| **Cereal** | Medium (68) | 2.9 | 28 | 25 | 90 | 90 | 0.19 |
| **Early grass control** | BDL (<19.5) | 2.1 | 33 | 25 | 120 | 100 | 0.25 |
| **Late Grass control** | BDL (<19.5) | 2.6 | 32 | 25 | 130 | 90 | 0.20 |
| **No Grass control** | Low (23) | 1.7 | 32 | 26 | 120 | 100 | 0.21 |
| **Maxim XL** | BDL (<19.5) | 2.2 | 32 | 25 | 160 | 100 | 0.25 |
| **Terrachlor** | Low (21) | 1.7 | 31 | 25 | 130 | 90 | 0.21 |
| **Apron** | BDL (<19.5) | 2.1 | 31 | 25 | 140 | 130 | 0.18 |
| **Fluids same cost gran** | BDL (<19.5) | 1.9 | 30 | 23 | 120 | 110 | 0.25 |
| **Fluid same rate gran** | BDL (<19.5) | 2.0 | 35 | 27 | 130 | 120 | 0.24 |
| **Fluid same rate gran + TE** | BDL (<19.5) | 2.6 | 30 | 24 | 180 | 150 | 0.24 |
| *LSD (P=0.05)* | *27* | *0.7* | *NS* | *NS* | *0.08* | *NS* | *0.06* |

*BDL = below detection level*

Disease

*Table 2 Total soil water (mm) in profile (0–60 cm) with different crops*

| Variety Trial Year 1 Treatment | Soil water Miltaburra Feb 07 (mm) | Soil water Miltaburra Nov 07 (mm) | Soil water Poochera Nov 07 (mm) |
|---|---|---|---|
| Cereal | 63 | 82 | 60 |
| Chemical Fallow | 66 | 98 | 78 |
| ATR – Stubby | 68 | 86 | 55 |
| Medic | - | 87 | 71 |
| Vetch | 63* | 95 | 72 |
| *LSD (P=0.05)* | *ns* | *7.2* | *ns* |

**Extra 27 mm in one plot at depth from 60-100 cm, November samples taken at Miltaburra after 14.5 mm rainfall event.*


## Acknowledgements

Apron seed dressing – registered product of Syngenta

Maxim XL seed dressing – registered product of Syngenta

Terrachlor seed dressing – registered product of Crompton

Thank you to SAGIT and GRDC for funding this project. Thanks to the Mudge family for allowing us to have trials on their property.

SAGIT

GRDC Grains Research & Development Corporation


*ABB representatives at the Minnipa Agricultural Field Day 2007.*

# Disease Suppression Trial at Streaky Bay

**Amanda Cook and Wade Shepperd**
SARDI, Minnipa Agricultural Centre

Research

## Key messages

- **Brassicas within the rotation reduced *Rhizoctonia* inoculum levels again in 2007, but not as much as previous years.**
- **Higher input systems had better early plant growth but no yield benefits in 2007.**

## Why do the trial?

A long term trial was established at Streaky Bay in 2004 to determine if disease suppression is achievable and if soil microbial populations can be influenced by rotation and nutrient inputs in a grey highly calcareous soil.

## How was it done?

The trial was established in 2004 and was sown into a grassy pasture with 8 kg/ha zinc sulphate applied and worked in before seeding. In 2005 the trial was sown on 24 June with a knock-down of Roundup @ 1 L/ha, Treflan @ 1 L/ha and Hammer @ 100 mL/ha pre-seeding, and Ally @ 5 g/ha later in the season to control Lincoln weed. In 2006 the trial was sown on 30 May with Sprayseed @ l L/ha and Treflan @ 1 L/ha pre-seeding. Rotation treatments are described in Table 1. In 2007 Clearfield Stiletto was grown to help control grass weeds which were becoming an issue in the plots. The trial was sown on 29 May and received a knock down of Roundup @ 1 L/ha and Striker @ 75 mL/ha, with a post-emergent spray of Midas @ 900 mL/ha.

Root disease inoculum was measured using DNA-based bioassays at the start of the season, root disease infection on roots was visually scored at late tillering, and dry matter and grain yield data was collected at maturity.

## What happened?

*Rhizoctonia* inoculum at the start of the 2007 cropping season was lower after the medic crop in the district practice treatment. The medic plots were sown in 2006 and had poor establishment and plant growth during the season, and may have provided little root material to host the disease (i.e. acted like a fallow). *Pratylenchus neglectus* numbers increased slightly under the medic plots, which supports previous research.

Brassica treatments did not reduce *Rhizoctonia* inoculum in 2007 possibly due to lower microbial activity last season and hence less competition for the *Rhizoctonia*. Alternatively a green bridge leading in to the 2007 season may have boosted *Rhizoctonia* inoculum levels.

Both high input systems had better plant growth in 2007 but this was not converted to an increase in grain yield. High fertiliser inputs used in this trial are aimed to maximise the nutrition of the whole system rather than be economic, which is reflected by the low gross margins.

## What does this mean?

Brassicas within the rotation did not reduce the *Rhizoctonia* inoculum level as much as previous trial results, possibly due to less microbial activity which would decrease the competition against *Rhizoctonia* resulting in higher inoculum levels, or weeds acting as a green bridge. The higher input systems had better plant growth but this did not increase yield this season. Disease suppression was measured in 2006 using the 'potential disease suppression' bioassay and the beneficial microbes *Pantoaea agglomerans*, *Exiguobacterium acetylicum* and Microbacteria (PEM'S) were also measured. At this time there were no differences between treatments. This trial will be ongoing to monitor changes in disease levels and the possible development of disease suppression.

### Searching for answers

**Location**
Streaky Bay - K, D and K Williams
Streaky Bay Ag Bureau

**Rainfall**
Av. annual: 298 mm
Av. GSR: 243 mm
2007 total: 202 mm
2007 GSR: 113 mm

**Yield**
Potential: 1.3 t/ha
Actual: up to 0.77 t/ha

**Soil**
Highly calcareous grey loamy sand

**Plot size**
60 m x 1.48 m

**Other factors**
Moisture stress, grass competition

*Table 1 Rotations and treatments used in the Long Term Disease Suppression trial*

| Rotation | Fertiliser | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|
| **District Practice** | 14 kg P/ha and 16 kg N/ha applied as DAP @ 60 kg/ha | Excalibur Wheat @ 55 kg/ha | Keel Barley @ 60 kg/ha | Angel Medic @ 5 kg/ha | Clearfield Stiletto @ 60 kg/ha |
| **Intensive Cereal – District Practice Inputs** | 16 kg P/ha applied as MAP @ 60 kg/ha | Excalibur Wheat @ 55 kg/ha | Keel Barley @ 60 kg/ha | Ticket Triticale @ 60 kg/ha | Clearfield Stiletto @ 60 kg/ha |
| **Intensive Cereal -– High Inputs** | 20 kg P/ha applied as APP, 18 kg N/ha as UAN and TE (Zn, Mn, Cu) | Excalibur Wheat @ 55 kg/ha | Keel Barley @ 60 kg/ha | Ticket Triticale @ 60 kg/ha | Clearfield Stiletto @ 60 kg/ha |
| **Brassica Break – District Practice Inputs** | 16 kg P/ha applied as MAP @ 60 kg/ha | Rivette Canola @ 5 kg/ha | Keel Barley @ 60 kg/ha | Stubby Canola @ 5 kg/ha | Clearfield Stiletto @ 60 kg/ha |
| **Brassica Break – High Inputs** | 20 kg P/ha applied as APP, 18 kg N/ha as UAN and TE (Zn, Mn, Cu) | Rivette Canola @ 5 kg/ha | Keel Barley @ 60 kg/ha | Stubby Canola @ 5 kg/ha | Clearfield Stiletto @ 60 kg/ha |

*Table 2 RDTS rating of rotations at the start of the 2007 season*

| Rotation | *Rhizoctonia* | Take-all | Common root rot | *Pratylenchus neglectus* | *Pratylenchus thornei* | Fusarium pseud. | CCN |
|---|---|---|---|---|---|---|---|
| **District Practice** | Low (30) | Low (20) | Low (27) | Medium (22) | Low (1) | Low (2) | BDL |
| **Intensive Cereal - District Practice Inputs** | High (84) | Low (21) | Low (30) | Low (7) | Low (3) | Low (4) | BDL |
| **Intensive Cereal - High Inputs** | Medium (72) | Low (22) | Low (10) | Low (6) | Low (3) | Low (4) | BDL |
| **Brassica Break - District Practice Inputs** | Medium (45) | Low (20) | Medium (268) | Low (19) | Low (1) | Low (4) | BDL |
| **Brassica Break - High Inputs** | Medium (44) | Low (21) | Low (18) | Low (8) | Low (3) | Low (3) | BDL |
| *LSD (P=0.05)* | *ns** | *ns* | *ns* | *11* | *ns* | *ns* | *ns* |

**ns = non-significant (BDL = Below Detection Level)*

***Table 3 Rhizoctonia infection and wheat growth in 2007***

| Rotation | *Rhizoctonia* Root Score (0 = none, 5 = severe) | Early Root Dry Matter (mg/plant) | Early Shoot Dry Matter (mg/plant) | Dry Matter at maturity (t/ha) |
|---|---|---|---|---|
| **District Practice** | 2.39 | 41 | 69 | 1.30 |
| **Intensive Cereal - District Practice Inputs** | 2.23 | 47 | 82 | 1.19 |
| **Intensive Cereal - High Inputs** | 2.09 | 70 | 150 | 1.71 |
| **Brassica Break - District Practice Inputs** | 2.39 | 47 | 78 | 1.66 |
| **Brassica Break - High Inputs** | 1.71 | 74 | 150 | 1.93 |
| *LSD (P=0.05)* | *ns* | *12* | *28* | *0.45* |

*(BDL = Below Detection Level)*

***Table 4 Yield, Input Costs and Gross Margins of rotations in 2007***

| Rotation | 2005 Yield (t/ha) | 2006 Yield (t/ha) | 2007 Yield (t/ha) | 2007 Input Costs ($/ha) | 2007 GM ($/ha) | Overall GM ($/ha) |
|---|---|---|---|---|---|---|
| **District Practice** | 0.88 Keel Barley | Not harvested Angel medic | 0.65 Clearfield Stiletto | 92 | 245 | 294 |
| **Intensive Cereal District Practice Inputs** | 0.81 Keel Barley | 0.23 Ticket Triticale | 0.77 Clearfield Stiletto | 92 | 291 | 434 |
| **Intensive Cereal High Inputs** | 1.16 Keel Barley | 0.42 Ticket Triticale | 0.73 Clearfield Stiletto | 265 | 276 | 46 |
| **Brassica Break District Practice Inputs** | 2.08 Keel Barley | 0.03 ART- Stubby Canola | 0.77 Clearfield Stiletto | 92 | 291 | 396 |
| **Brassica Break High Inputs** | 2.43 Keel Barley | 0.05 ART- Stubby Canola | 0.64 Clearfield Stiletto | 265 | 242 | -79 |
| *LSD (P=0.05)* | *0.16* | *0.03* | *ns* | | | |

*GM calculated using prices - Wheat $140/t and Canola $302/t for 2004, Barley $126/t for Feed 1 in 2005, Triticale $220/t and Canola $480/t for 2006, AH $377/t for 2007.*

Disease

## Acknowledgements

Thank you to SAGIT and GRDC for funding this project. Thanks to the Williams family for allowing us to have trials on their property.

SAGIT

GRDC Grains Research & Development Corporation

| Barley | Scald | Spot form net blotch | Net form net blotch | Leaf rust | Powdery mildew | CCN | | Root lesion nematodes | | Barley grass stripe rust | Covered Smut | BYDV | Common root rot | Black point |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Resistance | Tolerance | *P. neglectus* | *P. thornei* | | | | | |
| **Barque** | S-VS | MR | MS-S | MS | MR | R | T | R-MR | MR | MR | – | S | S | **S** |
| **Baudin** | MS-S | MS-S | MR-MS | VS | S-VS | S | T | – | – | MR | – | MR | MS-S | **MS** |
| **Buloke** | MR | MS-S | MR | MS-S | MR | S | T | – | – | R | MR | S | – | **S** |
| **Capstan** | MR# | MS | MR-MS | MS | MR | R | T | MR | – | MS | MR | S | S-VS | **MS** |
| **Flagship** | MS | MR-MS | MR-MS | MS-S | MR | R | T | R | – | MS | MR-MS | S | S | **S** |
| **Fleet** | MR-MS | MR-MS | MR | MS | MS | R | T | – | – | MR | MR | S | – | **S** |
| **Gairdner** | R# | S-VS | MR-MS | MS | MR | S | T | MR | MR-MS | R | – | MR | MS-S | **MR** |
| **Hindmarsh** | MS | S | MR | MS-S | MS | R | T | – | – | R | – | S | – | **–** |
| **Keel** | MR-MS | MR | MR-MS | VS | MR-MS | R | T | MR | MR | MS | R | S | S | **S-VS** |
| **Maritime** | MS-S | MR-MS | R | MS | S | R | T | MR | – | S | MS | S | S | **S** |
| **Schooner** | MS-S | MS-S | MR | S-VS | S | S | T | MR-MS | R | R | MR | S | S | **S** |
| **Sloop** | S | S-VS | MR | S | S | S | T | MS | MR | MR | R | S | S | **MS** |
| **Sloop SA** | S | S-VS | MR | S | S | R | T | MS | R | MR | – | S | S | **MS** |
| **Sloop Vic** | S | S | MR | MS-S | MR | R | T | MS | R | MR | – | S | – | **MS** |
| **Vlamingh** | MR | MS-S | MR | MS-S | S | S | T | – | – | – | R | – | S | **–** |
| **Yarra** | S/VS | MS | MS | R | S | R | T | – | – | R | MS | S | S-VS | **S-VS** |
| **WI3416/1572** | S | S | MS | S | MR | R | T | – | – | – | R | S | S | **S** |
| **Quickstar** | MR | S | - | R | R | R | T | – | – | – | – | – | – | **–** |
| **Starmalt** | MS | S | - | S | R | S | T | – | – | – | – | – | – | **–** |

*#These varieties may be susceptible if alternative strain is present.*
*R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible, VS = very susceptible ,T = tolerant,  – = uncertain*

| Wheat | Rust | | | CCN | | Septoria tritici blotch | Yellow leaf spot | Powdery mildew | Root lesion nematodes | | | Crown rot | Common root rot | Flag smut | Black point | Quality in SA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P. neglectus | | P. thornei | | | | | |
| | Stem | Stripe# | Leaf | Resistance | Tolerance | | | | Resistance | Tolerance | Resistance | | | | | |
| Annuello | R | MS | MR | R | I | S | S | – | MS-S | MI | – | S | – | – | MS | AH |
| Axe | MS | MR | MR | S | – | MS-S | S | MR | S | – | S | S | MS | MS | MS-S | AH |
| Barham | MR | #MS-S | MR-MS | MS | – | MS-S | MS-S | MR-MS | MR | – | MS | S | MS-S | MR-MS | MS | - |
| Bolac | MS | R | MS-S | S | – | MS | MS-S | – | – | – | – | S | – | R-MR | MR-MS | APW |
| Bowie | S | S | MR | MR-MS | MT | MS | S | – | MR | MT | MS | S | S | – | MR-MS | Soft |
| Camm | S | #S | S | S | MI | S | S | – | MS | – | – | S | MS-S | MR | MS | APW |
| Carinya | MR | #MS | MR-MS | S | – | MS | S-VS | MS | S | – | MS-S | S | MS-S | MS | S | AH |
| Catalina | MR-MS | MR-MS | R-MR | R | – | MS-S | MS-S | MR-MS | S | – | MS | S | MR-MS | R-MR | – | AH |
| Chara | MR-MS | MS | MS | R | MI | MS | MS-S | – | MS-S | MT | MR | S | S | – | MS | AH |
| Corell | MR-MS | MR-MS | MS | MR | – | MS | S-VS | R | S | – | MS | S | MS-S | R | MR-MS | AH |
| Derrimut | R-MR | #MS^ | R | R | – | MS-S | MS-S | MS | S | – | MS-S | S | S | R | S | AH |
| Frame | MS | MR-MS | MS | MR | MT | MS | S-VS | R | MS-S | MT-T | S | S | S | MR | MS | APW |
| Gladius | MR | #MR-MS | MS | MS | – | S-VS | MS | MR-MS | MS-S | – | MS-S | S | MS-S | R-MR | MR | AH |
| Guardian | MR | MS | MS | R | – | MS | S | MR-MS | S | – | MS | S | MS | S | MS | APW |
| H46 | MR-MS | VS | R | S | MI | VS | MR-MS | S-VS | MS | – | MS-S | S | MS-S | R-MR | MR-MS | APW |
| CLF Janz | MR | MS | MS | S | I | MS | S | MS | MS-S | MI | S | S | MS-S | R | S | AH |
| Krichauff | MR | S | S | S | MT | MS | MS | – | MR | MT | MS | S | MS | MR-MS | MR | ASW |
| Kukri | MR | MR-MS^ | R* | S | I | MR | MS | – | MR-MS | MT | MS | MS | S | MS | MS | AH |
| Magenta | R | MS-S | MR | MS-S | – | MR-MS | MR | R | – | – | – | – | – | S-VS | – | – |
| Peake | MR/MS^ | MR-MS^ | R^ | R | – | S | MS-S | MS | S | – | MS | S | S | MR-MS | MS-S | AH |
| Pugsley | MS | #S | MR | MS | MI | MS | S | MS | S | MT | – | S | MS | MR | MS | APW |
| Ruby | MR-MS | R-MR | R | S | – | MR-MS | MR | MS | – | – | – | S | | | – | ASW |
| Scythe | MR | MS-S | MS-S | S | – | MS | S | R | – | MS | MS-S | S | MS | S-VS | MR | APW |
| Sentinel | R | R-MR | R | S | – | MS-S | MR-MS | R | S | – | MS | MS | – | – | – | ASW |
| Westonia | S | VS | MS | S | – | S | MS | S | MS-S | MT | – | S | – | – | MS | APW |
| Wyalkatchem | MS | S§ | R | S | MI | MR-MS | MR | S | MR | MT-T | – | S | S | S | MS | APW |
| Yenda | R | #MS-S^ | MR | MS | – | MS-S | MR | MS | MR | – | S | S | MS-S | MR | MR | – |
| Yitpi | S | MR-MS | MS | MR | MT | MS | S-VS | – | MR-MS | MT-T | – | S | MS | MR | MS | AH |
| Young | MR | #MS^ | MR-MS | R | – | MS | MR-MS | R | S | – | MS | S | MS-S | MS | MR | AH |
| RAC1263 | R-MR | # – | R-MR | MS | – | S | MR-MS | – | MS | – | – | S | – | MS | MS-S | – |

*# - The stripe rust ratings are for the new WA Yr17 strain prevalent in SA in 2007. Varieties with a # have the Yr17 (VPM) seedling resistance and so will be resistant to the older WA strain.*
*^ - Some susceptible plants in mix*
*§ - Wyalkatchem shows markedly stronger resistance later in the season*

Disease

# Wheat cont.

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Durum** | | | | | | | | | | | | | | | | |
| Kalka | ***R*** | ***MR*** | ***MR*** | ***MS*** | ***MT*** | ***MS*** | ***MR*** | ***–*** | ***MR-MS*** | ***–*** | ***R*** | ***VS*** | ***MS*** | ***R*** | ***–*** | ***Durum*** |
| Tamaroi | ***R*** | ***MR*** | ***MR*** | ***MS*** | ***–*** | ***S*** | ***MR*** | ***–*** | ***MR-MS*** | ***MI*** | ***R*** | ***VS*** | ***MS*** | ***R*** | ***MR-MS†*** | ***Durum*** |
| **Triticale** | | | | | | | | | | | | | | | | |
| Jaywick | ***MR*** | ***R*** | ***R*** | ***R*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | | ***–*** | ***–*** | ***Triticale*** |
| Hawkeye | ***MR-R*** | ***R*** | ***R*** | ***R*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***Triticale*** |
| Kosciuszko | ***–*** | ***S<*** | ***–*** | ***S*** | ***T*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***–*** | ***Triticale*** |
| Rufus | ***–*** | ***R*** | ***–*** | ***R*** | ***T*** | ***–*** | ***–*** | ***–*** | ***R-MR*** | ***MT*** | ***R-MR*** | ***–*** | ***–*** | ***–*** | ***–*** | ***Triticale*** |
| Speedee | ***R*** | ***S<*** | ***R*** | ***S*** | ***T*** | ***–*** | ***–*** | ***–*** | ***R-MR*** | ***MT*** | ***–*** | ***S*** | ***–*** | ***–*** | ***–*** | ***Triticale*** |
| Tahara | ***R*** | ***MR*** | ***R*** | ***R*** | ***T*** | ***R*** | ***R*** | ***–*** | ***R-MR*** | ***MT*** | ***R*** | ***S*** | ***–*** | ***R*** | ***–*** | ***Triticale*** |
| Treat | ***R*** | ***MR*** | ***MR*** | ***MS*** | ***T*** | ***–*** | ***R*** | ***–*** | ***MR-MS*** | ***MT*** | ***–*** | ***S*** | ***MS*** | ***R*** | ***–*** | ***Triticale*** |
| | *S< = These varieties are MS to the WA strains.* | | | | | | | | | | | | ***MS*** | | | |

*†Tolerance levels are lower for durum receivals.R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible, VS = very susceptible,*
*Black point is not a disease but a response to certain humid conditions*
*T = tolerant, MT = moderately tolerant, MI = moderately intolerant, I = intolerant, VI = very intolerant, – = uncertain*

| **Oats** | Rust | | Septoria | BYDV | CCN | | Stem nematode | | Bacterial | *Pratylenchus neglectus* | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | stem | leaf | avenae | | Resistance | Tolerance | Resistance | Tolerance | blight | Resistance | Tolerance |
| Bettong | MS | R | MS | MR | R | VI | R | T | MR | MR | – |
| Brusher | MS | R | MR-MS | MS | R | MI | – | I | MS | MR-MS | – |
| Echidna | S | S | VS | MS | S | VI | R | T | S | MR | MI |
| Eurabbie | MS | S | MR | MS | MS | MI | MS | MI | S | – | – |
| Euro | VS | MS | S | MR | R | VI | VS | I | MS | MR | T |
| Glider | R | R | MR | S | MS | I | R | MT | R | – | – |
| Kangaroo | R | MR | MR | MS | R | MT | – | MI | MS | – | – |
| Marloo | S | S | MS | MR | R | MT | MS | MI | S | – | – |
| Mitika | R | MR | MS | MS | VS | I | – | MT | MR | – | – |
| Mortlock | MS | S | S | MS | MS | I | VS | VI | MS | MR | – |
| Numbat | S | MR | MS | R | S | I | – | I | S | MR | – |
| Potoroo | S-VS | MS | VS | MS | R | T | MR | MT | S | MR | T |
| Possum | MS | MS | MS | MS | VS | I | – | MI | S | MR | – |
| Quoll | R | R | MR | MS | S | I | R | T | MS | MR-MS | – |
| Swan | VS | S | MS | S | R | VI | VS | VI | MS | MR-MS | – |
| Wallaroo | S | S | S | MS | R | MT | MS | MT | MS | MR | MI |
| Wintaroo | S | S | MR | MR-MS | R | MT | MR-MS | T | MS | MR-MS | – |
| Yallara | MR | R | MS | MS | R | I | – | I | MS | – | – |

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Section 9

Section editor:
**Nigel Wilhelm**
SARDI,
Minnipa Agricultural Centre

# Nutrition

Research

## Response of Wheat and Canola to K, Mg, S and Zn at Port Kenny

**Sam Stacey[1], Bob Holloway[2], Dot Brace[3] and Mike McLaughlin[1]**

[1]The University of Adelaide, [2]Formerly SARDI, Minnipa Agricultural Centre, [3]SARDI, Minnipa Agricultural Centre

**Try this yourself now**

**Location: Port Kenny**
Wayne Little

**Rainfall**
Av. annual: 350 mm
Av. GSR: 245 mm
2006 total: 333 mm
2006 GSR: 158 mm

**Soil Type**
Highly calcareous grey sandy loam

**Plot size**
13.2 m x 1.58 m x 4 reps

**Yield Limiting Factors**
Moisture

### Key messages

- **Wheat yields were improved by using a nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), sulphur (S) and zinc (Zn) fertiliser.**
- **Canola yields were improved by using an N, P, S and Zn fertiliser.**
- **Gross margins suggested that balanced crop nutrition could improve farm profitability despite dry conditions and high fertiliser prices.**

### Why do the trial?

With high fertiliser prices, farmers may be tempted to rely on products such as MAP and DAP to reduce production costs. However, with high grain prices, the application of secondary and trace nutrients may improve farm profits by optimising crop yields where multiple deficiencies exist. Field trials were undertaken at Port Kenny to investigate wheat and canola responses to potassium (K), magnesium (Mg), sulphur (S) and zinc (Zn) fertilisers. Gross margins were calculated using trial yield responses and current grain, seed and fertiliser prices. The results indicate that a balanced fertiliser program can improve farm profits even under dry conditions.

### How was it done?

In 2006, field experiments were carried out at Port Kenny to test wheat (Yitpi) and canola (Clearfield 44C73) responses to K, Mg, S and Zn. The soil was a highly calcareous grey sandy loam, with approximately 50-60% $CaCO_3$. Table 1 provides details of the fertilisers used in this study. KMag contains 18.3% K, 11.3% Mg and 22.4% S. Each plot was 13.2 m long by 1.58 m wide and received the equivalent of 10 kg P/ha. Nitrogen rates were 20 kg N/ha, balanced between treatments using granular urea. Each treatment was replicated four times.

The field trials were sown in early May. Crop samples were taken in the first week in August, during early tillering of wheat. Three one-metre length samples were randomly selected and cut from the centre rows of each plot. The samples were dried, weighed and analysed for their nutrient contents. Grain harvest weights were also recorded.

## What happened?

The season was extremely dry between August and late October, when the field trials were harvested. Total rainfall during the growing season equated to only 64% of the long-term average (245 mm).

The use of a balanced K and Mg fertiliser increased wheat dry matter production and grain yield (Table 1). Whole shoot nutrient analysis showed that wheat shoots had K concentrations between 3.36% and 3.89%, whereas the deficiency range published by Bergmann (1992) for Feekes stage 5 was below 3.5%. Shoot Mg concentrations were between 0.14% and 0.19%, below the adequate level of 0.2% published by Bergmann (1992). The use of a balanced K + Mg fertiliser also increased canola dry matter production but not grain yields (Table 1).

Sulphur application increased canola dry matter production and S applied with Zn increased grain yields (Table 1). Canola shoot Zn concentrations were below the critical deficiency level of 29 mg/kg in the no fertiliser, MAP and MAP + 15%S treatments (data not shown) (Reuter and Robinson, 1997). Zinc application increased Zn levels above the deficient level (data not shown), which explains why MAP + 10%S + 1%Zn produced higher seed yields than MAP only. Compared with MAP application, secondary and micronutrients increased wheat and canola yields by 20% and 39% respectively.

Gross margins were calculated to determine the profitability of applying secondary and micronutrients at the trial site. Based on a wheat price of $370/t ESR, the application of a balanced Zn, K and Mg fertiliser would be more profitable than using MAP + urea by keeping the cost of 0.57 kg Zn/ha, 4.2 kg K/ha and 2.6 kg Mg/ha below $49.16/ha. The application of Zn without K or Mg would be profitable if the cost of 0.57 kg Zn/ha were below $10.80/ha. At current fertiliser prices and by using the products tested in this trial, the application of a balanced P, N, S, Zn, K and Mg fertiliser would increase wheat gross margins by approximately $20.60/ha, compared with using MAP + urea.

Based on a canola price of $550/t, the application of a balanced S and Zn fertiliser would be more profitable than using MAP + urea if the cost of 5.7 kg S/ha and 0.57 kg Zn/ha were below $32.20/ha. At current fertiliser prices and by using the products tested in this trial, the application of a balanced P, N, S and Zn fertiliser would increase canola gross margins by $18.70/ha.

## What does this mean?

- With high grain prices, small increases in productivity can significantly improve farm profitability.
- A balanced crop nutrition program is extremely important to optimise crop yields if multiple nutrient deficiencies exist.
- At Port Kenny, wheat yields were increased using a balanced fertiliser regime including N, P, S, K, Mg and Zn.
- Canola early dry matter production was increased by S application, and further increased by K and Mg fertiliser when compared with MAP alone.
- Final canola yields were increased by S and Zn applied together.
- An analysis of gross margins showed that the application of secondary and trace elements may have improved farm profitability despite the dry season and current high fertiliser prices.

Further trials will help determine the distribution of K, Mg, S and Zn responsive soils in southern Australia.

***Table 1   Response of wheat and canola to P, S, Zn, K and Mg at Port Kenny in 2006***

| Fertiliser | Wheat | | Canola | |
|---|---|---|---|---|
| | Early dry matter (t/ha) | Grain yield (t/ha) | Early dry matter (t/ha) | Grain yield (t/ha) |
| No fertiliser | 0.19 a | 0.47 a | 0.23 a | 0.10 a |
| Mono Ammonium Phosphate (MAP) | 0.28 b,c | 0.62 b | 0.41 b | 0.18 b |
| MicroEssentials S15 (MAP + 15%S) | 0.27 b | 0.63 b,c | 0.54 c | 0.22 b,c |
| MicroEssentails SZ (MAP + 10%S + 1%Zn) | 0.29 c,d | 0.65 b,c | 0.61 c | 0.24 c |
| MicroEssentials SZ + 13 kg/ha KMag | 0.33 d,e | 0.68 c,d | 0.76 d | 0.25 c |
| MicroEssentials SZ + 22 kg/ha KMag | 0.35 e | 0.75 d | 0.82 e | 0.25 c |
| MicroEssentials SZ + 35 kg/ha KMag | 0.39 e | 0.73 d | 0.78 d,e | 0.25 c |

*Within columns, values with the same letter were not significantly different (P=0.05).*

## Acknowledgement

We would like to thank Mosaic L.L.C. for funding and supplying fertilisers for the trial and the SARDI Minnipa Agricultural Centre for managing the trials. MicroEssentials – registered trademark of Mosaic L.L.C., KMag – registered trade mark of Mosaic L.L.C.



## References

Bergmann W (1992) Nutritional Disorders of Plants: Development Visual and Analytical Diagnosis. Gustav Fischer, New York.

Reuter DJ, Robinson JB (1997) Plant Analysis: An Interpretation Manual. 2nd edn. CSIRO, Collingwood. pp 243.


# Types of work in this publication

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

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

# Managing Trace Element Deficiencies in Crops for 2008

Information

**Nigel Wilhelm**

SARDI, Minnipa Agricultural Centre

## Key messages

- **There are three trace elements important to EP farming systems: manganese (Mn), copper (Cu) and zinc (Zn).**
- **Zn deficiency is probably the most important because it occurs over the widest area.**
- **Consider using a foliar spray or seed dressing to correct any trace element deficiencies in 2008 rather than a soil dressing.**

## Is there a need for trace elements, particularly zinc & copper?

Essential trace elements are nutrients required by plants and animals to survive, grow and reproduce but are needed in only minute amounts. There are three trace elements which are important to EP farming systems because there can be too little of them available in our cropping soils; these are manganese (Mn), copper (Cu) and zinc (Zn). Of these three, Zn deficiency is probably the most important because it occurs over the widest area, although it has not been seen to cause the total crop failures that Mn and Cu deficiencies are capable of. However, Zn deficiency can severely limit medic production and reduce cereal grain yields by up 30%. If these trace elements are not managed well, the productivity of your crops and pastures can suffer valuable losses and further productivity can be lost through secondary effects such as increased disease damage and susceptibility to frost.

Consider using a foliar spray or seed dressing to correct any trace element deficiencies in 2008 rather than a soil dressing. Foliar or seed dressing treatments are the cheapest option to meet the needs of the 2008 crop but will not provide any residual benefits for subsequent crops or pastures. However, if opting for a seed dressing a foliar spray should also be budgeted for because the seed dressing may not be sufficient to meet the needs of the crop if the deficiency is severe. Using seed from a soil with good levels of trace elements will produce similar benefits to a commercial seed dressing. If this seed comes from another property, be aware of the potential cost of importing weed seed compared to the cost of a commercial trace element seed dressing. If paddocks have adequate levels of Zn and Cu consider not applying either of these nutrients in 2008.

If the high initial costs of a soil application are affordable (which has the long term benefit of substantial carry over for many years in the case of Cu, and for several years in the case of Zn) then banded into or near the seed row, as a fluid is the most effective approach. This technique combines the dual benefits of being able to use the cheapest source of easily soluble trace elements (sulphates) with reduced application rates (compared to "conventional" soil applications).

To refresh memories, here is a summary of the appearance and management options for the three important trace element deficiencies for crops on EP.

## Zinc deficiency

In current farming systems Zn deficiency has re-appeared as an obvious and major problem. The widespread use of high analysis fertilisers and some herbicides (especially the sulfonylureas and some of the group A's) can make a Zn deficiency more severe.

Zn deficiency has been identified on many soil types; acid sandy soils, sandy duplex soils, red-brown earths, "mallee" soils, calcareous grey and heavy red soils have all had either Zn responses confirmed or crops have been identified with Zn deficiency symptoms. Zn deficiency appears to be equally severe in both high and low rainfall areas.

### *Symptoms*

It is very difficult to diagnose Zn deficiency in pasture or grain legumes because characteristic leaf markings are rarely produced in the field. Zn deficiency causes shortening of stems and leaves fail to expand fully. This results in plants that appear healthy but are stunted and have small leaves.

In cereals, symptoms are usually seen on seedlings early in the growing season. An early symptom of Zn deficiency is a longitudinal pale green stripe on one or both sides of the mid-vein of young leaves. The leaf tissue in this stripe soon dies and the necrotic area turns a pale brown colour. Severely affected plants have a "diesel-soaked" appearance due to the necrotic areas on leaves, which generally start mid-way down the leaf, causing the leaf to bend or break in the middle.

Plant symptoms appear to be worst early in the season when conditions are cold, wet and light intensity is low. In spring, symptoms often do not appear on new leaves but grain yields will usually be reduced.

### *Diagnosis*

Plant tests for diagnosing Zn deficiency are reliable and have been calibrated in the field under SA conditions for wheat, barley, medic, beans and peas. In tillering plants of wheat and barley, youngest emerged blade (YEB) levels above 20-24 mg $kg^{-1}$ are considered adequate. The minimum youngest open leaf (YOL) value of medic is 15 mg $kg^{-1}$ and in beans and peas the figure is approximately 23 mg $kg^{-1}$ (although our information on peas is very limited).

## Copper deficiency

Cu deficiency in crops is largely restricted to sandy soils but has been more common and widespread in recent years because of the frequency of dry conditions around flowering time of crops. Cu does not move within the soil and is not available to crops if it is in dry soil. Cu deficiency can occur in soils with normally good supplies of Cu if most of that Cu is in the surface layers of the soil. Under dry conditions in spring, the surface soil layers dry out, the crop no longer has access to Cu in the soil and the plants become deficient. If this happens around flowering time, seed set can be severely impaired. Crops in high N situations (eg. following a vigorous medic pastures) can also suffer more severely from Cu deficiency.

### *Symptoms*

Apart from shrunken heads in cereals, heads with gaps in them or "frosted" heads, Cu deficiency rarely produces symptoms in plants in the field. The symptoms produced by Cu deficiency in the maturing cereal plant are due to poor seed set from sterile pollen and delayed maturity. However, under conditions of severe Cu deficiency cereal plants may have leaves that die back from the tip and twist into curls. Cereal stubble from Cu-deficient plants has a dull grey hue and is prone to lodging due to weak stems.

Cu-deficient pasture legumes are pale, have an erect growth habit and the leaves tend to remain cupped (as if the plant were suffering from moisture stress).

### *Diagnosis*

Leaf analysis to detect Cu deficiency in plants is a very important management tool because Cu deficiency can produce devastating losses in grain yield of crops and pastures with little evidence of characteristic symptoms.

Cu concentrations in YEB's of cereals above 3 mg $kg^{-1}$ are considered adequate and below 1.5 mg $kg^{-1}$ deficient. Pasture legumes have higher requirements for Cu and plants are considered deficient if YOL values are below 4.5 mg $kg^{-1}$. Lupins are tolerant of Cu deficiency and levels above 1.2 mg $kg^{-1}$ are adequate.

## Manganese deficiency

The availability of Mn in soil is strongly related to soil pH; the higher the pH, the lower the availability. Hence, Mn deficiency is most frequently a problem on alkaline soils although responses to Mn have also been recorded on impoverished, acid to neutral sandy soils. The availability of Mn is also strongly affected by seasonal conditions and is lowest during dry spring weather. Transient Mn deficiency may also appear during cold, wet conditions but affected plants are often seen to recover following rains in spring when soil temperatures are high.

### *Symptoms*

Mn is poorly translocated within the plant so symptoms first appear in young leaves. Old leaves on plants severely affected by Mn deficiency can still be dark green and healthy because they acquired Mn from the seed and once Mn enters a leaf it cannot be shifted out.

Mn deficiency results in plants that are weak and floppy and pale green/yellow in appearance. Mn-deficient crops can appear to be water-stressed due to their sagging appearance. Close examination of affected plants can reveal slight interveinal chlorosis; the distinction between green veins and "yellow" interveinal areas is poor.

In oats, Mn deficiency produces a condition known as "grey speck". Mn-deficient oats are pale green and young leaves have spots or lesions of grey/brown necrotic tissue with orange margins (this contrasts with *Septoria* lesions which have purple/red margins). These lesions will join together under severely Mn-deficient conditions.

Mn deficiency delays plant maturity, which is a condition most marked in lupins. Mn-deficient patches in lupins will continue to remain green months after the rest of the paddock is ready for harvest. Delayed maturity in patches of the crop is frequently the only visual symptom of Mn deficiency in lupins. Mn deficiency will also cause seed deformities in grain legumes. Lupins suffer from "split-seed" which is caused by the embryo breaking through a very weak seed coat. "Split-seed" will reduce yields and also viability of the harvested grain. A similar condition in peas is known as "marsh spot" due to a diffuse dark grey area within the seed.

### *Diagnosis*

Plant analysis will accurately diagnose Mn deficiency in crops and pastures at the time of sampling but Mn availability in the soil can change dramatically with a change in weather conditions. This means that the Mn status of the sampled crop or pasture can also change dramatically after sampling - this must be allowed for when making recommendations on Mn deficiency.

Concentrations of Mn in YEB's greater than 15 mg $kg^{-1}$ are considered adequate for cereals at tillering. For legumes, the corresponding figure in YOL's is 20 mg $kg^{-1}$. The WA Dept. of Agriculture also advocates a main stem analysis of lupins for diagnosing Mn deficiency at flowering.



SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

*Leighton George and Winton Scholz checking the depth to clay layer, an important step before clay delving.*

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Section 10

**Section editor:**
**Sam Doudle**
SARDI,
Minnipa Agricultural Centre

# Soils

## Buckleboo "Subsoil Enhancer" Demonstration (4th year)

Research


**Jon Hancock[1], Buckleboo Farm Improvement Group (BIG FIG)**

[1]SARDI, Minnipa Agricultural Centre


### Key messages

- **Gypsum increased grain yield on the sand site for the fourth consecutive year.**
- **Gypsum increased grain yield on the loam site in 2007.**

### Why do the demonstrations?

These demonstrations, initiated by the Buckleboo Farm Improvement Group (BIG FIG), were designed to test whether deep ripping, nutrition and/or gypsum applications can increase the depth of soil profile accessed by crops and increase grain yield.

They aimed to answer the following questions over a number of years and soil types;

- Is there a benefit from deep ripping?
- Are fluid fertilisers more effective than granular fertilisers?
- Is deep placed fertiliser (40 cm) better than conventionally placed fertiliser (5 cm)?
- Are higher rates of deep placed fertiliser better than standard rates?
- Does the application of gypsum improve yield and/or access to subsoil moisture by improving soil structure?

Previous results were published in EPFS Summary 2004 pp. 115-118, EPFS Summary 2005 pp. 122-123 and EPFS Summary 2006 pp. 149-152.

### How was it done?

In 2004 the BIG FIG gained sponsorship to build a precision seeder and set up long term demonstrations on four different soil types of the Buckleboo district (sand, red, grey and loam). The precision seeder, equipped with Primary Sales hydraulic tynes is capable of delivering granular or fluid fertilisers to a depth of 40 cm. Two gypsum treatments (2 t/ha in 2004 and 2006 or 5 t/ha in 2004 only) were each applied to a strip running the length of

**Try this yourself now**

**Location**
Buckleboo Sand – Tony Larwood
BIG FIG

**Rainfall**
Av annual: 325 mm
Av GSR: 230 mm
2007 total: 294 mm
2007 GSR: 176 mm

**Yield**
Potential: (W) 1.81 t/ha
Actual: up to 1.04 t/ha

**Paddock History**
2006: Clearfield stiletto wheat
2005: Clearfield stiletto wheat
2004: Mundah barley

**Location**
Buckleboo Red – Graeme Baldoock
BIG FIG

**Rainfall**
Av annual: 300 mm
Av GSR: 210 mm
2007 total: 233 mm
2007 GSR: 101 mm

**Yield**
Potential: (W) 0.66 t/ha
Actual: failed

**Paddock History**
2006: Clearfield stiletto wheat
2005: Clearfield stiletto wheat
2004: Mundah barley

continues

each demonstration with control strips (no gypsum) on either side. Two replications of the different nutrition and ripping treatments (Table 1) were applied perpendicular to the gypsum strips and were in the same location each year.

In 2007, the demonstrations were sown to Wyalkatchem @ 60 kg/ha on 30 May after the application of 1L/ha Sprayseed, 1 L/ha TriflurX and 70 ml/ha Striker. The sand, grey and loam sites were sprayed with 750 ml/ha of Tigrex and 75 ml/ha of Lontrel on 26 July for broadleaf weed control. The district practice and rip only treatments at the sand site were also sprayed with a trace element brew which delivered 160, 400, 80 and 364 g/ha of Zn, Mn, Cu and S respectively. Plots were harvested at maturity and grain samples were retained for grain quality analysis. Soil at the sand site was sampled post harvest and samples from the top 20 cm of the clay layer were analysed to assess the affect of gypsum application on soil properties.

## What happened?

The 2007 season was extremely dry at Buckleboo and the lack of plant available water resulted in crop failure at the red and grey sites. The sand and loam sites were harvested and grain yield increased in response to gypsum application at both sites (Table 3). 2007 was the fourth consecutive year that gypsum application resulted in a yield increase at the sand site.

Grain protein was reduced by the 5 t/ha gypsum application at both the sand and loam sites (Table 3) but responded to nutrition treatment and was highest with the deep placed fluid brew (Table 4). Grain screenings were unaffected by any treatment and averaged 3.0% and 3.6% respectively for the sand and loam sites respectively.

The soil analysis showed a distinct increase in sulphur content where gypsum was applied (Table 5), however there was no measurable difference in exchangeable sodium percentage, a measure of soil sodicity. Analysis of grain samples from the 2005 season showed adequate nutrient levels for all nutrients tested (including sulphur) and little variation between treatments where gypsum was and was not applied. This indicated that the consistent yield response on the sand was not due to sulphur, promoting the soil investigation. However, so far no soil measurements have indicated a reduction in sodicity due to the gypsum application.

**Location**
Buckleboo Grey & Loam – Bill & 'Gadj' Lienert
BIG FIG

**Rainfall**
Av annual: 325 mm
Av GSR: 250 mm
2007 total: 250 mm
2007 GSR: 119 mm

**Yield**
Potential: (W) 1.05 t/ha
Actual: up to 0.40 t/ha at loam site, crop failed at grey site

**Paddock History**
***Loam Site***
2006: Clearfield stiletto wheat
2005: Clearfield stiletto wheat
2004: Mundah barley
***Grey Site***
2006: Clearfield stiletto wheat
2005: Clearfield stiletto wheat
2004: Mundah barley

## What does this mean?

This trial work has shown that there is no reason for Buckleboo farmers to change from their traditional fertiliser practice, using low rates of NP fertiliser at seeding. None of the alternative nutrition techniques outperformed district practice over the last two very dry seasons. Some small yield benefits

***Table 1 Nutrition and Placement Treatments for Buckleboo Demonstrations***

| Treatment Number | Name | Fertiliser rate and type | | Fertiliser Placement |
|---|---|---|---|---|
| | | Granular @ seeding | Fluid @ seeding | |
| 1 | District Practice | 65 kg/ha 18:20:00 (12 N + 13 P) | - | Shallow |
| 2 | Rip Only | 65 kg/ha 18:20:00 (12 N + 13 P) | - | Shallow |
| 3 | Shallow Fluids | - | 11.7 N + 13P + 1Zn + 1Mn, + 0.5Cu | Shallow |
| 4 | Deep Fluids | 25 kg/ha 18:20:00 placed shallow | 7.2N + 8P + 1Zn + 1Mn, + 0.5Cu | Fluid placed deep |
| 5 | Deep Fluids - super brew | 25 kg/ha 18:20:00 placed shallow | 20 N + 15P + 1Zn + 1Mn + 0.5Cu | Fluid placed deep |

*Table 2 Influence of gypsum on wheat grain yield (t/ha) at the sand and loam sites in 2007*

| Gypsum Treatment | Sand Site | Loam Site |
|---|---|---|
| **Nil** | 0.91 a | 0.17 a |
| **2 t/ha biannually** | 1.03 b | 0.21 ab |
| **5 t/ha in 2004** | 1.04 b | 0.28 b |
| *LSD (P=0.05)* | *0.09* | *0.08* |

*Table 3 Effect of gypsum on grain protein (%) at the sand and loam sites in 2007*

| Gypsum Treatment | Sand Site | Loam Site |
|---|---|---|
| **Nil** | 15.0 a | 14.7 a |
| **2 t/h a biannually** | 14.4 ab | 13.8 b |
| **5 t/ha in 2004** | 14.2 b | 14.1 b |
| *LSD (P=0.05)* | *0.8* | *0.4* |

*Table 4 Effect of nutrition on grain protein (%) at the sand and loam sites in 2007*

| Gypsum Treatment | Sand Site | Loam Site |
|---|---|---|
| **Deep Fluids - super brew** | 16.1 a | 15.5 a |
| **Deep Fluids** | 14.9 b | 14.7 b |
| **Shallow Fluids** | 14.4 bc | 14.6 b |
| **Rip Only** | 15.2 b | 13.9 c |
| **District Practice** | 13.9 c | 13.1 d |
| *LSD (P=0.05)* | *0.9* | *0.5* |

*Table 5 Soil sulphur (mg/kg) in the top of the clay across gypsum treatments at the sand site*

| Soil Depth (cm) | Nil Gypsum | 2 t/ha Gypsum[1] | 5 t/ha Gypsum[2] |
|---|---|---|---|
| **20-25** | 8.5 | 18.5 | 13.2 |
| **25-30** | 7.3 | 39.9 | 20.7 |
| **30-40** | 19.8 | 69.7 | 54.1 |

[1]*applied biannually*
[2]*applied in 2004*

were recorded at the red and grey sites in 2004 and 2005, but the lack of plant available water at these sites over the last two seasons has prevented any follow up of these trends.

Gypsum produced yield responses at the sand and loam sites in 2006 and 2007. The sand site has had grain yield responses to the initial application of 5 t/ha gypsum since the demonstration's inception. The reason for the gypsum response at this site is still not clear, with evidence that it is not a response to sulphur. Any benefit of the gypsum in reducing sodicity of the subsoil has not been confirmed through soil tests, but it is likely that gypsum has improved the structure of the clay layer to improve water availability to the crop. Over the last four seasons at this site, grain yield was increased by an average of 0.14 t/ha, worth around $51/ha per year at current grain prices. The cost of applying 5 t/ha of gypsum, including product, freight and spreading costs is approximately $170/ha, which should be recovered within four seasons, making the application of gypsum a viable proposition on this soil type at the present time.

## Acknowledgements

Thanks to co-operators, Tony Larwood, Graeme Baldock and Bill and 'Gadj' Lienert for providing the demonstration sites. Special thanks to Fertisol and Agrichem for providing the fluid brews.

Thanks to Sam Doudle for helping establish these demonstrations and Wade Shepperd, Ian Richter and Brenton Spriggs for technical assistance.

Clearfield – registered trademark of BASF Corporation. Sprayseed – registered trademark of Syngenta, Tigrex – registered trademark of Bayer CropScience. TriflurX and Striker – registered trademarks of Nufarm. Lontrel – registered trademark of Dow AgroSciences.

## BIG FIG sponsors

Major Sponsors – AWB Ltd, Rabobank, Primary Sales, KEE.

Sponsors – Pringles Ag Plus, Hardi Australia, Fertisol, SARDI, Liquid Systems.

Minor Sponsors – Mooses Metalworks, Landmark Kimba, Agsave, K&D Paul and Agrichem.

Grains Research & Development Corporation

# Site Specific Benefits of Deep Ripping

**Allan Mayfield and Sam Trengove**
Southern Precision Agriculture Association

Research

**Almost ready**

**Location: Buckleboo**
Graeme Baldock
Southern Precision Agriculture Association (SPAA) and the Buckleboo Farm Improvement Group

**Rainfall**
Av annual: 302 mm
Av GSR: 208 mm
2007 total: 224 mm
2007 GSR: 114 mm

**Yield**
Potential: (W) 0.65 t/ha
Actual: 0.49 t/ha

**Paddock History**
2005: 1.52 t/ha Wyalkatchem wheat
2004: 0.89 t/ha Westonia wheat

**Soil Type**
Range from loamy flats to sand hills

**Plot size**
Dimensions: 40 m x 190 m x 2 reps

**Yield Limiting Factors**
July finish!

**Soil Health**
***Chemical use:***
2007, 0.9 L/ha glyphosate + 20 ml/ha Hammer, 0.8 L/ha trifluralin + 500 ml/ha Dual + 350 g/ha diuron pre-emergence, 1.5 kg/ha 21% Zinc sulphate foliar post emergence.
2006, trifluralin + diuron pre-emergence
2005, trifluralin pre-emergence, Ally + 2,4-D amine625 post emergence
2004, trifluralin + Logran pre-emergence.

**Resource Efficiency**
Energy/fuel use: Not recorded for trial, but a significant increase for deep rip.

continues

## Key messages

- **Deep ripping increased wheat yields on sandhill tops and slopes in 2006, but there was no yield benefit by deep ripping heavier textured flats.**
- **Deep ripping increased crop growth, and nitrogen and phosphorous uptake of the wheat.**
- **Deep placement of fluid fertiliser increased crop growth, but not grain yield.**

## Why do the trial?

The trial was conducted to assess the longer-term benefits of deep ripping in different soil types in a low rainfall environment, and the benefit of deep placement of nutrients when deep ripping across different soil types.

Deep ripping is an expensive operation and not all soil types may respond with sufficient yield increases to cover costs. This also applies to deep placement of nutrients. The use of EM mapping to identify zones, which are more or less responsive to deep ripping and deep fertiliser placement, was investigated in a paddock at Buckleboo. This paddock had a typical variation in soil types from loamier flats to sandier hills.

## How was it done?

The paddock was mapped in 2004 using an EM38 sensor in vertical dipole mode. Four treatments were applied across different soil zones at the end of May 2006 and sown with Wyalkatchem wheat @ 60 kg/ha:

1. Non rip control sown with 80 kg/ha 18:20:00 (DAP),
2. Deep rip with 80 kg/ha DAP placed with the seed,
3. Deep rip with 80 kg/ha DAP placed at depth, and
4. Deep rip with 150 L/ha fluid fertiliser (6 N: 10 P: 1.1 Zn) placed at depth.

Treatments were replicated twice and plots were 190 m x 40 m and sown with the BIGFIG seeder (one pass no-till seeding with 16 mm Agmaster points on 225 mm spacing with press wheels and fertiliser deep banded). In 2007 Wyalkatchem wheat was sown over all treatments on the 5 May @ 65 kg/ha with 45 kg/ha MAP. This was sown with the farmer's no-till bar. Crop biomass was assessed using the Yara N-Sensor. Grain yield differences were assessed from the harvester yield map. Plants were also analysed for nutrient uptake.

***Table 1 Differences in soil nutrition in different soil zones, Buckleboo***

| | Soil Nutrients (0-10 cm) | |
|---|---|---|
| | **Sand hill (Low EM)** | **Flat (High EM)** |
| **Phosphorus (ppm)** | 24 | 28 |
| **Potassium (ppm)** | 140 | 470 |
| **Sulphur (ppm)** | 10.8 | 18.2 |

Time (hrs): 22 hrs for approx 6 ha (to sow trial).
Clash with other farming operations: Trial sowed once main seeding completed.
Labour requirements: 1.5 labour units (extra labour required with fluid fertiliser treatments).

**Economic**
Infrastructure/operating inputs: BigFIG seeder and 360hp tractor.
Cost of adoption risk: Fuel and time, plus extra hp and better "bar" required. Not enough response on flats to warrant outlay at this stage.
Market stability risk: If wheat stayed at $400/t it would help!

## What happened?

EM38 mapping showed where soil types varied, with higher EM values on loamy soil types and lower EM values on sandier soils. Soil tests also showed that increasing EM38 values were associated with increased levels of sodicity, salinity and boron. Little difference was found in soil P levels between sand hills and flats, but potassium and sulphur levels were higher on the flats than the sand hills (Table 1).

In 2006 deep ripping increased crop growth, nitrogen (N) uptake and leaf phosphorus (P) concentrations (Table 2). These increases in crop growth and N uptake were greater in the lower EM zone (sandier soil) than in the higher EM zone (loamier soil). Deep placement of granular fertiliser had no benefit over shallow placement, but fluid fertiliser placed at depth increased crop growth and N uptake further.

Crop yield increased in response to deep ripping on the lower EM soil types (sand hill tops and slopes), but there was no yield response on the heavier textured high EM soils (Table 3). There was no yield response to deep placement of fluid fertiliser in 2006, despite the increased growth this treatment produced. Grain yields from 2007 yield maps are being analysed.

***Table 2 Crop growth and nutrient uptake responses to deep ripping and fertiliser type and placement in 2006***

| Crop Growth & Nutrient Content Of Wheat (Gs 39) | | | | | |
|---|---|---|---|---|---|
| **Deep ripped** | **Fertiliser** | **Soil Zone** | **Crop Bio-mass Index** | **Crop N uptake (g N/m$^2$)** | **Leaf P content (ppm)** |
| No | DAP with seed | High EM | 100 (3.2) | 100 (1.7) | 100 (2600) |
| | | Low EM | 100 (3.19) | 100 (1.4) | 100 (2700) |
| Yes | DAP with seed | High EM | 118 | 141 | 113 |
| | | Low EM | 137 | 207 | 102 |
| Yes | DAP deep | High EM | 120 | 135 | 121 |
| | | Low EM | 125 | 186 | 113 |
| Yes | Fluid fert deep | High EM | 132 | 194 | 117 |
| | | Low EM | 157 | 214 | 109 |

*Values are % of non rip control; values in brackets are actual values, units are for crop biomass (N-Sensor biomass index).*

***Table 3 Crop yield response to deep ripping and fertiliser type and placement in 2006***

| Grain Yield Of Wheat (t/ha), 2006 | | | | |
|---|---|---|---|---|
| **Deep Ripped** | **Fertiliser** | **Low EM zone (hill)** | **Medium EM zone (slope)** | **High EM zone (flat)** |
| No | DAP with seed | 0.68 | 0.45 | 0.18 |
| Yes | DAP with seed | 1.11 | 0.68 | 0.21 |
| Yes | DAP deep | 1.09 | 0.65 | 0.28 |
| Yes | Fluid fert deep | 1.06 | 0.63 | 0.19 |
| **Average of ripping treatments** | | 1.08 | 0.65 | 0.19 |
| **Yield response to deep ripping** | | 0.4 | 0.2 | 0.01 |

## What does this mean?

Deep ripping gave the greatest increase in grain yields on the sand hills and no increase on the flats in this trial. EM mapping can assist in identifying the areas where the greatest response is likely. This may also be done more simply from an elevation map or soil texture map of the paddock. Grain yield response may be different in wetter years (hopefully sooner rather than later).


## Acknowledgements

Thanks to Graeme Baldock for implementing and harvesting trial treatments, Nigel Wilhelm, Jon Hancock and Michael Wells for assistance with trial design and John Kirk (Fertisol) for kindly donating the fluid fertilisers. Funded by GRDC, SAGIT and the National Landcare Program.


SAGIT

Australian Government
Department of Agriculture, Fisheries and Forestry
National Landcare Program

SPAA Southern Precision Agriculture Association

GRDC Grains Research & Development Corporation

Soils

# Soil Compaction Survey

**Cathy Paterson and Ben Ward**
SARDI, Minnipa Agricultural Centre

Research

**Searching for answers**

**Location:**
From Charra to Cowell and down to Wanilla.

## Key messages

- **A high proportion of soils surveyed across EP are compacted.**
- **Sandy soils are the more likely to be compacted under current farming systems than soils with some clay content.**
- **Ongoing research is needed to determine full effect of soil compaction.**

## Why do the survey?

At the 2003 round of EPFS farmer meetings the majority of groups nominated soil compaction as an area of concern. A survey was carried out to begin investigating how extensive soil compaction is on Eyre Peninsula (EP), which farming systems and soil types are more prone than others and to what extent is compaction reducing crop yields and profitability?

## How was it done?

After numerous round table discussions on how to best to survey the major soil types across EP it was decided that the survey should build on the soil characterisation sites analysed by Jon Hancock as part of the plant available water research in the EP Farming Systems project (p. 95 of this Summary). These sites have already been characterised for 'bucket size' and any chemical constraints through the soil profile. Additional sites were selected to cover lower EP making a total of fifty three sites surveyed so far across EP.

Compaction was estimated by resistance to a cone penetrometer inserted down the profile. Benchmarks for penetrometer readings as a measure of compaction have been developed at field capacity (the amount of water a soil holds after drainage has ceased). Both 2006 and 2007 did not present opportunities to sample soils at field capacity courtesy of nature, so the MAC team established a method of artificially wetting up a soil to field capacity.

Each soil profile was artificially 'wetted up' along a 10 metre transect approximately 24-48 hours before sampling then allowed to drain to field capacity. The length of time for the water to move through the soil profile depended on the soil type; heavier clay soils needed 48 hours to be at field capacity while the lighter sandy soils only required 24 hours.

Cone penetrometer readings to 400 mm were taken at 15 mm increments from ten points along the transect, with the average from each site being used to generate a graph of the resistance down the soil profile. A small soil pit was then dug at the most representative point, where the soil profile was described, bulk density samples were taken from each soil horizon and root density scored.

A paddock information sheet was given to each farmer requesting details of the management history for the paddock, e.g. tillage type and cropping intensity. This information will be used to determine whether some farming systems are more prone to soil compaction than others.

## What happened?

A resistance value of greater than 2500 kPa is the theoretical level that will restrict root growth and the plant's ability to extract soil water and available nutrients. In addition the following benchmarks for penetration resistance measurements (Soil Analysis: An Interpretation Manual, p. 99) must also be considered:

- Penetrometer resistance of less than 1000 kPa at field capacity and drier will not impede root and shoot growth.
- Penetrometer resistance between 1000 kPa and 2000 kPa will retard seedling emergence. Root growth may become restricted as the level of resistance can exceed 2500 kPa before the soil reaches wilting point.
- If the penetrometer resistance is above 2000 kPa at field capacity, root growth will be impeded except through old root channels and cracks.

As part of the survey, fifty three sites between Charra, Cowell and Wanilla were investigated. Of these, 40 had a soil resistance of 2500 kPa or greater at field capacity, with most of these soils being over 2500 kPa before a depth of 20 cm (Table 1).

Figures 1-3 show a range of results from the various soil types. At Charra on a grey loamy sand, the figure of 2500 kPa is reached at around 350 mm, from where it continues to increase. At Minnipa on a red sandy loam 2500 kPa is reached at around 400 mm and on a sandy clay loam nearby the resistance does not go above 1500 kPa. The differences between these two paddocks are soil type (more clay in the second paddock) and land use (second paddock is continuously cropped).

## What does this mean?

From the survey results it could be concluded that the soils under agricultural systems least likely to be compacted are sandy clay loams and clay loams. This is most likely due to the clay content of the soil, which will shrink and swell with wetting and drying events, providing these soil types with the ability to naturally resist changes in soil structure brought about by stresses.

Even though forty of the fifty three sites surveyed had a resistance greater than 2500 kPa (the theoretical level that will restrict root growth and the plants ability to extract soil water and available nutrients) it has not yet been established what impact this compaction is having on crops and pastures. Figures 1-3 also highlight the layers with toxic subsoil constraints, so it is still possible that in some cases the compaction layers may be assisting in slowing the growth of plant roots towards these toxic layers.

During 2008 a subset of the sites investigated will be revisited and some deep ripping treatments will be applied to assess the impact of compaction on growth and yield. An economic analysis will be conducted for these sites to see whether it is economical and practical to mechanically intervene in these soils to overcome the compaction.

Trials conducted as part of this project (Soil Compaction Trials p. 159 of this Summary) are so far producing inconsistent responses to deep ripping, although those results have come from two very dry years. Regardless of the seasonal conditions, if deep ripping is being considered or working to break up a compaction layer it would be very wise to do a small trial to see if a response is received, and how many years that

***Table 1 Summary of the soil types surveyed in 2007, grouped by soil texture 0-10 cm***

| | Total | Sand | Loamy Sand | Sandy Loam | Clay Sand | Sandy Clay Loam | Clay Loam | Loam |
|---|---|---|---|---|---|---|---|---|
| **Number of sites surveyed** | 53 | 1 | 9 | 25 | 4 | 9 | 4 | 1 |
| **Sites ≥ 2500 kPa (within the root zone)** | 40 | 1 | 9 | 21 | 4 | 3 | 1 | 1 |
| **Sites ≤ 2500 kPa (within the root zone)** | 13 | 0 | 0 | 4 | 0 | 6 | 3 | 0 |
| **% soil resistance ≥2500 kPa** | 76 | 100 | 100 | 84 | 100 | 33 | 25 | 100 |

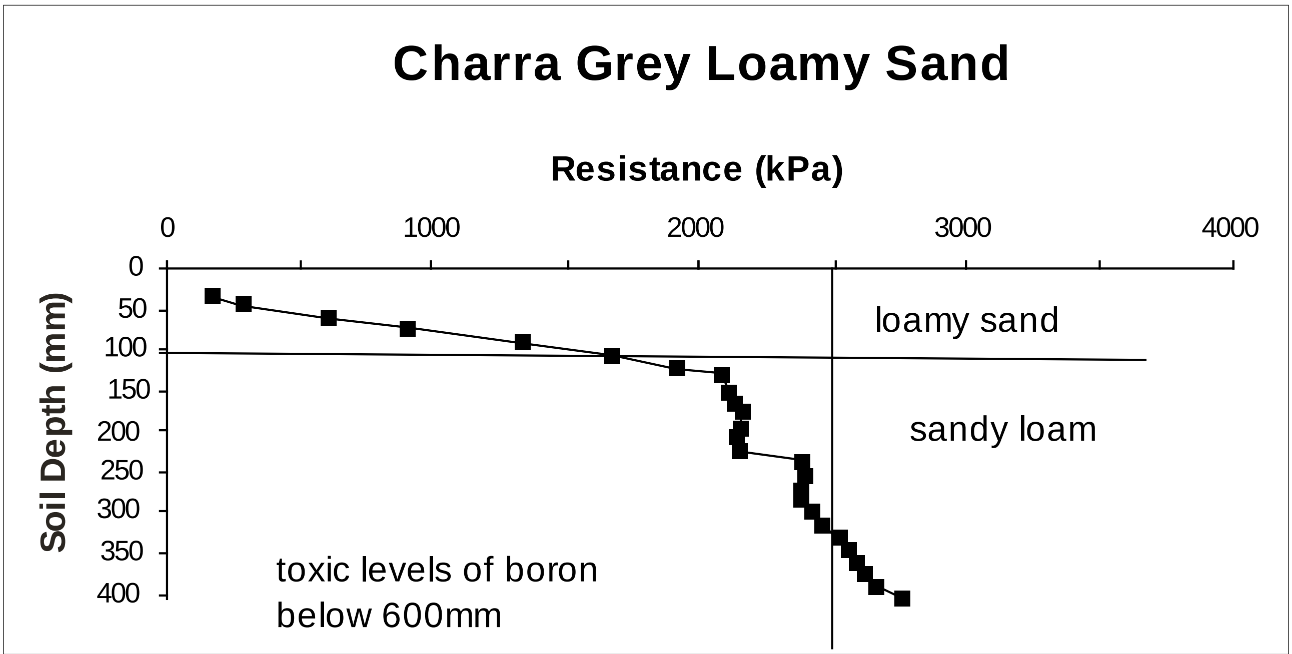



***Figure 1 Penetrometer readings from Charra, 2007.***

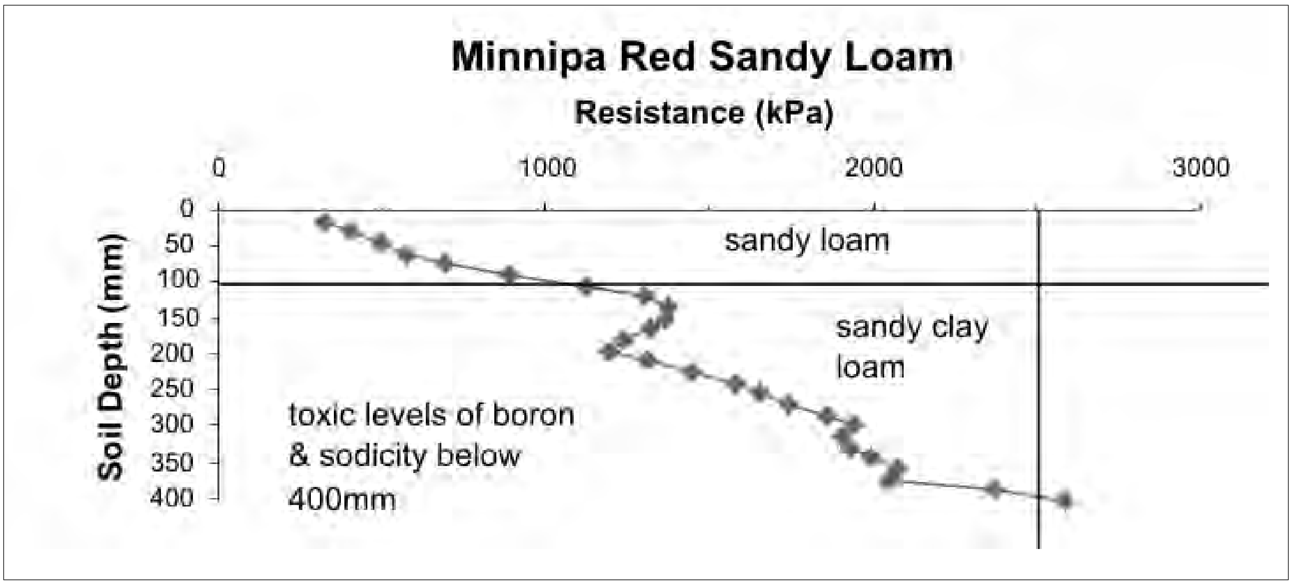



*Figure 2 Penetrometer readings from Minnipa, 2007.*

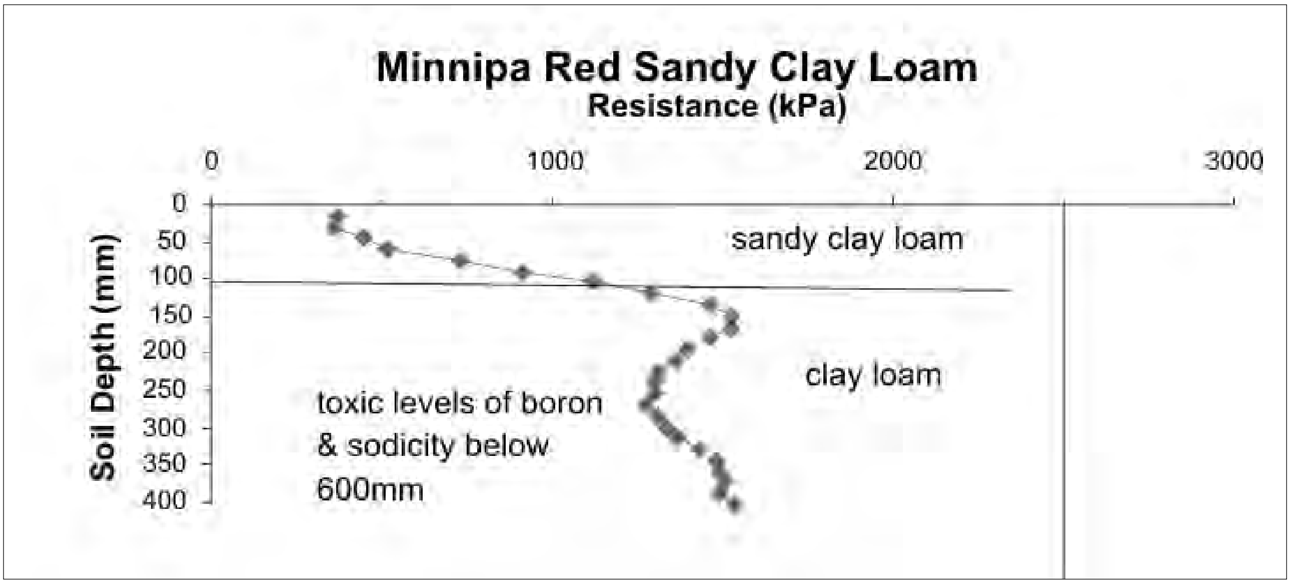



*Figure 3 Penetrometer readings from Minnipa, 2007.*

response will last for. Techniques such as delving can markedly increase the length of time a deep ripped line will stay uncompacted because the soil profile has been physically changed. If plain deep ripping is only going to be used then it would be wise to consider a change to a technique such as controlled traffic as well. There is no better way to make a road than to 'rip and roll', so by keeping traffic to defined tracks the rip lines will have more opportunity to stay uncompacted.

There are plenty of investigations to be conducted so stay tuned to this space in the 2008 Summary.

## Acknowledgements

Thanks to Ian Richter and Wade Shepperd for their technical assistance during the year. Thanks to Sam Doudle, Nigel Wilhelm, Jon Hancock, Brendan Frischke and Cliff Hignett (and anyone else who I've forgotten) for their advice during the past few years. Finally, a big thankyou all the farming businesses who participated in the survey.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

GRDC Grains Research & Development Corporation

# Soil Compaction Trials

**Cathy Paterson and Ben Ward**
SARDI, Minnipa Agricultural Centre

## Key messages

- **Deep ripping is a high risk option in below average years.**
- **The cost of deep ripping may be recovered over several years.**

## Why do the trial?

During the 2003 EPFS farmer meetings, fourteen groups nominated soil compaction as an issue which needed further research. Consequently, the EPFS project supported farmers from Buckleboo, Ceduna, Streaky Bay, Piednippie and Koongawa to set up or monitor their own deep ripping demonstrations so they could investigate whether soil compaction was an issue for them (EPFS Summary 2003, p. 121). In addition, the project undertook a soil compaction survey across a range of soil types on upper Eyre Peninsula (EP) during 2004 (EPFS Summary 2005, p. 117).

The research reported here is from the second year of a SAGIT funded project to investigate if compaction is causing yield penalties on EP and if so, can compaction be profitably corrected? The project is also building on the soil compaction survey of 2004 to develop a more detailed understanding of soil types and management systems that have caused soil compaction on Eyre Peninsula.

The report summarises the trial component of the project evaluating the impact of different tillage systems on crop yield across various rainfall zones and soil types. The results from 2006 can be found in the EPFS Summary 2006 pp. 160-162.

## How was it done?

Three replicated trials were established in 2006 (Piednippie, Warramboo, Minnipa Agricultural Centre (MAC)) with a further three being established in 2007 (Cummins, Wangary, Wharminda). All trials are replicated and small plot, except MAC which is replicated and broad scale. These trials will be continued during the 2008 season.

### *Treatments*

In 2006, the treatments in the small plot experiments were:

- Control – district practice;
- Deep ripping prior to seeding in 2006 with a custom made ripper (Minnipa, Piednippie and Warramboo);
- Deep ripping prior to seeding in 2007 with a custom made ripper (all small plot sites);
- Deep working (to 15 cm during the seeding pass with knife points);
- Rotational tillage (10 cm for Cummins, Wangary and Wharminda and 15 cm for Piednippie and Warramboo), and;
- Spare plots were included for deep ripping in 2008 to investigate seasonal variability and compare the longevity of deep ripping effects.

At Minnipa there was no deep ripping applied prior to seeding and the deep working depth was 25 cm.

**Searching for answers**

**Location: Cummins**
LEADA Focus site

**Rainfall**
Av. annual: 425 mm
Av. GSR: 344 mm
2007 total: 328 mm
2007 GSR: 223 mm

**Yield**
Potential: (W) 2.3 t/ha
Actual: 1.6 t/ha

**Paddock History**
2006: Wheat
2005: Canola
2004: Pasture

**Soil Type**
Sandy clay loam

**Diseases**
Crown rot

**Plot size**
20 m x 1.6 m x 4 reps

**Yield Limiting Factors**
Dry spring, crown rot

---

**Location:**
Minnipa Agricultural Centre
Minnipa Ag Bureau

**Rainfall**
Av. annual: 368 mm
Av. GSR: 242 mm
2007 total: 286 mm
2007 GSR: 141 mm

**Yield**
Potential: (C) 1.1 t/ha
Actual: 0.18 t/ha

**Paddock History**
2006:Wheat
2005: Wheat

continues

### *Site Details*
### *Sites established in 2006*

**Warramboo** - Sown 22 May with Clearfield Janz wheat and 18:20:00 fertiliser, both @ 60 kg/ha and Urea Zinc coat @ 16 kg/ha. Deep ripped to 30 cm.

**Minnipa** - Sown on 9 May with Tarcoola canola @ 3.5 kg/ha, fertiliser 18:20:00 @ 40 kg/ha. Deep ripped to 30 cm in 2006.

**Piednippie** - Sown 25 May with Flagship barley and 18:20:00 fertiliser, both @ 60 kg/ha and Urea Zinc coat @ 16 kg/ha. Deep ripped to 25 cm.

### *New sites established in 2007*

**Cummins** - Sown 8 May with Yitpi wheat @ 80 kg/ha, fertiliser 18:20:00 @ 100 kg/ha. Top dressed with urea 22 August @ 100 kg/ha. Deep ripped to 25 cm.

**Wangary** – Sown 8 May with Stubby canola @ 5kg/ha and 20:10:00:12 fertiliser @ 150 kg/ha. Urea top dressed 28 June and 15 July @ 75 kg/ha. Deep ripped to 35 cm.

**Wharminda** - Sown 21 May with Yitpi wheat and 18:20:00 fertiliser, both @ 65 kg/ha. Deep ripped to 35 cm.

Deep ripping was applied prior to seeding and deep working treatments were applied during the seeding pass.

Measurements included; plant establishment, dry matter - early and harvest, soil characteristics, soil profile description, soil constraints, soil moisture after harvest, yield, harvest index, and grain quality.

## What happened?

In 2007 the growing season rainfall was well below average for all sites, with Cummins, Minnipa, Piednippie and Warramboo below decile 1.

### *Soil strength*

Soil resistance of 2500 kPa at field capacity is the level at which plant root growth is restricted. All small plot trial sites reached soil resistances of more than 2500 kPa within 25 cm, whilst Minnipa reached this limit at a depth of 40 cm (Figure 1).

### *Soil Moisture*

All sites were below theoretical wilting points throughout the sampling depths for all treatments post harvest.

### *Sites established in 2006*

During the first year of this trial at Warramboo there were no differences between any treatments. In 2007, the second year of the trial, despite no differences in early dry matter, the fresh deep ripping treatment (2007) increased yield by over

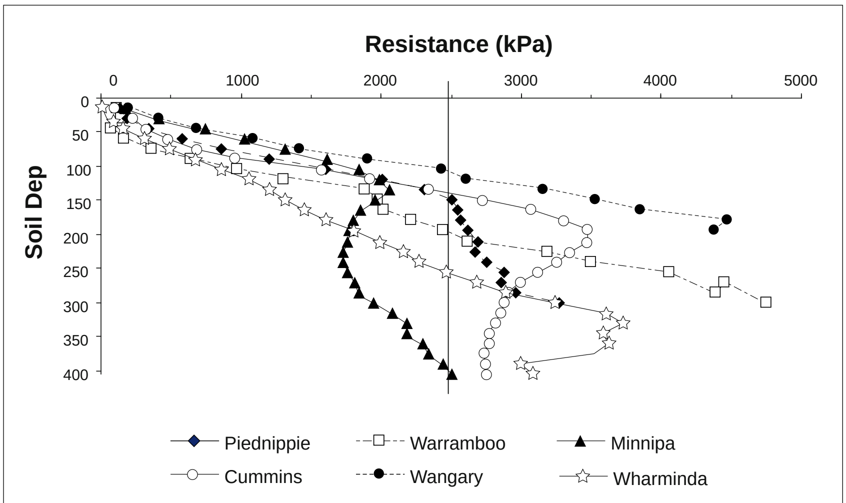



***Figure 1 Soil resistance measurements taken at field capacity for all trial sites. Soil resistance over 2500 kPa is considered to restrict growth of roots.***

**Soil Type**
Red calcareous sandy clay loam

**Diseases**
Nil

**Plot size**
350 m x 9 m x 3 reps

**Yield Limiting Factors**
Moisture stress, insect damage, shattering at harvest

---

**Location: Piednippie**
John & Ian Montgomerie
Streaky Bay Ag Bureau

**Rainfall**
Av. annual: 368 mm
Av. GSR: 280 mm
2007 Total: 254 mm
2007 GSR: 223 mm

**Yield**
Potential: (B) 1.9 t/ha
Actual: 0.3 t/ha

**Paddock History**
2006: Barley
2005: Wheat

**Soil Type**
Sandy loam/loamy sand/calcrete rock

**Diseases**
*Rhizoctonia*

**Plot size**
20 m x 1.6 m x 4 reps

**Yield Limiting Factors**
Moisture stress, *Rhizoctonia*

---

**Location: Warramboo**
Trevor, Leon and Simon Veitch

**Rainfall**
Av. annual: 325 mm
Av. GSR: 235 mm
2007 total: 232 mm
2007 GSR: 148 mm

**Yield**
Potential: (W) 1.6 t/ha
Actual: 0.5 t/ha

**Paddock History**
2006: Wheat
2005: Wheat

**Soil Type**
Deep siliceous sand

**Diseases**
*Rhizoctonia*

**Plot size**
20 m x 1.6 m x 4 reps.

**Yield Limiting Factors**
Moisture stress, non-wetting sand, *Rhizoctonia*

continues

50% compared to the control. In comparison, the 2006 deep ripping treatment showed no yield increase in either year. Screenings were also markedly reduced by the 2007 deep ripping treatment (Table 1).

Piednippie showed no response across all treatments in either 2006 or 2007 for all measurements taken (Table 1).

The broad scale trial at Minnipa had poor emergence in the deep worked treatment because much of the canola seed fell down to the bottom of the sowing point. Despite this there were no yield differences between any treatments (Table 2).

***Sites established in 2007***

Early crop growth at Cummins was good with over 7 t/ha of dry matter being produced. As the season finished there was not enough soil water to sustain the heavy early growth and all treatments "hayed off" badly. There were no early dry matter or yield differences between any of the treatments (Table 3).

Deep ripping increased yield by 24% at Wharminda despite having a reduced emergence rate and lower early dry matter production than the control (Table 1).

Deep ripping and deep working increased early dry matter and yield at Wangary (Table 2) and increased yield by 41% in the deep ripped treatments and 28% in the deep worked treatments.

## What does this mean?

Even with the below average rainfall events of 2007, crops growing in soils with a compacted layer below the surface did not appear to be restricted in the amount of soil water they were able to extract. Modelling in WA (Farming Ahead, June 2006) has shown that in dry years there is no adverse effect from compacted layers due to there being very little subsoil moisture available for the crop.

No treatments produced any benefits to crop growth at Cummins, Minnipa and Piednippie, even though the deep ripping operation would have ameliorated a compacted layer at Cummins and Piednippie. The deep working and the rotational working depth would have also disrupted the compacted layer at Piednippie but a calcrete layer at 30 cm restricts root growth to this depth. Warramboo and Wharminda both showed a response to deep ripping this season, which was the only treatment to rip beneath the compacted layer. Similar amounts of water remained in the soil for treatments post harvest.

Wangary showed a response to both deep ripping and deep working, which both ripped below the compacted layer. A contributing factor to the higher yield at this site could be that sand over buckshot soils have a tendency to be become waterlogged. The deep ripping and deep working could have increased the rate at which rain soaked into the soil profile, reducing the amount of water logging stress during the season.

Deep ripping is a costly and time consuming exercise so it is important that the benefits are large and long lasting. The trials established at Warramboo, Piednippie and Minnipa in 2006 showed no yield response to ripping in that year. In 2007 only Warramboo has responded to the newly deep ripped plots, there was no residual response to the ripping conducted in 2006. Even though both 2006 and 2007 were extremely dry years, these results do not provide any incentive to change management practice to reduce the effect of compaction on these soil types.

It will be interesting to follow the progress of the Wangary and Wharminda sites in 2008 to see if the large response to deep ripping in 2007 can be maintained for a second year.

**Location: Wangary**
Peter and Chris Puckridge
**Rainfall**
Av. annual: 500 mm
Av. GSR: 380 mm
2007 total: 508 mm
2007 GSR: 371 mm
**Yield**
Potential: (C) 3.89 t/ha
Actual: 0.45 t/ha
**Paddock History**
2006: Wheat
2005: Canola
2004: Barley
**Soil Type**
Sandy loam over buckshot
**Diseases**
Blackleg
**Plot size**
20 m x 1.6 m x 4 reps
**Yield Limiting Factors**
Blackleg, insect damage, shattering at harvest

**Location: Wharminda**
John Masters
Wharminda Ag Bureau
**Rainfall**
Av. annual: 327 mm
Av. GSR: 302mm
2007 total: 328 mm
2007 GSR: 223 mm
**Yield**
Potential: (W) 0.82 t/ha
Actual: 0.97 t/ha
**Paddock History**
2006: Grass free pasture
2005: Barley
**Soil Type**
Siliceous sand over clay
**Diseases**
*Rhizoctonia*
**Plot size**
20 m x 1.6 m x 4 reps
**Yield Limiting Factors**
Non-wetting sand, moisture stress

## Acknowledgements

Thanks to Ian Richter, Wade Shepperd and Carey Moroney for all their technical assistance during the year. Thanks to Sam Doudle, Nigel Wilhelm, Neil Cordon and Brendan Frischke for their advice during the year. Finally, but most importantly, thanks to the Montgomerie, Puckridge, Veitch and Masters families and MAC and ABB staff for the provision of the trial sites.

Clearfield – registered trademark of BASF Corporation.

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SAGIT

GRDC Grains Research & Development Corporation

***Table 1 Summary of deep ripping trial results from Piednippie, Warramboo and Wharminda, 2007***

| Site | Treatment | Emergence (plants/m$^2$) | Early Dry Matter (kg/ha) | Screenings (%) | Protein (%) | Yield (t/ha) |
|---|---|---|---|---|---|---|
| **Piednippie** | **Average all*** | 117 | 241.2 | 18.1 | 15.5 | 0.28 |
| | **Control** | 76 | 2907 | 9.9 | 12.1 | 0.23 |
| | **Deep Ripped 06** | 83 | 3205 | 10.9 | 11.7 | 0.35 |
| **Warramboo** | **Deep Ripped 07** | 77 | 2954 | 4.9 | 11 | 0.48 |
| | **Deep worked** | 84 | 3247 | 11.3 | 12.2 | 0.27 |
| | **Rotational** | 72 | 2773 | 9.9 | 12.2 | 0.27 |
| *LSD (P=0.05)* | | *14.8* | *567.7* | *4.3* | *0.4* | *0.13* |
| | **Control** | 102 | 3926 | 6.2 | 10.6 | 0.92 |
| **Wharminda** | **Deep Ripped 07** | 79 | 3038 | 5.4 | 10.1 | 1.2 |
| | **Deep worked** | 115 | 4418 | 6 | 10.5 | 0.94 |
| | **Rotational** | 114 | 3490 | 5.9 | 10.4 | 0.97 |
| *LSD (P=0.05)* | | *22.3* | *856.2* | *1.3* | *0.3* | *0.08* |

** No difference across all treatments*

***Table 2 Summary of trial results from MAC and Wangary, 2007***

| Site | Treatment | Emergence (plants/m$^2$) | Early Dry Matter (kg/ha) | Oil Content (%) | Protein (%) | Yield (t/ha) |
|---|---|---|---|---|---|---|
| | **Control** | 60 | 1686 | 36.4 | 29.3 | 0.18 |
| **Minnipa** | **Deep Ripped 06** | 57 | 1629 | 35.7 | 29.4 | 0.16 |
| | **Deep worked** | 21 | 1101 | 37.1 | 28.5 | 0.15 |
| | **Rotational** | 51 | 1408 | 35.6 | 28.9 | 0.15 |
| *LSD (P=0.05)* | | *7.8* | *432.8* | *1.1* | *0.6* | *0.06* |
| | **Control** | 108 | 3442 | 36.7 | 24 | 0.32 |
| **Wangary** | **Deep Ripped 07** | 104 | 4628 | 37 | 23.4 | 0.45 |
| | **Deep worked** | 93 | 4068 | 36.7 | 24 | 0.41 |
| | **Rotational** | 98 | 3949 | 36.8 | 24.3 | 0.36 |
| *LSD (P=0.05)* | | *13.9* | *802.5* | *0.5* | *0.8* | *0.08* |

***Table 3 Summary of trial results from Cummins, 2007***

| Treatment | Emergence (plants/m$^2$) | Dry Matter Oct (kg/ha) | Screenings (%) | Protein (%) | Yield (t/ha) |
|---|---|---|---|---|---|
| **Control** | 81 | 7972 | 4.6 | 15.7 | 1.6 |
| **Deep Ripped 07** | 91 | 7706 | 4.5 | 15.8 | 1.5 |
| **Deep worked** | 73 | 7421 | 5.5 | 15.6 | 1.5 |
| **Rotational** | 84 | 7461 | 5 | 15.7 | 1.5 |
| *LSD (P=0.05)* | *11.5* | *819.3* | *0.8* | *0.31* | *0.21* |

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Section 11

**Section editor:**
**Nigel Wilhelm**
SARDI
Minnipa Agricultural Centre

# Tillage

Extension

Searching for answers

## What is Wide Row Sowing?

**Bruce Heddle[1] and Alison Frischke[2]**

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

### Key messages

- **Wide row sowing is a potential tool to manage soil water use in paddocks that run the risk of haying off.**
- **Several paddock and environmental conditions need to occur for the technique to be of benefit over your conventional sowing program.**
- **May have a role as a risk management technique – only for paddocks at risk, and when you are confident that certain conditions will be met.**

### Why consider wide row sowing?

In a nutshell, wide row sowing could be a potential tool to manage soil water in paddocks which run the risk of haying off. Below is our understanding of how and where wide rows might fit upper Eyre Peninsula (EP) farming systems.

In the context of low rainfall farming systems, wide row sowing is defined as sowing at row widths of 40–60 cm, in systems which benefit from lower seed rates of between 30 and 50 kg/ha.

So why, after years of research showing that yields are higher when wheat is sown on narrow rows and that plant populations between 150-180 plants/m$^2$ should be aimed for in an environment like the upper EP, are less than what is considered optimal agronomy being contemplated?

When plant development progresses through the season at a rate that matches the availability of moisture from either stored soil reserves or rainfall, the traditional approach allows the crop to develop ground cover quickly, access to as much nutrition and light as possible, increases competition on weeds and ultimately provides canopy cover to reduce evaporation – this maximises access to the requirements for growth and high yields - all good outcomes. Broadcast seeding works for good reasons when the agronomy is right.

Problems arise when the crop develops very high levels of dry matter and yield potential early in the season, exhausting the stored soil moisture. Then if rainfall fails to eventuate from mid to late season it leads to the classic haying-off effect, compromising either yield or quality, often both. The ability to bring on this effect may well have increased over the last couple of decades as everything that can enhance early vigour has been done - excellent agronomy increasing risk in dry finishes.

In northern NSW and QLD where sub-tropical cropping systems rely heavily on soil moisture stored prior to sowing but less so on in-crop rainfall, low sowing rates, wide rows and variations on skip and double skip rows are the norm. They use canopy management (reduced seed density and plant position) to reduce early crop water use, leaving moisture for finishing crops later in the season.

For people on EP it may also offer an opportunity to manage moisture reserves for a better outcome, but the circumstances where it will work need to be defined.

## So how does it work?

When we sow a crop on traditional row spacings over a reserve of soil moisture, that moisture reserve (or drying front) is evaporated and transpired from the surface so that the area of dry soil moves steadily and horizontally downwards, with the root mass of the establishing crop developing in a horizontal band and following it down. By establishing fewer plants it simply lessens the transpiration rate, slowing use of precious reserves of soil water. Hopefully, this can buy time for the crop to go on developing without stress while waiting for rain.

Paul Blackwell and fellow researchers have found that when crops are sown on wide row spacings the pattern of development of plant roots and use of soil moisture is very different to a conventionally sown crop. Root development is concentrated under the crop rows, moving down but not necessarily out into the inter-row (simply because crop rows are further apart), as they dry the soil down towards any chemical or physical barrier. Zones of dry soil are created under the crop row, with zones of relatively wetter soil remaining in the inter-row. If the beginning of the season has had enough rain to store a reserve in the inter-row, this reserve of moisture remains conserved for the crop to go on using after root systems have reached their maximum depth but continue to develop outwards into the inter-row.

For this pattern of root growth and water use to occur, and subsequently the wide row technique to have benefit over conventional sowing practices, several paddock and agronomic features need to be satisfied.

## What conditions are necessary for wide row success?

Research over the past seven years in low rainfall WA by Paul Blackwell, SA Mallee by Jack Desboilles (EPFS Summary 2006, p. 169), and Victorian Mallee by Ben Jones, have evaluated the potential for wide rows.

In general they have found that wide rows (400-600 mm) and low seeding rates (30-50 kg/ha) have a wheat yield and grain size advantage over conventional sowing where there is:

- Soil texture between loamy sand to clay loam – it needs to be able to store moisture and nutrients.
- Sufficient early rains to fill the profile, then limited rainfall in the middle to later stage of crop development.
- Maximum root depths between 30 cm to 80 cm – any stored soil water less than 30 cm will evaporate, and any water deeper than 1 m runs the risk of not being used effectively (less lateral root growth at depth into the inter-row, and on EP will be most likely in a zone of physical or chemical constraint).
- Good nutrition, especially N & P, to drive strong early vigour and canopy development. This will often occur after a pasture or crop legume.
- Crop *must* be sown early under warm conditions so it germinates and becomes established quickly.

The wide sowing approach also benefits from:

- Ribbon sowing, best used with a wide press-wheel (P. Blackwell pers. comm.). This enables plants to develop more freely in search of scarce resources in dry seasons.
- Either residue in place or soil types or topography that resist wind erosion. Residue may also aid moisture conservation in the inter-row.
- Low weed burdens or very robust weed control – wide rows are a haven for weeds and they will quickly negate any moisture benefits in the inter-row.
- A wheat variety with a vigorous growth habit, eg. Yitpi, Frame or Correll would be better than Wyalkatchem.
- Avoid cereals prone to lodging.

If the above features are not met or are compromised, the benefits that wide row sowing can offer over conventional sowing may disappear.

The practice would not be suitable for the grey calcareous soils and low fertility sands of EP as they generally remain challenged for early crop vigour, and so suffer from the opposite problem – they inadvertently already have canopy management in place.

## Machinery modification

Wide rows can be achieved relatively cheaply and quickly by either blocking every second sowing tube, lifting tines or you can create a skip row situation by taking every third tine out. Paul Blackwell believes that the most benefit will come from a wide row configuration – choice by the grower will be determined by what he is trying to achieve and manage in the paddock, e.g. concerns about weeds and potential use of shielded spraying.

## Is there a future for wide rows on EP?

- While this seems a pretty extensive list of criteria to meet, a substantial portion of farming systems in central and eastern EP meet it quite often.
- Yield and quality failure after producing an otherwise healthy and promising crop is not only frustrating, it also hurts financially.
- It is extremely cheap to do. Simply plugging half the hoses on your seeder is neither hard nor expensive.
- It may offer the opportunity to reduce phosphate fertiliser rates to no more than removal due to the greater concentration of granules in the crop row. With 2 cm auto-steer, it offers the opportunity to progressively develop zones of intensively fertilised soil rather than trying to build the fertility of all the soil in the paddock.

- Inter-row sowing requires either less accurate auto-steer, or none at all with some planning.

While shielded sprayers are rare or non-existent on EP, the concept does offer a whole range of possibilities for dealing with resistant weeds, or expensive herbicides and fungicides.

Paul Blackwell's research and broadacre experience has seen reasonably consistent success with the practice in WA over five years. In 2007, for the first time at Merredin there was an interaction between retained stubble and row spacing. Merredin does not usually see a response to wide rows, but in a difficult season which experienced yields less than 0.55 t/ha, yields improved as row width increased where stubble was retained. There was no effect of row spacing on yield where stubble was burnt. Ryegrass seed set was higher with stubble retained than burnt, and was higher with wider rows. These results reinforce the general finding that wider rows may only help in lower yielding (less than 1-1.5 t/ha) seasons and weed control can be an issue.

Jack Desboilles' and Ben Jones' research work in the SA and Victorian Mallee has shown seasonal success, but benefits have not been as great as those seen in WA.

On EP, after two years of work conducted by Brendan Frischke at MAC, the technique has looked promising early, but either criteria have not been met or the finishes to the season have been too dry to realise any early benefits in final grain yield – in fact wide row yields have been lower than conventional (30 cm) spacing. In 2007, halving the sowing rate had greater benefit. Unfortunately, for farming and research, 2006 and 2007 were similar seasons. Skip row work by Dean Willmott at Koongawa in 2007 however, did measure some benefits despite very low yields. See the article 'Wide Row Sowing at Minnipa and Koongawa in 2007', p. 166

And so the jury is still out for Eyre Peninsula. This technique certainly makes sense, and regardless of what climate change may bring in the future, our climate has always presented us with variable seasons so it is a practice worthy of further attention. We need to evaluate it over more seasons and locations to really understand its application, and quantify the extent of the yield penalty when it does not work. Some of our soil types have physical and chemical constraints anywhere from 40 cm down and so may not be suitable. Simply dropping sowing rates may be a safer option.

## Acknowledgements

Research over the past seven years in low rainfall WA by Paul Blackwell, SA Mallee by Jack Desboilles and Victorian Mallee by Ben Jones.

Thanks to SARDI and the SA Government Drought Response Team for funding the EP research.

## References

Wide rows help wheat production in dry seasons on many shallow soils, P. Blackwell (2006). Article written for SANTFA and WANTFA publications.

Barley yields higher in wide rows with stubble retained in a very dry season at Merredin, G. Riethmuller, B. Bowden, and P. Blackwell (2007). Article written for GRDC Updates.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

DROUGHT RESPONSE


***Figure 1 Broadacre wide row sowing trials at MAC, August 2007.***

# Wide Row Sowing at Minnipa and Koongawa

Research

**Alison Frischke[1] and Brendan Frischke[2]**

[1]SARDI, Minnipa Agricultural Centre, [2]GPS Ag

**Searching for answers**

**Location**
Minnipa Agricultural Centre
Paddocks S6W and N4

**Rainfall**
Av. annual: 325 mm
Av. GSR: 242 mm
2007 total: 286 mm
2007 GSR: 141 mm

**Yield**
Potential: (W) 1.44 t/ha
Actual: 0.62 t/ha

**Paddock History**
*S6W*
2006: Pasture
2005: Pasture
2004: Krichauff wheat
*N4*
2006: Pasture
2005: Yitpi wheat
2004: Scythe wheat

**Soil Type**
Red calcareous sandy clay loam

**Diseases**
Very low levels

**Plot size**
Small plot: 50 m, Header: 200 m

**Yield Limiting Factors**
Good early growth with poor finish

**Location:** Koongawa
Dean Willmott

**Rainfall**
Av. annual: 300 mm
Av. GSR: 225 mm
2007 total: 218 mm
2007 GSR: 117 mm

**Yield**
Potential: (W) 0.86 t/ha
Actual: 0.3 t/ha

continues

## Key messages

- **In 2006 and 2007 at MAC, grain yields with wide row sowing were no better than narrow row sowing.**
- **In 2007, halving the sowing rate and sowing on narrow rows produced better yields even though it was in a suitable 'wide row paddock'.**
- **At Koongawa in 2007, skip row sowing had yield benefits over narrow row sowing.**
- **Further research into wide rows is needed over more sites and seasons before a conclusion can be made about their place in EP farming systems.**

## Why do the trial?

On central and eastern Eyre Peninsula, cereal crops following medic or a grain legume frequently experience high soil nitrogen levels which encourages vigorous early plant growth. These crops can then run out of moisture later in the season if late winter and/or spring rainfall is inadequate to finish the crop. Wide row sowing coupled with lowered seeding rates offers an opportunity for an altered pattern of root growth and moisture use, which may help conserve moisture in the crop inter-row for use later in the season. However, the success of using wide row sowing appears to depend on several seasonal and agronomic features (EPFS Summary 2007, p. 163).

This report follows on from work conducted at MAC in 2006 (EPFS Summary 2006, p. 166). The 2006 season experienced an early break, but then did not see any more rainfall after mid July creating a very dry finish. It is expected that wide rows will show an advantage in this situation, however despite early expectations, wide rows failed to produce any yield benefit over conventional sowing widths and sowing rates. It is suspected that because the season was *so* dry to finish, that any early moisture saved by wide rows was needed earlier, losing the potential for a grain yield or quality advantages come grain fill.

To trial the technique for another season, broadacre trials were sown again at MAC in 2007 to evaluate wide row sowing and reduced seeding rate vs. conventional sowing agronomy. Dean Willmott of Koongawa also set up his own broadacre trial comparing skip row sowing to his conventional sowing practice.

## How was it done?

### *Minnipa Agricultural Centre*

Paddock S6w was selected as a paddock to benefit from wide row and low seeding rate sowing as it was following two successful medic pastures in 2005 and 2006, resulting in soil nitrate levels of 146 kg N/ha pre-seeding. It also had very good soil P levels with a Colwell P of 46 ppm. Paddock N4 was also selected (3$^{rd}$ consecutive cereal) but as a paddock where you would *not* expect a yield benefit from wide rows.

Each trial was sown with five treatments; two row spacings – 30 cm (normal spacing) and 60 cm (double spacing), sown to Yitpi wheat in S6w and Wyalkatchem wheat in N4, at either 30 kg/ha or 60 kg/ha. For the 60 cm spacing, all tines were working but only every second seeding. A fifth treatment used

**Paddock History**
2006: Pasture – spray topped
2005: Wheat
2004: Wheat

**Soil Type**
Red calcareous sandy clay loam to deep siliceous sand

**Soil test**
Gypsum 4 years ago

**Diseases**
Very low levels

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

**Yield Limiting Factors**
Good early growth with poor finish

**Resource Efficiency**
Energy/fuel use: Improved efficiency (Koongawa)
Greenhouse gas emissions ($CO_2$, $NO_2$, methane): Would assume lowered

**Social/Practice**
Time (hrs): Initial machine setup, nil extra thereafter
Clash with other farming operations: nil
Labour requirements: same

**Economic**
Infrastructure/operating inputs: nil
Cost of adoption risk: needs further work
Market stability risk: not applicable

the 60 cm spacing with 30 kg/ha of seed but every second tine was removed, i.e. sowing was at 60 cm row spacing with no inter-row working. Fertiliser was applied with the seed (40 kg/ha of 18:20:00) for all treatments. S6w was sown early in the seeding program on 10 May, and N4 a little later on 17 May.

The bar used was a 30 tine Horwood Bagshaw PSS seeder with 30 cm row spacing. The Morris aircart used has four primary hoses for seed and starter fertiliser and another four hoses for deep banding. Each primary hose supplies a secondary distribution head with either seven or eight outlets to tines. To create the wide rows two additional secondary heads, one seven outlet and the other eight, were installed feeding the odd numbered tines through a D-Cup diffuser with dual hose inputs. Thus to switch between single spacing and double spaced seeding, the operator only had to shift two primary hoses on a common quick coupling. This method is quicker to change (2 minutes) and does not affect air flow as it does when blocking off every other tine. To remove every second tine took 1-1.5 hours.

For both paddocks, treatments were sown as replicated broadacre strips 250 m long. The treatments were monitored for soil moisture at anthesis and maturity, and plant, tiller and head density and dry matter (DM) production from hand cuts at maturity. Small plot header strips of 50 m and farm header strips of 200 m estimated grain yield.

## Koongawa

At Koongawa, Dean chose a paddock which grew a dense medic pasture in 2006 following two cereal crops. The paddock was variable in soil type ranging from red brown sandy clay loam ironstone flats, to red brown sandy loam over orange sandy clay.

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

Kempy sowed six runs for the length of the paddock of skip row sown at 30 kg seed/ha, then six runs of skip row at 60 kg seed/ha, then the remainder of the paddock using standard practice of single row at 60 kg/ha sowing rate.

## What happened?

### *Minnipa Agricultural Centre*

Soil moisture at sowing was plentiful after receiving good opening rains in March (62 mm) and April (40 mm), followed by 33 mm after sowing in May. Rainfall then dropped to a total of 13.6 mm for June, with the only significant rainfall events of 15.2 mm at the start of July, and 11.2 mm mid August. There was virtually no rainfall thereafter.

Table 1 shows plant establishment and final dry matter for both paddocks.

In S6w, establishment was similar for the sowing rates whether sown as single or double rows, with higher plant numbers occurring with the higher seeding rate. However, despite different plant densities between sowing rates for each sowing width, plants were able to compensate and the viable head density was the same for each sowing width. Head density was lower for the double row treatments than single row treatments at both seeding rates. Likewise, final dry matter production was similar for each sowing width treatment, and lower for double rows compared with single rows.

In N4, establishment of double rows was slightly lower than for single rows at both seeding rates. Likewise, head density and final dry matter production of double rows was also lower for each sowing rate in a similar fashion. In this paddock the crop was not able to compensate in head density or dry matter production for different establishment levels.

In S6w, medic still managed to come through in the crop despite a knockdown before sowing and Lontrel on 10 May. Where there was no inter-row working for the double row treatments, medic density appeared much higher.

Mid-season, wide row spacings and lower seeding rate treatments in S6w appeared to be reflecting what would be expected from the sowing changes in a moisture challenged situation, i.e. lower seeding rates and wide row treatments were greener than their conventional counterparts. The wide row, 30 kg/ha treatment with inter-row working appeared to be the tallest and greenest treatment.

Figure 1 shows the plant available water for the treatments in S6w on 17 August, just before anthesis. At this time soil water for the conventional single rows at 60 kg/ha was 77 mm. All other treatments had more water in their profiles with the double rows at 30 kg/ha with inter-row working having the highest water content – 16 mm more than the conventional. This was followed by single rows at 30 kg/ha, with 13 mm more, and remaining treatments with 9 mm more.

In N4, soil water for the conventional single rows at 60 kg/ha was similar at 81 mm. Again, all other treatments had more water in their profiles, the greatest difference with wide row treatments having 10–14 mm more water (wide rows at 30 kg/ha).

By harvest, soil moisture differences had lessened between treatments. Interestingly, the double row, 30 kg/ha sowing rate with inter-row working had more moisture in the profile at the end of the season. It is likely that as water entered the inter-row furrow, a pressure head formed encouraging infiltration to a greater depth, and hence conserved more moisture. Unfortunately though, the crop was not able to utilise this extra water. (NB. Another benefit of an inter-row working is that it provides a furrow to guide skid-guided shield sprayers.)

In S6w, for both harvesting methods, similar grain yield results were measured (Figure 2). The highest yielding treatment was single row, sown at the reduced sowing rate of 30 kg/ha. All other treatments were the same for each harvesting method, i.e. wheat sown at 60 kg/ha sowing rate yielded the same whether sown single or double row. The exception was for the 30 kg/ha double row treatment reapt by the small plot header which was lower yielding. It is possible that the greater density of medic drew moisture from the inter-row and affected yields.

All sowing treatments had protein levels above 16%. Screenings were low for all treatments, with single row treatments averaging 1.3% and double row treatments slightly higher averaging 2.8%. When grain quality was taken into account, the single row sowing at 30 kg/ha had the highest gross income of $255/ha (plus the value of an extra 30 kg/ha of seed saved at sowing time). The single row sowing at 60 kg/ha and the double row sowing with inter-row working treatments at both 60 and 30 kg/ha had similar incomes averaging $218/ha. The double row sowing at 30 kg/ha without inter-row working had a lower gross income at $199/ha.

In N4, grain yields were highest for the single row sown at 60 kg/ha with both headers, and equalled by the single row at 30 kg/ha for the farm header (Figure 3). In this paddock barley grass grew between the double rows, but density did not vary between worked or un-worked inter-rows, and made no difference to grain yield between the double row treatments. In this paddock results were as expected, i.e. did not expect a yield benefit from wide rows.

Gross income was highest for single rows sown with 60 kg/ha seed at $280/ha. All other sowing rates and spacings had gross incomes between $190-$219/ha.

A point to note from the MAC farm reaping experience of wide rows was that an air front would have fed the straw through the comb better than the bat reel used, given the distance between rows and the lightness of the crop.

### *Koongawa – Dean Willmott*

At harvest, the standard sowing practice of single row at 60 kg/ha looked poorer than the skip row at 60 kg/ha - plants were darker indicating that they had matured earlier.

Grain yield increased on all three soil types for skip row sowing compared with single row sowing at 60 kg/ha (Table 2). Reducing seeding rate from 60 kg/ha to 30 kg/ha improved grain yield for skip row sowing on the light soil type only, but made no difference on the intermediate soil type and reduced yield on the heavy soil.

Protein was above 14.5% for all treatments. Screenings varied with soil type across the paddock but were on average under 5%.

***Table 1 Plant growth of wheat sown with single or double row spacing at MAC 2007***

| Paddock | S6W - after 2 medics | | | N4 – 3rd cereal | | |
|---|---|---|---|---|---|---|
| Treatment (Row spacing, sowing rate) | Plant density (plants/m$^2$) | Heads/m$^2$ | Maturity DM (t/ha) | Plant density (plants/m$^2$) | Heads/m$^2$ | Maturity DM (t/ha) |
| **Single row, 60 kg/ha** | 124 | 149 | 2.44 | 121 | 124 | 2.09 |
| **Single row, 30 kg/ha** | 71 | 150 | 2.38 | 108 | 91 | 1.62 |
| **Double row, 60 kg/ha, worked between rows** | 114 | 120 | 2.03 | 104 | 108 | 1.67 |
| **Double row, 30 kg/ha, worked between rows** | 63 | 122 | 1.83 | 67 | 72 | 1.31 |
| **Double row, 30 kg/ha** | 56 | 127 | 1.96 | 57 | 71 | 1.15 |
| *LSD (P=0.05)* | *13* | *26* | *0.39* | *18* | *11* | *0.29* |

With high grain prices, even small yield advantages made a big difference in gross income per ha. For all soil types, by changing from single row to skip row at least an extra $50/ha gross income was made. Changing from 60 kg/ha to 30 kg/ha sowing rate with skip rows however had a more variable outcome (Table 3).

The machine changeover was very quick and Kempy reported that the tractor was using considerably less fuel with one third of the tines lifted. Dean chose to do it this way because he had seen the benefit to having the rows next to the tram lines over a number of years and if shrouded sprayers became an option he would need a lot less shrouds compared to if he had lifted every second tyne.

At this stage Dean is experimenting with the idea, as it is obvious weeds could be a problem (hence the choice of clearfield Stiletto). If the wide row sowing technique can be refined and proven to have reliable yield benefits in dry years then he would consider sowing a small percentage of his sowing program each year as part of his risk management.

## What does this mean?

For the last two seasons on the MAC farm, despite wide rows showing initial promise, i.e. were lusher while single rows were tipping off, wide rows have not offered a yield or grain quality advantage over single row spacing. It is likely that the dryness of the finishes was too harsh to realise any yield benefits – a single rain event could have been enough to allow them to capitalise on their healthier status.

In addition, one of the criteria deduced from previous research elsewhere for wide row sowing is to have a maximum root profile from 30 cm – 80 cm. In general, all MAC paddocks have layers of boron and salt from 60 cm down. S6w has toxic boron levels and moderate salt levels below 50 cm. It may be that our hostile subsoils on EP are going to limit the soil

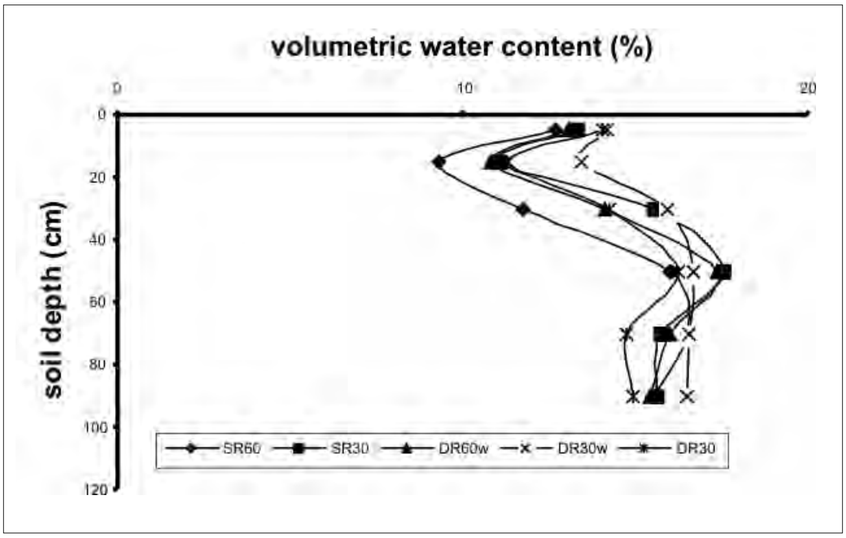



***Figure 1 Soil moisture content pre-anthesis, S6w MAC 2007.***

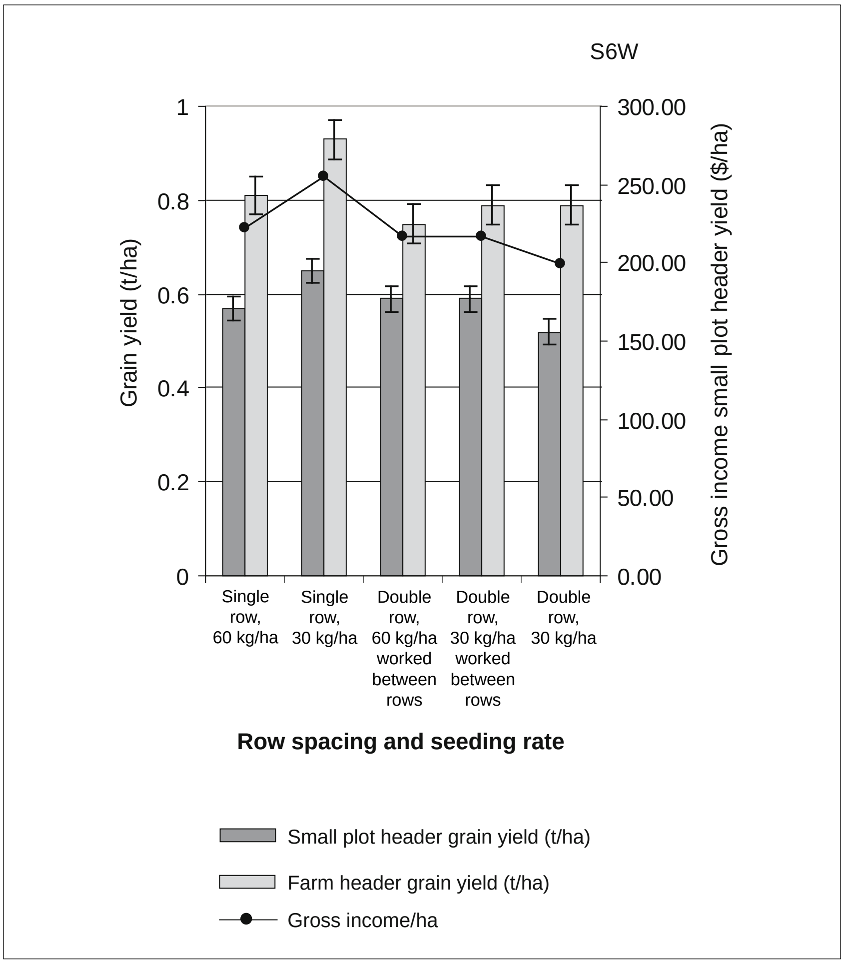



***Figure 2 Grain yield and gross income of Yitpi wheat sown with different sowing rates and row spacing in paddock S6w, MAC 2007.***

Tillage

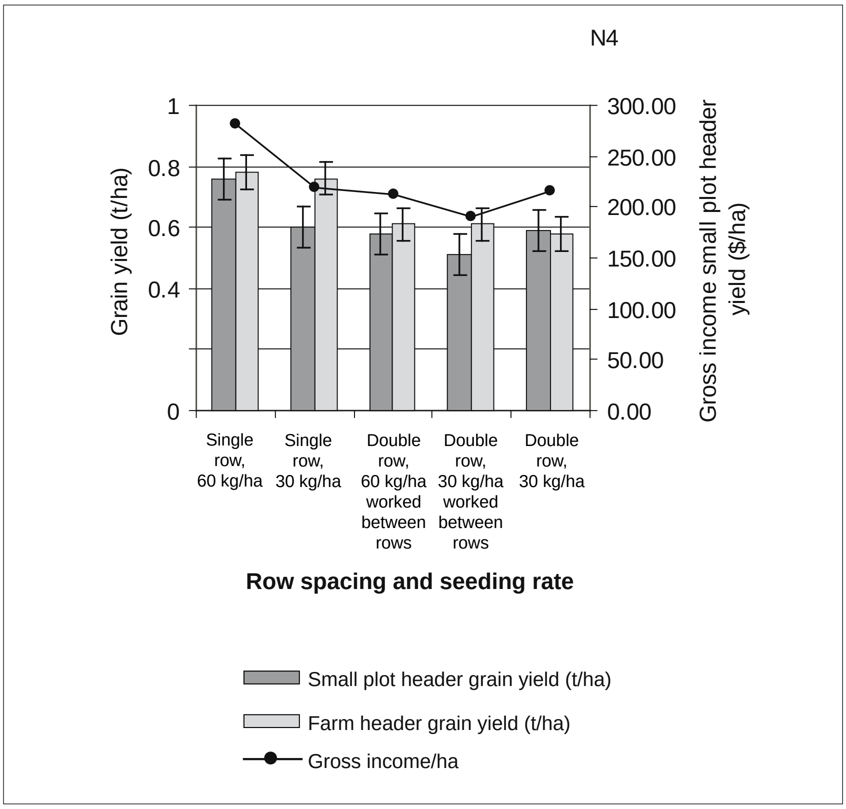



***Figure 3** Grain yield and gross income of Wyalkatchem wheat sown with different sowing rates and row spacing in paddock N4, MAC 2007.*

***Table 2** Grain yield for cf Stiletto wheat on different soil types and sowing regimes, Koongawa 2007*

| | Grain Yield (t/ha) | | |
|---|---|---|---|
| **Sowing Treatment** | **Heavy soil** | **Intermediate soil** | **Light sandy soil** |
| **Skip row, 30 kg/ha** | 0.28 | 0.23 | 0.75 |
| **Skip row, 60 kg/ha** | 0.38 | 0.22 | 0.48 |
| ***P for T-test*** | *0.05* | *ns* | *0.01* |
| **Skip row, 60 kg/ha** | 0.24 | 0.33 | 0.52 |
| **Single row, 60 kg/ha** | 0.10 | 0.10 | 0.37 |
| ***P for T-test*** | *0.08* | *0.00* | *0.03* |

***Table 3** Gross income of cf Stiletto wheat on different soil types and sowing regimes, Koongawa 2007*

| | Gross Income ($/ha) | | |
|---|---|---|---|
| **Sowing Treatment** | **Heavy soil** | **Intermediate soil** | **Light sandy soil** |
| **Skip row, 30 kg/ha** | 106 | 87 | 285 |
| **Skip row, 60 kg/ha** | 144 | 84 | 182 |
| ***$ difference*** | *-38* | *3* | *103* |
| **Skip row, 60 kg/ha** | 91 | 125 | 198 |
| **Single row, 60 kg/ha** | 38 | 38 | 141 |
| ***$ difference*** | *53* | *87* | *57* |

water storage capacity and hence usefulness of wide row sowing.

It is worthy to note though, that by keeping sowing rates the same but widening the sowing width, yields were not penalised in 2007 on a paddock suitable for wide row sowing – the change had not put the system at risk. On a paddock not suitable for wide row sowing, yields did suffer.

At Koongawa skip row sowing showed some promise in 2007, even though the heavier ground at this site would more than likely have some subsoil constraints occurring between 30–80 cm deep.

Further research into wide rows is needed over more sites and seasons before a firm conclusion can be made about the place for wide row sowing in EP farming systems.

## References

Wide Crop Rows in Wheat at Minnipa Agricultural Centre, B. Frischke, B. McEvoy and S. Moroney (2007), Eyre Peninsula Farming Systems Summary 2006, pp. 166-168.

## Acknowledgements

We would like to thank Brett McEvoy, Shane Moroney, Mark Klante, Brenton Spriggs, Jon Hancock, Wade Shepperd and Ian Richter for their efforts in trial management, and soil moisture and harvest evaluation.

Thanks to SARDI and the SA Government Drought Response Team for funding the EP research.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

DROUGHT RESPONSE SOUTH AUSTRALIA

# Inter-Row Sowing


## Michael Bennet and Amanda Cook

SARDI, Minnipa Agricultural Centre


Research

## Key messages

- **Inter-row sowing can provide yield benefits in certain situations, but it is not a silver bullet.**
- **Stubble handling is improved with inter-row sowing.**

## Why do the trial?

The concept of sowing between stubble rows or inter-row sowing attracted a lot of interest in 2004 following trial work at Sandilands on Yorke Peninsula by Jack Desbiolles and Matt McCallum. Substantial yield benefits with inter-row sowing were obtained in these trials and these benefits were attributed to lower levels of root disease, mainly crown rot. Following these encouraging results, trials were established at Kimba to test whether similar benefits could be realised in a low rainfall farming system.

Previous results from inter-row sowing on Eyre Peninsula are reported in the EPFS Summary 2006, pp. 173-175 and EPFS Summary 2005, p. 136.

## How was it done?

### *Kimba*

Inter-row sowing trials were sown with a six row plot seeder on 3 May with 60 kg/ha of Wyalkatchem wheat. One half of each plot received 50 kg/ha of 18:20:00 while the other half received no fertiliser. Fertiliser was withheld from one half of the trial to test how well wheat could access residual nutrition when seeded with precision row placement. The trials were sown using gps-Ag 2cm RTK autosteer.

Two separate trials were sown, one on 23 cm (9") row spacings and the other on 28 cm (11") row spacings. Three row orientations were used in the 28 cm row trial:

- ***"On-row"*** The 2007 crop row was sown into the stubble of the two previous seasons' crops.
- ***"Inter-row"*** The 2007 crop row was sown between the 2006 stubble rows, but into any remaining stubble from 2005.
- ***"One-third"*** The 2007 crop row was sown to one side of the 2006 stubble, avoiding the residue from 2005.

Due to the narrower row spacing of the 23 cm trial, only the "On-row" and "Inter-row" treatments were used in that situation.

A comparison between discs and knife points was also made in the 28 cm trial. Primary Sales knife points and boots with Agmaster press wheels were compared to Yetter coulters, K-Hart discs and press wheels.

Treatments were monitored for plant establishment, disease level, harvest index and grain yield and quality.

### *Minnipa*

MAC paddock South 5 was sown with a Gason 9 m seeder (Beeline 2 cm RTK autosteer) set on 23 cm row spacings with knife points and press wheels, 55 kg/ha of Clearfield Stiletto wheat and 40 kg/ha of DAP on 16 May. Alternate seeder runs were seeded either on-row or inter-row. Four areas within this paddock were monitored for plant establishment, disease level, harvest index and yield in both row orientations.

**Try this yourself now**

**Location: Kimba**
Trevor Cliff
BIG FIG

**Rainfall**
Av. annual: 341 mm
Av. GSR: 247 mm
2007 total: 319 mm
2007 GSR: 181 mm

**Yield**
Potential: 1.86 t/ha
Actual: 1.62 t/ha

**Paddock History**
2006: Wheat
2005: Wheat
2004: Wheat

**Soil Type**
Red clay loam

**Plot size**
12 m x 1.5 m x 4 reps

**Yield Limiting Factors**
Moisture, hot spring

**Location**
Minnipa Agricultural Centre
Paddocks S5

**Rainfall**
Av. annual: 325 mm
Av. GSR: 242 mm
2007 total: 286 mm
2007 GSR: 141 mm

**Yield**
Potential: (W) 1.44 t/ha
Actual: 0.71 t/ha

**Paddock History**
*S5*
2006: Pasture
2005: CL Janz
2004: CL Stilleto

## What happened?

In 2007 emergence was the same for all row positions in both Kimba trials (Tables 1 and 2). Establishment was similar for both row orientations in 2005 and 2007, the years were characterised by low levels of residue compared to 2006 where stubble loads were high.

However, emergence was higher with the knife point press wheel system compared to the disc system, with 123 and 107 plants/m$^2$ respectively for 28 cm spacing. The differences in plant emergence between the sowing systems occurred irrespective of row orientation. However, these differences did not translate into yield differences at harvest, with both sowing systems having similar yields.

A yield benefit from inter-row sowing occurred in the 23 cm trial, but only in 2006.

Early growth of wheat on 28 cm rows was better with inter-row sowing than on-row in 2007. Inter-row sowing also yielded higher than both on-row and one-third row placement in the 28 cm row spacing trial in 2007, but not in 2006 (Table 2).

Applying fertiliser in 2007 did not affect wheat growth in either trial, regardless of row position (Table 3). This indicates that soil reserves were sufficient to grow the crop without applied fertiliser and row alignment did not appear to improve access to the residual nutrition. However, grain protein increased to 13.7% where fertiliser had been applied compared to 13.1% where none had been used (data not shown).

## What does this mean?

Despite the presence of Take-all and Crown rot in low levels at the Kimba site, positive responses in emergence were measured in situations with high levels of stubble and narrow row spacing. Row orientation, which decreases the severity of these two diseases, was a contributing factor in the increased yield measured at the Sandilands site.

Positive yield responses for inter-row sowing were measured in two experiments out of the five reported here. The experiences at Kimba highlight that inter-row sowing is not a silver bullet. In many situations (relatively low stubble levels, low soil-borne disease levels, good seed bed moisture and reasonable soil fertility) precision row placement may provide very few benefits to grain yields. However, if any of these factors are present, then it is more likely that this technology may be of benefit to crop performance. Where soil fertility is low or seed bed moisture is marginal and stubble levels are manageable, on-row seeding may help establishment, early vigour and perhaps grain yield at the end of the season.

Conversely, if stubble levels or inoculum of Take-all or Crown rot are high, then inter-row sowing may be advantageous. To fully realise the benefits of precision row placement, each paddock must be individually assessed for the likely pressures on crop performance, so that the appropriate strategy can be used.

It may be that for many paddocks in most seasons on upper Eyre Peninsula, there may be little difference in the yield performance of cereal crops whether they are sown with precision row placement or not. However, only a small yield increase on the occasional paddock every now again will still provide a reasonable return on the investment in precision row placement.

The Kimba site was unresponsive to fertiliser in 2007, so it was not possible to test how well wheat could access residual nutrition when seeded with precision row placement.

***Table 1 Establishment and yield – 23 cm row spacing, Kimba 2005–2007***

| Row | 2005 | | 2006 | | 2007 | | |
|---|---|---|---|---|---|---|---|
| Orientation | Plants/m$^2$ | Yield (t/ha) | Plants/m$^2$ | Yield (t/ha) | Plants/m$^2$ | DM (t/ha) | Yield (t/ha) |
| **On-row** | 166 | 2.82 | 131 | 0.09 | 125 | 4.36 | 1.62 |
| **Inter-row** | 152 | 2.79 | 141 | 0.13 | 129 | 4.48 | 1.62 |
| *LSD (P=0.05)* | *ns* | *ns* | *9.5* | *0.03* | *ns* | *ns* | *ns* |

## Acknowledgements

Thanks to Jack Desbiolles and Dean Thiele from UniSA-AMRDC for sowing the trial, gps-Ag and Beeline for supplying the RTK autosteer and Trevor Cliff for the use of his land. Thanks to SAGIT, National Landcare Programme, Buckleboo Farm Improvement Group and SANTFA for funding the three-year trial.

SAGIT

BUCKLEBOO FARM IMPROVEMENT GROUP

Australian Government
Department of Agriculture, Fisheries and Forestry
National Landcare Program

SANTFA
SOUTH AUSTRALIAN NO-TILL FARMERS ASSOCIATION

***Table 2 Establishment and yield – 28 cm row spacing (average of knife points and discs, Kimba 2007***

| Row | 2006 | | 2007 | | |
|---|---|---|---|---|---|
| Orientation | Plants/m$^2$ | Yield (t/ha) | Plants/m$^2$ | DM (t/ha) | Yield (t/ha) |
| **On-row** | 112 | 0.15 | 108 | 3.65 | 1.50 |
| **Inter-row** | 108 | 0.15 | 116 | 4.25 | 1.58 |
| **One-third** | 110 | 0.16 | 121 | 4.15 | 1.50 |
| *LSD (P=0.05)* | *ns* | *ns* | *ns* | *0.51* | *0.07* |

***Table 3 Yield response to application of fertiliser in 23 cm and 28 cm trials, Kimba, 2007***

| | 23 cm trial | | 28 cm trial | |
|---|---|---|---|---|
| | 50 kg/ha DAP | No Fertiliser | 50 kg/ha DAP | No Fertiliser |
| **On-Row** | 1.62 | 1.62 | 1.52 | 1.48 |
| **Inter-Row** | 1.63 | 1.61 | 1.55 | 1.62 |
| **One-Third** | - | - | 1.53 | 1.48 |
| *LSD (P=0.05)* | *ns* | | *ns* | |

***Table 4 Effect of inter-row sowing on wheat at Minnipa paddock South 5 in 2007***

| Row | Fertile tillers/m$^2$ | Infertile tillers m$^2$ | Rhizoctonia root score | Plants/m$^2$ | DM (t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|---|
| **On-Row** | 165 | 104 | 1.7 | 131 | 3.7 | 0.66 |
| **Inter-Row** | 133 | 85 | 2.02 | 122 | 2.8 | 0.52 |
| *LSD (P=0.05)* | *ns* | *ns* | *ns* | *ns* | *ns* | *ns* |

# No-till on Stony Soils

**Michael Bennet**
SARDI, Minnipa Agricultural Centre

Research

**Almost ready**

**Location: Colton**
Darren Sires
Elliston Ag Bureau

**Rainfall**
Av. annual: 370 mm
Av. GSR: 275 mm
2007 total: 305 mm
2007 GSR: 245 mm

**Yield**
Potential: 2.79 t/ha
Actual: 0.60 t/ha

**Paddock History**
2006: Oat pasture
2005: Grassy pasture
2004: Grassy pasture

**Soil Type**
Shallow grey calcareous loam over limestone and grey calcareous loam.

**Plot size**
30 m x 1.5 m x 4 reps

**Yield Limiting Factors**
Late sowing, moisture, polyphrates weevil damage.

## Key message

- **No-till can be achieved on stony soils, however seed placement is critical.**

## Why do the trial?

Sowing on stony soils, particularly with knife points, presents many challenges to growers. Achieving good seed placement while minimising machinery damage is a considerable obstacle for no-till on stony soils. The trial aimed to assess no-till and conventional systems on their ability to handle stony sowing conditions.

## How was it done?

The trial was sown at Colton, north of Elliston, using a 6 row plot seeder set on 25.4 cm (10") row spacings and sowing 50 kg/ha of Wyalkatchem wheat with 50 kg/ha of DAP.

The trial was sown in to good moisture conditions on 6-7 June, which rapidly dried out post-sowing. Long plots were sown over two soil types, a shallow limestone reef and a calcareous sandy loam flat, using autosteer technology. This allowed a comparison between stony and good seeding conditions, representing a mix many growers face each year. The trial area was stone rolled prior to sowing to provide an even surface and again post emergence to reduce harvest problems.

Six different soil openers were compared in the experiment including DBS, Conservapak, Agmaster, full cut sweep, K-Hart disc and "Rock Hopper." An innovative design, the "Rock Hopper" features a backward rake angle, which rides over rocks and pushes them down, rather than lifting rocks to the surface. This action may, in some soil types and moisture conditions, lead to seed row compaction and smearing, which can adversely affect crop growth. This could be a minor compromise for particularly bad stony paddocks.

## What happened?

Despite fearing the worst, there were no casualties from the stony soils program. There were visions of broken tines, points and boots, as well as severely twisted and shattered machinery frames, which thankfully did not eventuate. Unfortunately, it was that fear which led to a very shallow seeding tactic being employed at this site, which was detrimental when the soil surface dried out post-sowing.

There were differences observed between the various seeding systems with the amount of stone brought to the surface. The disc units were exceptional at leaving the majority of stone underground, however they dislodged some small stones along the path of the coulters. The "Rock Hopper" point brought the least stone to the surface of the point systems, however still dislodged stone along the path of the point. When working deeper with point systems the amount of stone dislodged increased sharply. Increasing the speed of sowing also contributed to greater amounts of stone being lifted to the surface. The conventional treatment still lifted stone to the surface, however the star harrows covered some and pushed others into the soft soil.

The impact of sowing speed was investigated in the trial by using contrasting speeds of 6 and 8 km/hr in several treatments (Table 1).

Increased sowing speed did not change crop emergence in this situation. However, the increased sowing speed resulted in more tripping action of the tines, which in turn raised more stones increasing the wear on points and boots.

No differences were measured between hydraulic systems and spring tine seeding systems.

The disc system produced similar yields to other treatments, except for the deep working treatments 5 and 8 (Table 1). These were the only treatments to have better establishment than the disc system. Like all of the no-till systems in hindsight, the K-Hart should have been set to target deeper sowing depth, which may have improved the final result.

## What does this mean?

The problem with many "standard" no-till systems is the point is often set up to work well below the seed, requiring a reasonable working depth of the point in order to achieve the desired seeding depth. One option for growers to reduce machinery damage at seeding is to set their sowing boots for reduced tillage depth. This option could be especially useful particularly for stony paddocks, however care needs to be taken to make sure that adequate seeding depth is still achieved despite the shallow working.

Many of the shallow working treatments in this trial suffered a yield penalty due to poor seed placement; moderate boot adjustments may have improved the situation.

Many growers find hydraulic tines are generally the best choice for stony soils. The main reason for the adoption of hydraulic tines is the smoother recoil speed compared to spring tines. This results in less stress applied to the tines, points and boots. Disc units can be equally successful on stony soils but with the advantage of less stone brought to the surface. Aspects such as wear and machinery maintenance are well outside the scope of small plot trials.

Independent sowing systems such as the Conservapak, DBS and Agmor allow tillage depth to be reduced over stony outcrops, while sowing depth remains relatively unchanged. This allows machinery wear to be greatly reduced while still placing seed in the soil.

***Table1 Wheat performance with different seeding systems at Colton in 2007***

| Treatment | Opener | Boot | Setting | Depth | Plants/m$^2$ | | DM (t/ha) | | Yield (t/ha) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (mm) | Soil | Stone | Soil | Stone | Soil | Stone |
| 1 | K-Hart | | 6 km/h | 22 | 101 | 41 | 1.35 | 0.53 | 0.34 | 0.23 |
| 2 | K-Hart | | 9 km/h | 21 | 89 | 55 | 1.31 | 0.69 | 0.35 | 0.21 |
| 3 | 12 mm point | Flexi Boot | Work Shallow | 22 | 100 | 42 | 1.17 | 0.61 | 0.38 | 0.24 |
| 4 | 12 mm point | Flexi Boot | Work Shallow + 8 km/h | 19 | 63 | 59 | 1.22 | 0.62 | 0.35 | 0.27 |
| 5 | 12 mm point | Flexi Boot | Work Deep | 26 | 131 | 103 | 1.47 | 0.91 | 0.41 | 0.30 |
| 6 | 12 mm point | Agmor | Work Shallow | 21 | 85 | 56 | 1.09 | 0.49 | 0.28 | 0.21 |
| 7 | 12 mm point | Agmor | Work Shallow + 8 km/h | 22 | 79 | 32 | 1.08 | 0.59 | 0.28 | 0.23 |
| 8 | 12 mm point | Agmor | Work Deep | 35 | 109 | 78 | 1.27 | 0.49 | 0.45 | 0.32 |
| 9 | Rock Hopper | Agmor | Work Shallow | 22 | 77 | 39 | 0.99 | 0.41 | 0.25 | 0.17 |
| 10 | Rock Hopper | Agmor | Work Shallow + 8 km/h | 22 | 44 | 32 | 0.76 | 0.48 | 0.16 | 0.12 |
| 11 | Rock Hopper | Agmor | Work Deep | 24 | 123 | 37 | 1.10 | 0.65 | 0.31 | 0.20 |
| 12 | Sweeps | Agmor | Agmor Boots + Star Harrows | 50 | 95 | 55 | 1.19 | 0.50 | 0.32 | 0.19 |
| 13 | Conservapak | High Breakout | Work Deep | 32 | 103 | 57 | 1.21 | 0.70 | 0.35 | 0.29 |
| 14 | DBS | Low Breakout | Work Deep | 25 | 59 | 36 | 0.96 | 0.51 | 0.29 | 0.19 |
| 15 | DBS | High Breakout | Work Shallow | 31 | 68 | 44 | 1.16 | 0.45 | 0.35 | 0.26 |
| *LSD (P=0.05)* | | | | | *43* | *32* | *ns* | *ns* | *0.08* | *0.07* |

Tillage

An alternative point design not used in the trial is the Canadian manufactured "Atom Jet". A seed outlet is incorporated in the back of the point, therefore reducing the requirement for deeper working of the point to achieve seeding depth. The stony soils trials are likely to continue in 2008, and are anticipated to include the "Atom Jet" design to compare with locally manufactured equipment.

## Acknowledgements

Darren Sires for use of his land and machinery. Elliston Ag Bureau for enthusiastic input. National Landcare Program and SANTFA for funding. David Brands, Nigel Wilhelm and Brenton Spriggs for technical assistance. Thanks to Conservapak, K-Hart, Agmaster, Flexi-Coil and CASE IH for use of equipment for the purposes of the trial. Special thanks to Dr Jack Desbiolles from UniSA for his help with equipment and design of the trial. Thanks also to Matt Cook for loaning his Flexi Coil Tines for use in the trial.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Australian Government
Department of Agriculture, Fisheries and Forestry
National Landcare Program

SANTFA
SOUTH AUSTRALIAN NO-TILL FARMERS ASSOCIATION

# Types of work in this publication

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

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

# Managing Water Repellent Sands

**Michael Bennet**
SARDI, Minnipa Agricultural Centre

Research

## Key messages

- **Use wide press wheels on deep sand to avoid excessive furrow in-fill.**
- **Crop competition is critical to reduce the impact of brome grass.**
- **Soil wetters were ineffective in 2007.**

## Why do the trial?

The management of water repellent sands represents a significant challenge in terms of establishing crops while reducing the risk of wind erosion. Achieving satisfactory emergence can be difficult, especially with a poor break to the season. The aim of this trial was to further investigate seeding modifications to improve establishment on these problematic water repellent sands. Results from the first season were reported in the EPFS Summary 2006, pp. 176–177.

## How was it done?

The trial was sown between the 30 May and 1 June on a strongly repellent sand at Wharminda. A six row plot seeder set on 25.4 cm (10”) row spacings was used to sow 60 kg/ha of Wyalkatchem wheat and 60 kg/ha of 18:20:00 deep banded. A range of different tillage systems were used in the trial, from K-Hart discs to flexi-coil and Conservapak tine units. Soil wetters were applied through a fluid delivery system, in a continuous stream behind the press wheels. The soil wetters were used with a 16mm knife point + press wheel system. Measurements taken throughout the season included plant establishment, seeding depth, dry matter and grain yield. The level of brome grass was estimated by cleaning the harvest sample of wheat grain and calculating how many seeds were present per half litre of wheat.

## What happened?

The trial was sown in good moisture conditions but at a time when the majority of growers in the district were finishing their seeding programs. The site did not suffer severe wind erosion post sowing and the trial was able to emerge and develop substantial ground cover prior to any windy weather.

Seeding depth had a major impact on emergence, crop growth and final grain yield (Figure 1). Furrow collapse in the Conservapak system resulted in the targeted depth of 30-40 mm becoming 80-100 mm. This severely decreased both emergence and crop growth, which resulted in increased competition from brome grass. The Conservapak units were fitted with standard narrow profile plastic press wheels, which failed to maintain furrow structure post-sowing. Many growers who use the Conservapak system on sandy soils purchase the units fitted with wider Manutec style press wheels. The standard knife point + press wheel treatments were sown with 70 mm wide Agmaster press wheels and did not suffer excessive furrow collapse. The Concord-Anderson system did not suffer from furrow collapse either, and is not expected to with 165 mm wide press wheels.

**Almost ready**

**Location: Wharminda**
Tim Ottens
Wharminda/Arno Bay Ag Bureau

**Rainfall**
Av. annual: 322 mm
Av. GSR: 222 mm
2007 Ttotal: 246 mm
2007 GSR: 152 mm

**Yield**
Potential: 1.16 t/ha
Actual: 0.6 t/ha

**Paddock History**
2006: Pasture
2005: Schooner barley
2004: Frame Wheat

**Soil Type**
Deep siliceous sand

**Plot size**
40 m x 1.5 m x 4 replications

**Yield Limiting Factors**
Late sowing and drought

The highest emergence occurred in the K-Hart disc units, which achieved a seeding depth of 60 mm (Table 1). This level of emergence was similar to the plots sown with the Concord – Anderson system or knife point + rotary harrows. However, the good establishment with Anderson, K-Hart and rotary harrow treatments did not improve grain yields over the standard no-till treatments.

With the exception of the shallow setting, the Conservapak plots were generally uncompetitive with brome grass due to excessive sowing depth and poor emergence resulting in poor early vigour. This is especially evident when comparing the shallow setting with the deep working. The deep working resulted in 22 mm deeper sowing depth, less crop emergence and greater contamination of brome grass; 902 seeds/½ L up to 1923 seeds/½ L.

Sweeps + Rotary Harrows had a higher level of brome grass contamination than many of the no-till treatments. This is due to the combination of deep sowing depth (operator error), poor early vigour and increased soil disturbance from the seeding pass.

The use of soil wetters had no impact on grain yield or dry matter production (Table 2) but emergence was reduced in several of the wetter treatments. The shallow planting depth (<20 mm) may haven resulted in direct contact with the soil wetters which may have contributed to the negative impact that some of the soil wetter treatments had on crop establishment.

## What does this mean?

Sowing with the K-Hart disc gave excellent results for emergence, however did not achieve a higher yield than other no-till treatments in the trial. It did, however provide excellent emergence with less disturbance than a standard no-till system, which could prove highly advantageous in situations of post sowing wind erosion.

Using low disturbance systems that resulted in good emergence, such as the K-Hart disc and other no-till systems, resulted in reduced brome grass contamination at harvest.

Soil wetters were ineffective at Wharminda during 2007.

Clay spreading still remains the best agronomic solution for water repellent sands but requires a large investment of time and money up front. The availability of suitable clay in some areas is also limited.

***Table 1 Performance of wheat with different sowing systems on water repellent sand at Wharminda in 2007***

| Treatment* | Modification | Seeding Depth (mm) | Emergence (plants/m$^2$) | Anthesis DM (t/ha) | Brome (seeds/½L) | Grain Yield (t/ha) |
|---|---|---|---|---|---|---|
| KPPW | 12 mm point | 29 | 84 | 1.52 | 297 | 0.53 |
| KPPW | 16 mm point | 38 | 99 | 1.02 | 196 | 0.56 |
| KPPW | 16 mm point + snake chains | 38 | 102 | 1.62 | 138 | 0.61 |
| KPPW | 16 mm point + light chain | 39 | 87 | 1.48 | 312 | 0.52 |
| KPPW + RH | Incorporation of seed behind press wheels | 30 | 84 | 1.26 | 431 | 0.48 |
| KPPW | Concord – Anderson System (165 mm seed spread) | 36 | 157 | 0.90 | 606 | 0.37 |
| KPPW | Work shallow, sow at cultivation depth (seed down deep band boot) | 51 | 97 | 1.14 | 373 | 0.40 |
| K-Hart | Double Shoot | 64 | 160 | 1.22 | 382 | 0.50 |
| K-Hart | Single Shoot | 60 | 165 | 1.18 | 251 | 0.47 |
| KPPW | Work up then sow with points | 54 | 97 | 1.30 | 234 | 0.59 |
| KP + RH | | 49 | 136 | 1.31 | 751 | 0.46 |
| Sweeps + RH | | 105 | 101 | 0.99 | 999 | 0.37 |
| Conservapak | Paired Row | 114 | 63 | 0.57 | 1114 | 0.28 |
| Conservapak | Setting 8 (Deep) | 100 | 51 | 0.39 | 1366 | 0.17 |
| Conservapak | Setting 5 (Medium) | 83 | 70 | 0.70 | 1534 | 0.33 |
| Conservapak | Setting 3 (Shallow) | 78 | 75 | 0.55 | 902 | 0.34 |
| Conservapak | Work deep, sow at setting 3 | 100 | 56 | 0.52 | 1923 | 0.19 |
| Conservapak | Work to 30 mm, sow at setting 5 | 46 | 86 | 0.90 | 491 | 0.39 |
| *LSD (P=0.05)* | | - | *28* | *0.46* | *739* | *0.21* |

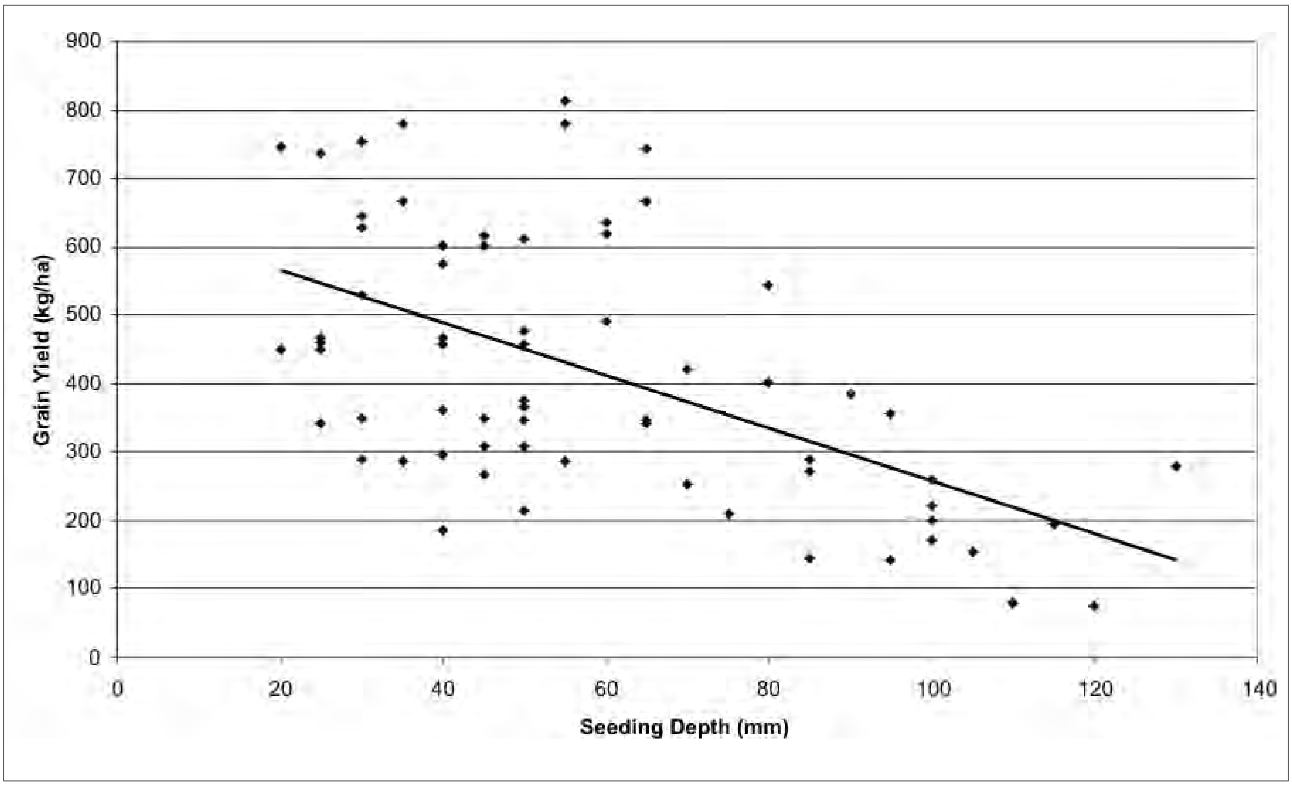



***Figure 1 Seeding depth impact with different sowing systems on grain yield of wheat at Wharminda in 2007.***

***Table 2 Effect of soil wetters on wheat performance at Wharminda***

| Product | Rate (L/ha) | Emergence (plants/m$^2$) | Anthesis DM (t/ha) | Grain Yield (t/ha) |
|---|---|---|---|---|
| **Wettasoil** | 0.75 | 101 | 1.06 | 0.50 |
| **Wettasoil** | 1 | 128 | 0.88 | 0.30 |
| **Wettasoil** | 1.5 | 112 | 0.80 | 0.27 |
| **Irrigator** | 0.25 | 111 | 0.57 | 0.40 |
| **Irrigator** | 0.5 | 139 | 0.80 | 0.30 |
| **Irrigator** | 0.75 | 97 | 0.71 | 0.34 |
| **BS1000** | 0.25 | 109 | 1.04 | 0.37 |
| **BS1000** | 0.5 | 120 | 0.46 | 0.28 |
| **BS1000** | 0.75 | 107 | 0.91 | 0.35 |
| **Control** | 0 | 146 | 1.07 | 0.42 |
| *LSD (P=0.05)* | | *31* | *ns* | *ns* |


## Acknowledgements

Tim Ottens for use of his land and machinery. Wharminda/Arno Bay Ag Bureau for enthusiastic input. National Landcare Program and SANTFA for funding. David Brands, Ben Ward and Brenton Spriggs for technical assistance. Thanks to Conservapak, K-Hart, Agmaster, Flexi-Coil and CASE IH for use of equipment for the purposes of the trial.


SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Australian Government

Department of Agriculture, Fisheries and Forestry
National Landcare Program

SANTFA

# Breeding for Improvement in Weed Competitive Ability in Wheat

Research

**Michael Zerner and Gurjeet Gill**

University of Adelaide, Roseworthy Campus

## Key messages

- **Herbicide resistance means weed management strategies need to be reconsidered and more integrated approaches followed, increasing the importance of crop competitiveness with weeds.**
- **Plant traits associated with increased early plant vigour increase the competitive ability of wheat (early leaf area development, tiller number, canopy leaf area and plant height).**
- **Over 6000 lines of highly competitive wheat cultivars are currently being evaluated at Roseworthy.**

## Why do the research?

Many current Australian wheat varieties compete poorly with weeds. This is a concern for farmers considering the prevalence of herbicide resistant weeds, notably annual ryegrass, which is strongly competitive with wheat. The University of Adelaide and CSIRO Plant Industry are collaborating to develop wheats with superior competitiveness against weeds. This is being achieved through plant breeding based on an understanding of the traits important to competitiveness.

## How was it done?

Previous research has identified that traits which increase light interception during early crop development improve wheat's ability to tolerate and suppress weeds.

A doubled haploid population of wheat was created from a cross between 'Vigour 18' (tall, high vigour wheat) and 'Chuan-Mai 18' (short, high vigour wheat) which contains the dwarfing gene *Rht8*. This gene will reduce plant height without adverse effects on leaf growth, unlike the current dwarfing genes used in most commercial wheat cultivars. Furthermore, this created a population containing a large, genetically diverse range of vigour-related traits. This allowed competitive studies to further characterise the contribution of different traits to the competitive ability in wheat.

## What does this mean?

Plant traits found to contribute to competitive ability include crop height, tiller number, light interception, leaf size and early vigour. Although this material showed improved competitive ability, most lines lacked general agronomic characteristics (susceptible to lodging, grain shedding, disease and grain quality), leading to the current breeding approach.

The top performing lines in terms of weed tolerance (low crop yield loss) and suppression (low weed growth and seed-set) were selected. These lines have since been incorporated into two current breeding streams aimed at improving agronomic, disease and grain quality while maintaining high vigour.

The first stream involves twelve elite early vigour lines, which were crossed to a range of commercial varieties (Annuello, Wyalkatchem, Yitpi, Lang, Sunvale and Sunstate). From these crosses, three thousand five hundred lines were grown and assessed at Roseworthy during 2007.

The second breeding stream aimed to exploit vigour beyond that of 'Vigour 18' by using recurrent selection and to introduce alternative dwarfing genes, *Rht12* and *Rht13*, in addition to *Rht8*. This material was also top-crossed to the same commercial varieties, creating three thousand lines. These lines were grown during 2006 and assessed for a wide range of plant characteristics, including early vigour. The best material in terms of early vigour will be selected from both streams and used to determine the gains made in weed tolerance and suppression ability within the program.

Wheat lines are grown with and without weeds to evaluate their ability to tolerate and suppress weeds. In much of the recent work, oats has been used as the competitor, as they are much more competitive with wheat than ryegrass. This research has found that breeding lines have a consistent response to different weed species so a line highly competitive with ryegrass will also be more competitive against wild oats or mustard.

## Acknowledgements

This research was funded by the Grains Research and Development Corporation (GRDC).

THE UNIVERSITY OF ADELAIDE AUSTRALIA

GRDC Grains Research & Development Corporation

# Marshmallow Control

**Michael Bennet**
SARDI, Minnipa Agricultural Centre

Research

## Key messages

- **Target marshmallow while small to reduce the overall herbicide rates required.**
- **Sprayseed was ineffective on cotyledon-stage marshmallow, yet effective on two leaf marshmallow.**

## Why do the trial?

Marshmallow (*Malva parviflora*) is a weed that has grown in importance in recent years with the increase in adoption of no-till. Marshmallow is an extremely hardy weed that, if left unchecked, will develop a strong deep taproot which requires robust rates of herbicides or cultivation for effective control.

In 2006, marshmallow germinated with early rains and were large by the time seeding knockdown herbicides were applied. After a major rainfall event in March 2007 at Minnipa, the opportunity was taken to compare early chemical control methods for this weed.

Many growers use "spikes" in their glyphosate knockdowns to improve weed brown out and final kill. Glyphosate by itself is usually weak on marshmallow, requiring the addition of another herbicide to improve control levels. The trial was done to evaluate the cost effectiveness of various combinations of herbicides.

## How was it done?

The treatments were applied to marshmallow which had emerged from the heavy rains received on 23 March. The first treatments were sprayed on 30 March at the cotyledon stage, and one week later (5 April) the same treatments were applied to larger plants with two true leaves.

A hand boom was used with 11001 Turbodrop Airmix nozzles, calibrated to deliver 75 L/ha at a pressure of 3 bar at walking pace.

All treatments were sprayed late in the afternoon, not the ideal time to spray, however still within acceptable delta T ratings (Table 1). However, at the later timing (two true leaves), marshmallow plants were beginning to show signs of stress as the soil surface was drying out.

A base rate of only 600 mL/ha glyphosate was used to emphasise the performance of the additional herbicides and also to account for the weeds being sprayed early.

Weed control was measured by an assessment of brown out, expressed as a percentage and by counting the number of surviving weeds on 4 May, which was 35 (cotyledon stage) and 29 (two true leaves) days after application (DAA) (Table 2).

## What happened?

The rates of herbicide used at both timings were too low for a 100% kill of the marshmallow, however, the herbicides slowed growth enough that the marshmallow was still small at seeding time.

A higher rate of glyphosate should have been used as a base rate at the first timing (perhaps 800 mL/ha) and even higher at the second timing (perhaps 1 L/ha).

The highest levels of early brown out were measured in the treatments using Sprayseed, Ester or a combination of both. Although providing good early brown out, Sprayseed was ineffective at

**Try this yourself now**

**Location: Minnipa**
Minnipa Agricultural Centre

**Rainfall**
Av. annual: 325 mm
Av. GSR: 242 mm
2007 total: 286 mm
2007 GSR: 141 mm
March-April: 102 mm

**Paddock History**
2006: Wheat
2005: Pasture
2004: Wheat

**Soil Type**
Red clay loam

**Plot size**
3 m x 9 m x 3 reps

controlling marshmallow at the cotyledon stage.

With the exception of Ester, no spike products markedly improved the performance of the base rate of 600 mL/ha of glyphosate, effective even on cotyledon marshmallow.

Increasing the rate of Goal from 50 to 100 mL/ha did not further improve the control of marshmallow at cotyledon stage.

All of the treatments applied at the later timing resulted in brown out and reduced plant numbers. The levels of control achieved however, were not at commercially acceptable levels (except the Sprayseed treatments) compared to the final control levels achieved at the earlier timing.

The only improvement to the levels of control by 600 mL/ha of glyphosate was either by the addition of Logran B power or more glyphosate. The other spike herbicides did not improve control over 600 mL/ha of glyphosate base rate. The rate of glyphosate was too low (and the weeds too advanced) for any of the other spike products to improve control levels.

Sprayseed was the most effective treatment in the second trial, and weed control wasn't improved with the addition of ester.

## What does this mean?

All knockdowns except Sprayseed were effective at slowing down cotyledon-stage marshmallow and many were killed. This would have resulted in increased moisture availability at sowing.

However, at the two true leaf stage, when the weeds were under more moisture stress, Sprayseed was one of the more effective knockdowns.

The aim of the trial was to investigate reduced cost options for marshmallow control. A rate of 600 mL/ha of glyphosate should be considered too low for applying on cotyledon marshmallow, regardless of the spike or rate used.

***Table 1 Weather conditions at spraying, Minnipa 2007***

| | Wind (km/hr) | | Temp (°C) | Relative Humidity (%) | Delta T |
|---|---|---|---|---|---|
| | Max | Av | | | |
| **30 March** | 9.6 | 4.5 | 20.3 | 47.4 | 7 |
| **4 April** | 19 | 13.6 | 18.4 | 44.3 | 7 |

***Table 2 Marshmallow control – cotyledon stage, Minnipa 2007***

| Herbicides* (all rates per ha) | Herbicide Cost ($/ha) | Brown Out** (DAA) | | | Plants /m² (35 DAA) |
|---|---|---|---|---|---|
| | | 4 | 11 | 17 | |
| **600 mL Glyphosate + 3 g Ally** | 5.23 | 37 | 50 | 85 | 200 |
| **600 mL Glyphosate + 10 g Logran B power + 0.5% Hasten** | 9.36 | 28 | 55 | 88 | 81 |
| **600 mL Glyphosate + 250 mL Ester** | 6.70 | 60 | 83 | 98 | 22 |
| **600 mL Glyphosate + 50 mL Goal** | 5.88 | 48 | 63 | 96 | 63 |
| **600 mL Glyphosate + 100 mL Goal** | 7.05 | 57 | 63 | 83 | 148 |
| **600 mL Glyphosate** | 4.70 | 27 | 53 | 83 | 211 |
| **2 L Glyphosate** | 14.50 | 42 | 67 | 95 | 74 |
| **800 mL Ester** | 6.90 | 17 | 47 | 88 | 81 |
| **600 mL Sprayseed** | 6.50 | 47 | 25 | 60 | 489 |
| **600 mL Sprayseed + 250 mL Ester** | 8.50 | 52 | 53 | 78 | 304 |
| **Untreated** | - | 0 | 0 | 27 | 656 |
| *LSD (P=0.05)* | | *15* | *19* | *14* | *201* |

** All treatments included 1% granular Ammonium Sulphate.*
*DAA = Days after application.*
*** 100% brown out means that all marshmallow plants were completely dead.*

***Table 3 Marshmallow control – two true leaves, Minnipa 2007***

| Herbicide (all rates per ha) | Herbicide Cost ($/ha) | Brown Out (DAA) | | Plants/m$^2$ (29 DAA) |
|---|---|---|---|---|
| | | 4 | 11 | |
| 600 mL Glyphosate + 3 g Ally | 5.20 | 28 | 50 | 367 |
| 600 mL Glyphosate + 10 g Logran B power + 0.5% Hasten | 9.40 | 32 | 73 | 181 |
| 600 mL Glyphosate + 250 mL Ester | 6.70 | 28 | 67 | 337 |
| 600 mL Glyphosate + 50 mL Goal | 5.90 | 30 | 68 | 374 |
| 600 mL Glyphosate + 100 mL Goal | 7.10 | 33 | 55 | 361 |
| 600 mL Glyphosate | 4.70 | 28 | 55 | 419 |
| 2 L Glyphosate | 15.00 | 27 | 62 | 211 |
| 800 mL Ester | 6.90 | 30 | 58 | 289 |
| 600 mL Sprayseed | 6.50 | 67 | 77 | 111 |
| 600 mL Sprayseed + 250 mL Ester | 8.50 | 73 | 90 | 107 |
| Untreated | - | 0 | 27 | 694 |
| *LSD (P=0.05)* | | *12* | *16* | *120* |

*All treatments included 1% granular Ammonium Sulphate.*
*DAA = Days after application*

## Acknowledgements

Thanks to Ashley Barns, Andy Bates and Martyn Chandler for assistance with trial design.

Thanks to Ben Ward for technical assistance.

This work would not have been possible without the generous financial support of SANTFA and the National Landcare Program.

Ally is a registered product of DuPont. Logran B Power and Sprayseed are registered products of Syngenta. Goal is a registered product of Dow Agro Sciences, Ester 800 and Roundup Powermax are registered products of Nufarm.

Australian Government
Department of Agriculture, Fisheries and Forestry
National Landcare Program

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SANTFA
SOUTH AUSTRALIAN NO-TILL FARMERS ASSOCIATION

Tillage

# Wide-row Cropping for Weed Management Opportunities

Research

**Sam Kleemann and Gurjeet Gill**
The University of Adelaide, Roseworthy Campus

## Key messages

- **When weeds were controlled with the application of post-sowing pre-emergent simazine followed by Select, beans sown on wide-rows yielded more grain than the crop sown at conventional row spacing.**
- **Higher bean yields with wide-rows could partly be explained by lower ryegrass density than in the conventional spacing. Such differences in rye-grass recruitment could be due to differing soil disturbance between the row spacing configurations.**
- **Use of integrated early control strategies (soil residual herbicides) with shielded application of knockdown herbicides in spring provided effective control (>93%) of herbicide resistant ryegrass in beans sown on wide-rows. However, use of shielded strategies should be seen as an opportunity to control weed escapes from early season control tactics rather than a stand alone method of weed management.**
- **Preliminary data has shown that in low rainfall seasons (eg. 2006) the yield penalty associated with growing wheat and barley on wide-rows is small (2-5%) relative to conventional row spacing. At the same time, beans showed a yield increase (20-24%) when sown on wide-row spacings.**

## Why do the research?

Herbicide resistance in weeds is a major issue confronting many growers in the Australian wheat-belt, and is causing re-examination of the way in which weeds are managed in crops. One approach being explored with the arrival of GPS guidance involves cultivation of crops on wider rows to allow shielded spraying of troublesome weeds between crop rows. Previous research has shown that crops such as lupins and chickpeas can maintain yield in wide-rows and provide an opportunity to safely apply non-selective herbicides with shields between rows (inter-row), and to utilise more expensive options within the row (intra-row). Such strategies could have significant cost and resistance management benefits for growers through reduction in the amount of selective herbicides applied.

As a consequence, we are investigating a range of agronomic (i.e. water and nutrient use) and weed management issues for three crops (faba beans, wheat & barley) grown on wide-rows in southern Australia.

Seeding rates per hectare for each crop were kept the same at all row spacings in the following experiments.

## Weed management opportunities under wide-rows

In 2006, inter- and intra-row herbicide application strategies for the control of annual rye-grass (ARG) in faba beans grown on wide-rows (54 cm) was evaluated in the field at Roseworthy Campus.

In the absence of weed control, faba beans grown on wide-rows were unable to compete with ARG (189 plants/$m^2$) and produced very little grain yield (156 kg/ha) (Table 1). The standard farmer practice of applying post-sowing simazine (1.5 kg/ha) followed by post-emergent Select (250 mL/ha) to beans sown on conventional row spacing (18 cm) provided effective control of ARG (84%) and a 4-fold increase in grain yield (681 kg/ha) relative to the weedy control. However, the same herbicide combination used in wide-rows yielded even more grain (1046 kg/ha), which could have been partly due to much lower ARG density (48 plants/ $m^2$) than that in the conventional row spacing (139 plants/ $m^2$). Such large differences in ARG recruitment in response to soil disturbance have been shown in previous research.

In addition, intra-row applications of a residual experimental compound in combination with shielded inter-row applications of glyphosate or paraquat in wide-row beans resulted in large reductions in ARG plant and spike density (93-97%) relative to the untreated control (Figure 1). Further research will be undertaken to integrate early control strategies with shielded application of herbicides to manage herbicide resistant ARG. Faba beans are very sensitive to early weed competition and sole reliance on shielded sprays in spring could result in large yield losses due to weed competition. Therefore, use of shielded strategies should be seen as an opportunity to control weed escapes from early control options rather than as a primary and stand alone method of weed control.

***Figure 1 Commercial shields used to spray knockdown herbicides between crop rows at the experimental site.***

## Crop performances under wide-rows (yield and water use)

Resource use efficiency of wheat, barley and faba beans grown on conventional (18 cm) and wide-row spacings (36 & 54 cm) were also investigated in the field at Roseworthy Campus in 2006.

Clear differences in yield response were apparent for the crops grown at the different row spacings (Figure 2). At wide-rows (36 & 54 cm) grain yield relative to the conventional spacing (18 cm) was reduced for wheat and barley (2-24%). However, the penalty at double the conventional spacing (36 cm) was only 2 and 5% for barley and wheat, respectively. In contrast the grain yield of faba beans increased at 36 (24%) and 54 cm (20%) spacings in comparison to the 18 cm arrangement which yielded 0.79 t/ha. This yield increase in beans was associated with greater numbers of pods per plant.

Water use by wheat and barley over the course of the growing season was the same for all row spacings. In contrast, faba beans grown on wider spacings (36 & 54 cm) appeared to use less water during the early vegetative phase than the crop grown at conventional spacing (18 cm). This enabled beans grown on wide-rows to defer some of its water use into its reproductive phase. This may have contributed to increased pod retention and subsequent higher grain yields observed for these treatments. Research undertaken in WA concluded that lupins in wide-rows deferred use of soil water between rows until later into grain filling and were therefore less stressed, and filled more grain.

Faba beans were less effective at extracting soil water than either of the cereals leaving more than 50 mm of water in the soil profile. This water was left in layers below 85 cm from the surface. This additional soil water should be of significant benefit to any following cereal crop.

In dry seasons (eg. 2006) the yield penalty from growing cereals on wide-rows appears to be small (2-5%), and in contrast to beans which showed an increase in yield relative to the conventional sowing arrangement. These results provide some confidence that wider-row cropping can be used for weed management opportunities without compromising yield and profitability. However, further research is required to determine yield responses in growing seasons with average to above average rainfall.

*Table 1 Results from a field study at Roseworthy Campus in 2006 which evaluated inter- and intra-row herbicide strategies for the control of ARG in faba beans grown on wide-rows*

| Herbicide treatment | Row Spacing (cm) | Faba bean Yield (kg/ha) | ARG density (plants/m$^2$) | | ARG (spikes/m$^2$) |
|---|---|---|---|---|---|
| | | | Initial | Final | |
| Simazine 1.5 kg/ha PSPE, Select 250 mL/ha POST | 18 | 681 | 139 | 30 (84) | 125 |
| Simazine 1.5 kg/ha PSPE, Select 250 mL/ha POST | 54 | 1,046 | 48 | 5 (97) | 20 |
| Exptl 2.0 L/ha PSPE | 54 | 705 | 28 | 22 (88) | 187 |
| Intra-row Exptl 2.0 L/ha PSPE | 54 | 346 | 98 | 81 (57) | 333 |
| Intra-row Exptl 2.0 L/ha PSPE + Inter-row Simazine 1.5 kg/ha PSPE | 54 | 623 | 55 | 38 (80) | 205 |
| Intra-row Exptl 2.0 L/ha PSPE + Inter-row Glyphosate 1.5 L/ha POST | 54 | 614 | 108 | 6 (97) | 30 |
| Intra-row Exptl 2.0 L/ha PSPE + Inter-row Paraquat 2.0 L/ha POST | 54 | 502 | 115 | 13 (93) | 54 |
| Inter-row Glyphosate 1.5 L/ha POST | 54 | 309 | - | 41 (78) | 127 |
| Untreated weedy control | 54 | 156 | 222 | 189 | 722 |
| *LSD (P=0.05)* | | *114* | *44* | *27* | *66* |


## Acknowledgements

We wish to thank ACIAR (Australian Centre for International Agricultural Research) for providing project funding.


THE UNIVERSITY OF ADELAIDE AUSTRALIA

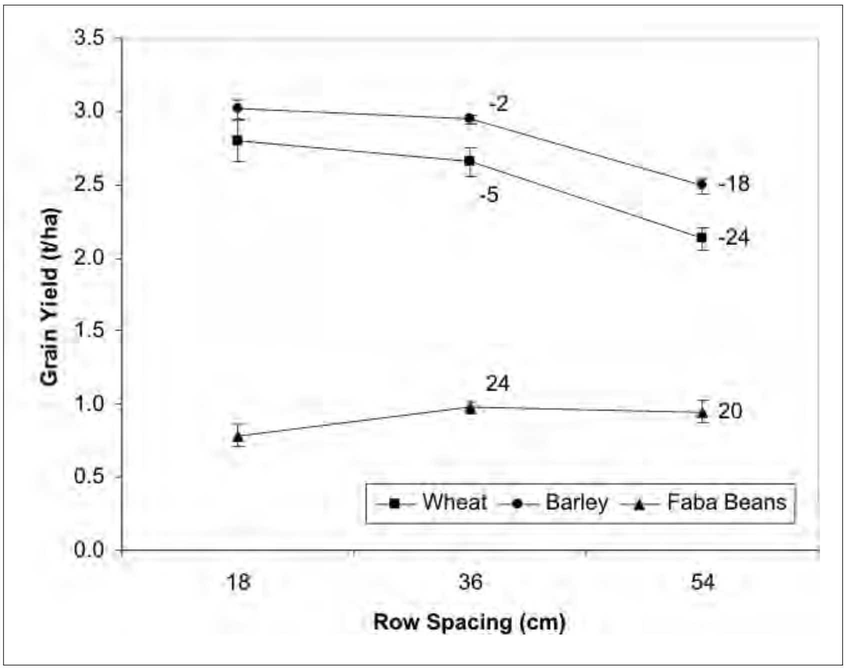



***Figure 2** Yield responses of wheat (cv Pugsley), barley (cv Sloop SA) and faba beans (cv Fiesta) grown on 18, 36 and 54 cm row spacings at Roseworthy in 2006. Values on the graph represent relative grain yield (%) at 36 & 54 cm compared to 18 cm spacing.*

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

# Section 12

**Section editor:**
**Naomi Scholz**
SARDI
Minnipa Agricultural Centre

# Sharing Information

## The Low Rainfall Collaboration Project

Information

**Geoff Thomas and Nigel Wilhelm**
Low Rainfall Collaboration Project

One of the many activities with which Eyre Peninsula Farming Systems project (EPFS) is involved is the GRDC funded Low Rainfall Collaboration Project (LRCP).

This project aims to share knowledge and ideas between low rainfall farming systems groups in south-eastern Australia. The other groups are Central West Farming Systems, Mallee Sustainable Farming, Birchip Cropping Group and Upper North SA. It has four components:

1. **Communication -** involves a newsletter between the groups; an annual workshop on technical issues and issues for the effective operation of the groups themselves; a programme of visits by farmers to farms, research facilities and field days in other areas; and on going support to the groups.
2. **R&D Support -** involves bringing scientific "grunt" together and making it available to all the groups; establishment of guidelines for R&D so that results can be better shared; an annual summary or compendium of the work being done by all the groups; and support for the groups to extract the most value from their results. An expert panel has been formed to bring intellectual support from across southern Australia to help with these issues for all the groups.
3. **Farm Decisions and Economics** - the importance of integrating technologies into the farm system cannot be over emphasized. However, the adoption of many technologies, while they improve production, also involve higher costs and risks. The aim here is to assess the emerging technologies in terms of economic risk.
4. **Evaluation** - it is no longer adequate to assess performance in terms of farm production alone. A balance of economic, environmental and social aspects is essential and their integration involves quite complex tools. It is more efficient if groups can share these tools and compare the results collectively.

In pursuit of goals within these four components, we have produced the following, all of which have been, or will be, available to EPFS:

- Seven papers to assist group staff – "How to Win Funds and Influence People", "Planning and Evaluation Surveys", "Planning Research and Extension Projects – the Seven Steps", "Getting the Balance Right – the Continuum from Research to Extension", "Contract Research" and "A Themes Approach to Future FS Projects".
- Three expressions of interest have been submitted to GRDC in the current funding round - Risk Management (a new approach to assessing risks for farming businesses and investigating the profit from different enterprise mixes using workshops for all LRFS groups); Common Evaluation Approach (to be implemented across all the groups); Summer Weed Control (using weed mapping and precision ag tools for least cost control).
- An application to GRDC for a PhD scholarship to independently assess the whole raft of decision support tools such as Plan to Profit, Risk Manager and Yield Prophet, which aim to assess profitability and/or risks for farming businesses.
- David Roget has agreed to join the LRCP team as a consultant. David's decades of experience with LR farming systems, especially in soil health and soil-borne diseases, is now available again to Low Rainfall Farm Systems Groups on an "as needed" basis.
- The LR expert panel met recently to develop low risk, low cost management options for cropping and livestock in "Meeting the Challenges of 2008". Such guidelines, including marketing strategies, will be provided to LRFS groups in 2008.

# Decision Making Focus For New Farming Guide

**Geoff Thomas and Nigel Wilhelm**
Low Rainfall Collaboration Project

Information

## Key message

- **A free low-risk farming guide has been released.**

The GRDC 2008 Planning Guide for Low-Risk Farming incorporates an innovative decision-making framework designed to help cropping farmers with key risk and management decisions for the coming season.

An initiative of the Low Rainfall Collaboration Group and GRDC Southern Panel, the Guide is available from the Eyre Peninsula Agricultural Research Foundation by phoning Dot Brace on (08) 8680 5104 or email brace.dot@saugov.sa.gov.au.

The aim of the guide is to help growers work through a decision-making process that will lead to the best possible outcomes this season. To achieve this, growers need to identify and address the essential decisions needed to prepare their farm businesses for the 2008 season and as the basis for their discussions with the bank.

Agronomy is only part of farming, as the experiences of last season have highlighted. There is no point in focusing on agronomy if the key issue is long-term viability, or whether to continue farming or to lease or share farm. Many important management decisions need to be made now, well ahead of seeding, and the guide is structured to help growers work through these vital pre-planning decisions as well as address the agronomic challenges.

In addition to the decision-making framework the guide contains the latest information on finance, marketing, risk management, how to maximise benefit from limited resources, storing summer moisture, pre-sowing and post-sowing agronomy and livestock management.

This information, based on the latest research results and the practical experience from the past two seasons, was presented at a November 2007 workshop convened by the Low Rainfall Collaboration Project.

Copies of the guide will also be available on GRDC's website www.grdc.com.au/lowriskfarming.

*Cattle nutrition and marketing day held at Cummins, 2007.*

# Grazing Cereals in the Upper North

**Charlton Jeisman**
Rural Solutions SA, Jamestown

Research

## Key messages

- **Sow early to maximise growing season moisture.**
- **Wyalkatchem is better suited to the Warnertown district than Morchard.**
- **Do your sums before grazing cereal crops.**
- **Only graze if the feed is required (i.e. to bridge the feed gap).**

## Why do the trial?

The aim of the trial was to maximise early feed availability and profitability of cereals while minimising the impact on potential grain yield.

A grazing cereals trial was conducted in the Upper North in 2006 (EPFS 2006, pp. 188-190) using a range of cereal types. Farmers wanted to expand this trial in 2007 with different varieties, seeding rates, fertiliser rates and sowing times. The aim of the trial was to identify profitable crops and management options to bridge the autumn/early winter feed gap, which is a common issue for many livestock farmers, particularly in low rainfall zones. In bridging this feed gap it is important to maximise the productivity of the whole system, so dry matter production was assessed with grain yield.

## How was it done?

The trial was a split-plot design with four replications using wheat, barley, oat and ryegrass varieties. Correll wheat and Maritime barley were sown dry on 19 April at Warnertown and 18 April at Morchard with the remainder of each trial sown on 4 and 7 May respectively. Plots were harvested on 30 October (Warnertown) and 8 November (Morchard). At both sites wheat and barley sowing rates were 60 kg/ha, high rates were 100 kg/ha and oats were 80 kg/ha. Ryegrass and ryegrass high (Morchard) were sown @ 15 kg/ha and 30 kg/ha respectively and extra high wheat and barley plots (Warnertown) were sown @ 130 kg/ha. All plots received 18:20:00 @ 50 kg/ha (60 kg/ha @ Warnertown) and +N plots also received urea @ 43 kg/ha. All fertiliser was applied at sowing.

Dry matter (DM) cuts were taken at late tillering/early jointing growth stages (depending on treatment) before being mown to approx 25-50 mm by a ride-on lawnmower in June to simulate grazing. Morchard dry sown plots were grazed twice (first grazing on 12 June) to simulate a more realistic scenario to make the most of the earlier sowing.

## What happened?

### *Morchard results*

Dry sown Maritime produced higher amounts of biomass than all other treatments. These results indicate a two-fold increase in DM over standard Maritime, and up to a four-fold increase over sown ryegrass. This was also reflected in grain yield where dry sown Maritime was higher than standard Maritime.

Plots with high sowing rate and urea (+N) generally produced higher biomass, but this was a result of higher seeding rate rather than a response to added N, despite the low N reserves at Morchard. Low winter rainfall may have caused some N to remain unavailable to plants.

Wyalkatchem DM was low, similar to ryegrass and oats, as it had slower early growth. Wyalkatchem has a narrower leaf blade than

**Location: Morchard and Warnertown**
Cooperators: Morchard Community; Brendon & Graham Johns
Upper North Farming Systems

**Rainfall**
*Morchard*
Av. annual: 325 mm
Av. GSR: 233 mm
2007 GSR: 120 mm
*Warnertown*
Av. annual: 343 mm
Av. GSR: 236 mm
2007 total: 378 mm
2007 GSR: 135.5 mm

**Potential yields**
*Morchard*
1.4 t/ha (W)
1.8 t/ha (B)
*Warnertown*
2.0 t/ha (W)
2.4 t/ha (B)

**Actual yields**
*Morchard*
0.9 t/ha (W)
0.8 t/ha (B)
*Warnertown*
3.9 t/ha (W)
3.2 t/ha (B)

**Paddock History**
*Morchard*
2006: Fallow
2005: Wheat
2004: Barley
*Warnertown*
2006: Kaspa peas
2005: Keel barley
2004: JNZ wheat (Midas tolerant)

**Soil Type**
*Morchard*
Alkaline, red clay loam
*Warnertown*
Neutral-alkaline red light sandy clay loam

**Land Value**
$990/ha Morchard
$1875/ha Warnertown

**Plot size**
25 m (split plot) x 2.2 m x 4 reps

Sharing Info

Correll and showed a reduced ability to recover from grazing at Morchard compared with other wheat treatments. Wyalkatchem recorded the lowest grain yield of all wheat treatments.

Grain yields were highly variable and if the trial was repeated in another season, there is no guarantee that grain yields will not differ considerably between treatments.

### *Warnertown results*

Dry sown Maritime produced the highest DM, highlighting the benefit of dry sowing. Dry sowing resulted in a tripling of grazing value over Maritime sown at a standard time, which is reflected in the total gross margin. A similar result was seen with dry sown Correll and standard Correll. The DM of the Maritime extra high seeding rate was approximately double the standard seeding rate of Maritime, however the difference in total gross margin was minimal.

High sowing rates generally produced high DM values, regardless of additional N. The +N treatments did not respond to the extra N since the paddock had large N reserves from the previous season.

There were no differences in DM production for Wyalkatchem, Wintaroo oats, Correll and Correll + N, however Wyalkatchem had the highest grain yield of all treatments in the trial. Wyalkatchem has the ability to tolerate grazing and is a very efficient variety at Warnertown. Oats yielded higher when grazed than ungrazed, increasing the total gross margin.

In terms of overall profitability Wyalkatchem was the best crop, however if more grazing days are required, dry sown Maritime barley has shown to produce the most dry matter.

## What does this mean?

The benefits of sowing cereals early for increased DM production are quite evident (providing a good opening rain is received) particularly for Maritime barley. Timeliness of sowing is always a crucial factor for a crop's success and also provides a longer growing season for more grazing opportunities.

It is important to ensure feed demand is an issue before grazing crops (as noted by Eyre Peninsula grazing trials) since grazing can cause yield reductions in some varieties. Barley crops should be grazed in preference to wheat at Warnertown, as barley yields were higher in many cases after grazing. This also allows wheat crops to achieve their full potential. At Morchard (on heavier soil) there was minimal difference between most grazed and un-grazed treatments (wheat or barley). Grazing oats for grain yield at Morchard was not profitable, however in reality the oats would have been cut for hay or grazed instead of being reapt.

Grazing is a risk management tool, which can be used to carry stock over until pasture feed is available. With high grain prices and fertiliser prices in 2008, it will be worthwhile to do your sums before applying high sowing and/or fertiliser rates. The profitability of grazing cereals depends on crop type and variety, and these can all differ between regions. Although Wyalkatchem was most profitable at Warnertown, at Morchard it was outperformed by other wheat and barley varieties, highlighting the importance of matching crop variety with district.

It may be worthwhile conducting a trial in the future where sheep are used (similar to trials conducted on EP) to assess the effects of stock trampling, compaction and uneven grazing on crop performance. Though these factors may impact on grain yield, there is the added bonus of N, which may help with crop recovery, especially in a wet year.

## Acknowledgements

Research by the Upper North Farming Systems project is made possible by funding through GRDC. Technical support from Brendon and Graham Johns (farmers, Warnertown), Bentley Foulis (farmer, Willowie) and Gilmour Catford (farmer, Morchard) was appreciated. Thanks to Nigel Wilhelm and Peter Telfer from SARDI for their help in designing, sowing and harvesting the trials, and also to the Morchard community for the use of the trial site land.

UNFS Upper North Farming Systems

GRDC Grains Research & Development Corporation

***Table 1 Grain yield, DM production, grazing value and total gross margin for the 2007 grazing cereals trial, Morchard 2007***

| Treatment | Variety | Early DM (t/ha) | Grazing Value* ($/ha) | Yield (t/ha) | Total Gross Margin** ($/ha) |
|---|---|---|---|---|---|
| **G** | Correll | 0.26 | 18 | 0.97 | 243 |
| **UG** | Correll | - | - | 0.96 | 221 |
| **G** | Correll + N | 0.24 | 17 | 0.96 | 239 |
| **UG** | Correll + N | - | - | 1.01 | 238 |
| **G** | Correll dry sown | 0.41 | 29 | 1.06 | 285 |
| **UG** | Correll dry sown | - | - | 0.98 | 229 |
| **G** | Correll high | 0.36 | 26 | 1.14 | 308 |
| **UG** | Correll high | - | - | 1.03 | 245 |
| **G** | Correll high + N | 0.32 | 23 | 1.06 | 278 |
| **UG** | Correll high + N | - | - | 0.93 | 212 |
| **G** | Wyalkatchem | 0.19 | 13 | 0.68 | 135 |
| **UG** | Wyalkatchem | - | - | 0.81 | 165 |
| **G** | Keel | 0.30 | 21 | 0.96 | 180 |
| **UG** | Keel | - | - | 1.05 | 183 |
| **G** | Maritime | 0.28 | 20 | 0.82 | 140 |
| **UG** | Maritime | - | - | 0.88 | 137 |
| **G** | Maritime + N | 0.30 | 21 | 0.88 | 158 |
| **UG** | Maritime + N | - | - | 0.68 | 81 |
| **G** | Maritime dry sown | 0.58 | 41 | 1.04 | 222 |
| **UG** | Maritime dry sown | - | - | 1.18 | 218 |
| **G** | Maritime high | 0.29 | 21 | 1.03 | 200 |
| **UG** | Maritime high | - | - | 0.83 | 124 |
| **G** | Maritime high + N | 0.48 | 34 | 0.85 | 162 |
| **UG** | Maritime high + N | - | - | 0.78 | 110 |
| **G** | Ryegrass | 0.15 | 11 | - | -64 |
| **UG** | Ryegrass | - | - | - | -75 |
| **G** | Ryegrass high | 0.22 | 16 | - | -79 |
| **UG** | Ryegrass high | - | - | - | -95 |
| **G** | Wallaroo oats | 0.16 | 11 | 0.16 | -53 |
| **UG** | Wallaroo oats | - | - | 0.21 | -52 |
| **G** | Wintaroo oats | 0.13 | 9 | 0.15 | -58 |
| **UG** | Wintaroo oats | - | - | 0.12 | -74 |
| *LSD (P=0.05)* | | *0.09* | | *0.23* | |

*G = grazed, UG = un-grazed*
**Grazing value has been calculated assuming that 1 DSE will consume 1 kg of DM/day. Values are based on the 2007 Rural Solutions SA Farm Gross Margin Guide, where the value of a Merino is $26/DSE/year*
***Total gross margin = Grazing value + (Yield x ESR) – seeding costs. Costs include seed, fertiliser, chemicals and operational costs taken from the 2007 Farm Gross Margin Guide.*
*Estimated silo return (ESR) price based on daily cash price at Gladstone on 30 November 2007.*

Sharing Info

***Table 2 Grain yield, DM production, grazing value and total gross margin for the grazing cereals trial, Warnertown 2007***

| Treatment | Variety | Early DM (t/ha) | Grazing Value* ($/ha) | Yield (t/ha) | Total Gross Margin** ($/ha) |
|---|---|---|---|---|---|
| G | Correll | 0.29 | 20 | 3.63 | 1,176 |
| UG | Correll | - | - | 4.39 | 1,418 |
| G | Correll + N | 0.27 | 19 | 3.79 | 1,230 |
| UG | Correll + N | - | - | 4.26 | 1,372 |
| G | Correll dry | 0.66 | 47 | 3.94 | 1,310 |
| UG | Correll dry | - | - | 4.38 | 1,414 |
| G | Correll high | 0.42 | 30 | 3.69 | 1,204 |
| UG | Correll high | - | - | 4.00 | 1,281 |
| G | Correll high + N | 0.33 | 24 | 3.62 | 1,175 |
| UG | Correll high + N | - | - | 4.15 | 1,336 |
| G | Correll Extra High | 0.48 | 34 | 3.63 | 1,189 |
| UG | Correll Extra High | - | - | 4.10 | 1,317 |
| G | Wyalkatchem | 0.19 | 13 | 4.22 | 1,357 |
| UG | Wyalkatchem | - | - | 4.61 | 1,477 |
| G | Keel | 0.37 | 27 | 3.59 | 934 |
| UG | Keel | - | - | 4.01 | 1,025 |
| G | Maritime | 0.37 | 26 | 3.16 | 812 |
| UG | Maritime | - | - | 3.32 | 831 |
| G | Maritime + N | 0.37 | 26 | 3.14 | 807 |
| UG | Maritime + N | - | - | 3.71 | 941 |
| G | Maritime dry | 0.97 | 69 | 3.15 | 852 |
| UG | Maritime dry | - | - | 3.02 | 745 |
| G | Maritime high | 0.56 | 40 | 3.21 | 839 |
| UG | Maritime high | - | - | 3.08 | 764 |
| G | Maritime high + N | 0.46 | 32 | 3.12 | 809 |
| UG | Maritime high + N | - | - | 3.02 | 746 |
| G | Maritime Extra High | 0.63 | 45 | 3.15 | 829 |
| UG | Maritime Extra High | - | - | 3.08 | 763 |
| G | Wallaroo oats | 0.32 | 23 | 1.42 | 289 |
| UG | Wallaroo oats | - | - | 1.15 | 197 |
| G | Wintaroo oats | 0.23 | 17 | 1.72 | 361 |
| UG | Wintaroo oats | - | - | 1.46 | 278 |
| *LSD (P=0.05)* | | *0.12* | | *0.31* | |

*G = grazed, UG = un-grazed*
**Grazing value has been calculated assuming that 1 DSE will consume 1 kg of DM/day. Values are based on the 2007 Rural Solutions SA Farm Gross Margin Guide, where the value of a Merino is $26/DSE/year*
***Total gross margin = Grazing value + (Yield x ESR) – seeding costs. Costs include seed, fertiliser, chemicals and operational costs taken from the 2007 Farm Gross Margin Guide.*
*Estimated silo return (ESR) price based on daily cash price at Gladstone on 30 November 2007.*

# Grazing Crops in Higher Rainfall Areas

Extension

**Tim Prance**
Rural Solutions SA, Victor Harbor

## Key messages

- **Crops have been hugely underestimated as a feed source for livestock in recent years. This includes cereal crops as well as canola.**
- **It is possible to produce 2500 kg/ha dry matter in 50 days from germination with 55 mm of actual and 100 mm of stored rainfall.**

There are five ways in which crops can be utilised by livestock:

- Grazing crops from early tillering through to growth stage (GS) 31 (early reproductive phase) with the intention of preserving most, if not all, the potential grain yield (or even increasing it). This system is the focus of most attention in the Grain and Graze program, and has been successful in southern NSW, Victoria and the lower mid-north region and southern Eyre Peninsula in SA where average annual rainfall is over 500 mm, and in years with at least average winter/spring rainfall. There may also be a grain yield advantage by using early grazing to manage the canopy in districts where dry finishes reduce grain yields in very leafy crops.
- Sowing crops for grazing, where a commercial grain harvest is not intended. Cereals can be sown dry for early feed. This seems to work well in drier areas with average rainfall less than 400 mm. On any farm, paddocks (or parts of paddocks) that do not make money for grain should be grazed rather than reapt.
- Conserving a crop for hay or silage.
- Grazing dry standing crops near, or after, maturity where livestock utilise both the grain and the leaf. This can be done to carry livestock before stubbles are available.
- Grazing crop stubbles after harvest.

The way crops can be used in a farming system will depend on:

- Livestock numbers and type.
- Average rainfall and distribution.
- Likelihood of dry conditions in spring.
- Size of feed gaps.
- Weed problems in particular paddocks.
- Need for disease control in your cereal grain rotations.

Regardless of rainfall, there are principles that determine the grazing productivity – these include:

- Early sowing.
- High density sowing.
- Adequate fertiliser.
- Early grazing.

If these principles are followed, it is possible to produce 2500 kg/ha dry matter (DM) in 50 days from germination with 55 mm of actual and 100 mm of stored rainfall. This was the production from Barque barley at the Mallee Sustainable Farming Systems Waikerie core trial site from mid April to mid June 2007.

This is highly productive – resulting in 50 kg DM/ha per day or 16 kg DM/mm total rainfall or 45 kg DM/mm growing season rainfall.

Allowing for 3 kg DM per day for a 60 kg lactating ewe and lamb, the winter carrying capacity will be sixteen ewes with lambs at foot/ha.

The key factors to using cereals for grazing are:

- Sow as early as possible or dry sow where weeds permit.
- Use high seeding rates – double the normal grain rates. Target establishment is 300 plants/m$^2$.
- Narrow rows (15–18 cm) appear to produce more DM/ha than 25–30 cm row spacings.
- Use adequate P at seeding, along with N – at least as much as you would if sowing wheat in a continuous cropping regime.
- Another 25 kg/ha N can be applied at the 3-leaf stage and even later. See nitrate poisoning below.
- Start grazing early – as soon as plants are anchored and secondary roots have developed. Aim to start grazing at about 800 to 1000 kg/ha dry matter.

## Managing grazing

A dense, well-fertilised crop should be able to continuously carry 20 to 30 DSE/ha until GS 31. Once stem elongation starts, stock will remove growing points and this will reduce grain yields. If a grain harvest is not intended the stock can be left in the paddock.

If grazing starts too late, for example once stem elongation has started, leaf production is greatly reduced and crops rapidly run to head - especially in dry conditions.

Early continuous grazing will delay stem elongation. Crops can be grazed quite low – to the "white line" – as long as the growing points are not removed. Stocking density will need to be reduced if livestock are grazing to below 800 kg/ha DM. Higher seeding rates mean that crops can be grazed lower and still maintain 800 kg/ha DM. Total dry matter production may be lower with several early grazings (or continuous grazing), compared to one grazing at GS 30. The dry matter penalty will be less (or non existent) with high density, vigorously growing crops, in high

Sharing Info

fertility paddocks, where feed on offer is above 800 kg/ha DM.

Early grazing will also reduce "patch" grazing by livestock.

## Advantages and disadvantages of grazing cereals

- Grazing will delay flowering by approximately one week. Depending on the district and seasonal conditions, this may (or may not) be an appropriate risk management strategy. In later districts (i.e. average annual rainfall greater than 450 mm) grazing can increase grain yields, whereas in earlier districts grain yields may be suppressed. Grazing crops and then harvesting them for grain will be opportunistic in areas with less than 450 mm rainfall. It will depend on adequate, or above average, rainfall.
- Grazing can be used to control weeds such as turnip or radish, and ryegrass and wild oats. Sheep will preferentially graze young ryegrass plants in a cereal crop.
- Grazing young crops will help to reduce stubble mass following harvest in continuous cropping systems.
- Observations suggest that removing excessive leaf in winter can increase soil moisture levels, which may improve grain fill in late spring – if temperatures allow.
- Grazing can be used for canopy management in heavy crops, and this may also increase grain bearing tiller numbers, if excessive leaf is shading young tillers.

Cereals offer great possibilities to fill the early winter feed gap. At stem elongation, the decision should be made to either:

- Continue grazing to remove the crop, e.g. if weedy or you are short of feed.
- Close up for harvest.
- Continue grazing and later close up for a standing crop for grazing in November e.g. with oats.
- Spray top for weed control in spring.

## Variety and species selection

- Assuming density and fertility are not limiting, there are few differences between cereal species or cultivars – select the cheapest cereal to suit the rotation, disease control, weed control and livestock needs.
- Oats is a little slower for early growth compared to barley, but offers great flexibility (graze, hay, standing crop, or grain). Oats is the preferred option for early sowing, as it will remain vegetative for longer than barley.
- Barley has excellent early growth, but if not used efficiently for grazing, will run to head early. Barley will also run to head if sown very early. Barley is the preferred option for later winter sowings e.g. late June. However, barley hosts more crop diseases.
- Winter wheats offer very good grazing possibilities if sown early (February/March) but these conditions do not often arise in South Australia compared to NSW. There appear to be no grazing advantages in using winter wheats in SA with April or May sowings.
- Spring wheats and triticale are quite acceptable for grazing in South Australia – depending on your rotation and weed control needs.
- Canola offers good grazing possibilities – especially if grassy weed control is needed.
- Feed quality of cereals and canola is very high, with metabolisable energy (ME) levels of 12.5 to 13 MJ ME/kg DM, digestibility 80 to 90%, neutral detergent fibre (NDF) 30 to 40% and crude protein 22 to 30%.
- Growth rates of 300 g a day for lambs and 1.5 kg a day for weaner steers should be possible.
- Observe herbicide withholding periods before grazing – read the label before spraying.
- Test crop before grazing for mineral and trace element levels – especially Ca, Mg, Na, K, $NO^{3}$-N and Cu.

## Minimise animal health problems

- Offer the stock an 80:20 mixture of stocklime:salt in a drum or tyre. If magnesium levels are low, replace half the stock lime with Causmag.
- Check internal parasite levels – worm egg count (WEC).
- Ensure vaccinations are up to date – especially for clostridial bacteria.
- Do not introduce hungry animals to crops – if in doubt fill them up first with good quality hay.
- Nitrate poisoning. There is a risk, albeit small, of excessive nitrate nitrogen levels killing livestock. Risks are higher if stock are rotationally grazing young regrowth in fertile and heavily nitrogen-fertilised paddocks during dull overcast weather. Stock must be kept out for at least twenty days following nitrogen application.
- Observe animals for three days after introducing them to a crop. Look for lethargy, animals not ruminating (or eating), very excited stirry animals, or animals lying down.

## Acknowledgements

This information is based on evidence collected from trials funded by the EP Grain & Graze Project, and managed by Chris McDonough, Rural Solutions SA, Loxton, Emma McInerney, SARDI, Minnipa Agricultural Centre plus GRDC funded trials managed by Rick Morris, Kangaroo Island and Northern and Yorke NRM Board funded trials at Tarlee managed by Mick Faulkiner, Agrilink Farm Consultants, plus nearly 30 years of experiments in southern NSW.

GRDC Grains Research & Development Corporation

# Biosolids at Kimba

**Corey Yeates**
EP Natural Resources Management Board, Cleve

Demo

**Searching for answers**

**Location:**
Buckleboo - D & C Williams

**Rainfall**
Av. annual: 273 mm
Av. GSR: 179 mm
2007 total: 154 mm
2007 GSR: 302 mm

**Yield**
Potential: 1.4 t/ha
Actual: 0.4 t/ha

**Soil**
Red loam

**Other factors**
Moisture stress

## Key messages

- **Biosolids appeared to produce no advantage for wheat over 50 kg/ha of MAP, in a poor year at Buckleboo.**
- **More replicated work is required to determine if biosolids can be used as a suitable alternative fertiliser treatment for unproductive soils.**

## Why do the work?

The demonstration was established to test if biosolids from SA Water at Bolivar are a suitable alternative fertiliser for unproductive soils and to measure their effectiveness as a soil stabiliser or conditioner.

Dene Williams (Buckleboo) had identified sections of a paddock that were not performing as well as the rest of the paddock (partly due to soil type), and he wanted to increase production on these areas. Spiraling costs in fertiliser prompted Dene to investigate alternative products. Biosolids may improve agricultural productivity and soil health in a multi-benefit approach.

## Background

Biosolids are the organic solid residues produced by wastewater treatment processes. Some 20,000 equivalent dry tonnes of bio-solids are produced annually by Adelaide's wastewater treatment plants, and the occasional clean-out of effluent lagoons produces additional large quantities.

The product can be used to increase soil fertility and as a source of nutrients for various crops. It can also improve the water holding capacity of the soil. The only cost to farmers is the cost of transporting the product from Bolivar and spreading the material on their land, provided that an order for at least 100 tonnes is placed.

Previous research has found that:

- Applying biosolids has had either no effect or been positive – improving the quantity and quality of the crops grown
- Biosolids can provide an alternative to conventional fertilisers, especially as a natural source of carbon and other nutrients such as nitrogen and phosphorus
- Nutrients are released more slowly from biosolids than from inorganic fertilisers, reducing potential losses through leaching
- Biosolids provide additional benefits for soil structure and other physico-chemical properties.

## How was it done?

Approvals were required from the EPA for an application to be considered. These include:

- Analysis of the biosolids to be applied
- Details of the receiving paddock (including a location sketch)
- A soil survey and analysis showing the pH and background metal concentrations

Dene applied three treatments; MAP @ 50kg/ha, Biosolids @ 4.6 t/ha and both MAP + Biosolids.

After gaining approval from the EPA, 115 tonnes of biosolids were spread with a Marshall spreader on 25 ha at approximately 4.6 t/ha. The paddock had been ploughed with an offset disc in February prior to the biosolids being spread on 6 March and incorporated with a

Sharing Info

cultivator on 8 March. The paddock was cultivated again across the original cultivation in April and then sown on 11 May with Carnamah wheat @ 50 kg/ha. MAP was applied at a later date.

## What happened?

Rainfall is needed to activate and breakdown biosolids and it was difficult to see the benefits of either fertiliser application. The MAP portion of the demonstration looked the most productive early on. MAP treated areas looked fresher, greener, had produced more tillers and was significantly taller than the biosolids treatment where the wheat looked thin and was well behind in crop growth. Later in the season, the biosolid treated areas appeared to catch up to the MAP areas. Towards the end of the season the MAP site looked to be under moisture stress and started to lose tillers whereas the site with the biosolids still looked healthy. Prior to reaping, there were no visual differences between treatments.

Biomass cuts were taken from each of the areas at harvest. There were no differences between treatments with the wheat only yielding about 0.5 t/ha.

## What does this mean?

CSIRO research & anecdotal evidence by landholders that have been using the product for over ten years in South Australia have indicated that biosolids can be used on a broad scale and have a neutral to positive effect on cereal crops on various soil types. However, in a poor year at Buckleboo, biosolids appeared to produce no advantage for wheat over 50 kg/ha of MAP.

This demonstration has indicated that there needs to be replication in future work to say with conviction that biosolids can be used as a suitable alternative fertiliser treatment for unproductive soils.

Due to the lack of rainfall, meaning minimal breakdown of biosolids, there is the expectation that the biosolids treatment may provide some sort of benefit in the second year without the need for another fertiliser treatment. At worst, the unproductive soil has received an application of organic matter.

With several biosolids sites established and new sites identified on Eastern EP, EPNRM hope to continue monitoring these sites to provide some insight into the potential benefits and claims that biosolids can be an alternative fertiliser treatment and soil conditioner for unproductive soils.

## Acknowledgements

Dene and Chris Williams for hosting and managing this demonstration. Garry Smith (United Water), supplier of biosolids and technical advice. EPNRM and Kimba NRM group for initiating and providing financial assistance and technical advice.

Government of South Australia
Eyre Peninsula Natural Resources Management Board

Australian Government
Department of Agriculture, Fisheries and Forestry
National Landcare Program

SAGIT

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

# Biodiversity in Grain & Graze on EP

Survey

**Kim Heynen**

EP Natural Resources Management Board, Streaky Bay

## Key messages

- **Biodiversity in Grain & Graze (BiGG) is a national initiative of the National Grain & Graze Program investigating biodiversity and mixed farming systems.**
- **The outcomes of the program should be available soon and will give some insight into links and benefits of biodiversity in mixed farming systems on Eyre Peninsula.**

## What is it all about?

Biodiversity is the variety of different plants and animals in a given area. The more species of plants and animals found in an area means the greater the biodiversity.

The aim of the Biodiversity in Grain & Graze (BiGG) program is to establish if there is a relationship between biodiversity and land use, and to examine how biodiversity can support on-farm productivity. BiGG is an extension of the National Grain & Graze program. There are 47 farms involved around Australia, with nine from Eyre Peninsula. The purpose of the study has been to discover how biodiversity is influenced by different site conditions and management practices of mixed farming systems on Eyre Peninsula.

## How was it done?

Many people from different organisations across Eyre Peninsula have been involved in the program, undertaking sampling annually in spring and autumn since the commencement of the program in early 2006.

Each sampling occurred over a three week period. Plant species diversity was measured using vegetation surveys, invertebrate species (insects) were collected by setting small pitfall traps (Figure 2), bird numbers and activity were assessed with bird surveys and soil microbial activity was gauged using a method involving cotton strips (Figure 1) buried in the soil.

These factors were measured in four different land use types on all participating farms. The land uses were continuous cropping, crop rotation involving a pasture or Brassica break, permanent pasture and remnant vegetation.

## What happened?

The Coordinators of this study at the University of Tasmania, collated results from the first three samplings. Results from the 2006 sampling showed over 80 different families of insects were found on Eyre Peninsula alone. This invertebrate sampling has been undertaken on Eyre Peninsula at largely un-researched sites so there may be some exciting new invertebrate discoveries.

More than 60 species of birds were sighted during the bird surveys. The Southern Scrub-Robin, Purple-Gaped Honeyeater and the Western Yellow Robin are considered uncommon and were just a few of the species sighted.

## What does this mean?

The results from the BiGG survey in Spring 2007 are still being analysed, and should available in the not too distant future. A bird guide is currently being compiled to explain the benefits of certain types of birds found on Eyre Peninsula and how they can decrease pests and threats. The guide will include information on how you can encourage these birds on your property.

Searching for answers

We are aiming to utilise some of the invertebrate information gained from this project in new research into integrated pest management in low rainfall environments, based at the Minnipa Agricultural Centre.

It is hoped the survey results will highlight the benefits of maintaining a balance between biodiversity and production in mixed farming systems, not only on the Eyre Peninsula but also throughout Australia.

## Acknowledgements

The landholders involved; Phillip & Jan Wheaton, Nigel & Debbie May, Shaun Freeman, Malcolm & Sue Heddle, Ian Rodgers, Paul Kaden, Minnipa Agricultural Centre, Mark Klante, Sim Farm at Cleve Area School, Donald and Julian Baillie. Those involved in the data collection in 2007; Trevor Cox, Jane Cooper, Christine Taylor, Peter Needle, students at Karcultaby Area School & teacher Sarah Pfennig, Roger & Suzanne Story, Greg Treloar, Sam Doudle, Sophie Keen, Justine Graham, Cleve Area School, Nicole Reichelt, Andrew Freeman, Corey Yeates, Geraldine Turner and Naomi Scholz.

***Figure 1** Cotton strips used to measure soil microbial activity. The strips were buried wet and left in the soil for three weeks, then sent to the University of Tasmania laboratory for testing.*

Natural Heritage Trust
Helping Communities Helping Australia

Government of South Australia
Eyre Peninsula Natural Resources Management Board

Grain & Graze
Profit through knowledge
EYRE PENINSULA

***Figure 2** An example of the invertebrate pitfall traps. These were buried at ground level and filled with coolant to preserve the insects. The samples were sent to the University of Tasmania for identification.*

# Farmers and the Triple Bottom Line

**Nigel McGuckian and Dr Lauren Rickards**
RM Consulting Group, Bendigo

Information

Around ten years ago people started using another TLA (three letter acronym), the TBL (Triple Bottom Line).

It was meant to allow people to discuss the notion that business was not all about profit but about a balance between goals - profit, environment and people. This approach is now used in planning, project management and evaluation. Some people refer to the quadruple bottom line by including culture as a consideration. Another variation is the triple helix, which aims to describe how the three are perfectly entwined.

It is interesting to note farmers are sometimes adopting a TBL approach with statements such as – "Farming isn't a business, it's a lifestyle". These criticisms imply farmers are not really serious businesses because they will often trade off profit for lifestyle and/or environment.

People are also worried that the condition of the land may suffer if it is left in the hands of farmers who are desperate to stay afloat in tough times. They may "flog" the country.

It is proposed that farmers have quietly been ahead of the game for years and in fact considering the "TBL" for years without giving it a name.

*"We want to be semi- retired on an ecologically healthy property and financially secure."*

Interviews carried out in the Grain and Graze social research project asked approximately eighty farmers around Australia how they make their decisions and what motivates their decision-making. Interviews were in great depth.

The first and most important lesson is the answers are not simple, they are complex. Farmers are motivated by a complex range of motivations such as family, their attachment to the land, the desire to make a living, their general level of wealth, and financial success. All of these are closely entwined and cannot be separated.

When asked to sum up what motivated them, the majority of farmers were motivated by handing on the farm in better condition than when they took it on. In particular, they want to improve the productivity of their farm by improving the condition of the soil. When asked how they know it has improved they would say, "I just know because the soil is easier to work with". For a farmer this improvement is easy to measure. It is something that is obvious.

*"All our crop could be better financially but environmentally it may not be."*

*"Our land is better now than 10 years ago or 50 years ago."*

Financial goals are difficult to set. Business analysts would like to say return should be measured on capital because that is how all businesses are measured. Many farmers and family businesses would argue the year has been a success if the family has earned a living, invested in improving the farm and put a bit aside in superannuation. Beyond this, many farmers would consider investing money in farm improvements such as tree planting, subdivision or water supply. These improvements may be considered by outside observers as a waste of money as they may not achieve a high return on capital. This approach is no different to that of the general population. Income level is often compromised for social or family goals. People work part time because their income level is satisfactory and working longer hours would cause too much disruption to their lifestyle. Farmers are often criticised because they are not making business-like decisions when they make a choice to sacrifice profit for lifestyle or environment.

*"People either get biodiversity or they don't."*

Social goals are very important to farming families. The farming life is very important. To have flexibility, and choice in how time is used, to choose to carry out enterprises they enjoy rather than find frustrating, to apply the skills they are good at is very important and an important benefit of being a farmer.

In reality, all of these goals combine whenever decisions are made. For example, in choosing enterprises, farmers will weigh up financial returns, the effect on the environment, the impact on the farming lifestyle and make a decision which takes all of these into account and is ultimately a compromise. On mixed farms where there are multiple enterprises, many decisions are made every day that require a TBL approach. To graze a crop stubble, to decide on the time of lambing, to decide on whether to buy another mob of cattle to fatten all require consideration of profit, people and environment.

*"Father has always had a love of livestock. Dad was farming with 3 brothers. Dad ran the livestock."*

On top of all these considerations the farmer will also be taking into account a range of risks and factors where the future is unknown such as weather and markets. This decision-making is extremely sophisticated and complex. Farmers would often conclude by saying "At the end of the day you just have to use gut feeling".

*"We would be quite happy to continuous crop if the weather wasn't so variable. We need enough land so we are not putting too much pressure on the land."*

Farmers have been making these complex decisions for years without any fuss or credit. It is patronising to suggest farmers need to be taught to take a triple bottom line approach. Maybe farmers could teach the advisors about taking a triple bottom line approach.

If there is any doubt about this theory, listen to a farmer describe the factors they consider when making a decision.

*"We have got to hand over the land in better condition. How can I improve profitability and viability? How can I improve the land?"*

*"Agriculture is the best lifestyle in the world. Done correctly there is also good money in it."*

*"Balancing livestock and biodiversity - maintaining production but not going backwards ecologically."*

# Types of work in this publication

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

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

# Acronyms and Abbreviations

| | |
|---|---|
| **ABA** | Advisory Board of Agriculture |
| **ABS** | Australian Bureau of Statistics |
| **AFPIP** | Australian Field Pea Improvement Program |
| **AGO** | Australian Greenhouse Office |
| **AGT** | Australian Grain Technologies |
| **AH** | Australian Hard (Wheat) |
| **AM fungi** | Arbuscular Mycorrhizal Fungi |
| **APSIM** | Agricultural Production Simulator |
| **APW** | Australian Prime Wheat |
| **AR** | Annual Rainfall |
| **ASBV** | Australian Sheep Breeding Value |
| **AWI** | Australian Wool Innovation |
| **BCG** | Birchip Cropping Group |
| **BYDV** | Barley Yellow Dwarf Virus |
| **CBWA** | Canola Breeders Western Australia |
| **CCN** | Cereal Cyst Nematode |
| **CLL** | Crop Lower Limit |
| **DAP** | Di-ammonium Phosphate (18:20:00) |
| **DM** | Dry Matter |
| **DPI** | Department of Primary Industries |
| **DSE** | Dry Sheep Equivalent |
| **DWLBC** | Department of Water, Land and Biodiversity Conservation |
| **EP** | Eyre Peninsula |
| **EPARF** | Eyre Peninsula Agricultural Research Foundation |
| **EPFS** | Eyre Peninsula Farming Systems |
| **EPR** | End Point Royalty |
| **FC** | Field Capacity |
| **GM** | Gross Margin |
| **GRDC** | Grains Research and Development Corporation |
| **GSR** | Growing Season Rainfall |
| **IPM** | Integrated Pest Management |
| **LEADA** | Lower Eyre Agricultural Development Association |
| **LEP** | Lower Eyre Peninsula |
| **LRCP** | Low Rainfall Collaborative Project |
| **LSD Test** | Least Significant Difference Test |
| **MAC** | Minnipa Agricultural Centre |
| **ME** | Metabolisable Energy |
| **MLA** | Meat & Livestock Australia |
| **MRI** | Magnetic Resonance Imaging |
| **NDF** | Neutral Detergent Fibre |
| **NLP** | National Landcare Program |
| **NRM** | Natural Resource Management |
| **NVT** | National Variety Trials |
| **PAWC** | Plant Available Water Capacity |
| **PDRF** | Premier's Drought Relief Fund |
| **PEM** | *Pantoea agglomerans*, *Exiguobacterium acetylicum* and *Microbacteria* |
| **pg** | Picogram |
| **PIRD** | Producers Initiated Research Development |
| **RDE** | Research, Development and Extension |
| **RDTS** | Root Disease Testing Service |
| **SAFF** | South Australian Farmers Federation |
| **SAGIT** | South Australian Grain Industry Trust |
| **SANTFA** | South Australian No Till Farmers Association |
| **SARDI** | South Australian Research and Development Institute |
| **SBU** | Seed Bed Utilisation |
| **SGA** | Sheep Genetics Australia |
| **SU** | Sulfuronyl Ureas |
| **TE** | Trace Elements |
| **TT** | Triazine Tolerant |
| **UNFS** | Upper North Farming Systems |
| **WAA** | Water Affecting Activities |
| **WP** | Wilting Point |
| **WUE** | Water Use Efficiency |
| **YEB** | Youngest Emerged Blade |
| **YP** | Yield Prophet |

# Contact list for Authors

| Name | Position | Location | Address | Phone/Fax Number | E-mail |
|---|---|---|---|---|---|
| **Ashton, Brian** | Senior Livestock Consultant | Rural Solutions SA<br>Pt Lincoln | PO Box 1783<br>Port Lincoln SA 5606 | Ph (08) 8688 3403<br>Fax (08) 8688 3407<br>Mob 0427 201 958 | ashton.brian@saugov.sa.gov.au |
| **Bellati, Judy** | Research Officer | National Invertebrate Pest Initiative<br>SARDI Entomology Unit | GPO Box 397<br>Adelaide SA 5001 | Ph (08) 8303 9670<br>Fax (08) 8303 9542 | bellati.judy@saugov.sa.gov.au |
| **Bennet, Michael** | Research Agronomist<br>SANTFA | SARDI<br>Minnipa Agricultural Centre | PO Box 31<br>Minnipa SA 5654 | Ph (08) 8680 5104<br>Fax (08) 8680 5020<br>Mob 0428 103 792 | bennet.micheal@saugov.sa.gov.au |
| **Bridle, Kerry** | National Project Coordinator | Tasmanian Institute of Agricultural Research<br>University of Tasmania | PB 98<br>Hobart TAS 7001 | Ph (03) 6226 2837<br>Fax (03) 6226 2642<br>Mob 0427 846 050 | kerry.bridle@utas.edu.au |
| **Cook, Amanda** | Research Officer | SARDI<br>Minnipa Agricultural Centre | PO Box 31<br>Minnipa SA 5654 | Ph (08) 8680 6233<br>Fax (08) 8680 5020 | cook.amanda@saugov.sa.gov.au |
| **Coventry, Stewart** | Research Associate | University of Adelaide | PMB 1<br>Glen Osmond SA 5064 | Ph (08) 8303 6738 | stewart.coventry@adelaide.edu.au |
| **Crouch, Jo** | Research Officer | SARDI<br>Port Lincoln | PO Box 1783<br>Port Lincoln SA 5606 | Ph (08) 8688 3417<br>Fax (08) 8688 3430 | crouch.joanne@saugov.sa.gov.au |
| **Cordon, Neil** | Extension Agronomist<br>EP Farming Systems | SARDI<br>Minnipa Agricultural Centre | PO Box 31<br>Minnipa SA 5654 | Ph (08) 8680 5104<br>Fax (08) 8680 5020<br>Mob 0427 600 266 | cordon.neil@saugov.sa.gov.au |
| **Davey, Sjaan** | PhD Student<br>Farming Systems | University of Adelaide<br>Discipline of Soil and Land Systems | PMB 1<br>Glen Osmond SA 5064 | Ph (08) 8303 8114<br>Mob 0424 542 877 | rowena.davey@adelaide.edu.au |
| **Doudle, Sam** | Leader<br>Minnipa Agricultural Centre | SARDI<br>Minnipa Agricultural Centre | PO Box 31<br>Minnipa SA 5654 | Ph (08) 8680 5104<br>Fax (08) 8680 5020 | doudle.sam@saugov.sa.gov.au |
| **Egan, Jim** | Senior Research Agronomist | SARDI<br>Port Lincoln | PO Box 1783<br>Port Lincoln SA 5606 | Ph (08) 8688 3424<br>Fax (08) 8688 3430 | egan.jim@saugov.sa.gov.au |
| **Frischke, Alison** | Research Agronomist - PAW<br>EP Farming Systems | SARDI<br>Minnipa Agricultural Centre | PO Box 31<br>Minnipa SA 5654 | Ph (08) 8680 6223<br>Fax (08) 8680 5020<br>Mob 0428 831 236 | frischke.alison@saugov.sa.gov.au |
| **Guerin, Liz** | Land Management Consultant | Rural Solutions SA - LAWS<br>Streaky Bay | 15 Bay Road<br>Streaky Bay SA 5680 | Ph (08) 8626 1108<br>Fax (08) 8626 1671<br>Mob 0427 261 671 | guerin.liz@saugov.sa.gov.au |
| **Hancock, Jon** | Research Agronomist - PAW<br>EP Farming Systems | SARDI<br>Minnipa Agricultural Centre | PO Box 31<br>Minnipa SA 5654 | Ph (08) 8680 6212<br>Fax (08) 8680 5020<br>Mob 0428 360 012 | hancock.jonathan@saugov.sa.gov.au |
| **Horne, Sarah** | Student | Cleve Area School | 2nd Street<br>Cleve SA 5640 | Ph (08) 8628 2104<br>Fax (08) 8628 2511 | majchorne@activ8.net.au |
| **Howie, Jake** | Senior Research Officer<br>Annual Pasture Legume Improvement | SARDI<br>Pastures Group | GPO Box 397<br>Adelaide SA 5001 | Ph (08) 8303 9407<br>Fax (08) 8303 9607 | howie.jake@saugov.sa.gov.au |
| **Heynen, Kim** | NRM Officer | EPNRM Board - Western EP | PO Box 181<br>Streaky Bay SA 5680 | Ph (08) 8626 1108<br>Fax (08) 8626 1671 | kim.heynen@epnrm.com |
| **Jefferies, Steve** | CEO<br>Australian Grain Technologies | University of Adelaide<br>Roseworthy Campus | Roseworthy SA 5371 | Ph (08) 8303 7835<br>Fax (08) 8303 4964 | stephen.jefferies@ausgraintech.com |
| **Jeisman, Charlton** | Consultant<br>Sustainable Agricultural Systems | Rural Solutions SA<br>Jamestown | PO Box 223<br>Jamestown SA 5491 | Ph (08) 8664 1408<br>Fax (08) 8664 1405<br>Mob 0438 875 290 | jeisman.charlton@saugov.sa.gov.au |
| **Kleemann, Sam** | Research Officer<br>Soil & Land Systems | University of Adelaide<br>Roseworthy Campus | Roseworthy SA 5371 | Ph (08) 8303 7908<br>Fax (08) 8303 7979 | samuel.kleemann@adelaide.edu.au |
| **Krause, Mike** | Consultant<br>Applied Economic Solutions | Adelaide | 10 Warramunda Cresent<br>Banksia Park SA 5091 | Ph (08) 8396 7122<br>Fax (08) 8396 7133<br>Mob 0408 967 122 | mike@AppES.com.au |
| **Kuhlmann, Peter** | Farmer<br>Chairman EPARF | Mudamuckla | 62 Hastings Avenue<br>Glenelg South SA 5045 | Ph (08) 8376 3492<br>Fax (08) 8376 9403<br>Mob 0428 258 032 | mudabie@bigpond.com.au |
| **Lynch, Brenton** | Consultant<br>Lynch Monitoring | Streaky Bay | PO Box 293<br>Streaky Bay SA 5680 | Ph (08) 8626 7037<br>Fax (08) 8626 7037<br>Mob 0407 802 967 | bnlynch@activ8.net.au |

| Name | Position | Location | Address | Phone/Fax Number | E-mail |
|---|---|---|---|---|---|
| **Mason, Dr Sean** | Post Doctoral Fellow | University of Adelaide<br>Discipline of Soil and Land Systems | PMB 1<br>Glen Osmond SA 5064 | Ph (08) 8303 8107<br>Fax (08) 8303 6717<br>Mob 0422 066 635 | sean.mason@adelaide.edu.au |
| **May, Rachel** | Land Management Consultant | Rural Solutions SA - LAWS<br>Lenswood | C/- PO<br>Lenswood SA 5240 | Ph (08) 8389 8837<br>Mob 0428 102 190 | may.rachel@saugov.sa.gov.au |
| **Mayfield, Allan** | Consultant<br>Allan Mayfield Consulting | Clare | 14 Vanga Avenue<br>Clare SA 5453 | Ph (08) 8842 3230<br>Fax (08) 8842 3330<br>Mob 0418 818 569 | mayfield@chariot.net.au |
| **McGukian, Nigel** | Consultant<br>Business Communities<br>Environment | RM Consulting Group<br>Bendigo | Box 2410<br>Mail Centre<br>Bendigo Vic 3552 | Ph (03) 5441 4821<br>Fax (03) 5441 2788<br>Mob 0418 510 644 | nigelm@rmcg.com.au |
| **McInerney, Emma** | Research Officer<br>Grain & Graze | SARDI<br>Minnipa Agricultural Centre | PO Box 31<br>Minnipa SA 5654 | Ph (08) 8680 6217<br>Fax (08) 8680 5020<br>Mob 0428 112 713 | mcinerney.emma@saugov.sa.gov.au |
| **McMurray, Larn** | Senior Research Agronomist | SARDI<br>Field Crop Improvement Centre | PO Box 822<br>Clare SA 5453 | Ph (08) 8842 6265<br>Fax (08) 8842 3775 | mcmurray.larn@saugov.sa.gov.au |
| **Paterson, Cathy** | Research Officer<br>Soil Compaction | SARDI<br>Minnipa Agricultural Centre | PO Box 31<br>Minnipa SA 5654 | Ph (08) 8680 6205<br>Fax (08) 8680 5020 | paterson.cathy@saugov.sa.gov.au |
| **Potter, Trent** | Senior Research Officer<br>Oilseeds | SARDI<br>Struan Research Centre | PO Box 618<br>Naracoorte SA 5271 | Ph (08) 8762 9132<br>Fax (08) 8764 7477<br>Mob 0427 608 306 | potter.trent@saugov.sa.gov.au |
| **Prance, Tim** | Senior Consultant<br>Pastures & Grazing Systems | Rural Solutions SA - Field Crops<br>Victor Harbor | PO Box 1439<br>Victor Harbor SA 5211 | Ph (08) 8552 8058<br>Fax (08) 8552 8501<br>Mob 0427 812 655 | prance.tim@saugov.sa.gov.au |
| **Ramsey, Rowan** | Farmer<br>Past Chairman - EPARF | Buckleboo | PO Box 213<br>Kimba SA 5641 | Ph (08) 86274062<br>Fax (08) 86274019<br>Mob 0427 274 064 | rtramsey@activ8.net.au |
| **Scholz, Naomi** | Project Manager<br>EP Farming Systems/Grain & Graze | SARDI<br>Minnipa Agricultural Centre | PO Box 31<br>Minnipa SA 5654 | Ph (08) 8680 6233<br>Fax (08) 8680 5020<br>Mob 0428 540 670 | scholz.naomi@saugov.sa.gov.au |
| **Solly, Ken** | Agribusiness Consultant<br>Solly Business Services | Naracoorte | 172 Smith Street<br>Naracoorte SA 5271 | Ph (08) 8762 0895<br>Fax (08) 8762 0896 | kensolly@rbm.com.au |
| **Stacey, Sam** | Senior Research Fellow | University of Adelaide<br>Earth & Environment | PMB 2<br>Glen Osmond SA 5064 | Ph (08) 8303 7467<br>Fax (08) 8303 6511 | samuel.stacey@adelaide.edu.au |
| **Thomas, Geoff** | Principal Consultant<br>EPARF board Member<br>Coordinator - Low Rainfall Collaboration Project | Thomas Project Services<br>Adelaide | 48 Grevillea Way<br>Blackwood SA 5051 | Ph (08) 8178 0886<br>Fax (08) 8178 0008<br>Mob 0409 781 469 | gtps@bigpond.net.au |
| **Wallwork, Hugh** | Leader<br>Wheat & Barley Improvement | SARDI<br>Plant Research Centre | GPO Box 397<br>Adelaide SA 5001 | Ph (08) 8303 9382<br>Fax (08) 8303 9393<br>Mob 0427 001 568 | wallwork.hugh@saugov.sa.gov.au |
| **Wauchope, Kieran** | Consultant<br>Sustainable Agricultural Systems | Rural Solutions SA - Field Crops<br>Port Lincoln | 5 Adelaide Place<br>Port Lincoln SA 5606 | Ph (08) 8688 3409<br>Fax (08) 8688 3407<br>Mob 0428 761 502 | wauchope.kieran@saugov.sa.gov.au |
| **Wheeler, Rob** | Leader<br>Crop Evaluation & Agronomy | SARDI<br>Plant Genomics Centre | GPO Box 397<br>Adelaide SA 5001 | Ph (08) 8303 9480<br>Fax (08) 8303 9378<br>Mob 0401 148 935 | wheeler.rob@saugov.sa.gov.au |
| **Whitbread, Anthony** | Farming Systems Scientist | CSIRO Sustainable Ecosystems | PMB 2<br>Glen Osmond SA 5064 | Ph (08) 8303 8455<br>Fax (08) 8303 8455<br>Mob 0408 690 825 | Anthony.Whitbread@csiro.au |
| **Wilhelm, Nigel** | MAC Research Leader<br>Scientific Consultant - Low Rainfall Collaboration Project | SARDI<br>Minnipa Agricultural Centre<br>Waite | PO Box 31<br>Minnipa SA 5654<br>GPO Box 397<br>Adelaide SA 5001 | Mob 0407 185 501<br>Ph (08) 8303 9353 (Adel)<br>Ph (08) 8680 6230 (Min) | wilhelm.nigel@saugov.sa.gov.au |
| **Yeates, Corey** | NRM Officer | EPNRM Board - Eastern EP | PO Box 156<br>Cleve SA 5640 | Ph (08) 8628 2091<br>Fax (08) 8628 2512 | corey.yeates@epnrm.com |
| **Zerner, Michael** | Research Officer | University of Adelaide<br>Roseworthy Campus | Roseworthy SA 5371 | Ph (08) 8303 7988<br>Fax (08) 8303 7979 | michael.zerner@adelaide.edu.au |

ABB

**ABB Grain are proud to invest in the future of the Australian grains industry**



















GRDC Grains Research & Development Corporation

# GRDC's Eyre Peninsula Farming Systems Project

...increasing the relevance and impact of research in low rainfall areas...

# Eyre Peninsula Grain & Graze Project

...maximising returns to growers while improving the natural resources and increasing social capital...

mla MEAT & LIVESTOCK AUSTRALIA

australian wool innovation limited

Australian Government Land & Water Australia

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE