Eyre Peninsula Farming Systems Summary 2009

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Foreword

Once again I am delighted to have the opportunity to welcome you to the 2009 Eyre Peninsula Farming Systems (EPFS) Summary.

The GRDC is proud to be associated with the trials, hard work and ingenuity that go into generating the results that are summarised in this publication.

It is widely accepted that water is the most universally limiting factor in Australian agricultural production systems. Over recent years growers across most of Australia have suffered from unreliable rainfall – too little, too early or too late. With the aim of improving water use efficiency (WUE) of grain-based farming systems the GRDC is investing $17.6 million between 2008 and 2013 in a coordinated initiative across the southern and western regions to help. The intention is to help growers make more profitable use of the rainfall received.

The Eyre Peninsula Farming Systems project is one of these that share the ultimate goal of the initiative to increase the WUE of our farming systems by 10 per cent through the most profitable and sustainable means.

By coordinating projects in an initiative like this a team approach can be taken to address ways to improve average WUE, understand and articulate elements of business risk management and improve the characterisation of the physical, financial and social environment in which the farming systems operate. This approach ensures the best use of the available expertise and provides the opportunity for different experiences to be shared.

In 2010 the GRDC will be embarking on a new initiative to more accurately define specific research questions. This will involve working with farming systems projects across the country in better understanding their local issues, what is already known, trial design and whether it is best answered through R, D or E, what value or impact the results are likely to have, how farming practices may change and what further work, if any is required.

The work outlined in the following pages goes a long way to provide a better understanding of water use efficiency, risk management, break crops and the integration of livestock into our farming systems to help us improve yields, productivity and profit for the benefit of individual growers, communities on the Eyre Peninsula and the grains industry as a whole.

These activities, as always are a collaborative effort with continued support from SARDI, the University of Adelaide, SAGIT, CSIRO, EPARF and growers throughout the Eyre Peninsula.

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

I hope you find the articles useful and have a prosperous 2010!

STUART KEARNS
Manager, Validation & Integration
GRDC

Eyre Peninsula Farming Systems 2009 Summary

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

This manual was compiled by The Printing Press

March 2010

Front Cover:

Main photo: Canola time of sowing trial plots (photo by John Heap)

From left to right: Alison Frischke, Peter Kuhlmann & Roy Latta; MAC Farm; Cutting hay

Back Cover:

From top to bottom: EPARF Board members; Willie Shoobridge,

Brenton Spriggs & Wade Shepperd; Mudamuckla Focus Site Field Day

Inside Back Cover:

Photos from various Eyre Peninsula agricultural events in 2009.

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Minnipa Agricultural Centre Update

Hi Everyone,

This year the Eyre Peninsula Farming Systems Summary 2009 is proudly supported by Viterra, Grains Research & Development Corporation (GRDC) through the Eyre Peninsula Farming Systems project (EPFS 3) and the Australian Government's Caring for our Country program via the No-till project. We would like to thank the sponsors for their contribution to Eyre Peninsula (EP) for research, development and extension and enabling us to extend our results to farm businesses on EP and beyond in other low rainfall areas.

This year's summary includes information about the work done on the EPFS 3 focus sites across upper EP, with trial work focusing on how we can be 'responsive' to seasons, prices and gaining optimal outcomes for the same or reduced inputs.

In staff news, Roy Latta has taken on the leadership role at MAC, and Linden Masters has been appointed to the position of Farming Systems Specialist. Linden will be providing a strong support role to farmer groups such as Ag Bureaus on upper EP, as well as developing strong links with EPNRM Board staff in the region. Leaving us in 2009 were Alison Frischke, who has moved to Bendigo and Willie Shoobridge, who has moved to Adelaide. Both Alison and Willie have been key long term contributors to MAC and we wish them well.

The first Farming Systems Focus Site Field Day was held at the Mudamuckla Focus Site, west of Wirrulla in August 2009. This was a well attended event, with farmers having the benefit of a range of experts to discuss issues out in the paddock. We look forward to holding more of these events in 2010 across the three focus sites on upper EP.

In 2009 the EPARF Members Day was combined with the upper EP GRDC Update and the Low Rainfall Collaboration Conference. The theme was Flexible Farming – Building in Resilience, with Ed Hunt providing information on common characteristics of farming businesses that had weathered the past few poor seasons well. A panel then discussed how resilience can be built into farming businesses. Other topics included using precision agriculture in weed control, variable rate technology and on-farm grain storage techniques.

The MAC Annual Field day was again a great success, with approximately 170 farmers, researchers and agribusiness representatives having the opportunity to hear some great speakers and topics, including the principles of grain marketing and potential for foliar phosphorus fertilisation of crops. Thanks to our sponsors and the Ag Excellence Alliance for their contribution of $1,000 towards getting speakers over for the day. Other highlights included the launch of the AGT wheat variety Mace, and the launch of the Improving Feed Utilisation case study booklet by Woolworths, Landcare Australia and the Eyre Peninsula Natural Resources Management Board. The greatest highlight of the field day was the fantastic state of the crops – a stark contrast to those of 2008.

DATES TO REMEMBER

EPARF Field Day: Wednesday 28 July 2010

MAC Annual Field day: Wednesday 15 September 2010

Current funded projects include:

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

We are also developing a new Grain & Graze mixed farming project on Eyre Peninsula, with further work on grazing cereals, the impact of livestock on soil health and finding suitable perennial pasture species for EP.

Thanks for your support at farmer meetings, sticky beak days and field days. Without strong farmer involvement and support, we lose our relevance to you and to the industries that provide a large proportion of the funding to make this work possible. I look forward to seeing you all at farming system events throughout 2010, and here's hoping for a great season too!

Naomi Scholz
Project Manager
Eyre Peninsula Farming Systems

MAC Staff and Roles

Roy Latta	Senior Research Scientist
Nigel Wilhelm	Senior Research Scientist
Mark Klante	Farm Manager
Dot Brace	Senior Administration Officer
Leala Hoffmann	Administration Officer
Naomi Scholz	Project Manager
Linden Masters	Farming Systems Specialist (EP Farming Systems & EPNRM)
Amanda Cook	Research Officer (Disease Suppression, Rhizoctonia)
Michael Bennet	Research Officer (No-till)
Catherine Paterson	Research Officer (EP Farming Systems)
Leigh Davis	Agricultural Officer (New Variety Trials)
Wade Shepperd	Agricultural Officer (EP Farming Systems, Rhizoctonia)
Willie Shoobridge	Agricultural Officer (NVT, EP Farming Systems)
Brenton Spriggs	Agricultural Officer (No-till)
Trent Brace	Agricultural Officer (MAC Farm)
Brett McEvoy	Agricultural Officer (MAC Farm)

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

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Multidrive Tractor

Eyre Peninsula Agricultural Research Foundation 2009 Report

EPARF
Eyre Peninsula Agricultural Research Foundation Inc.

Peter Kuhlmann, Chairman

Current Board

Farmers - Peter Kuhlmann (Mudamuckla), Matt Dunn (Rudall), Dean Willmott (Kimba), Simon Guerin (Port Kenny), Craig James (Cleve), Bryan Smith (Coorabie)

Special Skills & Expertise - Geoff Thomas (Adelaide), Andy Bates (Streaky Bay)

SARDI – Prof Simon Maddocks (Chief Scientist, Livestock & Farming Systems)

University of Adelaide – Dr Glenn McDonald (Waite Campus)

Minnipa Agricultural Centre - Roy Latta (Leader), Dot Brace (Executive Officer)

Members: Currently 195 members

Role of EPARF

Advise and assist:

- MAC management in strategic decisions like funding opportunities Defining research priorities at Project Management meetings
- MAC Farm on major decisions
- Support project applications
- Seek sponsorship and provide a pathway to contribute to positive outcomes for Eyre Peninsula farmers
- Maintain a relationship with our research funders and sponsors
- Utilise our reserve to leverage other funds
- Provide a service to our members

Finance: EPARF is a foundation and its income is from membership, sponsorship and reimbursements. Expenditure is supporting projects and administration, meeting expenses, project leveraging and services to members.

2009/10 Sponsors Gold

- GPS-Ag – Navigation system deal
- ABB/Viterra – Eyre Peninsula Farming Systems Summary
- Glencore Grain – Farming Systems Competition Paddock

Silver

- Rabobank
- Bank SA
- Nufarm
- Calcookara Stud
- CBH Grain
- AGT
- Alosca Technologies

Bronze

- Letcher and Moroney Chartered Accountants
- AWB Seeds
- Vaderstad
- Multidrive Tractor

Election of Board Members

There are 6 farmer member representatives on the board and each year 2 members are elected for a 3 year term. Peter Kuhlmann and Brent Cronin completed a 3 year term in 2009.

Brent chose not to renominate due to increased farming commitments and we thank him sincerely for his passion and involvement.

Peter Kuhlmann and Bryan Smith from Coorabie were nominated and accepted.

Bryan has a lot of enthusiasm for the research that comes out of Minnipa and despite having to travel 660 km round trip he has been a regular field day attendee. Welcome Bryan to the board.

EPARF Members' Day

We combined with the GRDC 2009 Grower updates and had the theme of 'Resilience'. There was lots of discussion about decision making and the impact on profitability, risk and ability to bounce back.

Low Rainfall Farming Systems Collaboration Group

Minnipa hosted the annual meeting this year and had farmers and researchers from Birchip, Mallee Sustainable Farming, Upper North and Central West Farming Systems groups.

Discussion involved building capacity, contract research and shared information on the various projects. The second day was the EPARF Field Day and it was with great pride that we were able to show them the farm trials under decile 10 conditions.

Ministerial Visit

EPARF members and senior staff met with Paul Caica, the Minister of Agriculture for a discussion and a farm tour.

MAC Field Day

The farm was a picture and the staff and visiting specialists did a great job in sharing the results of their work to an appreciative crowd.

Projects

EPFS 3

This project is focusing on water use efficiency, carbon and nitrogen interactions. We have focus paddocks at Mudamuckla, Minnipa and Wharminda where detailed information will be gathered on different soil types and managed by local growers.

EPNRM and G&G 2

Climate change and modelling work has started.

SANTFA

Michael Bennet is still extending No Till on EP and had some very interesting trials.

SAGIT

Amanda Cook is working on a Carbon and Disease Suppression project.

Minnipa Farm

The farm is impressive and had the best ever season.

Staff

Roy Latta was appointed Principal Research Scientist - Dryland Farming Systems and started in April. Roy was the manager of Walpeup Research Station and has a wealth of experience in pastures, lucerne and mixed farming systems.

Ali Frischke has resigned and Cathy Paterson is temporarily filling the position.

Linden Masters has returned to Eyre Peninsula as the Farming Systems Extension person and his extensive experience in education and farming will be extremely beneficial in assisting growers in making the best decisions for their businesses.

Thanks

Thanks to Dot's commitment and support of the EPARF board.

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

Back Row (L-R): Glenn McDonald, Simon Maddocks, Geoff Thomas, Matt Dunn, Craig James, Andy Bates.

Front Row (L-R): Peter Kuhlmann, Dean Willmott, Brent Cronin, Simon Guerin, Dot Brace, Roy Latta.

Eyre Peninsula Agricultural Research Foundation Members 2009

Atkinson	Phillip	KIMBA SA
Baillie	Terry	TUMBY BAY SA
Baldock	Graeme	KIMBA SA
Baldock	Heather	KIMBA 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
Bubner	Daryl	CEDUNA SA
Burns	E	CUMMINS SA
Burrows	Warren	LOCK SA
Burrows	Ian	LOCK SA
Calliss	Gary	ARNO BAY SA
Calliss	Jeremy	ARNO BAY SA
Cant	Brian	CLEVE SA
Cant	Mark	KIMBA SA
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Carey	Paul	STREAKY BAY SA
Carey	Peter	MINNIPA SA
Carey	Matthew	STREAKY BAY SA
Carey	Damien	STREAKY BAY SA
Carmody	Steven	COWELL SA
Cliff	Trevor	KIMBA SA
Cook	Matt	MINNIPA SA
Crettenden	Brenton	LOCK SA
Cronin	Brent	STREAKY BAY SA
Cronin	Pat	STREAKY BAY SA
Cummins	Richard	LOCK SA
Cummins	Lyn	LOCK SA
Cummins	Neil	LOCK SA
Daniel	Neil	STREAKY BAY SA
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Franklin	Ashley	COWELL SA
Freeman	Shaun	CEDUNA SA
Freeth	John	KIMBA SA
Freeth	Thomas	KIMBA SA
Fromm	Jon	MINNIPA SA
Fromm	Jerel	MINNIPA SA
Grund	John	KIMBA SA
Grund	Gary	KIMBA SA
Guerin	Simon	PORT KENNY SA
Guest	Terry	SALMON GUMS WA
Hamence	Les	WIRRULLA SA
Harris	John	KIMBA SA
Heath	Basil	PORT LINCOLN SA
Heath	Stacey	WUDINNA SA
Heddle	Bruce	MINNIPA SA
Hegarty	Kieran	WARRAMBOO SA
Herde	Bill	RUDALL SA
Hitch	Max	PORT LINCOLN SA
Hitchcock	Peter	LOCK SA
Hitchock	Nathan	LOCK SA
Holman	Kingsley	LOCK SA
Hood	Ian	PORT KENNY SA
Hood	Mark	PORT KENNY SA
Horgan	John	STREAKY BAY SA
Horgan	Mark	STREAKY BAY SA
Howard	Tim	CEDUNA SA
Hurrell	Leon	KIMBA SA
James	Craig	CLEVE SA
Jericho	Neville	MINNIPA SA
Jericho	Marcia	MINNIPA SA
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Kaden	Tony	COWELL SA
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Koch	Jeffrey	KIMBA SA	Prime	Andrew	WHARMINDA SA
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Lynch	Bradley	STREAKY BAY SA	Schwarz	Noel	CEDUNA SA
Lynch	Aden	STREAKY BAY SA	Seal	Brook	KIMBA SA
Lynch	Brenton	STREAKY BAY SA	Shepherd	Kym	BUTLER TANKS SA
Lynch	Damien	POOCHERA SA	Simpson	John	WUDINNA SA
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May	Ashley	KYANCUTTA SA	Turnbull	Mark	CLEVE SA
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Nicholls	Anthony	CEDUNA SA	Wheaton	Philip	STREAKY BAY SA
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Octoman	Matthew	TUMBY BAY SA	Williams	David	PORT NEILL SA
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Oswald	Clint	YANINEE SA	Willmott	Dean	KIMBA SA
Ottens	Tim	WHARMINDA SA	Woolford	Simon	KIMBA SA
Patterson	Simon	STREAKY BAY SA	Woolford	Peter	KIMBA SA
Pearson	Jeff	PORT LINCOLN SA	Woolford	James	KIMBA SA
Penfold	Liz	PORT LINCOLN SA	Woolford	Michael	CLEVE SA
Phillis	Jamie	UNGARRA SA	Woolford	Graham	KIMBA SA
Polkinghorne	Andrew	LOCK SA	Woolford	Barb	KIMBA SA
Pope	Lindsay	WARRAMBOO SA	Zacher	Michael	LOCK SA
Pope	Mark	WARRAMBOO SA	Zerna	Allan	COWELL SA

Eyre Peninsula Seasonal Summary 2009

Linden Masters[1] and Kieran Wauchope[2]

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

After three poor seasons, Eyre Peninsula (EP) farmers were waiting to see what would happen in 2009. Fertiliser and chemical costs had moved back from a record high but in the low to medium rainfall area, fertiliser, seed and spray applications were reduced reflecting the financial pressure farmers are under. Last season (2008) saw a patchy start, good winter rains but an exceptionally dry spring, resulting in below average yields and variable grain quality. Season 2007 was similarly variable with below average production following the severe state-wide drought of 2006.

What would the 2009 season bring forth?

A mixed season with extremes of wind and rain – ranging from decile 3 on Eastern EP to decile 10 at Minnipa. A localised thunderstorm of 43 mm and a tornado occurred at Cummins on 12 March and hail damage from Elliston to Cleve in September saw significant crop losses.

Good rains in the West in early March allowed sowing of feed and a general rainfall of over 25 mm across EP near ANZAC day, allowed seeding to get underway (earlier in the far west). Light patchy rain in May slowed some seeding operations as drier conditions and windy weather were experienced. Severe winds late in the month cut crops off at ground level and caused recently sown crop paddocks to drift on Western EP. However a good rain in June allowed farmers to complete sowing, with good conditions continuing into July. Decile 8 to 10 rainfall helped stored soil moisture to increase and only needed favourable spring weather to realise a good yield potential. A portion of Eastern EP did not get adequate rain until June and were many weeks behind the rest of the Peninsula. Eastern Eyre has had another poor season, in contrast water logging was noted on Lower EP around Cummins, White River and Stokes, while heavy rainfall mid-June caused localised flooding and sheet erosion in the Calca district between Streaky Bay and Venus Bay on Western EP.

A predominately dry August which persisted into September with hot dry windy conditions caused concern. However wet conditions returned to ensure for many one of the best harvest yields ever. Hot days late in October dried out many of the extra green heads that were appearing and allowed reaping to begin in the Far West.

Rainfall deciles for the period May to November showed that Eyre Peninsula received average to above average rainfalls for the growing season and this was reflected in record tonnages and many growers reaping record yields. Grain delivered had good grain size, although wheat protein was down. Water logging on Lower Eyre affected some barley and canola yields were less than anticipated. Late germinating rye and barley grass will pose problems for continuous croppers and summer weeds have had ideal growing conditions. Harvest was frustrating with several rainfall events and Falling numbers machines were used at major delivery sites.

Overall 2009 on Eyre Peninsula was an outstanding year except for grain prices and poor yields from Cowell to Arno Bay to Cleve which restricts recovery unless livestock are part of the system. For most of EP record tonnages were delivered. The rural situation is at a level where both yield and price parameters need to be achieved for farm survival.

Water quality and supply is becoming a major barrier to improvements in livestock productivity in localised areas of Eyre Peninsula.

DISTRICT REPORTS

EASTERN EYRE PENINSULA

- Eastern Eyre Peninsula was a mixed bag with some areas average, others well above average yields to another disaster on the Eastern sea board.
- After three to five poor years farmers tended to adopt low risk farming options and operated within their own personal comfort zone.
- Flexibility has been identified as a key strategy in low to medium rainfall districts. Rural communities are facing severe financial constraints coming into this season, with across the board reductions in inputs such as fertiliser, seed and herbicides.

Weather

- Hot, and dry with little to no rainfall and occasional strong wind dominated the weather in January and February, which reduced any green bridge, after some December rains. March conditions were mild to warm with some localised thunderstorm activity resulting in rainfalls at Cleve 8 mm (20) and Kimba 14 mm (16) (averages in brackets).

- April saw some good rainfall late in the month. Rainfall on Eastern EP was much patchier than the rest of the Peninsula. The rainfall received gave some farmers confidence going into this season, by providing a good start, with the exception of the only light falls on the east coast. An area from Cowell through to almost Butler inland through Cleve to Rudall lacked a break to the season until the June long weekend. An 80 mm thunderstorm in Wharminda - Pt Neill area was well received which put them on track for an average season.

- July rainfall varied from 23 mm (Cowell) to 81 mm (Wharminda), while August rainfall varied from 12 mm (Cowell) to 36 mm (Cleve). Late September saw significant hail damage in a 2-3 km wide strip near Elliston widening to 15 km plus at Rudall-Verran Cleve.
- Growing season rainfall (April-October) was near average for most of the district, with the driest area being Cleve-Cowell-Arno Bay.

Crops

- Early indications were for similar sowings to last season with a swing away from high-risk pulse and canola sowings and a trend towards more wheat than barley. On Eastern EP sowing was a more measured approach, with no significant March rains and the April rainfall was generally not as high as other parts of EP. Strong winds in the first week of June caused erosion on sandy paddocks near Mangalo. By June seeding was completed across the district, with farmers sowing all their intended crop area. Areas around Cowell to Arno Bay inland to Rudall to Butler struggled for soil moisture until mid June, which meant late sowing and emerging crops were vulnerable to wind erosion. Most crops looked good despite below average rainfall; however crops in the area east of Cleve from Cowell to Arno Bay struggled the whole year.
- Crops grew rapidly in response to milder temperatures during August and crop development was estimated to be 2-3 weeks earlier than normal. From mid August net form net blotch was widespread in susceptible barley crops particularly in coastal areas; stripe rust was also widespread. End of September hail damage of 30-100% impacted crops in a wide swath from Elliston through to Cleve.
- Generally high grain weight and lower protein cereals have been delivered, with a small amount of frost damage. Yields were well above average except for Eastern EP where some considered it worse than previous years!

Pastures

- Stock feed supply has diminished making some paddocks prone to erosion. Good management saw farmers able to carry normal stock numbers through. Water quality is of concern in the Cowell and Mangalo areas. Most pastures put on good growth during July-August.
- Paddock feed was more than adequate for stock requirements in all but the driest districts. There was potential for hay and fodder production during spring.

WESTERN EYRE PENINSULA

- Flexibility has been identified as a key strategy in low to medium rainfall districts, with this being demonstrated in many ways, such as working within financial constraints, weed control, tillage practice and this season land being worked up for early crop sowing.
- Good rains in March started providing some sub soil moisture and those areas that received substantial rains started sowing cereals, especially oats for early feed or attempting to get cover on areas that were badly drifting. Growing season rainfall (April-October) varied from average for the Far West to well above average for the remainder of Western EP.
- Record yields and tonnages were grown on many properties in the Central west area, including MAC.

Weather

- Hot, dry with occasional strong winds dominated the weather throughout the district with no rain in January and February.
- In March rainfall recordings were up to six times above average in places. Rainfall readings at selected centres (averages in brackets) were: Streaky Bay 28 mm (14), Penong 47 mm (15), Ceduna 45 mm (15), Wirrulla 60 mm (14), Minnipa 66 mm (15), Mt Cooper 43 mm (15), Nundroo 102 mm (16), Elliston 46 mm (15). Conditions during April saw good rainfall late in the month. Western EP recorded its second successive month of above average rainfall, Streaky Bay 47 mm (24), Penong 29 mm (22), Ceduna 23 mm (19), Wirrulla 27 mm (18), Minnipa 26 mm (18), Mt Cooper 42 mm (25), Nundroo 30 mm (24), Elliston 44 mm (27). The rainfall received was of great significance as it gave farmers confidence going into the season, by providing a text book start.
- May was a month of extreme contrasts of weather distribution across the district, with strong winds on 22 and 23 causing dust storms across the district, as there was still not sufficient cover in pasture and crop paddocks. June rainfall was well below average in some areas whilst others almost had average recordings, helped by a significant downpour late in the month which caused localised flooding and sheet erosion in the Calca district between Streaky Bay and Venus Bay. An area ranging from east of Wirrulla through to Kyancutta with the far west area of Nundroo also receiving good falls. Streaky Bay 15 mm (46), Penong 9 mm (39), Ceduna 14 mm (35), Wirrulla 26 mm (32), Minnipa 34 mm (37), Mt Cooper 40 mm (46), Nundroo 27 mm (36), Elliston 16 mm (53).

- The rainfall cemented a good start for sown crops on Western EP where that rain fell. All other areas were urgently looking for significant follow-up rains. July rainfall varied from 33 mm (Nullarbor) to 120 mm (Streaky Bay), while August rainfall varied from 14 mm (Nullarbor) to 35 mm (Elliston). The latter rains saw most areas hit a cumulative rainfall reading of decile 10 in July and maintaining decile 8. October's bursts of hot days were not destructive due to sub soil moisture and the advanced nature of the crops. Several rainfall events slowed harvest but were not excessive.

Crops

- Early indications were for an easing in area sown to cereals of up to 15%. There appeared to be a swing away from high-risk pulse and canola sowings and a trend towards more wheat than barley. The rural communities were facing severe financial constraints coming into this season, with reductions across the board in inputs such as fertiliser, seed and herbicides. There was a trend away from narrow point, no till systems to full cut, full soil disturbance sowing machines or minimum tillage operations. Good early rains provided an excellent start to the season and generated subsoil moisture not seen for the last four seasons, which laid a foundation for high yield potentials.
- Areas that received substantial rains started sowing cereal feed in March and in April seeding was well underway as many paddocks were prepared following the good rains in March. However most cropping paddocks were very fragile and at risk to soil erosion. Severe winds in May cut newly emerging crops, especially on light sandy rises and some re-seeding was needed, as were good follow up rains. Crop establishment had been patchy according to soil type and rainfall, with poor emergence on heavy soils and those that suffer from transient salinity or magnesia patches. Excellent later rains provided germination and good yields were reapt. It is essential to keep cover over next summer to prevent salts again wicking to the top.
- Nitrogen deficiency became visible throughout the area, due to wet conditions and the reduction of nitrogen input at seeding time. Some farmers applied post-seeding nitrogen, but finance and risk adversity limited the potential to apply nitrogen to their farming system. Crops were generally looking good and continued to grow rapidly in response to milder temperatures during August, despite below average rainfall. Rhizoctonia consistently showed up in paddocks and Predicta B tests should be taken prior to next season's program.
- From mid August net form of net blotch was widespread in Maritime barley crops, particularly in coastal areas and there was some fungicide application for stripe rust in wheat, with wheat leaf rust and oat rust also being reported. The weather conditions during spring were good as the crops were advanced enough when several extremely hot days occurred.
- Several rainfall events over harvest slowed operations but relatively little quality damage occurred, except on suspect wheat or barley varieties. Record yields over a large area saw new bunkers being built at Wudinna and line ups of semi's and road trains were a common occurrence even at the smaller handling facilities.

Pastures

- Stock feed was in good supply and quality following the December rains, however this feed supply deteriorated quickly. Cover on paddocks was poor and stock containment implemented earlier than usual, as sandy rises were prone to wind erosion. Lincoln weed growth on paddocks or areas of paddocks that were drifting in 2008 assisted in stabilising the soil.
- Hay and grain supplies proved to be adequate to get stock through to the break of the season. Dry and early sown cereals provided good soil protection and produced an excellent source of stock feed. Pasture growth responded quickly to the early rainfall, which allowed hand feeding to cease, as feed quality and quantity was excellent. High mutton and lamb prices returned good gross margins. Lambing percentages and wool cuts have been good. Water supply is an issue in the Mt Cooper district, resulting in costly, widespread carting of water in that area, highlighting the need for better water supplies.

LOWER EYRE PENINSULA

- The season opening this year filled farmers with hope and got the tractors into the paddocks early but memories of the last few seasons were never far away. Many had reduced their inputs and were looking for ways to reduce risk. Cereal crops were sown early for feed with the hope of reaping grain at the season's end, early summer weeds were sprayed for moisture conservation and some alternative fertilisers were trialled.
- Climatic conditions throughout the year were generally ideal; the main issue being paddock access for spraying and fertiliser spreading as they were too wet. The lower parts of the region suffered from water logging but the areas that weren't under water in the paddocks yielded well, allowing the paddock yields to balance out around average.
- Over all, the season enabled above average yields to be harvested with no major losses from pests and disease. Grain prices were the one major let down to the otherwise very positive season.

Weather

- The year started with high temperatures, with Port Lincoln having many days above the decile 9 record of 32°C. Some mild wind erosion occurred on the paddocks with little cover. February conditions were moderate and then March followed with wild, windy conditions bringing some heavy downpours for a strip through Cummins to Cockaleechie and Ungarra; a tornado touched down near Cummins. Port Lincoln received 23 mm, Coles Point 34 mm and Cummins had in excess of 60 mm.
- Good opening rains then fell in April with most of the region receiving 20-40 mm. Areas north of Tumby Bay along the coast were still needing rains, Port Neill had only received 15 mm. This area remained dry until June, with other areas becoming too wet after 175 mm fell at Wanilla and most parts receiving more than 100 mm.
- The remainder of the growing season brought average to above average rains and generally ideal growing conditions. November had a week of hot weather which ripened the crops quickly but some rain followed to hold up harvest – no significant damage was reported though. Water logging was more of an issue than drought this year, a welcome change for most.

Crops

- Early indications were that the area sown to canola may slightly reduce, while pulses and barley hectares were reduced dramatically due to the volatility in the markets and associated risks. Weed spraying occurred after the early rains to retain moisture and sowing began in early April with canola and pastures first in. Some delayed sowing to get a good weed kill as paddocks had become dirty after the last few years of dry sowing.
- The central and western areas had an ideal run for seeding and most were completed by the end of May. The upper eastern areas struggled with dry conditions and only finished seeding through June.
- Mites, slugs and lucerne flea caused some early issues but control measures ensured little damage.
- Wet, cool conditions slowed crop development and some water logged crops showed severe signs of stress. August brought warmer conditions and crops took off.
- Net form of net blotch was prevalent and damaged the susceptible varieties. Stripe rust was discovered mid August and spraying commenced immediately as the large yield potential warranted it. The diamond back moth presented once again on the west coast and stripped some paddocks bare. This pest is a major threat to the canola industry and research needs to be done to ensure the longevity of our main break crop.
- Spray topping cereals become a more common practice throughout the region with high numbers of ryegrass and wild oats coming through late in the season.
- The hot week in November allowed harvest to begin early and most finished by early December. Wheat yields ranged from 1.8 t/ha in the drier areas to 5 t/ha around Cummins. Quality was generally poor with low protein resulting from the climatic conditions and farmers being conservative with late nitrogen applications - the majority was delivered as ASW. Barley yields ranged from 2-6 t/ha and again quality was not great with the majority delivered being feed. Canola yields ranged between 1.5 and 3 t/ha and oils were very good with some above 50%. Lupins were patchy, where they weren't water logged yields were up to 4 t/ha, but a lot of yields suffered due to the excess moisture. Peas struggled with black spot and yields ranged from 0.7-2 t/ha. The few beans that were grown did well with yields averaging around 2 t/ha.

Pastures

- Feed supplies and quality were generally good throughout the whole year, with the exception of some of the drier areas. Some areas had excess supplies and had stock on agistment from Broken Hill.
- There were reports of a few stock losses due to cobalt deficiency which hadn't occurred for a while, resulting from such a large flush of feed in spring in the coastal parts.
- Some farmers were able reap crops that they had sown for pasture as there was sufficient feed around, providing an extra form of income. Most paddocks cut for hay had large amounts of re-growth which also provided extra feed.

MAC Farm Report 2009

Mark Klante and Roy Latta
SARDI, Minnipa Agricultural Centre

INFORMATION

Try this yourself now

Location: Minnipa Ag Centre

Rainfall
Av. Annual: 320 mm
Av. GSR: 240 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Key messages

Record commercial MAC grain yields achieved in 2009 due to;

- **Excellent seasonal conditions including above average rainfall**
- **Timely seeding operations**
- **Good agronomic management**
- **An effective and committed workforce**

Why do the trial?

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

How was it done?

Sowing commenced on 22 April with Winteroo oats and Maritime barley for sheep feed. Sowing was completed on 14 May with good conditions throughout. The GPS guidance system worked well without any hold-ups.

The area sown was 864 hectares (wheat 660, barley 130, oats 44 and peas 30) with 165 ha of permanent or regenerating pasture.

What happened?

Record wheat yields of 3.8 t/ha were higher than that of 1991 and 2001 (approximately 3 t/ha). The yields were achieved in response to an optimum sowing time, first 2 weeks of May, coupled with a 330 mm growing season rainfall. Estimated water use efficiency of 17 kg/ha/mm of available water achieved >80% of optimum.

Table 1 presents a representative sample of grain yields and protein aligned with paddock histories.

What does this mean?

The MAC commercial farm has improved grain yield productivity/mm of available water above previous high producing years of 1991 and 2001. There has also been an increase in the proportion of grain crops being sown, increasing from approximately 50% to almost 80% of the property in 2009. This has been achieved while maintaining a ewe flock of approximately 450 plus lambs on 200 hectares of growing season forage crops and pasture.

An opportunity to increase the water use efficiency of the crops with the application of 20 kg/ha N at growth stage 41 was evaluated on one paddock. The result was an increase in grain protein content but not in grain yield.

Acknowledgements

MAC farm staff Brett McEvoy and Trent Brace.

Table 1 Harvest results 2009

Paddock	Paddock History 05-08	Crop 2009	Sowing Date	Yield (t/ha)	Protein (%)
South 1	P P W W	Wyalkatchem	7 May	4.2	10.0
South3 N	W W Pe P	Mace	8 May	3.9	10.5
South 3 N	W W Pe P	Wyalkatchem	8 May	3.6	10.5
South 4	W W P W	Yitpi	1 May	3.6	11.6
South 5	P W W W	Kaspa	5 May	1.7	
South 6 E	O P P W	Espada	1 May	4.0	12.5
South 7	W P W W	Wyalkatchem	7 May	4.1	9.7
South 9	W W B P	Espada	28 April	4.1	11.2
South 10	W P W W	Wyalkatchem	7 May	3.4	9.1
North 1	P W W W	Wyalkatchem	6 May	4.0	11.1
North 5 N	P W W W	Correll	11 May	3.4	11.3
North 5 S	B P P B	Hindmarsh	2 May	3.9	
North 6 E	W W P P	Axe	3 May	3.2	11.9
North 6 E	W W P P	Gladius	3 May	3.0	12.2
North 6 W	B W C W	Gladius	4 May	4.0	11.5
North 7/8	W W P W	Wyalkatchem	7 May	4.0	9.9
North 7/8	W W P W	AXE	13 May	2.8	11.4
North 7/8	W W P W	Gladius	14 May	3.0	11.5
North 11	O Pe W W	Wyalkatchem	27 April	4.2	10.6
North 12	W T W B	Wyalkatchem	28 April	3.8	9.0
Competition Paddocks					
Paddock	**Paddock HIstory 05-08**	**Crop 2009**	**Sowing Date**	**Yield (t/ha)**	**Protein (%)**
Consultants	Pe W W O	Oats	22 April	5.5 t/ha hay	
District Practice	P W W C	Wyalkatchem	27 April	4.4	10.0
Farmers	P W W B	Gladius	30 April	4.2	10.1
Researchers	W P P W	Angel			

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

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 "$P \leq 0.05$". This means there is a 5% probability or less that the observed difference between treatment means occurred by chance, or we are at least 95% certain that the observed differences are due to the treatment effects.

The size of the LSD can then be used to compare the means. For example, in a trial with four treatments, only one treatment may be significantly different from the other three – the size of the LSD is used to see which treatments are different.

Results from a replicated trial

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

Table 1 Mean grain yields of fertiliser treatments (4 replicates per treatment)

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

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

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

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

On-farm testing – Prove it on your place!

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

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

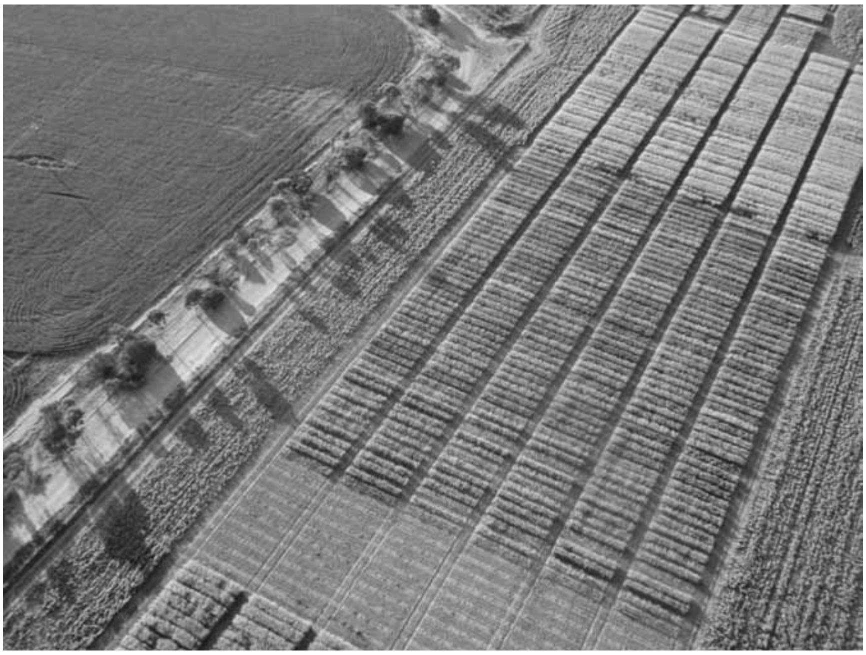
The carefully planned and laid out farmer un-replicated trial or demonstration does have a role in agriculture as it enables a farmer to verify research findings on his particular soil type, rainfall and farming system, and we all know that "if I see it on my place, then I'm more likely to adopt it".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

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

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

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

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



Trials Sown but not Harvested or Reported 2009

Low Rainfall Juncea Canola Breeding

Miltaburra, Mudges

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

Not harvested due to poor growth.

Types of Work in this Publication

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

Type of Work	Replication	Size	Work conducted by	How Analysed
DEMO	No	Normally large plots or paddock size	Farmers and Agronomists	Not statistical, trend comparisons
RESEARCH	Yes, usually 4	Generally small plot	Researchers	Statistics
SURVEY	Yes	Various	Various	Statistics or trend comparisons
EXTENSION	N/A	N/A	Agronomists	Usually summary of research results
INFORMATION	N/A	N/A	N/A	N/A

Some Useful Conversions

Area

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

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

1 ha = 2.471 acres

Mass

1 t (metric tonne) = 1,000 kg

1 imperial tonne = 1,016 kg

1 kg = 2.205 lb

1 lb = 0.454 kg

A bushel (bu) is traditionally a unit of volumetric measure defined as 8 gallons.

For grains, one bushel represents a dry mass equivalent of 8 gallons.

Wheat = 60 lb, Barley = 48 lb, Oats = 40 lb

1 bu (wheat) = 60 lb = 27.2 kg

1 bag = 3 bu = 81.6 kg (wheat)

Volume

1 L (litre) = 0.22 gallons

1 gallon = 4.55 L

1 L = 1,000 mL (millilitres)

Speed

1 km/hr = 0.62 miles/hr 10 km/hr = 6.2 miles/hr

15 km/hr = 9.3 miles/hr

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

Pressure

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

25 psi = 1.7 bar = 172 kPa

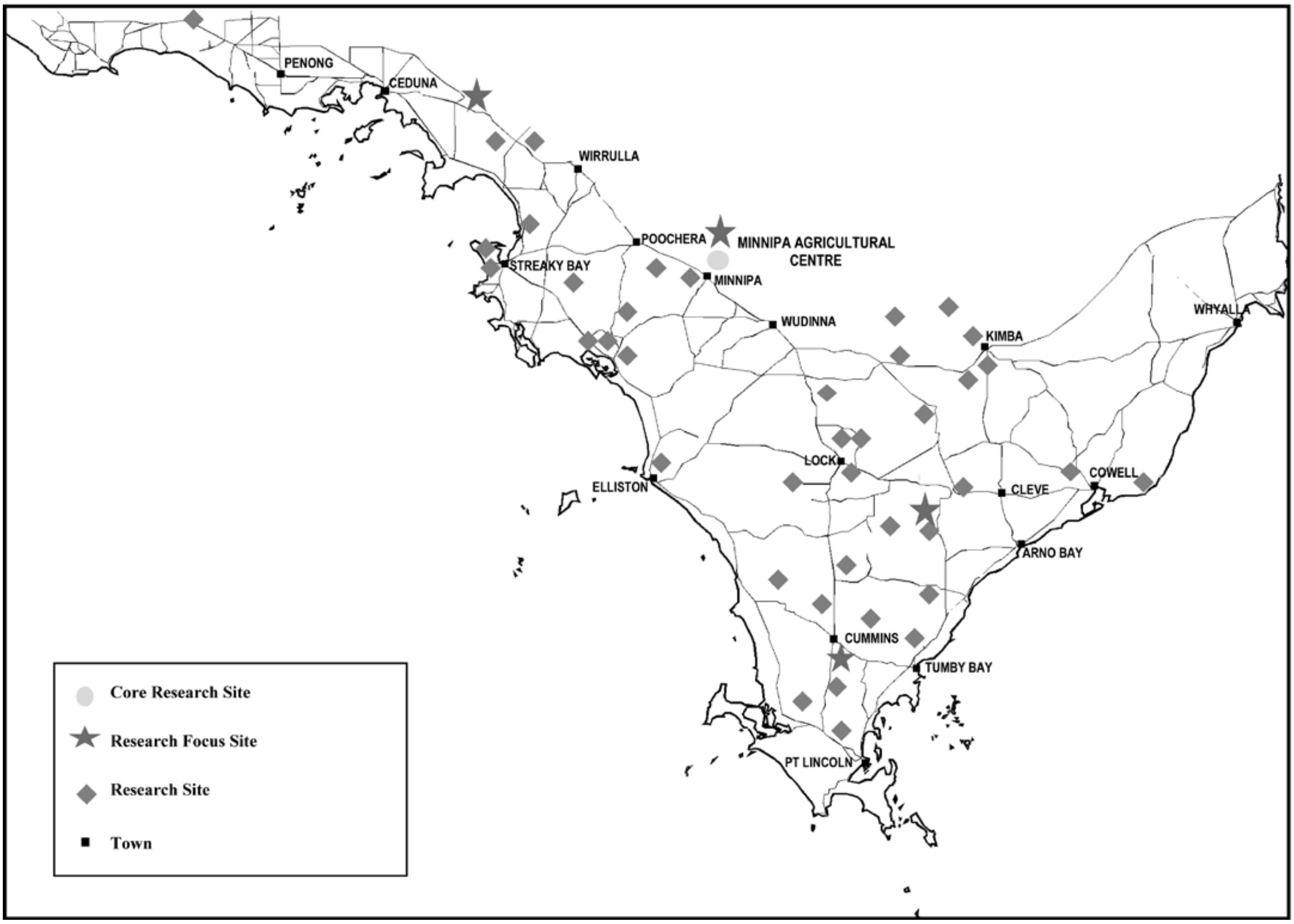
Yield

1 t/ha = 1000 kg/ha

Yield Approximations

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

Eyre Peninsula
Agricultural Research Sites 2009



Section Editor:
Cathy Paterson
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Cereals

The total 2009 production figures for Eyre Peninsula were approximately 1,798,000 t of wheat, 712,000 t of barley, 384,000 t of oats and 9,900 t of triticale.
[PIRSA Crop Production Estimates, January 2010]

SA Triticale Variety Yield Performance

2009 and long term (2001-2009) expressed as % of site average yield and as t/ha

Variety	2009				Long Term average across sites within region (2000-2009) as % site average and No of trials			
	Greenpatch	Minnipa	Streaky Bay	Wharminda	Lower Eyre		Upper Eyre	
					%sites av.	# Trials	%sites av.	# Trials
Bogong	123	111	115	103	115	5	110	5
Canobolas	116	102	103	104	110	5	105	5
Crackerjack	-	-	-	-				
Hawkeye	107	104	106	110	108	7	105	7
Jaywick	106	94	100	104	107	7	103	7
Kosciuszko	72	-	-	98	97	18	96	13
Rufus	94	86	96	102	99	13	99	13
Speedee	-	105	94	-	94	15	97	15
Tahara	96	94	111	98	98	19	101	17
Tickit	103	102	100	104	99	19	100	17
Tobruk	73	-	-	73	103	6	103	3
Yukuri	101	-	-	95				
Site av. yield t/ha	5.70	4.59	3.0	2.65	2.65		1.49	
LSD (P=0.05) as %	*6*	*5*	*6*	*11*				
Date Sown	19 May	8 May	11 May	29 May				
Soil Type	L S	L	L S C L	N W S				
pH (water)	5.3	8.5	8.4	7.4				
A-O rain mm	496	333	359	245				
Stress factors				r				

Abbreviations

Soil Types: S=sand, C=clay, L=loam, F=fine, K=course, M=medium, Li=light, H=heavy, /=divides topsoil from subsoil

site stress factors: r=rhizoctonia

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

Data analysis by GRDC funded National Statistics Group

SA Wheat and Durum Variety Yield Performance *(2009 and predicted regional performance, expressed as % of site average yield)*

Variety	Mid and Lower Eyre Peninsula						Upper, Eastern and Western Eyre Peninsula									
	2009 (%) site average			Long Term average across sites			2009 (as % site average)							2009 (as % site average)		
	Cummins	Rudall	Ungarra	t/ha	as %site av.	# trials	Kimba	Minnipa	Mitchelville	Nunjikompita	Penong	Streaky Bay	Warramboo	t/ha	as % site av.	# trials
AGT Katana	108	109	100	3.14	108	9	112	104	120	101		999	104	1.60	111	17
AGT Scythe	-	-	-	3.04	104	18	-	-	-	-		-	-	1.55	107	36
Axe	93	93	90	3.01	103	18	110	92	124	86		83	90	1.55	107	35
Barham	102	-	106				-	-	-	-		-	-			
Catalina	97	94	99	2.98	102	12	99	89	95	93		87	93	1.50	104	21
Clearfield Jnz	95	83	105	2.84	97	6	40	96	46	95		87	93	1.33	92	13
Correll	104	107	108	3.08	106	15	107	96	100	94		106	105	1.58	109	28
Derrimut	109	108	110	3.13	107	15	98	101	104	91		87	100	1.52	105	28
Espada	105	94	101	3.17	109	12	119	105	109	110	NO	109	104	1.63	112	21
Frame	90	79	92	2.79	96	30	59	84	70	97		109	92	1.43	99	66
Gladius	101	99	100	3.15	108	15	111	102	104	104	VALID	100	105	1.62	112	28
Guardian	104	-	96	3.12	107	11	-	-	-	-		-	-	1.56	108	15
Kukri	-	98	-	2.76	95	25	84	89	98	96	RESULT	99	98	1.41	98	66
Lincoln	107	92	104	3.09	106	9	101	99	86	109		109	98	1.59	110	17
Mace	106	106	98				119	105	113	100		95	100			
Magenta	109	109	107	3.08	106	15	102	100	88	114		121	105	1.55	107	28
Peake	102	108	107	3.08	106	15	99	101	119	88		75	100	1.54	106	28
Pugsley	98	96	100	3.04	104	30	73	93	76	107		108	102	1.52	105	66
Scout	118	118	119				134	110	109	106		105	109			
Wyalkatchem	92	110	102	3.18	109	27	114	107	102	113		114	106	1.59	110	58
Yitpi	99	100	100	2.96	102	30	83	97	88	105		105	103	1.54	106	66
Young	104	91	107	3.09	106	18	117	103	118	101		86	98	1.57	108	35
Site av. yield t/ha	5.53	2.98	4.54	2.91			1.66	4.86	0.88	2.60		2.70	3.61	1.45		
LSD (P=0.05) as %	*7*	*5*	*6*				*8*	*7*	*13*	*6*		*10*	*5*			

Variety	Mid and Lower Eyre Peninsula						Upper, Eastern and Western Eyre Peninsula									
	2009 (%) site average			Long Term average across sites			2009 (as % site average)							2009 (as % site average)		
	Cummins	Rudall	Ungarra	t/ha	as %site av.	# trials	Kimba	Minnipa	Mitchelville	Nunjikompita	Penong	Streaky Bay	Warramboo	t/ha	as % site av.	# trials
Durums																
Caparol	95	94	99	2.18	100	11										
Hyperno	107	100	106	2.32	106	11										
Jandaroi	102	90	101	2.16	99	14										
Kalka	97	100	96	2.20	101	14										
Saintly	107	107	108	2.38	109	11										
Tamaroi	102	98	104	2.20	101	14										
Site av. yield t/ha	5.15	2.37	3.43	2.18												
LSD (P=0.05) as %	*9*	*10*	*9*													
Date sown	20 May	28 May	26 May				27 May	8 May	27 May	25 May	20 May	11 May	26 May			
Soil Type	CL	S	CL				SCL	L	LS	SL		LSCL	SCL			
A - 0 Rain mm	380	285	332				287	333	184	262		359	313			
pH (water)	7.9	7.7	8.1				8.3	8.5	6.9	8.6		8.4	8.5			
Site Stresses		de,r					de		de,ht							

Abbreviations

soil type: S = sand, L = loam, C = clay, Li = Light, M = medium, H = heavy, F = fine

Site stress factors: de = pre flowering moisture stress, ht = heat stress during grain fill, r = rhizoctonia

Rain recorded in mm, / = separates top soil from sub soil

Data source: NVT & SARDI/GRDC (long term data based on weighted analysis of sites, 2000 - 2009) *Durum varieties trialed separatly and not completely valid to compare against bread wheats

Data analysis by GRDC funded National Statistics Group

SA Barley Variety Yield Performance *2009 and long term, (2001 - 2009) expressed as t/ha and % of site average yield*

Variety	LOWER EYRE PENINSULA					CENTRAL AND UPPER EYRE PENINSULA							
	2009 (t/ha)		Long Term average across sites			2009 (as % site average)					Long Term average across sites		
	Cummins	Wanilla	t/ha	as %site av.	# trials	Darke Peak	Elliston	Minnipa	Streaky Bay	Wharminda	t/ha	as % site av.	# trials
Barque	94	95	3.16	105	27	102	126	92	115	95	2.13	110	36
Baudin	90	94	3.09	102	26	-	-	-	-	102	1.98	102	28
Buloke	110	101	3.30	109	20	105	99	107	105	111	2.10	108	24
Commander	106	101	3.29	109	26	103	106	103	104	104	2.09	107	32
Finniss	112	83	2.83	94	13	-	-	-	-	93	1.87	96	3
Flagship	99	105	3.13	104	26	97	95	97	94	112	2.03	105	32
Fleet	99	108	3.38	112	20	107	122	116	138	101	2.28	117	24
Gairdner	80	93	2.98	99	28	-	-	-	-	85	1.97	101	28
Hannan	104	104	3.24	108	11	105	99	102	98	121	2.11	108	13
Hindmarsh	115	110	3.47	115	11	111	78	108	94	123	2.28	117	13
Keel	73	100	3.28	109	29	102	104	118	102	107	2.23	114	36
Lockyer	119	118	3.35	111	9	116	101	102	108	112	2.15	110	8
Maritime	92	99	3.24	108	23	90	115	93	112	110	2.07	107	30
Oxford	122	109				100	118	98	122	98			
Schooner	81	99	3.03	100	29	89	95	95	94	107	1.96	101	36
Sloop	94	104	3.00	100	29	-	-	-	-	98	1.97	101	32
Sloop SA	81	108	3.03	101	29	93	74	90	84	99	1.97	101	36
Vlamingh	102	101	3.07	102	17	97	110	89	103	102	1.94	100	20
Yarra	120	108	3.27	109	23	106	113	101	112	96	2.16	111	28
Site av. yield t/ha	5.37	5.03	3.02			2.82	2.89	4.92	2.69	2.53	1.95		
LSD (P=0.05) as %	*8*	*6*				*5*	*8*	*8*	*15*	*9*			
Date Sown	20 May	19 May				18 May	9 May	8 May	11 May	29 May			
Soil Type	CL	NWS				NWS	SL	L	SL	NWS			
A - O Rain mm	380	419				266	463	333	323	245			
pH (water)	7.9	8.0				7.7	8.4	8.5	8.3	7.4			
Site Stress Factors							ns, r			r			

Abbreviations

soil type: S = sand, L = loam, C = clay, Li = Light, M = medium, H = heavy, F = fine, NW = non wetting, / = separates top soil from sub soil

Site stress factors: ns = spot form net blotch, r = rhizoctonia

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

Data analysis by GRDC funded National Statistics Group

Cereals

SA Oat Variety Yield Performance

2009 and long term (2001-2009) expressed as % of site average yield and as t/ha

Variety	2009			Long Term average across sites within region (2000-2009) as % site average and No of trials			
	Greenpatch	Minnipa	Nunjikompita	Lower Eyre		Upper Eyre	
				%sites av.	# Trials	%sites av.	# Trials
Carrolup	-	92	-			102	2
Echindna	103	-	105	108	8	104	16
Euro	58	97	88	103	8	102	17
Mitika	131	104	96	110	8	103	17
Mortlock	70	93	84	93	7	93	14
Numbat	-	88	-			72	5
Possum	118	103	103	108	8	106	17
Potoroo	106	110	101	108	7	109	17
Wandering	-	112	-			115	2
Yallara	83	93	95	104	5	103	12
Site av. yield t/ha	4.50	4.23	2.43	3.08		1.45	
LSD (P=0.05) as %	*8*	*5*	*5*				
Date Sown	19 May	8 May	25 May				
Soil Type	L S	L	SL				
pH (water)	5.3	8.5	8.6				
A-O rain mm	496	333	262				

Abbreviations

Soil Types: S=sand, C=clay, L=loam, F=fine, K=course, M=medium, Li=light, H=heavy, /=divides topsoil from subsoil

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

Data analysis by GRDC funded National Statistics Group

District Cereal Trials and Demos

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RESEARCH
DEMO

Best Practice

Location: Cowell
Franklin Harbour Ag Bureau

Rainfall
Av. Annual: 400 mm
Av. GSR: 256 mm
2009 Total: 274 mm
2009 GSR: 231 mm

Yield
Potential: 2.3 t/ha (W)
Actual: 1.5 t/ha (W)

Paddock History
2008: Pasture
2007: Wheat
2006: Wheat

Soil Type
Red clay loam

Plot size
6 m x 50 m

Yield Limiting Factors
Dry period in August/September

Location: Port Kenny
Mt Cooper Ag Bureau

Rainfall
Av. Annual: 426 mm
Av. GSR: 332 mm
2009 Total: 459 mm
2009 GSR: 408 mm

Yield
Potential: 6.1 t/ha (W)
Actual: 5.6 t/ha (W)
Potential: 6.5 t/ha (B)
Actual: 6.7 t/ha (B)

Paddock History
2008: Peas
2007: Barley
2006: Wheat

Soil Type
Red loam

Diseases
Rust

Plot size
10 m x 1.5 m x 3 reps

Yield Limiting Factors
Rust
andy loam

Plot size
10 m x 1.5 m x 3 reps

Key messages

- **Axe and Gladius produced the highest gross income at Franklin Harbour.**
- **Correll and Yitpi produced the highest gross income at Mt Cooper.**
- **Pugsley and Yitpi produced the highest gross income at Elliston.**
- **Flagship and Capstan produced the highest gross income of barley at Mt Cooper.**

Why do these trials?

These variety demonstrations were identified as priorities by local Agricultural Bureaus to compare current varieties to ones which are not commonly grown in the district, and to compare varieties in soil types and rainfall regions where National Wheat Variety trials are not conducted.

Franklin Harbour Wheat Demonstration

How was it done?

The Franklin Harbour demo was sown by the Ag Bureau on 30 May with a local combine sowing into a mechanical fallowed medic pasture. The demonstration (not replicated) was coordinated by local growers and harvested by the Minnipa Ag Centre team.

What happened?

Old favourite Halberd was included in the demonstration in 2009, however suffered due to poor germination from weevil damage to the seed. The demonstration suffered considerable moisture stress in August and September. 40 mm rain on 23 September saw regrowth which survived well until the hot weather in November which caused it to ripen quickly.

Mt Cooper Cereal Trial

How was it done?

Eleven wheat varieties and nine barley varieties replicated 3 times were sown on 18 May at 60 kg/ha and 45 kg/ha respectively, with 70 kg/ha DAP fertiliser at sowing and 50 kg/ha Urea broadcasted 8 July. Grain yield and quality were measured.

What happened?

Mt Cooper received 408 mm of rain for the growing season which meant varieties had little moisture stress throughout the year. Nitrogen was a key factor for high yields in 2009. The trial was sown on 2008 pea stubble with 50 kg/ha of urea broadcast during July to capitalise on the season.

Yitpi out-yielded Mace, AGT Katana, Wyalkatchem, Axe and Espada. The top seven varieties yielded over 5 t/ha. Even though Yitpi had the highest yield it didn't have the highest gross income due to grain quality. Protein of 10.4% downgraded its classification from H1 potential to ASW quality. A new variety RAC 1412 topped the gross income with $965. RAC 1412 is a potential Yitpi/Correll replacement with better grain quality, CCN resistance and improved stem rust resistance.

Capstan, a malting variety, yielded better than all feed varieties tested; Hindmarsh, Keel, Fleet and Maritime and two other malting varieties Sloop SA and Flagship, while performing the same as WI 4262 and Commander. Despite Capstan meeting the requirements for malt grade, there is no segregation provided for this variety at Port Lincoln, so it would have been delivered as feed. Flagship was the lowest yielding variety, but had the best gross income due to grain quality and a premium provided for growing the variety.

Cereals

Location: Elliston
Elliston Ag Bureau

Rainfall
Av. Annual: 410 mm
Av. GSR: 340 mm
2009 Total: 450 mm
2009 GSR: 400 mm

Yield
Potential: 5.6 t/ha (W)
Actual: 4.3 t/ha (W)

Paddock History
2008: Wheat
2007: Barley
2006: Grassy pasture

Soil Type
Calcareous sandy loam

Plot size
10 m x 1.5 m x 3 reps

Table 1 Grain yield quality and gross income of wheat sown at Franklin Harbour, 2009

Variety	Yield (t/ha)	Test Weight (kg/hL)	Screen-ings (%)	1000 Grain weight (g)	Pro-tein (%)	Grade	Gross Income* ($/ha)
Axe	1.51	88.4	0.5	42.9	13.0	H1	345
Gladius	1.45	84.9	1.7	39.3	13.1	H1	334
Derrimut	1.37	86.1	1.7	34.3	12.4	H2	299
Espada	1.41	82.9	1.7	39.1	12.7	APW	289
Catalina	1.23	84.3	1.6	38.2	13.0	H1	283
Wyalkatchem	1.33	83.2	0.8	45.2	13.5	APW	271
Yitpi	1.17	85.1	2.7	37.4	13.9	H1	268
Carnamah	1.24	86.9	0.9	44.1	13.1	APW	253
Guardian	1.18	84.5	3.0	36.3	12.6	APW	240
Lang	1.09	84.7	5.0	34.6	12.7	H2	238
Correll	.95	81.8	1.1	39.4	13.3	H1	218
Halberd	1.04	82.8	3.8	33.4	13.3	APW	212
Scythe	.84	84.7	4.2	36.1	14.2	APW	171
Frame	.63	81.5	4.1	36.3	13.5	APW	128

**Gross Income is grain yield x price (with quality adjustments) delivered to ABB Cowell using daily cash price 7/12/09*

Table 2 Grain yield quality and gross income of wheat sown at Mt Cooper, 2009

Variety	Yield (t/ha)	Test Weight (kg/hL)	Screen-ings (%)	1000 Grain weight (g)	Protein (%)	Grade	Gross Income* ($/ha)
RAC 1412	5.42	83.9	1.1	42.1	11.3	APW	965
Correll	5.28	81.7	1.9	46.4	10.9	APW	941
Yitpi	5.69	81.6	2.2	41.5	10.4	ASW	933
Gladius	5.20	82.7	1.3	49.6	11.1	APW	925
Mace	5.05	83.1	0.7	46.4	10.8	APW	898
Magenta	5.48	84.2	1.7	49.8	10.8	ASW	898
Axe	4.50	81.8	0.8	45.9	11.8	H2	891
AGT Katana	4.93	85.0	1.0	46.9	11.4	APW	878
Wyalkatchem	4.90	85.2	0.7	49.0	10.6	APW	872
Derrimut	5.06	84.2	1.6	39.4	10.4	ASW	830
Espanda	4.28	81.7	1.2	47.0	11.6	APW	762
LSD ($P \leq 0.05$)	*0.64*						

**Gross Income is grain yield x price (with quality adjustments) delivered to ABB Port Lincoln using daily cash price 19/1/10*

Elliston Wheat Trial

How was it done?

The replicated trial was sown on 9 May, with 100 kg/ha N Rich 24 (24 N:16 P:0 K:1 S) banded below the seed.

What happened?

Rainfall in March and April allowed for optimum sowing time on 9 May. Growing season rainfall of approximately 400 mm contributed to grain yields up to 4 t/ha. The later maturing lines Pugsley and Yitpi produced higher yields than all other lines. The early maturing lines Axe, Bullet, Young and Peake produced lower yields than the site mean.

The top yielding varieties were also the highest income earners after their respective qualities were considered, with Pugsley and Yitpi $705/ha and $672/ha respectively (Table 4).

Table 3 Grain yield quality and gross income of Barley sown at Mt Cooper, 2009

Variety	Yield (t/ha)	Test Weight (kg/hL)	Screenings (%)	1000 Grain weight (g)	Protein (%)	Retention (%)	Grade	Gross Income* ($/ha)
Flagship	5.09	70.6	1.1	50.5	9.9	94.7	F1 1	819
Capstan	6.74	69.0	3.1	48.5	9.8	86.5	F1	714
Sloop SA	5.70	69.5	1.3	49.8	10.8	95.8	S1 1	713
WI 4262	6.60	68.3	1.0	45.2	9.6	95.6	F1	700
Commander	5.94	70.4	1.1	48.7	10.1	95.8	F1	630
Hindmarsh	5.89	70.2	1.1	45.5	10.6		F1	624
Keel	5.78	70.1	0.8	51.3	10.6		F1	613
Fleet	5.72	69.6	0.5	58.6	10.5		F1	607
Maritime	5.20	70.0	0.7	49.9	10.9		F1	551
LSD (P≤.005)	*.80*							

**Gross Income is grain yield x price (with quality adjustments) delivered to ABB Port Lincoln using daily cash price 19/1/10*

Table 4 Grain yield quality and gross income of Wheat sown at Elliston, 2009

Variety	Yield (t/ha)	Test Weight (kg/hL)	Screenings (%)	Protein (%)	Grade	Gross Income* ($/ha)
Pugsley	4.2	77.6	0.8	9.3	ASW	705
Yitpi	4.1	78.5	0.9	9.4	ASW	672
Gladius	4.3	81.2	1.2	10.5	APW	605
Frame	3.6	77.5	1.1	9.8	ASW	590
Mace	3.3	83.6	1.5	10.6	APW	587
Correll	3.5	81.3	2.0	10.2	ASW	574
Wyalkatchem	3.2	84.9	1.3	11.2	APW	569
Espada	3.1	81.0	1.2	11.0	APW	551
Lincoln	3.2	84.6	3.5	10.0	ASW	524
Guardian	2.9	84.1	2.8	10.4	ASW	475
Derrimut	2.9	84.1	2.7	10.4	ASW	475
Axe	2.4	82.0	1.0	11.9	H1	475
Bullet	2.6	84.2	2.7	10.8	APW	462
Young	2.5	84.6	2.7	10.7	APW	445
Peake	2.3	82.7	4.1	10.7	APW	409

**Gross Income is grain yield x price (with quality adjustments) delivered to ABB Port Lincoln using daily cash price 19/1/10*

Table 5 Grain yield of wheat varieties in Elliston trials as a % of Yitpi, 2006 - 2009

	2009	2008	2007	2006	Average
Variety	**Yield as % Yitpi**				
Axe	58	91	103	120	93
Bullet	63				63
Correll	85	85	104	136	103
Derrimut	71	100	99		92
Espada	76	105			90
Frame	88	94	83	95	90
Gladius	83	91	112	103	97
Guardian	71	87	96	120	94
Lincoln	78				78
Mace	80				80
Peake	56	87			72
Pugsley	105		100	98	101
Wyalkatchem	78	88	102	115	96
Yitpi	100	100	100	100	100
Young	61	95	96	111	91
Yitpi (t/ha)	**4.10**	**2.48**	**2.21**	**0.98**	**1.89**

Table 5 shows the long term data for the Elliston district wheat trials from 2006 to 2009, expressed as a percentage of Yitpi each year. Correll, Pugsley, Gladius and Wyalkatchem have a similar 4 year average yield to Yitpi, the rest at least 6% less.

What does this mean?

The high yields and gross incomes are very attractive based on 2009 results. New varieties should be considered for including in your farming system provided their other characteristics fit your requirements. Root disease characteristics, susceptibility to harvest damage and leaf disease profile are just some of the attributes which should be considered along with grain yield for variety choice.

For complete and detailed notes on all varieties refer to the NVT website, www.nvtonline.com.au, or refer to the articles NVT Cereal Yield Performance Tables and the Cereal Variety Disease Guide.

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SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

What Happened To Very Early Sown Cereals at Minnipa?

RESEARCH

Michael Bennet
SARDI/SANTFA, Minnipa Agricultural Centre

Searching for answers

Location:
Minnipa Ag Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Yield
Potential: 5.2 t/ha (W)
Actual: 4.4 t/ha (W)

Paddock History
2008: Wheat
2007: Canola
2006: Wheat

Soil Type
Sandy clay loam

Diseases
Net form of net blotch in barley

Plot size
10 m x 1.5 m x 4 reps

Key messages

- **Early to mid season wheat varieties (Axe, Gladius and Wyalkatchem) sown in March yielded less than May and June sown crops.**
- **A mid to late season wheat variety (Yitpi) and two barley varieties (Barque and Maritime) produced similar yields from a March and April sowing.**
- **The earlier the sowing the later maturing variety and vica versa.**

Why do the trial?

In three of the last four seasons many growers have been presented with the dilemma of having a good profile of moisture in March and April. This rainfall has germinated weeds and self sown cereals but also allowed the opportunity to store moisture for the coming winter crop. Having moisture at that time of the year begs the question, what would happen if a commercial cereal crop was sown at such an early date?

The drought years of 2006 and 2007 both had excellent rainfall events during March and April. In 2006, MAC received 50 mm in March, followed with 20 mm in April. March of 2007 delivered 62 mm, followed up by 40 mm in April. If these rainfall events had been used to seed a paddock or two, how would they have performed?

In 2006 the MAC farm broadcast wheat for stock feed on the March rainfall, which produced a successful pasture. Sheep struggled to keep up with the growth of the wheat, which eventually went through to head emergence before the paddock was slashed to allow for further grazing. After the crop was slashed, the season came in hot and dry. Perhaps this early sown crop could have been one of the better results on the farm, had it been managed as a grain crop.

When MAC received 19 mm in early March in 2009, followed up by 38 mm a week later, two enterprising researchers mustered enthusiasm and equipment for starting seeding a little early.

How was it done?

The trial was no-tilled into very light wheat stubble using small plot equipment. There were three times of sowing (TOS); very early (16 March), early (24 April) and late (2 June). It was decided to use varieties which may best suit the opportunity as well as very early varieties as a contrast. Short season varieties Axe and Gladius were used as well as medium maturity Wyalkatchem. Longer season varieties used were Yitpi and Napperoo, which is a dual purpose wheat typically grown for grazing and grain in the high rainfall zones of NSW. Barque and Maritime barley were also included. All varieties were sown for a target germination of 180 plants/m2, except the treatment Wyalkatchem low seeding rate (LSR), which was sown for a plant population of 90 plants/m2. The plots were sown with 30 kg/ha DAP, deep banded below the seed.

The March sown plots were sown into excellent moisture conditions, however the temperature was rising rapidly after sowing. The April sown plots were sown into marginal moisture conditions, except it was still raining at the time. Excellent moisture conditions were present for the June seeding date.

What happened?

Within days of the March sowing date, the daily maximum temperature exceeded 30oC, which quickly dried out the soil surface. As a consequence the March germination was patchy with the barley giving the best establishment. The April sown plots established better, with the June sown plots establishing best.

On 30 April Axe, which had germinated in March, were already at head emergence, only 6 weeks after planting.

Table 1 Time of sowing vs grain yield and quality, averaged across all cereal lines

Time of Sowing	Grain Yield (t/ha)	1000 grain weight (g)	Protein (%)	Screenings (%)	Test Weight (kg/hL)
March	2.94	43.6	11.9	1.4	77.1
April	3.8	44.0	12.0	1.6	77.2
June	3.43	40.6	12.4	3.7	76.0
LSD (P=0.05)	*0.15*	*0.7*	*0.2*	*0.6*	*0.6*

Table 2 Variety x time of sowing vs grain yield, quality and gross income

Variety	Time of Sowing	Yield (t/ha)	1000 grain weight (g)	Protein (%)	Screenings (%)	Test Weight (kg/hL)	Gross Income ($/ha)
Axe	March	1.63	43.9	12.4	0.7	80.6	331
Axe	April	3.44	45.9	12.2	0.3	80.2	699
Axe	June	3.82	46.3	11.7	0.4	82.6	776
Gladius	March	2.89	47.3	12.2	0.6	79.8	586
Gladius	April	4.13	47.7	12.0	0.5	80.5	839
Gladius	June	4.20	45.6	12.4	0.7	80.5	853
Naperoo	March	2.59	35.0	12.0	2.8	76.0	350
Naperoo	April	2.79	35.3	12.5	2.6	76.2	377
Naperoo	June	2.50	28.1	13.9	7.2	73.4	337
Wyalkatchem	March	2.70	46.7	11.0	0.6	82.0	516
Wyalkatchem	April	4.41	47.5	10.7	0.4	81.8	842
Wyalkatchem	June	3.72	44.7	10.9	0.5	81.4	711
Wyalkatchem LSR	March	2.22	47.5	11.3	0.6	81.6	423
Wyalkatchem LSR	April	4.08	47.4	10.6	0.5	82.7	780
Wyalkatchem LSR	June	3.46	44.4	11.1	0.5	81.6	661
Yitpi	March	4.24	43.4	11.3	1.2	81.5	810
Yitpi	April	4.37	43.7	11.9	1.1	82.1	887
Yitpi	June	3.86	41.8	12.8	0.8	80.2	783
Barque	March	3.64	42.1	12.5	2.5	67.4	419
Barque	April	3.84	43.7	12.7	2.7	66.9	441
Barque	June	2.98	37.7	13.2	9.0	64.4	343
Maritime	March	3.64	43.0	12.4	2.2	67.7	419
Maritime	April	3.31	40.7	13.3	4.3	66.8	380
Maritime	June	2.91	36.2	13.3	10.4	63.9	334
LSD (P=0.05)		*0.41*	*2.0*	*0.5*	*1.8*	*1.8*	

Maritime barley was effected with the onset of net form of net blotch and fungicide applied but possibly too late to fully recover potential grain yield.

The earlier maturing wheat lines (Axe, Gladius and Wyalkatchem) produced lower yields following the March TOS compared to the April and June TOS. Wyalkatchem and Yitpi produced higher yields with the April sowing than the June sowing. Yitpi and Naperoo produced similar yields from the March and April sowing dates with Naperoo yields lower than other varieties. The June sowing date produced the lowest 1000 grain weight and test weight but the highest grain protein and screenings.

The barley varieties yielded more from the March and April sowings than the June sowing. Maritime possibly because it was sufficiently advanced in its development by the time net form of net blotch hit that it was less affected than in the later sowing dates. The 10% screenings in the late TOS for Maritime indicates that the disease was well established in that situation.

Although grain yields between the Wyalkatchem sowing rates at any of the sowing dates were similar, the gross income was 10% higher with the higher sowing rate.The highest gross income for each variety was achieved at the April sowing date in most cases, except for Maritime barley, which had the highest gross income from the March sowing.

What does this mean?

In 2009 there was a disadvantage from early to mid-season wheat varieties in mid March but not the later season varieties. Sowing during March presents many challenges as March and April can be very hot months leading up to the break of the season. Wheat growing under good moisture sown in March with warm weather is likely to grow very rapidly, which will increase frost risk from bringing the flowering window earlier.

This rapid early growth however is of great advantage if you can keep up to the growth with grazing, as a management option to consider. Another problem that early sown cereals present is that if they were to be used for hay, cutting may need to be done in August, which may make drying the hay a challenge. Early sown crops can also be an excellent source of host material for cereal rusts, as can self sown cereals. The most reliable end use for a very early sown crop is as a grazing proposition with the potential for grain or hay recovery if the season permits. See the “Responsive Farming Using Wheat Agronomy” article in this book for further information.

The risks associated with very early sown crops may be too many to consider a viable proposition; however Bob Holloway’s best wheat crop at Minnipa was achieved through sowing well outside the traditional sowing window. This was in 1991 when Molineux wheat was sown on 4 April. The final grain yield was 3.74 t/ha which was significantly more than the farm average that year of 2.95 t/ha.

Another experience of Bob’s with early sown wheat highlights the importance of variety choice when choosing to sow very early. Shrike and Rosella wheat were sown on 1 March one year. Shrike was the highest yielder on the farm with 2.8 t/ha, however Rosella was out in head during June and subsequently eaten by galahs and was not harvested.

The experience of Bob Holloway at MAC, and with Yitpi in this trial suggest that the concept of very early sown crops has some merit, however it comes with associated risks which require further investigation.

Acknowledgements

Thanks to Haydn Kuchel and the AGT team for providing seed for the trial, Brenton Spriggs and Wade Shepperd for technical assistance, Alison Frischke for her enthusiasm in getting a trial in while we were still out at farmer meetings and to Bob Holloway for sharing his experiences.

SARDI

Grains Research & Development Corporation

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Not Everything Yellow is a Lemon…

Haydn Kuchel
Australian Grain Technologies, Roseworthy

RESEARCH

Cereals

Key messages

- **Yellowing of wheat leaves, similar to the old 'Frame yellows' has been observed again in SA over the last few years.**
- **There does not seem to be a clear cause of the yellowing.**
- **Yellowing can lead to yield reductions, but also yield increases!**
- **The effect of yellowing on the relative performance of varieties is far less than the effect of all the other traits that go into making a good variety.**
- **If anyone has any ideas on what is causing this yellowing – send them through!**

Why do the trial?

Growers have been reporting mysterious leaf yellowing (often forming in blotches and sometimes stripes) in some of their wheat crops, so we wanted to look into the cause and effects of yellowing so that growers can make effective management decisions.

Crop diseases can lead to a reduction in profit either through reduced production, or the added cost of control measures (i.e. fungicide application). The last thing anyone wants to do is spend money controlling a 'disease' if it isn't actually going to cause any yield damage. So for this mysterious yellowing, we want to know the answers to three questions: 1) does yellowing actually cause any yield loss, 2) what is causing the yellowing to occur, and 3) if it is necessary, how can you control it?

This work focussed mainly on question number one – does yellowing even matter (and to some extent we looked into its possible causes)?

How was it done?

1. AGT variety yield trials are scattered over the cropping zone of Australia, so within any one year we have the opportunity to observe a lot of different diseases. In 2008 and 2009, yellowing was scored at eight different locations across southern Australia and its effect on grain yield was investigated.
2. At Roseworthy in 2008, tissue samples were taken from plants affected and unaffected by the yellows and their nutrient status was compared.

What happened?

At four of the eight locations where yellowing was observed (Elmore, Roseworthy, Pinnaroo & Coomalbidgup), there was no effect of yellowing on yield (Table 1). In other words, varieties with a high degree of yellowing performed just as well as those with low levels of yellowing. The yields at the remaining four sites were affected by yellowing – but the results were not the same at all sites. Varieties with yellowing yielded less than the lines without yellowing at the high yielding (and relatively stress free) sites Winulta, Lake Bolac and Dookie, but at Kumarl (very similar to much of the EP) which suffered terminal heat and water stress, varieties with more yellowing actually yielded more than those without yellowing! Why would this happen? Perhaps at the high yielding sites where moisture was not limiting, the loss of green leaf area led to a reduction in yield? At Kumarl, where heat and drought were bigger factors, the reduction in green leaf area (and therefore water use) may have been an advantage. Regardless of the reason, it seems that even when yellowing is present in a trial, it is often not responsible for any yield differences between varieties.

Table 1 Effect of leaf yellowing on wheat variety permormance in southern Australia

Location	Significance of yellowing on yield	Average yield (t/ha) of ***least*** yellow lines	Average yield (t/ha) of ***most*** yellow lines
Coomalbidgup (WA)	Not significant		
Dookie (Vic)	*$P \leq 0.01$*	2.90	2.69
Elmore (Vic)	Not significant		
Kumarl (WA)	*$P \leq 0.001$*	2.15	2.52
Lake Bolac (Vic)	*$P \leq 0.01$*	2.96	2.43
Pinnaroo (SA)	Not significant		
Roseworthy (SA)	Not significant		
Winulta (SA)	*$P \leq 0.05$*	3.07	2.81

So how did a variety like Axe (which tends to suffer from the 'yellows') perform in comparison to a variety like Wyalkatchem which tends to remain greener? In Figure 1 you can see that at these eight sites where yellowing was observed, varieties that are often affected by the 'yellows' (Axe, Gladius, Correll) did not suffer a yield penalty when compared to a variety like Wyalkatchem. Why is this? Well even at the sites where yellowing did affect yield, it was only responsible for 3-5% of the variation in yield between varieties – most of the differences between varieties is due to all the other traits that go into making a variety yield well. This can be seen when we compare Mace and Wyalkatchem (neither of which go very yellow – usually) across all sites: there is a bigger difference between these two varieties than between any of the other varieties and this is simply because of the elite yield genes that have been bred into Mace.

So what is causing this yellowing?

The simple answer is: we still don't know. We cannot find any evidence of disease. And when we took leaf samples at Roseworthy in 2008 from affected and unaffected leaves (from the same plant and different plants) we could not find any consistent differences between them (eg iron or zinc differences). Our best guess (and it really is a guess), is that it is a genetically inherited physiological trait that is triggered by some environmental conditions that are still unknown. Axe, Gladius and Correll all have the drought tolerant line RAC875 in their pedigree and it seems fairly likely that they have inherited this yellowness along with the drought tolerance genes from RAC875. The good news is that varieties such as this that tend to go yellow, are still able to show high yields across a range of environments.

What does this mean?

- There does not seem to be any obvious disease or nutrient imbalance present when this yellowing is observed. So there does not seem to be any control options.
- Growers are still best off picking varieties based on performance data from their local area. That way, they are likely to grow varieties that have the resistances and tolerances that are needed to perform well on their farm.
- We would still like to find out what is causing this yellowing because no one wants to grow a yellow crop, even if it still yields well.
- If you have noticed any trend, or possible reason for the yellowing, feel free to send through your ideas!

Acknowledgements

Thanks to all the AGT team (particularly Russell Eastwood and Kevin Young) for collecting the yellows and yield data used in this study, and thanks to Hugh Wallwork for inspecting affected plants.

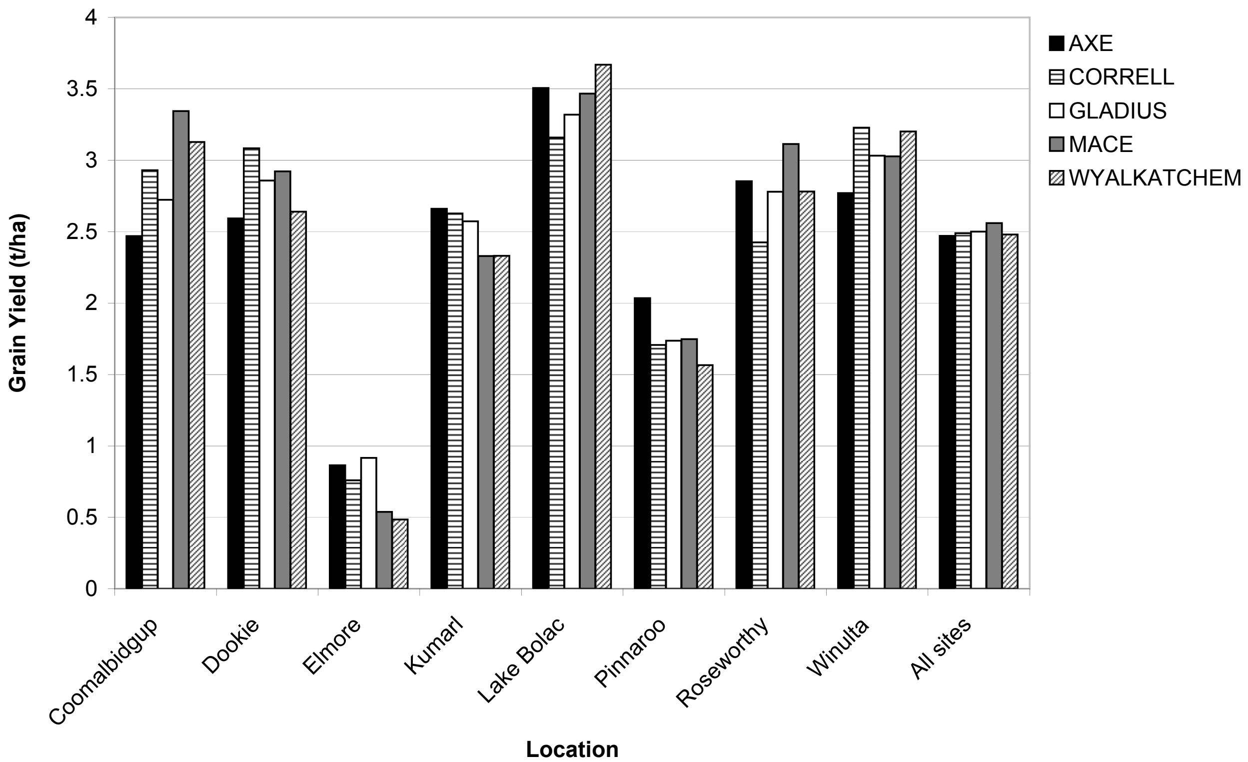

Figure 1 Performance of varieties at locations affected by 'leaf yellows'

Cereals

RESEARCH INFORMATION

Phosphate Use Efficiency in Dryland Wheat

Christian Preuss[1], Chunyuan Huang[1] and Haydn Kuchel[2]

[1]The University of Adelaide and the Australian Centre for Plant Functional Genomics (ACPFG),
[2]Australian Grain Technologies (AGT)

Location: Syria (ICARDA main research station, Tel Hadya)
Rainfall
Av. Annual: 340 mm
Av. GSR: 340 mm
2009 Total: 360 mm
2009 GSR: 340 mm
Paddock History
2008: Pasture
2007: Pasture
2006: Pasture
Soil Type
Calcareous clay; pH 7.8
Plot size
5 m x 1.8 m x 5 reps
Yield Limiting Factors
Early finish/lack of moisture
Environmental Impacts
Soil Health
Pest/disease level: Sunn Pest (<5% damaged).
Chemical use: Azoxystrobin, glyphosate and trifluralin.
Soil Nutrients: Colwell-P, 19 ppm; Total Nitrogen, 0.15 %; Organic Carbon, 2.0 %
Soil Salinity: 0.31 dS/m
Tillage type: Maximum tillage (i.e. using a rotary harrow before sowing)
Plant density: 300 plants/m²

Key messages

- **Variation in phosphate use efficiency exists in elite Aussie bread wheat germplasm.**
- **Gladius showed the highest and most consistent phosphorous use efficiency among the varieties tested.**
- **Although this data is just preliminary, it does suggest that farmers may be able to use variety selection to help manage the risk of rising phosphate prices.**

Why do the trial?

The fluctuating cost and availability of phosphate fertilisers worldwide over the past 5 years has concerned many. These trials were set up to determine the genetic variation for phosphorus use efficiency (PUE) in elite Australian bread wheat germplasm. In the future, we will build on this work by investigating what mechanisms lead to higher PUE.

How was it done?

Eight Australian wheat cultivars (and 12 other wheat lines: Australian breeding lines, CIMMYT cultivars and ICARDA bread wheats, data not shown) were tested for their yield response to phosphate fertiliser application. Australian trials were conducted in 2008 and Syrian trials were conducted in 2009.

Fertiliser application on the EP (Minnipa, Piednippie and Streaky Bay): Fluid fertiliser comprising 12 kg/ha N, 2 kg/ha S, 1.5 kg/ha Zinc, 1 kg/ha Copper, and 1 kg/ha Manganese was applied to all plots. The P treated plots also included 10 kg/ha of phosphorous.

Syria and Brentwood (Yorke Peninsula) fertiliser application: 100 kg/ha triple superphosphate added to +P plots; 100kg/ha Gran-AM was also applied to all plots. Brentwood; all plots also received 2.4 kg/ha Mn, 0.9 kg/ha Zn, and 0.4 kg/ha Cu at tillering.

Numerous measurements were made throughout the growing season to investigate plant phosphate relations, change in yield components and quality, and yield. The yield data is presented.

What happened?

Variation was found with how much yield was lost without P application at each site; Minnipa lost 56%, Streaky Bay 28%, Piednippie 17%, Syria 21% and Brentwood 30% when no P was applied. There was also variation in the phosphate use efficiency of the cultivars tested (Table 1).

Table 1 Wheat Cultivar phosphate use efficience ranked in descending order for each of the 5 sites

Wheat Phosphate Use Efficiency Rankings				
Minnipa	**Streaky Bay**	**Piednippie**	**Syria**	**Brentwood**
Gladius^{A}	Gladius^{A}	Krichauff^{A}	Excalibur^{A}	Gladius^{A}
Excalibur^{B*}	Kukri^{AB}	Kukri^{AB}	Gladius^{A}	Kukri^{AB*}
Axe^{C*}	Krichauff^{ABC*}	Gladius^{AB}	Kukri^{AB*}	Krichauff^{AB*}
Kukri^{D*}	Excalibur^{ABC*}	Yitpi^{AB*}	Krichauff^{BC*}	Yitpi^{AB*}
Yitpi^{E*}	Wyalkatchem^{BC*}	Excalibur^{AB*}	Wyalkatchem^{BCD*}	Wyalkatchem^{AB*}
Wyalkatchem^{E*}	Axe^{BC*}	Wyalkatchem^{AB*}	Drysdale^{CD*}	Drysdale^{AB*}
Krichauff^{F*}	Drysdale^{CD*}	Axe^{AB*}	Yitpi^{CD*}	Excalibur^{AB*}
Drysdale^{F*}	Yitpi^{D*}	Drysdale^{B*}	Axe^{D*}	Axe^{B*}

NB: Cultivars with the same superscript letter (^{A}) did not significantly differ in their phosphate use efficiency at that particular site. Varieties followed by an asterisk (*) suffered a significant yield loss when no phosphate was applied.

Location: Streaky Bay (2008)
Ken Williams

Rainfall
Av. Annual: 378 mm
Av. GSR: 305 mm
2008 Total: 302 mm
2008 GSR: 226 mm

Paddock History
2007: Pasture
2006: Oats
2005: Barley
Soil Type
Calcareous sandy loam, pH 8.5

Plot size
7 m x 1.4 m x 3 reps

Yield Limiting Factors
Early finish/lack of moisture

Environmental Impacts
Soil Health
Pests/diseases were undetected
Chemical use: Clopyralid, diquat, flumetsulam, glyphosate, imazethapyr, MCPA dimethylamine salt, Metsulfuron-methyl, paraquat, pyrethroid, trifluralin
Soil Nutrients: Colwell-P, 70 ppm; Total Nitrogen, 0.21 %; Organic Carbon, 2.1 %
Soil Salinity: 0.21 dS/m
Tillage type: No till
Plant density: 120 plants/m²

Location: Piednippie (2008)
Simon Patterson

Rainfall
Av. Annual: 340 mm
Av. GSR: 330 mm
2008 Total: 235 mm
2008 GSR: 229 mm

Paddock History
2007: Peas
2006: Barley
2005: Wheat

Soil Type
Calcareous sandy loam,
pH range 8.5

Plot size
7 m x 1.4 m x 3 reps

Yield Limiting Factors
Early finish/lack of moisture

Environmental Impacts
Soil Health
Pest/disease level: Root Lesion Nematode (<1% damaged)
Chemical use was: Bromoxynil, clopyralid, flumetsulam, glyphosate, imazethapyr, Metsulfuron-methyl, trifluralin
Soil Nutrients: Colwell-P, 73 ppm; Total Nitrogen, 0.18 %; Organic Carbon, 1.7 %
Soil Salinity: 0.20 dS/m
Tillage type: No till
Plant density: 120 plants/m²

Location: Brentwood (YP) (2008)
Mark Anderson

Rainfall
Av. Annual: 446 mm
Av. GSR: 359 mm
2008 Total: 253 mm
2008 GSR: 213 mm

As Table 1 shows, there are cultivars that did not show yield loss when P was withheld such as Gladius, while other cultivars consistently showed yield loss under low P such as Drysdale. Importantly this trend was apparent across all trial sites. At all sites at least one genotype did not show a yield loss where phosphate fertiliser was withheld. Similarly, at all sites differences in PUE were seen. For breeders, this result is promising, as it means that they should be able to genetically select for improved PUE. Along with PUE, yield is also of interest, average yields across all sites are presented below (Table 2).

Table 2 Average wheat cultivar yields with or without phosphate application

Cultivar Yield with Phosphate Treatment		
Cultivar	**Yield –P (t/ha)**	**Yield +P (t/ha)**
Gladius	1.03^{A}	1.2^{AB}
Excalibur	0.96^{AB}	1.3^{AB}
Krichauff	0.93^{BC}	1.2^{ABC}
Wyalkatchem	0.87^{BC}	1.2^{AB}
Kukri	0.87^{BC}	1.0^{D}
Axe	0.85^{CD}	1.3^{A}
Yitpi	0.84^{CD}	1.2^{BC}
Drysdale	0.76^{D}	1.1^{CD}

NB: Letters (^{A}) indicate significant difference in yield between cultivars under different phosphate treatment, average of all five sites.

Paddock History
2007: Wheat
2006: Lentils
2005: Barley

Soil Type
Calcareous sandy clay loam, pH 8.4

Plot size
7 m x 1.4 m x 3 reps

Yield Limiting Factors
Early finish/lack of moisture

Environmental Impacts
Soil Health
Pest/disease level: Root Lesion Nematode (<1% damaged)
Chemical use: Glyphosate, trifluralin
Soil Nutrients: Colwell-P, 57 ppm; Total Nitrogen, 0.22 %; Organic Carbon, 2.0 %
Soil Salinity: 0.26 dS/m
Tillage type: No till
Plant density: 130 plants/m²

Location: Minnipa Ag Centre (2008)

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2008 Total: 238 mm
2008 GSR: 109 mm

Paddock History
2007: Pasture
2006: Wheat
2005: Wheat

Soil Type
Calcareous sandy loam, pH 8.5

Plot size
7 m x 1.4 m x 3 reps

Yield Limiting Factors
Early finish/lack of moisture

Environmental Impacts
Soil Health
Pests/diseases were undetected
Chemical use: Azoxystrobin, glyphosate, trifluralin
Soil Nutrients: Colwell-P, 24 ppm; Total Nitrogen, 0.16 %; Organic Carbon, 1.1 %
Soil Salinity: 0.14 dS/m
Tillage type: No till
Plant density: 120 plants/m²

Gladius and Excalibur had the best yield no matter the phosphate treatment, while Drysdale had one of the worst, the other cultivars tested fell somewhere between these. In selecting a variety for low phosphate soils, not only is good phosphate use efficiency important, but also yield.

What does this mean?

Most importantly, this study shows that there is significant variation between varieties for their PUE. Although more investigation is needed, this knowledge can be used by farmers to either manage their current varieties more effectively, or help select varieties that may perform better under their environmental/ management constraints. For breeders, the information helps to tease apart the traits that are important when developing varieties for the Eyre Peninsula.

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Section 2

Section Editor:
Amanda Cook
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Break Crops

Break Crops

The 2009 production figures for Upper Eyre Peninsula were double the previous harvest with approximately 17,600 t of peas, 6,200 t of lupins, 200 t of beans and 4,200 t of canola. Lower Eyre Peninsula produced approximately 11,000 t of peas, 43,000 t of lupins, 15000 t of beans and 97000 t of canola

[PIRSA Crop Production Estimates January 2010]

SA Field Pea Variety Trial Yield Performance at Eyre Peninsula Sites

2009 and long term (2000 - 2009), yields expressed as a % of site mean yield

	Lower Eyre Peninsula				Upper Eyre Peninsula		
Variety/Line	**2009**		**2000-2009**		**2009**	**2000 - 2009**	
	Rudall **	**Yeelanna**	**% Site mean**	**Trial #**	**Minnipa**	**% Site Mean**	**Trials #**
Bundi	106	79	104	11	96	107	6
Kaspa	81	93	106	17	114	108	8
Parafield	89	96	104	17	98	104	8
Sturt			108	13	102	109	8
SW Celine			110	7			
Yarrum	73	89	110	11	118	110	6
OZP0601	119	84	109	6	96	109	3
OZP0602	125	92	111	7	96	110	3
OZP0703	123	100	113	6	109	112	4
Site mean yield (t/ha)	0.64	3.65	2.07		2.29	1.48	
LSD (P=0.05) as %	*12.5*	*10.4*			*15.5*		
Date sown	25 May	21 May			4 May		
Soil Type	SL	Li S C L			L		
A-O rainfall (mm)	324	392			333		
pH (water)	8.4	6.9			8.5		
Site stress factors	hd	ht, hd			bs, ht, pm		

Abbreviations
Soil Types: S=sand, C=Clay, L=loam, H=heavy, M=medium, Li=light, F=fine, /=over
**=variable and low yield dual to severe hail damage during podding, use caution
site stress factors: ht=high temperatures during flowering/pod fill, pm= powdery mildew
bs= black spot, hd= hail damage during early pod fill

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

Faba bean Variety Trial Yield Performance at Eyre Peninsula Sites

2009 and predicted regional performance, expressed as % of site average yield

Variety	Lower Eyre Peninsula				Upper Eyre Peninsula		
	2009	Long term average across sites			Long term average across sites		
	Cockaleechie	t/ha	% Site Mean	No. Trials	t/ha	% Site Mean	No. Trials
Doza	84	1.78	90	5	-	-	-
Farah	106	1.96	100	11	1.44	101	9
Fiesta	93	1.98	100	11	1.45	101	9
Fiord	101	1.97	100	11	1.40	98	9
Manafest	-	1.68	85	9	1.29	91	7
Nura	98	2.00	102	11	1.44	101	9
Site Av. Yield (t/ha)	4.49	1.97			1.42		
LSD (P=0.05) as %	*15*						
Date sown	22 May						
Soil Type	SCL						
pH (water)	5.9						
A-O rain (mm)	293						
Site stress factors	dl						

Abbreviations
Soil Types: S=sand, C=clay, L=loam
site stress factors: dl=post flowering moisture stress, wa=waterlogging, ht=high temperatures during flowering/pod fill, w=weeds
Results from 2009 NVT trial at Rudall not released due to hail damage
Data source: *SARDI/GRDC & NVT and PBA - Australian Faba Bean Breeding Program.*
2000-2009 MET data analysis by National Statistics Program
More Information: Andrew Ware (08) 8688 3417 or e-mail andrew.ware@sa.gov.au

SA Lupin Variety Trial Yield Performance at Eyre Peninsula Sites

2009 and predicted regional performance, expressed as % of site yield

Variety	Lower Eyre Peninsula					Upper Eyre Peninsula			
	2009		Long term average across sites				Long term average across sites		
	Wanilla	Ungarra	t/ha	% Site Mean	No. Trials	2009 Tooligie	t/ha	% Site Mean	No. Trials
Coromup	96	96	2.57	100	12	101	1.65	103	4
Jenabillup	115	100	2.73	107	8	95	-	-	-
Jindalee	51	80	2.36	92	29	88	1.53	96	8
Mandelup	96	97	2.65	103	25	91	1.69	106	7
Moonah	82	91	2.44	96	25	90	1.56	98	8
Wonga	95	95	2.42	94	28	105	1.60	100	8
Site Av. Yield (t/ha)	3.26	3.03	2.56			2.80	1.59		
LSD (P=0.05) as %	*8*	*7*				*10*			
Date sown	11 May	15 May				13 May			
Soil Type	S	S				S			
pH (water)	6.8	5.8				6.5			
Apr-Oct rain (mm)	419	308				422			
Site stress factors	dl								

Abbreviations
Soil Types: S=sand,
site stress factors: dl=post flowering moisture stress

Data source: *SARDI/GRDC & NVT 2000 - 2009 MET data analysis by National Statistics Program*
More Information: Andrew Ware (08) 8688 3417 or e-mail andrew.ware@sa.gov.au

SA Chickpea Variety Trial Yield Performance at Eyre Peninsula Sites

2009 and long term (2000 - 2009), yield expressed as % of site mean yield

Variety	LOWER EYRE PENINSULA			
	2009		2000 - 2009	
	Cocka-leechie	Rudall**	% Site mean	Trial #
Desi trials				
Genesis 509	75	96	99	8
Genesis 079#	106	94	112	3
Genesis 090#	86	97	101	8
Howzat	92	88	108	8
PBA HatTrick	77	98	99	4
PBA Slasher	99	115	112	5
Sonali			104	7
Site mean yield (t/ha)	1.55	0.93	1.55	
LSD (P=0.05) as %	*11.6*	*8.6*		
Kabuli trials				
Almaz	83		95	6
Genesis 079#	143		129	7
Genesis 090#	104		114	8
Genesis 114	67		94	6
Nafice			88	5
Site mean yield (t/ha)	1.11		1.28	
LSD (P=0.05) as %	*14.4*			
Date sown	21 May	25 May		
Soil Type	SCL	SL		
A-O rain (mm)	459	324		
pH (water)	5.5	8.4		
Site stress factors	ht	hd, ht		

 # Small kabuli type

*** = Low and variable yield due to severe hail damage during flowering and pod fill, use caution.*

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

Site Stress Factors: ht=high temperature during flowering/podfill, hd=hail damage

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

SA Lentil Variety Trial Yield Performance at Eyre Peninsula Sites

2009 and long term (2003 - 2009), yields expressed as % of site mean yield

Variety	LOWER EYRE PENINSULA			
	2009		2000 - 2009	
	Rudall **	Yeelanna	% site mean	Trial #
Aldinga		100	96	11
Boomer	79	82	105	7
Digger		82	97	10
Nipper	103	88	100	11
Northfield	82	80	92	12
Nugget	109	91	101	12
PBA Bounty	98	96	105	10
PBA Flash	112	83	112	10
Site mean yield (t/ha)	0.81	2.93	1.46	
LSD (P=0.05) as %	*12.4*	*16.7*		
Date sown	25 May	29 May		
Soil Type	SL	LiSCL		
A-0 rain (mm)	324	392		
pH (water)	8.4	6.9		
Site stress factors	hd	ht		

Soil type: S=sand, C=clay, L=loam, H=heavy, M=medium, Li=light, F= fine, Z=silt, /=over

*** = Low and variable yield due to severe hail damage, use caution.*

Site Stress Factors: ht=high temperature during flowering/pod fill, hd=hail damage at podding

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

Early season maturity Canola trials 2009 and long term averages

Entry	2009, % site mean	Long term	
	Tooligie	**Upper EP**	
Conventional & Clearfield	**%**	**Predicted**	**# trials**
Hyola 50	113	1.49	3
45Y77		1.22	3
AV-Garnet	123		
43C80	99		
44C79	88		
Oasis CL	85		
Tarcoola	103	1.32	3
Site Mean (t/ha)	1.31		
LSD (P=0.05) as %	*12*		
Triazine tolerant			
Bravo TT	99		
ATR - Cobbler	107		
Hurricane TT	104		
CB Tanami	96		
Rottnest TTC	110		
ATR409			
Tawriffic TT	106		
Tornado TT			
Lightening TT	89		
CB Jardee HT	105		
CB Mallee HT	-		
CB Scadden	94		
CB Telfer	95		
CB Tumby HT	96		
Site Mean	1.48		
LSD (P=0.05) as %	*6*		
Date sown	14 May		
Soil Type	SL		
A-O Rain (mm)	324		
pH (water)	7.7		
Site stresses	h		
Blackleg	62, 77		

Abbreviations

Soil Types: S=sand, C=Clay, L=loam, H=heavy, M=medium, Li=light, F=fine,

site stress factors: lo=lodging, bl=blackleg, f=frost, h=hail, htg=high temperature at grain fill, wa=waterlogging

Blackleg data: Polygenic variety: Bravo TT, Sylestris variety: Surpass 501TT

% average blackleg infection

***Data source:** NVT & SARDI / GRDC (long term data based on weighted analysis of sites, 2001 - 2009)*

Data analysis by GRDC funded National Statistics Group

Break Crops

Mid season maturity Canola trials 2009 and long term averages

Variety	2009, % site mean		Long Term 2001 - 2009	
	Lower EP		Lower EP	
Conventional	**Yeelanna**	**Mt Hope**	**Predicted**	**# trials**
AV - Garnet	100	106	1.82	8
Hyola 433	102	109		
Hyola 50	102	101	1.82	9
Hyola 76	96	84	1.64	6
Monola 130C C	-			
Tarcoola			1.47	5
V3001	-			
Site Mean (t/ha)	2.02	2.13		
LSD (P=0.05) as %	*10*	*15*		
Clearfield				
Hyola 571CL	103	100	1.54	4
43C80				
44C79	84	83	1.29	4
45Y77	94	103	1.39	6
45Y82	98	95		
46Y78	105	104	1.53	6
46Y83	108	112		
Site Mean (t/ha)	1.84	2.03		
LSD (P=0.05) as %	*11*	*15*		
Triazine Tolerant				
ATR-Barra			1.39	5
ATR-Cobbler	96	92	1.45	6
ATR-Marlin	97	99	1.39	8
ATR409	104	108	1.39	8
Bravo TT	105	111	1.49	10
CB Scaddan	100	92	1.34	4
CB Telfer	96	85		
CB Argyle	102	108	1.43	6
CB Jardee HT	100	105	1.56	3
CB Tanami	81	87		
CB Tumby HT	93	111		
Flinders TTC			1.37	6
Hurricane TT	104	100	1.43	4
Lightening TT	106	96		
Monola 76TT	95	90	1.42	4
Monola 77TT	98	91	1.43	4
Rottnest TTC	109	110	1.45	6
Storm TT			1.40	4
Tawriffic TT	99	101	1.46	6
Hyola 751TT	-	-		
CB Mallee HT	108	-		
Site Mean (t/ha)	1.79	1.77		
LSD (P=0.05) as %	*8*	*10*		
Date Sown	13 May	11 May		
Soil Type	NWS	SL		
A - O Rain (mm)	459	472		
pH (water)	6.5	5.1		
Site Stresses				
Blackleg	80, 94	44, 82		

Soil Types: S=sand, C=Clay, L=loam, H=heavy, M=medium, Li=light, F=fine,
site stress factors: lo=lodging, bl=blackleg, f=frost, h=hail, htg=high temperature at grain fill, wa=waterlogging
Blackleg data: Polygenic variety: Bravo TT, Sylestris variety: Surpass 501TT
% average blackleg infection

Data source: *NVT & SARDI / GRDC (long term data based on weighted analysis of sites, 2001 - 2009)*

Data analysis by GRDC funded National Statistics Group

Field Pea Performance at Minnipa 2009

Larn McMurray[1], Tony Leonforte[2], Michael Lines[1], Willie Shoobridge[3], Mark Bennie[1] and Leigh Davis[3]

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RESEARCH

Searching for answers

Location:
Minnipa Ag Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Yield
Potential: 3.6 t/ha (peas)
Actual: 2.6 t/ha Kaspa peas (Stage 3A variety trial)

Paddock History
2008: Wheat
2007: Wheat
2006: Wheat

Soil Type
Red calcareous sandy loam

Diseases
Blackspot moderate to high infection, moderate powdery mildew infection

Plot size
10 m x 1.5 m x 3 reps

Yield Limiting Factors
Blackspot (moderate), powdery mildew (low), water logging (exacerbated blackspot infection)

Key messages

- **A high rainfall growing season favoured blackspot disease build up and generally later flowering pea varieties at Minnipa in 2009.**
- **Kaspa was 17% higher yielding than Parafield, its highest margin over this variety at Minnipa in eleven years of testing.**
- **Kaspa's grain yield was reduced by 19% when sowing date was delayed from 30 April to 20 May, however no grain yield reduction occurred in the advanced PBA field pea lines OZP0602 and OZP0601 with this delayed sowing date.**
- **OZP0601 and OPP0602, despite lower performance than Kaspa in the MAC variety trial in 2009, will provide better adapted "Kaspa type" options for low rainfall environments when they become available due to their earlier and longer flowering periods.**

Why do the trial?

Pulse Breeding Australia (PBA) field peas has a focus on increasing adaptation in the medium to low rainfall areas of Australia. This particular work is aimed at developing cultivars and agronomic methods that will increase and stabilise production in environments characterized by variable soil types and low rainfall, of which Minnipa is a key site of the program. Major selection criteria for these environments include resistance to blackspot, shattering, lodging, tolerance to soil boron and soil salinity, and appropriate flowering/maturity time. PBA also has a germplasm enhancement (pre-breeding) program that focuses on identifying and incorporating genes with tolerance to frost, transient drought and heat at flowering/podding into adapted varieties.

The agronomic management trial aims to identify best sowing times in new pea varieties to maximise yield and minimise disease infection and is part of the GRDC funded southern region pulse agronomic project. This project also provides information back to PBA on the appropriate flowering and podding times required in field peas for optimum performance in low rainfall environments.

How was it done?

A replicated Stage 3 pea breeding trial containing 6 commercial entries and 70 advanced breeding lines were sown into good moisture levels on 4 May at Minnipa. An agronomic pea time of sowing trial with 2 varieties (Kaspa and Parafield) and 2 advanced breeding lines (OZP0601 and OZP0602) was sown on 30 April (early) and 20 May (mid) also at Minnipa.

All trials were sown with 70 kg/ha of di-ammonium phosphate and 1 L/ha Triflur X. Post emergent weed management included metribuzin @130 g/ha and Select @ 250 ml/ha with 1% Hasten. Insect sprays were applied as required. Scores for establishment, early vigour, disease, flowering, maturity, lodging, shattering and selection potential were recorded during the year and grain yields were measured at harvest.

What happened?

In stark contrast to 2008, extremely high growing season rainfall was recorded at Minnipa in 2009. Surprisingly symptoms of waterlogging were observed during winter and a moderate to high infection of blackspot disease occurred during winter and early spring. Blackspot infection levels were particularly severe in the Stage 3A PBA trial potentially due to increased waterlogging in this part of the paddock.

Blackspot was less severe in the sowing time trial however higher levels existed in the early sowing compared with the late sowing. Powdery mildew also occurred during late spring but had little impact on grain yield. Field pea growth in all trials was not suppressed by moisture stress and vegetative growth and yield potential was high.

Generally later flowering lines performed better in 2009 as they were able to make use of the long and favourable growing season. However sporadic high temperature events during spring led to some level of flower and pod abortion in most varieties, complicating variety performance.

Stage 3 breeding trial

Grain yield of Kaspa was 17% higher than Parafield, a result not seen before at Minnipa (Table 2). Kaspa's previous highest yield increases over Parafield at Minnipa were approximately 5% in 2001 and 2007. Another indication of the unusual year was that Kaspa was 15% higher yielding than Bundi and 11% higher yielding than Sturt, with both varieties yielding slightly higher than Kaspa in long term analysis at this site. OZP0601 and OZP0602, the two early and longer flowering lines from PBA being multiplied for release in 2011, were also lower yielding than Kaspa but performed similarly to Parafield. Like other early flowering lines at Minnipa in 2009, OZP0601 & OZP0602 were not favoured by the early sowing date and the long wet growing season, since they are better suited to shorter growing season conditions such as 2006 and 2007 (Table 2).

The late flowering advanced breeding line 01H280P-02HO2012-04HO5001 was the highest yielding entry in the trial (14% higher than Kaspa). It was also high yielding across all SA PBA sites in 2009 (Table 1). This line and others such as 03H078P-04H2007 & 03H117P-04HO2008, which both had lower blackspot disease levels than commercial entries, require further evaluation across sites and seasons to validate their performances, particularly in shorter growing seasons.

Agronomic time of sowing trial

A significant interaction between variety and sowing date for grain yield occurred at Minnipa in 2009. Grain yields of Parafield, OZP0601 and OZP0602 were the same at each sowing time however grain yield of Kaspa was reduced at the mid sowing date compared with the early sowing date (Figure 1).

Table 1 Blackspot disease score, grain yield, flowering date & number of days flowered of selected field pea lines in the 2009 Minnipa Stage 3A PBA trial

Variety / Line	Blackspot mean score*	Minnipa Flower		Grain yield % Kaspa	
	Minnipa	Start date	Days	Minnipa	Mean SA
Bundi	6.3	27 July	42	85	85
Kaspa	6.0	10 August	25	100	100
Maki	7.7	7 August	31	45	66
Parafield	6.3	31 July	35	86	90
Sturt	6.7	27 July	42	89	97
Yarrum	4.3	21 August	17	104	96
OZP0601	7.0	27 July	35	84	90
OZP0602	6.7	28 July	38	84	97
OZP0606	6.0	7 August	28	113	104
OZP0703	6.0	31 July	38	96	102
OZP0705	6.3	28 July	41	88	92
OZP0803	6.7	28 July	34	101	108
OZP0804	7.3	10 August	32	75	92
OZP0805	6.0	3 August	32	74	91
OZP0819	6.3	31 July	31	96	105
OZP0901	6.3	20 July	46	91	96
OZP0903	6.7	27 July	39	92	103
OZP0905	5.7	7 August	31	105	106
01H280P-02H02012-04HO5001	6.0	10 August	25	114	111
03HO78P-04H2007	4.0	7 August	35	81	87
03H117P-04HO2008	5.3	28 July	41	106	100
03H211P-04HO2004	8.3	31 July	35	55	61
Kaspa (t/ha)				2.61	2.42
Site mean yield	6.2			2.29	
CV %				7.8	
LSD (P>0.05)				*0.36*	

**Blackspot disease score on the 16th September, 0=no disease, 9=high disease*
 # Mean of PBA Stage 3A 2009 field pea trials conducted at Balaklava, Snowtown, Turretfield & Willamulka

Table 2 Grain yields of Parafield, Kaspa, OZP0601 & OZP0602 field peas compared with rainfall and sowing date at Minnipa in advanced pea breeding trials, 1999 - 2009

Line/Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Parafield	0.90	2.20	2.46	1.51	1.40	0.87	0.92	0.61	0.99	<0.2	2.24
Kaspa	0.81	2.24	2.54	1.52	1.40	0.79	0.86	0.54	1.04	<0.2	2.61
OZP0601								0.80	1.13	<0.2	2.19
OZP0602								0.68	1.12	<0.2	2.20
GSR (mm)	212	299	267	219	204	223	264	111	141	139	333
AR(mm)	268	389	354	277	263	288	334	236	286	251	421
Date Sown	31/5	2/6	29/5	27/5	8/6	1/6	24/1	15/5	8/5	20/5	4/5

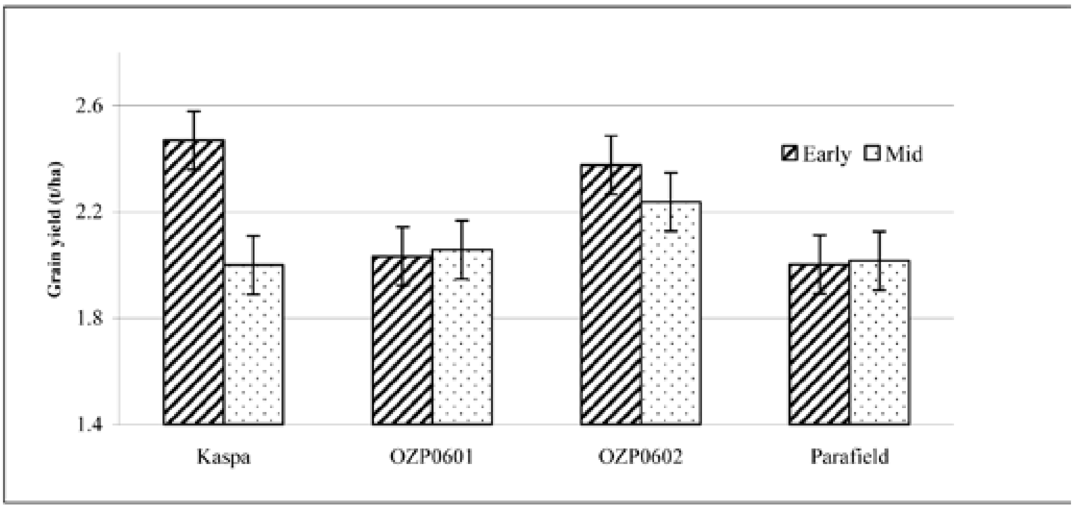

Figure 1 Effect of sowing date on the grain yield of four pea lines at Minnipa, 2009

Table 3 Flowering date and duration of four field peas from Minnipa sowing date trial, 2009

Date sown	Flowering date & duration *(in italics)*			
	Parafield	Kaspa	OZP0601	OZP0602
30 April	31 July *42*	10 August *32*	31 July *35*	28 July *38*
20 May	21 August *28*	28 August *18*	17 August *28*	14 August *31*

The flowering window of Kaspa was only 18 days at the mid sowing compared with 28-31 in the other three varieties (Table 3) most likely explaining this reduction in grain yield. OZP0602 was the highest yielding variety at the mid sowing time, 12% higher yielding than Kaspa.

What does this mean?

Very high yield potential existed during the year due to the favourable growing season however final grain yields were significantly lower than potential. The high level of blackspot disease infection caused by frequent rainfall events and water logged soils during winter and early spring resulted in grain yield losses and indicated major differences in disease tolerance between cultivars (e.g. Maki appears to be highly disease intolerant to blackspot compared to Kaspa). Interestingly, field pea breeding has regularly shown that tolerance to blackpsot is not always directly associated with the level of plant disease symptoms in the field, as was the case at Minnipa last year. For this reason screening for higher blackspot tolerance is an important component of the PBA program. This is currently undertaken at Wagga with disease loss studies using fungicides, however opportunistic screening in breeding nurseries (e.g. Minnipa last year) is highly valuable as ongoing drought has made breeding for disease tolerance difficult. Lines identified with potentially higher blackspot tolerance compared to Kaspa in SA (e.g. 01H280P-02HO2012-04HO5001) will be progressed for further evaluation and used in future breeding.

Kaspa currently remains an option for low rainfall environments since it has the best combination of round dun seed, pod shatter resistance, improved standing ability, good early vigour and grain yield. However its best yields, as seen in 2009 at Minnipa, occur in favourable years. OZP0601 and OPP0602, despite lower performance than Kaspa in the disease affected variety trial in 2009, will provide better adapted "Kaspa type" options for low rainfall environments when available due to their earlier and longer flowering periods. In particular they will provide greater yield stability than Kaspa in years where early sowing cannot be achieved (Figure 1) or where spring conditions are unfavourable for flowering and pod set in later flowering varieties.

Adaptive Peas for Low Rainfall Environments

RESEARCH

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Searching for answers

Location: Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Yield
Potential: 3.6 t/ha (peas)
Actual: 2.2 t/ha Kaspa peas

Paddock History
2008: Wheat
2007: Wheat
2006: Wheat

Soil Type
Red calcareous sandy loam

Diseases
Blackspot moderate to high infection, moderate powdery mildew infection

Plot size
10 m x 1.5 m x 3 reps

Yield Limiting Factors
Blackspot (moderate), powdery mildew (low), water logging (exacerbated blackspot infection)

Key messages

- **Variation for boron and salt tolerance in field pea germplasm was not associated with grain yield differences at Minnipa as a likely consequence of very low rainfall in 2008 and very high rainfall and Blackspot disease in 2009.**
- **Under favourable growing conditions the late flowering advanced PBA field pea line, 94-425*2b produced very high dry matter yields at the flat pod stage compared to other lines evaluated.**
- **Advanced field pea lines with a combination of higher dry matter and grain yield production were identified and potentially offer a dual purpose (grain and hay/silage/green manuring) option for growers in low rainfall environments and a way of managing some of the risk of production.**
- **Findings require further validation across years and environments.**

Why do the trial?

All current break crop options have adaptation limitations in low rainfall environments. Ongoing genetic improvements in field peas through plant breeding combined with agronomic management strategies based upon innovative modern farming systems offer potential for farming to be more flexible, adaptive and ultimately economic in variable seasons and environments.

Pulse Breeding Australia (PBA) field peas has been screening early generation breeding lines in glass house experiments to identify improved tolerance to soil boron and salinity ($NaCl_2$). These experiments have been conducted in soil boxes containing light sandy loam soils with the addition of boron at 10 mg/kg and in pots of sandy gravel where $NaCl_2$ was applied in water solution at a final concentration of 16 dS^{-1} at the seedling stage. Kaspa and Parafield are both rated as relatively susceptible to boron toxicity and Kaspa relatively susceptible to salinity. The performance of field peas, rated as tolerant to these constraints in glass house experiments, under high boron and salt field conditions is currently not well understood. Anecdotal evidence suggests some related lines with higher tolerance to either boron or salinity may perform relatively better on soils classified as having more boron or salt in the profile, however results are variable and field assessment is difficult due to the confounding affects caused by the transient toxicity of boron and salinity both within and across the soil profile, over the growth cycle of the plant and also due to plant interactions with rainfall and disease. Upper EP has a vast area of soils that have inherently high boron, sometimes as shallow as 30-40 cm. Performance of field peas on these soil types is unreliable and grain yields produced are often uneconomical. In 2008 and 2009 experiments were conducted at Minnipa to evaluate field pea breeding lines ranging in their glass house tolerance to boron and salinity, for their ability to perform under high field soil boron levels. The same lines were also evaluated in the same paddock at Minnipa but on a contrasting site where lower boron levels were identified.

Due to their ability to produce high amounts of good quality dry matter, field peas can be used for forage as well as grain. In low rainfall environments like upper EP peas are vulnerable to high grain yield loss from moisture stress, high temperatures and frost during the flowering and grain fill stages.

Field pea lines which have a dual purpose option i.e. have higher dry matter production compared with conventional varieties, while maintaining moderate to high grain yields are being investigated to spread grower risk in variable seasonal conditions. Forage type field peas will still provide the break effect in rotation and may reduce risk to growers by providing grain, hay or green manure options depending upon the season outcome.

Advanced PBA breeding lines exhibiting good early vigour, high dry matter production and boron tolerance are being evaluated for grain and dry matter yield potential and being compared against grain only pea varieties under low rainfall conditions.

How was it done?

Two trial sites were chosen in paddock S5 at Minnipa Agricultural Centre. Smaller differences in boron levels existed between the two sites in 2009 compared with the sites used in paddock N9 in 2008. Both sites in 2009 had similar and high boron levels (25-35 mg/kg) at depth (40-120 cm). However the high site had soil boron levels ranging from 5.5 – 22.8 mg/kg between 10 and 40 cm compared with lower levels (3.4 to 13.9 mg/kg) for the same depth range at the low boron site. The forage trial was sown at the low boron site.

All trials were sown on 8 May after 26 mm of rain. Varieties were sown at approximately 90 kg/ha, with 70 kg/ha DAP. All trials received standard weed management practices.

The boron tolerant pea trial consisted of 21 varieties (Table 1) and 15 varieties were chosen for the forage pea trial (Table 2), both experiments were replicated 3 times. Measurements included visual scores, flowering dates, dry matter production at the flat pod stage for each variety (forage trial only), grain yield and 100 grain weight.

What happened?

In stark contrast to season 2008, extremely high growing season rainfall was recorded at Minnipa in 2009. Surprisingly, symptoms of waterlogging were observed during winter and a moderate to high infection of Blackspot disease occurred during winter and early spring. Powdery mildew also occurred during late spring but had little impact on grain yield. Field pea growth in all trials was not suppressed by moisture stress so vegetative growth and yield potential was high. Only minor boron toxicity symptoms during spring were identified on plants at the high boron site and no symptoms were observed on plants at the low boron site. Plants at the high boron site generally matured later than plants at the low boron site. This is likely to have been due to do an increased moisture holding capacity of the soil type at the high boron experiment site rather than relatively smaller changes in soil boron levels between the two sites.

Boron tolerant trial

High and similar grain yields occurred at both sites (Table 1). Genotype performance at both sites was highly correlated for grain yield and yield rank ($R^2=0.87$, $P<0.001$). There was no yield advantage at the high boron site for lines with either one or both of the soil tolerances. The highest yielding line at both sites was 03H264P-04H2009, rated as sensitive to both constraints. Kaspa, also sensitive to both constraints, was the second highest yielding line at both sites. The early flowering line 02-256-5 (highly tolerant to boron) was one of two high yielding lines at the high boron site in 2008 and was the third highest yielding line at both sites in 2009.

Forage and dual purpose pea trial

Grain yields in 2009 (1.45 to 2.56 t/ha) and dry matter yields (3.4 – 7.44 t/ha) were very high compared to those achieved in 2008 (averages of 0.2 t/ha and 1.1 t/ha for grain and dry matter respectively). Dry matter production was poorly correlated with grain yield in 2009 unlike in the dry 2008 year where there was a stronger link between dry matter and grain yield. The very late flowering 'true' forage pea line 94-425*2b produced the highest dry matter yield at 7.4 t/ha, 23% higher than Kaspa and 37% higher than the current standard Morgan. However this line had by far the lowest grain yield at 1.45 t/ha, 35% less than Kaspa and 28% less than Morgan. The line 05H207-06HOS2002 (not evaluated in 2008) produced higher grain yields than Kaspa and Morgan and higher dry matter yields than Morgan (equivalent to Kaspa). The lines 03H033P-04HO2008 and 03H562P-04H02008 produced the highest grain and dry matter yields in 2008 however both lines were only average performers in 2009, indicating a strong influence of seasonal conditions on variety performance.

What does this mean?

Variation in boron and salt tolerance identified in field peas are likely to be important on Eyre Peninsula in most years, but were not relevant in these studies due to either extreme drought in 2008 or very high rainfall in 2009. These studies highlight the difficulty in validating abiotic stress tolerance in the field. The transient nature of both boron toxicity and salinity, spatially and temporally along with the confounding affects of climate (particularly rainfall) and disease need to be considered. However experimentally in the field these factors are difficult and expensive to manage.

In addition, genetic interactions with all these factors can be occurring in the field when comparing unrelated lines. Currently the PBA program is developing recombinant inbred lines (related lines that vary in both boron and salinity tolerance but otherwise are very similar) to reduce genetic interactions for field assessment. Yield nurseries and field screening at Minnipa remain very important in selecting for higher field tolerance to boron and salinity toxicity in seasons where these soil factors are limiting water uptake.

Table 1 Boron and salt rating, grain yield and weight of PBA breeding lines and commercial field peas on contrasting soils for boron toxicity, Minnipa 2009

Variety/Line	Boron tolerance#	Salt tolerance#	t/ha	Grain Yield %Kaspa	Rank	g/100 seeds	t/ha	Grain yield % Kaspa	Rank	g/100 seeds
Kaspa	S	S	2.19	100	2	18.91	2.32	100	2	18.91
OZP0601	S	S	1.86	85	14	17.38	1.88	81	15	17.11
OZP0602	S	MT-HT	1.95	89	10	18.11	2.03	87	10	17.80
OZP0703	S	MT-HT	1.85	85	15	15.73	1.99	82	14	15.74
00-254-26	S	MT-HT	1.76	80	18	16.51	1.88	81	16	15.21
01H071P-02HO2003-04HO5005	MT	MT-HT	1.88	86	12	16.09	1.76	76	18	16.64
02-093-1	MT-HT	MT-HT	1.84	84	16	14.16	1.91	82	13	14.51
02-220-3	S	MS	1.48	67	21	17.09	1.65	71	21	17.10
02-262-3	HT		2.04	93	6	18.98	2.24	96	5	19.86
02-323-3	MT-HT	MT-HT	2.17	99	4	18.44	2.20	95	6	17.48
02-356-5	HT		2.19	100	3	17.92	2.31	99	3	18.25
02-393-3	S	S	1.63	74	20	15.28	1.73	74	19	15.49
03H061-04HO2001	MT-HT	MT-HT	2.13	97	5	18.98	2.09	90	8	17.62
03H078P-04H2003	MT-HT	S	1.83	84	17	18.30	1.93	83	11	17.76
03H264P-04H2009	S	S	2.34	107	1	18.37	2.57	111	1	18.91
03H627-04HO2009	MS	MT-HT	2.01	92	8	17.80	2.26	97	4	18.81
03H348P-04HO2011	MT-HT	MT-HT	2.02	92	7	18.68	1.92	82	12	18.42
03H382-04HO2007	HT	MT	1.87	85	13	18.24	2.03	87	9	18.15
03H534-04HO2004	S	MT-HT	2.00	91	9	19.56	2.19	94	7	19.98
03H536-04HO2010	MT-HT	MS	1.89	86	11	16.34	1.85	80	17	15.83
03H562P-04HO2008	HT	MT-HT	1.66	76	19	16.78	1.67	72	20	15.86
Site mean yield			1.93			17.51	2.01			17.37
CV %			7.04			3.31	4.98			4.14
LSD (P<0.05)			*0.23*			*0.99*	*0.18*			*1.19*

 # derived from glass house pot experiments using boron at 10 ppm and $NaCl_2$ in water solution at a final concentration of dS^{-1}

Table 2 Flowering dates, grain yield, plant dry matter at early podding stage and grain weight of dual purpose PBA field pea breeding lines and commercial checks, Minnipa 2009

	Flower		Grain yield		Dry matter		
Variety/Line	Start Date	Days	t/ha	% Kaspa	t/ha	% Kaspa	g/100 seeds
Kaspa	14 August	24	2.24	100	6.06	100	19.00
Morgan	14 August	35	2.08	93	5.19	86	17.68
03A158P-04CH2001	10 August	39	1.87	84	4.62	76	22.05
03H033P-04HO2008	7 August	42	2.01	90	5.75	95	18.18
03H072P-04H2009	7 August	35	2.06	92	4.87	80	20.80
03H376P-04H2005	10 August	35	1.82	81	4.02	66	19.15
03H547P-04HO2014	7 August	42	1.90	85	6.20	102	17.45
03H554P-04HO2015	31 July	49	2.32	104	3.40	56	24.03
03H562P-04H2008	7 August	38	1.96	88	4.98	82	19.20
04H084P-05HO2003	10 August	39	1.97	88	4.73	78	19.47
04H090P-05HO2007	10 August	39	1.62	72	4.65	77	17.14
04H186P-05HO2002	14 August	35	1.61	72	4.78	79	22.01
05H170-06HOS2003	14 August	28	1.91	85	4.40	73	20.94
05H207-06HOS2002	14 August	28	2.56	114	6.39	105	21.79
94-425*2b	4 September	39	1.45	65	7.44	123	13.80
Site mean yield			1.96		5.16		19.51
CV %			4.26		10.46		3.22
LSD (P<0.05)			*0.14*		*0.96*		*1.1*

The advanced line, 94-425*2b, produced significantly higher dry matter production by the flat pod stage (ideal time for cutting peas for hay) than all other lines evaluated under favourable growing conditions in 2009 in contrast to its poor performance in 2008. However it has low grain yield potential in these environments which may limit its value as a dual purpose type for these regions. Results from 2008 and 2009 indicate there is potential to select field pea lines that have higher dry matter and grain yields than the current dual purpose field pea Morgan e.g. 05H207-06HOS2002. Further evaluation over seasons and in different environments is required to validate these findings. Additional work is also required to understand the key morphological and phenological traits required in field peas to provide high biomass in conjunction with high grain yield in low rainfall environments, as traditional high biomass types generally have low grain yields in these environments.

Acknowledgements

Thanks to Wade Shepperd and Cilla King for their technical assistance during the year with sampling the trial and processing grain samples.

Canola and Juncea Canola for Low Rainfall Areas in 2010

INFORMATION

RESEARCH

Trent Potter[1] and Wayne Burton[2]

[1]SARDI, Struan, [2]VicDPI, Horsham

Searching for answers

Location: Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm
Yield
Potential: 2.7 t/ha (canola)
Actual: 2.3 t/ha 45Y77 canola
Paddock History
2008: Wheat
2007: Wheat
2006: Wheat
Soil Type
Red calcareous sandy loam
Plot size
10 m x 1.5 m x 3 reps

What a difference a year makes. No canola or juncea yields at Minnipa in 2008 and the sky is the limit in 2009. What are you going to do to us in 2010? As yields were so high in 2009, we have also used 2008 and earlier data to give an understanding of what is likely to happen in a normal year.

Variety selection

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

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

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

New varieties released in 2008

Triazine tolerant (TT) varieties

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

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

CLEARFIELD® (imidazolinone tolerant) varieties

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

New varieties for 2010

A number of new varieties will be marketed for 2010 sowings. Information about new varieties has been provided by the seed companies as in most cases, entries have only come into NVT trials in 2009.

Conventional varieties

Hyola 433. Mid-early maturing conventional hybrid. High yielding. High oil and good protein content. Medium height. Suited from low to medium rainfall regions including irrigation zones. Anticipated Blackleg resistance rating by Pacific Seeds is R-MR. Tested in NVT trials 2005 and 2009. Bred and marketed by Pacific Seeds.

Triazine tolerant (TT) varieties

CB™ Telfer

Very early season for low rainfall areas. CBWA indicate high oil and good blackleg (CBWA estimate MS) resistance. Seed will be available in 2010. Tested in SA NVT trials in 2008. Bred by CBWA. An End Point Royalty (EPR) applies.

CB™ Scadden

Medium season for medium to high rainfall areas. CBWA indicate excellent blackleg (CBWA estimate MR) resistance and early vigour. Seed will be available in 2010. Tested in SA NVT trials in 2008. Bred by CBWA. An EPR applies.

CB Mallee HT™

Early season TT hybrid canola. CBWA indicate moderate blackleg resistance (MR-MS) and excellent early vigour. Small amounts of seed will be available in 2010. Tested in SA NVT trials in 2009 as Ttriumph CHYB157. Bred by CBWA.

CB Tumby HT™

Early-mid season TT hybrid canola. CBWA indicate blackleg resistance of MR-MS and excellent early vigour. Small amounts of seed will be available in 2010. Tested in SA NVT trials in 2009 as Triumph CHYB125. Bred by CBWA.

CLEARFIELD® *(imidazolinone tolerant) varieties*

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

45Y82 (tested as 06N785I). Pioneer HiBred indicate provisional blackleg rating likely to be R-MR. 45Y82 is an early-mid hybrid Clearfield variety with shorter stem and good standability. Included in NVT trials in 2009.

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

CLEARFIELD® (imidazolinone tolerant) *Juncea canola*

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

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

Grain quality

Grain quality data from trials conducted in 2008 are presented in Table 1. Many of the newer varieties have improved oil content over older varieties, but consider oil content amongst the other factors when choosing a new canola variety.

JUNCEA CANOLA FOR LOW RAINFALL ENVIRONMENTS

Two juncea canola varieties will be available in south eastern Australia for 2010. Both are Clearfield varieties called OasisCL and SaharaCL, (both cultivars are being marketed by Pacific Seeds under an EPR system). Due to limitations of seed, there will only be further yield evaluation and demonstration paddocks of these new varieties on Eyre Peninsula in 2010. Commercial production was limited to NSW, Victoria and the area around Lameroo in SA for 2009.

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

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

Table 1 Oil content of canola sown at Keith, Tooligie and Minlaton, 2008

Site	Keith	Tooligie	Minlaton
Triazine tolerant			
ATR Cobbler	37.6	36.1	37.6
ATR Stubby	36.8	35.3	37.8
ATR409	38.8	35.3	38.0
BravoTT	38.0	37.7	37.9
CB Boomer	37.1	33.1	35.4
CB Scaddan	37.6	34.9	36.9
CB Tanami	36.4	35.3	36.6
CB Telfer	37.3	38.3	39.1
Hurricane TT	38.3	39.0	38.5
Rottnest TTC	37.0	35.5	36.9
Tawriffic TT	39.8	39.4	39.1
TornadoTT	37.9	36.6	38.5
Conventional			
AG Muster		37.5	37.2
AV Garnet		42.0	40.1
Hyola 50		40.7	38.8
Hyola 571CL		39.7	39.5
43C80		40.8	38.1
44C73		39.5	37.3
44C79		39.1	39.1
Tarcoola		43.6	40.7

Table 2 Grain yield at Tooligie NVT trials, 2008

Variety	Conventional & CL varieties (t/ha)	% site mean	TT Varieties t/ha	% site mean
AG Muster	0.94	105	-	-
ATR Cobbler	-	-	0.71	101
ATR Stubby	-	-	0.71	101
ATR409	-	-	0.44	62
AV Garnet	1.03	116	-	-
BravoTT	-	-	0.77	109
CB Boomer	-	-	0.65	93
CB Scadden	-	-	0.79	113
CB Tanami	-	-	0.80	114
CB Telfer	-	-	0.84	120
Hurricane TT	-	-	0.64	91
Hyola 50	0.95	107	-	-
Hyola 571CL	0.87	97	-	-
43C80	0.84	94	-	-
44C73	0.80	90	-	-
44C79	0.70	78	-	-
Rottnest TTC	-	-	0.58	83
Tarcoola	0.88	99	-	-
Tawriffic TT	-	-	0.73	104
TornadoTT	-	-	0.68	97
Site Mean (t/ha)	0.89		0.7	
CV (%)	9.46		11.86	
LSD (t/ha)	*0.14*	*15*	*0.13*	*18*

Table 3 Grain yield of TT canola at Minnipa, 2008

Variety	kg/ha	% site mean
CB Telfer	214	146
CB Tanami	206	141
ATR Cobbler	181	123
CB Boomer	159	108
CB Scadden	139	95
BravoTT	133	91
Hurricane TT	131	90
Tawriffic TT	130	89
Rottnest TTC	125	85
ATR Stubby	119	81
TornadoTT	117	80
ATR409	93	64
Site Mean	146.4	
CV (%)	12.28	
LSD (kg/ha)	*29.57*	

Break Crops

Table 4 Grain yield of Clearfield canola and mustard 2009

	Lameroo (SA)	Minnipa (SA)	Beulah (Vic)	Horsham (Vic)	Average
Name	t/ha	t/ha	t/ha	t/ha	t/ha
Clearfield napus					
43C80	0.64	2.29	0.96	1.41	1.41
44C79	0.74	2.14	1.22	1.28	1.28
45Y77	0.68	2.32	1.36	1.62	1.62
Clearfield Jancea canola					
OasisCL	0.66	2.02	1.65	1.43	1.43
Selected high yielding clearfield Jancea canola advanced breeding lines					
J06Z-07739	0.87	1.87	1.48	1.72	1.72
J07Z-00348	0.75	1.96	1.55	1.60	1.60
J07Z-00756	0.75	1.95	1.54	1.61	1.61
J07Z-00777	0.63	2.08	1.43	1.62	1.62
J07Z-01904	1.00	2.02	1.57	1.96	1.96
JB0Z-800066	0.77	1.65	1.25	1.43	1.43
JB0Z-800090	0.62	1.94	1.13	1.51	1.51
JB0Z-800781	0.75	1.99	1.54	1.69	1.69
JB0Z-800789	0.71	1.93	1.46	1.28	1.28
JB0Z-801068	0.62	1.58	1.06	1.32	1.32
JB0Z-801346	0.73	1.94	1.59	1.22	1.22
Site mean	0.67	1.81	1.26	1.19	
CV (%)	10.83	4.28	14.26	10.02	
LSD (t/ha)	*0.14*	*0.15*	*0.35*	*0.23*	

Table 5 Yield of canola and juncea varieties in 2009

Entry	Minnipa		Minnipa	
	t/ha	% site mean	t/ha	% site mean
AV-Garnet	2.47	124	0.81	105
Tarcoola	2.22	111	0.67	86
Hyola50	2.17	109	0.71	91
SARDI515M	1.99	100	0.82	106
Ag-Outback	1.95	98	0.63	81
Site mean	1.99		0.78	
CV {%)	1.89		9.65	
LSD (t/ha)	*0.16*		*0.13*	

Future breeding priorities include further development of herbicide tolerant varieties with high yield, improved quality, good blackleg resistance and good adaptation. The first triazine tolerant advanced breeding lines were in multi-locations trials in 2009 and were tested on Eyre Peninsula, with first cultivars hopefully available in 2011. Hybrids and other herbicide tolerances are also currently being developed and will continue to be selected in low rainfall systems across Australia.

Juncea canola lines tend to yield the same or more than traditional canola in situations where canola yields are equal or less than 1.5 t/ha.

No breeding or advanced trial data was available for 2008 from Minnipa or Miltaburra sites due to the high level of variability within the trials or trials not being harvested due to the drought. New advanced breeding lines and released varieties were further evaluated in 2009 at Minnipa, Miltaburra and Lock sites. Demonstration blocks of the new Clearfield juncea canola varieties were also sown on larger scale in 2009. Results from some sites comparing Clearfield canola and juncea canola in 2009 are included in Table 4. At the lower rainfall sites at Lameroo and Beulah, juncea canola yielded similar to the better canola varieties. In higher yielding site at Minnipa the canola produced higher grain yields than juncea canola.

Grain yields of canola and mustard varieties sown in 2009 are shown in Table 5. At Minnipa, canola varieties produced the highest grain yields of well over 2 t/ha. Mustard yields were generally lower as would be expected at this yield level. At Lameroo, dry conditions in early spring restricted yield potential but late rain helped the canola varieties produce grain. However, the hectolitre weights of the higher yielding canola varieties were lower than the Australian Oilseeds Federation standard while the mustards were acceptable. One mustard of interest in these trials was SARDI515M which is being grown for biodiesel feedstock production.

Acknowledgements

Thanks to Willie Shoobridge and Leigh Davis for doing the trial management and field work at Minnipa Ag Centre.

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State Government Victoria Department of Primary Industries

Selection of Canola Lines for Low Rainfall Environments in South Eastern Australia

RESEARCH

Geoff Thomas[1], Roy Latta[2], Amanda Cook[2] and Leigh Davis[2]

[1]Manager, Low Rainfall Collaboration Project, [2]SARDI, Minnipa Agricultural Centre

Almost Ready

Location: Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Yield
Potential: 3.9 t/ha (C)
Actual: 2.9 t/ha (C)

Paddock History
2008: Wheat
2007: Clearfield Wheat
2006: Clearfield Wheat

Soil Type
Loam

Plot size
1.45 m x 10 m x 2 reps

Key messages

- **The first year of trials show that there is material with real potential to do well in low rainfall environments and develop lines which will be economic as break crops in future.**
- **In 2009, about 120 lines were trialled at Minnipa and Condobolin.**
- **At Minnipa with an exceptional season yields ranged from 1.7 to 2.9 t/ha, with an average over 2.4 t/ha.**
- **At Condobolin, under tough conditions, individual plots yielded up to 1 t/ha.**

Why do the trial?

The development of a profitable break crop in low rainfall cereal growing areas is essential for sustainable and profitable systems. Until now canola, peas and lupins have been the most promising options, with canola having several valuable characteristics (eg herbicide tolerance and high value grain). It is relatively free of disease in low rainfall areas and is able to utilise the high nitrogen levels following medics and leguminous crops which makes it ideally suited to low rainfall rotations.

With the decision by GRDC to withdraw from mainstream canola breeding, selection and evaluation, this role has been taken over by the four major commercial companies, namely Nuseed, Pioneer, Pacific Seeds and Canola Breeders Western Australia Pty Ltd.

There have been concerns that the commercial breeding companies may not select and evaluate new lines in low rainfall areas because of geography, cost, small size of the potential market and risk of losing material in poor seasons. This was confirmed in discussion with the breeders, although CBWA are committed to breeding for low rainfall areas.

Following discussion with the companies, GRDC agreed to support a program for early lines from the various canola breeding programs to be selected in trials in the districts located around Minnipa (SA), Walpeup (Vic), and Condobolin (NSW).

How was it done?

In 2009, about 120 lines were trialled at Minnipa and Condobolin. These included TT, Round up Ready (except in SA because of the GM Moratorium) and conventional lines. There were no trials in the Victorian Mallee because Vic DPI did not have its protocols in place.

The various lines were assessed for early vigour, height, lodging, time to mid-flowering and yield. Other characteristics which may be of commercial significance (eg sensitivity to herbicides) were also noted.

The trial at Minnipa was sown on 1 May with 19:13:0:0 @ 70 kg/ha and urea @ 50 kg/ha. The pre-sowing knock down used was 1.2 L/ha of Triflur-X and 1 L/ha Sprayseed, and 750 ml/ha Lorsban was also applied one week after sowing to prevent insect damage especially cut worm and Red-legged earth mite.

Grasses and insects were controlled 6 July with 250 ml/ha Select, 500ml/ha Astound, 1 L/100L Hasten and 100 ml/100L Chemwet 1000.

Plots were scored for emergence in May and for flowering time at the end of July, and harvested on 26 October. Grain analysis included commercial tests such as oil content and protein.

What happened?

At Minnipa a total of 64 advanced lines, with 35 conventional and 29 Triazine lines, were sown with current commercial lines as check varieties. At Minnipa, it was one of the best seasons ever, with 333 mm rainfall in the growing season.

Establishment conditions were ideal, with excellent rains received in March which continued throughout the growing season (Table 1). Germination was optimal as soil temperatures were warm, and plant growth exceptional for the district given the adequate moisture.

Water stress did not occur during the Minnipa growing season, and the varieties flowered between 7 and 10 weeks. The average height of the lines was 1.3 m. Despite a hot week in October the plants still filled well as adequate soil moisture was available so they were not too stressed. Soil water contents at emergence and maturity are shown in Figure 1.

Yields ranged from 1.7 to 2.9 t/ha, with an average over 2.4 t/ha. Many of the new lines yielded better than those currently available commercially, while others were disappointing, even under the good seasonal conditions. The grain quality analysis of the Minnipa site showed the average oil content was 43% and the average protein was 42%. This season was exceptional and the data needs to be treated with caution as the Minnipa environment this year was similar to a medium to high rainfall environment.

At Condobolin, under what were very tough conditions, there were some spectacular successes and some abject failures. A total of 120 advanced lines were received and these differed in herbicide tolerance; 28 conventional, 4 Clearfield, 29 Triazine and 59 Roundup Ready.

Establishment conditions were less than ideal, with little rain received in May after sowing (Table 1). There were considerable differences among the lines, a result of variations in seed size and quality. Rain in June and July was sufficient to give good growth and ground cover but August and September were exceptionally dry, so that flowering and seed fill occurred under severe water stress, particularly for later-flowering lines.

Water stress was exacerbated by the lack of stored moisture, following the relatively dry summer and autumn. Soil water contents at emergence and maturity are shown in Figure 2. There was no available water stored below 50 cm in 2009.

Table 1 Growing season rainfall (mm) at Minnipa and Condobolin, 2009

	April	May	June	July	August	September	October	Total
Minnipa	25	35	92	101	29	42	7	331
Condobolin	45	14	53	23	11	17	34	197

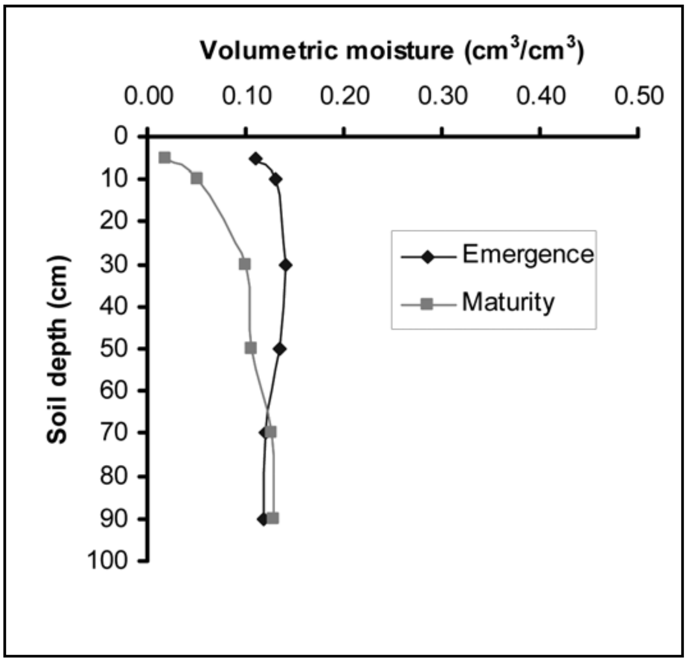

Figure 1 Soil moisture profiles at emergence and maturity at Minnipa, 2009

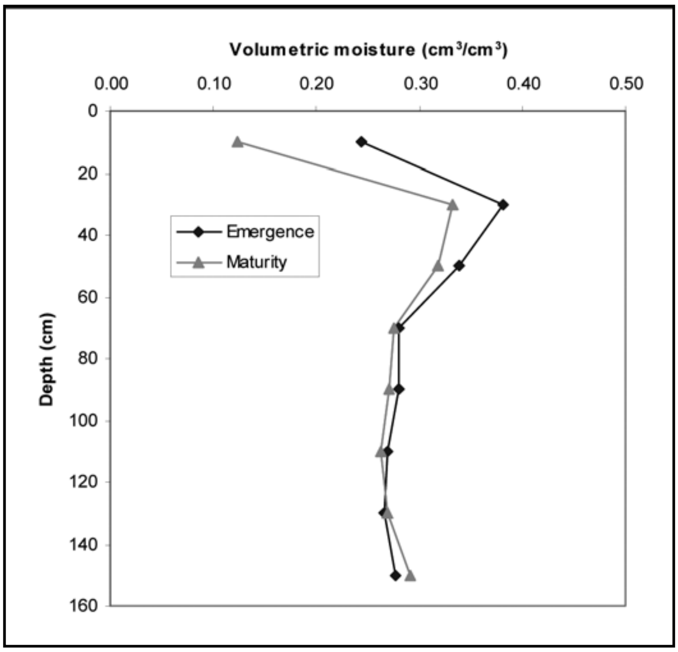

Figure 2 Soil moisture profiles at emergence and maturity at Condobolin, 2009

There was a large spread in flowering time among the entries and many were much slower to flower and begin seed filling than Tarcoola. These later-developing lines suffered greatly under the dry spring conditions and are not suited to low-rainfall regions.

Grain yields also differed among the entries, with individual plots yielding up to 1 t/ha. There was some variability across the site in establishment and water stress and careful spatial analysis will be required to reduce these effects. Despite this variability, it is likely that a number of the entries will be identified as promising for this low rainfall environment.

What does this mean?

Already this Low Rainfall Canola Project work is showing that there is real potential for some of the new material to do much better in the low rainfall environment, increasing the prospects of a more profitable and reliable break crop. The trials will continue in 2010 and 2011 and involve all four breeding companies and sites at Minnipa, Victorian Mallee and Condobolin.

Acknowledgements

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Canola Breeders
PACIFIC SEEDS Modern science - traditional values
GRDC Grains Research & Development Corporation

Mt Cooper Break Crop Trial

Leigh Davis and Willie Shoobridge
SARDI, Minnipa Agricultural Centre

EXTENSION

Try this yourself now

Location: Mt Cooper
Chris Lynch
Mt Cooper Ag Bureau

Rainfall
Av. Annual: 426 mm
Av. GSR: 332 mm
2009 Total: 459 mm
2009 GSR: 408 mm

Yield
Potential: Peas - 4.32 t/ha,
Canola - 4.62 t/ha
Actual: Average Peas - 2.29 t/ha,
Canola - 2.54 t/ha

Paddock History
2008: Peas
2007: Barley
2006: Wheat

Soil Type
Red loam

Diseases
Blackspot on peas

Plot size
10 m x 1.5 m x 3 reps

Yield Limiting Factors
Blackspot in peas

Key messages

- **No stand out varieties with peas at Mt Cooper in 2009.**
- **Av-Garnet conventional variety yielded the best at Mt Cooper followed by the two Clearfield varieties, Hyola 571CL and 43C80.**

How was it done?

One conventional, two Clearfield, three Triazine Tolerant (TT) canola varieties and one juncea Clearfield canola variety and six pea varieties were sown in a variety trial at Mount Cooper. The replicated trial was sown on 18 May with 70 kg/ha DAP fertiliser and 50 kg/ha Urea was broadcasted on 8 July. Trial received 1 L/ha Round up Power Max, 1 L/ha Triflur Xtra plus 0.75 L/ha Hammer at seeding and Select at 0.25 L/ha for grasses. No specific chemical was applied for the CLF and TT canola varieties, they were treated as conventionals. Grain yield and quality was measured.

What happened?

Mt Cooper received 408 mm of rain for the growing season which meant varieties had little moisture stress throughout the year. Nitrogen was a key factor for high yields in 2009. The trial was placed on pea stubble from 2008, boosting nitrogen reserves and also 50 kg/ha of urea was broadcast during July.

Peas

There was no stand out pea variety. Pea yields were reduced due to Blackspot, which was expected considering the trial was sown on pea stubble. The trial still yielded considerably well averaging 2.29 t/ha. The breeding line OZP 0703 had the highest yield and gross income with $644.

Canola

Canola yields were sound with the trial averaging 2.54 t/ha. AV-Garnet, a conventional variety, out yielded all other varieties with 3.32 t/ha and had the best gross income of $1,403. The two Clearfield varieties Hyola 571CL and 43C80 were second, both out-performing the TT varieties. The Clearfield Juncea Sahara yielded the same as the Triazine Tolerant varieties. Juncea canolas have been released and are grown in parts of Victoria and SA Mallee under a contract agreement.

Table 1 Peas yields, grain quality and gross income at Mt Cooper 2009

Variety	Grain Weight (g/100)	Yield (t/ha)	Price ($/t)	Gross Income ($/ha)
OZP 0703	24.82	2.83a	228	644
OZP 0602	23.45	2.36a	228	538
Morgan	17.68	2.33a	228	530
Kaspa	21.81	2.32a	228	529
OZP 0601	21.09	2.15a	228	489
OZP 0805	20.91	1.75b	228	398
Mean	21.63	2.29		521
LSD (P=0.05)		*0.69*		

**Gross Income is grain yield x price delivered to ABB Pt Lincoln using daily cash price 6/1/10*

Table 2 Canola yields and gross income at Mt Cooper 2009

Variety	Yield (t/ha)	Price** ($/t)	Gross Income* ($/ha)
AV-Garnet (Conventional)	3.32a	423	1,403
Hyola 571CL (Clearfield)	2.72b	423	1,151
43C80 (Clearfield)	2.67b	423	1,129
Tanami (TT)	2.34c	423	991
Cobbler (TT)	2.31c	423	975
Hurricane (TT)	2.31c	423	975
Sahara (Juncea Clearfield)	2.15c	423*	909
Mean	2.54		1,076
LSD (P=0.05)	*0.27*		

** Gross Income is grain yield x price (assuming 42% oil base) delivered to ABB Pt Lincoln using daily cash price Jan 6, 2009*

*** Price same as canola but there is no segregation in SA*

What does this mean?

When broadleaf weeds are under control choosing a conventional variety such as Av-Garnet can really increase profitability over using Clearfield and Triazine Tolerant technologies with canola.

Some new pea varieties are due for release soon, check their adaptability for your climate when choosing new varieties. Browse the NVT Web site, www.nvtonline.com.au for variety characteristics, yield and quality data.

Acknowledgements

Thanks to Chris Lynch for making his land available and Michael Bennet for help with the stats.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Break Crops

Peola at Minnipa in 2009

INFORMATION

EXTENSION

Michael Bennet
SARDI/SANTFA, Minnipa Agricultural Centre

Almost ready

Location: Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm
Yield
Canola potential: 3.9 t/ha
Canola actual: 0.9 t/ha
Peas potential: 3.6 t/ha
Peas actual: 2.2 t/ha
Paddock History
2008: Wheat
2007: Wheat
2006: Wheat
Soil Type
Sandy loam
Plot size
12 x 1.5 m x 3 reps
Yield Limiting Factors
Nitrogen deficiency in canola
Soil Health
Ground cover:
Potential erosion risk

Key messages

- **Inter-cropped peas and canola return higher gross income than monoculture peas or canola.**
- **The addition of canola to field peas reduced post harvest wind erosion risk.**

Why do the trial?

Targets for reducing wind and water erosion in the cropping zone have been set by the state government. One of the more risky crops grown on the low rainfall regions of Eyre Peninsula for wind erosion is field peas. The erosion risk for field peas is especially high after the crop has been harvested. The concept of growing canola in combination (inter-cropping) with peas to reduce erosion risk is simply to provide anchored material to help maintain groundcover until the following crop has established.

The aim of the trial was to determine the optimum ratio of peas and canola for grain yield, profitability and post harvest ground cover. It was also anticipated that the intercrop of peola would improve harvestability of the peas, helping them stand up better rather than have to use crop lifters.

Previous work done by Brendan Frischke at Minnipa is reported in EPFS Summary 2001, p 51-52.

How was it done?

The replicated trial was sown in the airport paddock at Minnipa on a sandy rise to maximise potential erosion risk. It was sown on 30 April using DBS tines set on 254 mm row spacing. Tanami canola was banded through the seed boot with 30 kg/ha DAP and inoculated Kaspa peas were deep banded through the fertiliser boot.

Terbyne was applied pre-sowing @ 1 kg/ha for broadleaf weed control. Plots were harvested without using lifters, with the sieves set for harvesting peas, while the fan was set for canola to reduce harvest losses. Erosion risk levels were assessed on 19 January 2010, with a rating system of 1= high risk of erosion, 3 = moderate erosion risk, 5 = low erosion risk.

What happened?

The soil type and paddock chosen for the trial has inherently low nitrogen reserves due to the long term cereal regime. The low N levels gave a competitive advantage to the peas over the canola. The pure canola plots failed to produce significant quantities of biomass and final grain yield.

The peas climbed up the canola stems in the peola plots and helped maintain crop height during the growing season. By harvest, however, the intercrop peas still lodged, although less in the plots with the higher canola sowing rates.

Canola sown at 2 kg/ha as a monoculture produced the highest yield (Table 1). The pea sowing rate treatments had similar yields with and without the addition of canola.

Gross income was highest in the inter-cropping treatments (Figure 1). Erosion risk was highest in the monoculture peas, decreasing with higher rates of canola in the crop mixture. Higher rates of canola, or canola sown as a monoculture contributed to a lower overall erosion risk.

What does this mean?

Peola is not a new concept. Research was conducted in the early 1990's on crop mixtures to improve the post harvest erosion risk in break crops in the mid north region by Alan Mayfield. After several years of trial work to test the concept with many crop combinations, it appeared that peas and canola had the best fit for a non monoculture crop. One issue which was highlighted through Alan's experience was the challenge of balancing peas and canola in the rotation. If there is too much nitrogen in the system, then the canola will outcompete the peas, whereas if there is a deficiency of nitrogen (which was the case at Minnipa in 2009), then the peas will dominate.

Table 1 Grain yield, gross income and erosion rating from pea + canola mixtures

Pea and Canola sowing rate (kg/ha)	Canola Yield (t/ha)	Pea Yield (t/ha)	Total Grain Yield (t/ha)	Gross Income ($/ha)*	Erosion Risk Rating (1 - 5)**
0+1	0.39	-	0.40	146	2.7
0+2	0.90	-	0.91	335	4.0
0+3	0.59	-	0.59	210	4.3
50+0	-	2.15	2.15	429	1.3
50+1	0.34	2.08	2.43	541	4.0
50+2	0.47	1.77	2.25	523	2.3
50+3	0.39	1.61	2.01	454	4.0
75+0	-	2.03	2.04	399	1.7
75+1	0.28	2.16	2.45	527	2.3
75+2	0.33	2.17	2.51	544	3.3
75+3	0.48	1.89	2.38	539	3.3
100+0	-	2.25	2.25	436	1.0
100+1	0.33	2.03	2.36	513	2.3
100+2	0.45	1.89	2.34	524	3.0
100+3	0.40	2.08	2.50	543	3.3
LSD ($P \leq 0.05$)			*0.39*		*1.4*

** Gross Income calculted with an on farm price of $380/t for canola and $205/t for peas*
*** Erosion risk rating: 1=high risk, 3=moderate risk, 5=low risk*

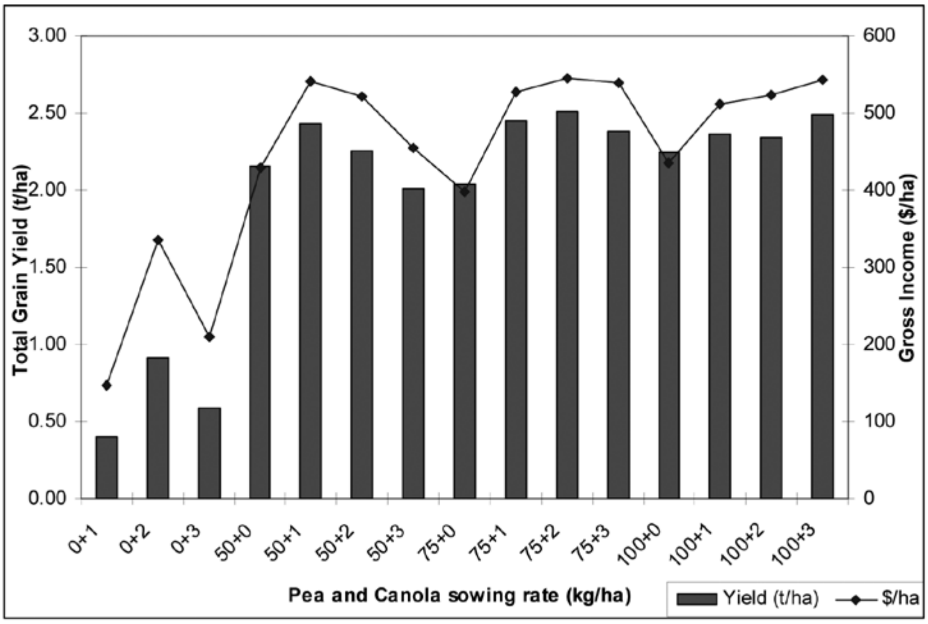

Figure 1 Total grain yield and gross income from peas and canola mixtures
Gross Income calculated with an on farm price of $380/t for canola and $205/t for peas

The profitability of an inter-crop will depend on the prices received for the grain harvested. In 2009 an on farm price of $380/t for canola and $205/t for peas was used for analysis. Although the addition of canola to the field peas did not contribute to higher overall yield, a higher gross income was achieved as the canola was of a higher value than the peas.

Erosion risk in an inter-crop of peas with canola is lower than a monoculture of peas. Growers who have tried inter-cropping peas and canola find the lower erosion risk the most impressive feature of the crop, above any other benefit from harvestability or other agronomic advantage.

It is difficult to assess erosion risk from small plot trials when the harvest residue is not evenly spread across the length of the plots. A more accurate assessment of erosion risk from crop mixtures would be best sought from a larger scale demonstration utilising commercial harvesting equipment with adequate residue spread.

The canola treatments should have had an adequate fertiliser package to ensure potential yields were achieved, however fitting this in the balance of a trial directed towards inter-cropping was a challenge.

Broadleaf herbicide management for peola is not as challenging as it has been in the past. Triazine tolerant canola can be used with Terbyne, which is a group C herbicide which is registered for use in peas and TT canola. The combination of Clearfield canola and field peas will open some group B options, such as Raptor, however Clearfield canola is not on the label and it does not control medics. Using conventional canola with field peas is an option if broadleaf weeds are not likely to be an issue. Group A herbicides can be used in the inter-crop system for grass weed control.

The 2001 trials by Brendan Frischke showed overall yield for inter-cropped peola was reduced compared to a conventional monoculture field pea crop. Using the 2009 harvest prices for peas and canola, greater profitability is found for an inter-crop of peola with reduced overall yield compared to a pea monocrop with higher yield.

nter-cropping does require more careful harvest management to get both crops off the paddock successfully. The harvested crop will need cleaning to separate the canola from the peas, fortunately due the size difference in the two, separation is not difficult.

In terms of reducing the post harvest erosion risk for field peas which is a perennial problem in the low rainfall environment, peola is an excellent concept, which requires more careful management, however still worthy of including in break crop options.

Acknowledgements

Thanks to: Brian Luck of Sipcam for supplying the Terbyne herbicide for the trial. Mark Benn of Canola Breeders Western Australia for supplying Tanami canola seed. Minnipa Ag Centre farm staff for not sowing or spraying through the trial and the Minnipa Progress Association for use of the land. Alan Mayfield for sharing his experience with crop mixtures. Special thanks to Brenton Spriggs and Leigh Davis for technical assistance.

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SOUTH AUSTRALIAN NO-TILL FARMERS ASSOCIATION

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Section Editor:
Annie McNeill
University of Adelaide, Waite

Disease

Understanding the Impact of Soil Mineral Nitrogen on Disease Suppression

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

RESEARCH

Searching for answers

Location: Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 236 mm
2009 Total: 421 mm
2009 GSR: 333 mm
Yield
Potential: 5.2 t/ha (W), 3.6 t/ha (P)
Actual: 4.5 - 5.6 t/ha (86 – 108% of potential yield)
Paddock History
2009: Wheat
2008: Barley
2007: Triticale
Soil
Red sandy loam
Plot size
40 m x 4 reps
Environmental Impacts
Soil Health
Disease levels: See article
Soil Nutrients: High phosphorus, low nitrogen system
Tillage type: Direct drill, stubble retained for 26 years
Economic
Cost of adoption risk: No livestock in system, higher risk cropping

Key messages

- **Vigorous growth in all crops and pasture treatments in 2009 has set up the trial for 2010, when the impact of soil mineral N on disease suppression will be assessed.**
- **At the start of the 2009 season there were already small differences in mineral nitrogen levels in the soil profile, spray topped medic having the highest with 63 kg N/ha and the control wheat the least with 44 kg N/ha.**
- **Since healthy medic will fix around 25 kg N/t DM, the medic spray topped treatment should have fixed around 125 kg N/ha during 2009.**
- **There were slight changes in Rhizoctonia inoculum in some treatments early this season but there were no visual differences in Rhizoctonia patches in the cereal plots in 2009.**

Why do the trial?

This research is the second year of a SAGIT funded project which aims to understand the impact of soil carbon and nitrogen cycling on disease suppression. Disease suppression is a result of increased activity of the soil microbial population reducing the impact of the disease on plant root systems. Rhizoctonia solani (AG-8) is a major disease in our cereal based farming systems. A better understanding of disease suppression offers hope for reducing the impact of this disease in the system.

The development of biological disease suppression in a dry land cereal system was first observed in a rotation trial at Avon, in the lower north of SA. Rhizoctonia caused poor plant growth in 46% of the trial area in 1983, but this declined to negligible levels by 1990. The Avon soil is an alkaline calcareous sandy loam, pH (H_2O) 8.2, organic carbon of 1.6%, total N 0.15%, $CaCO_3$ 8% (Roget, 1995). Mineral nitrogen in the soil is believed to be a 'switch' which turns disease suppressive activity on or off (Roget and Gupta, 2006) with suppressive activity being reduced with increasing mineral N in the surface soil.

Paddock N12 is located on the Minnipa Ag Centre and has been continuously cropped for 26 years and shows a level of disease suppression in both pot bioassays and in the field, although not as great as Avon.

The trial described here is in MAC N12 on the Ag Centre and was designed to see whether typical rotation or nitrogen fertiliser options for upper EP can 'switch' suppression off.

How was it done?

The trial was established in 2008 in MAC N12 to determine the relationships between soil mineral nitrogen, microbial populations and disease suppression. The treatments aimed to increase soil mineral nitrogen and then monitor how this affects disease suppression. The treatments included two nitrogen fertilisers, urea at 60 kg/ha and sulphate of ammonia at 120 kg/ha (split applications; half at seeding and other applied on 27 July), Kaspa peas, medic (with and without grass control or mown to simulate grazing), fallow (no carbon or N input into the system) and wheat, Wyalkatchem @ 60 kg/ha with 50 kg/ha DAP. The trial was sown on 5 May in ideal conditions with 1 L/ha Roundup, 1 L/ha Treflan and 80 ml of Hammer used pre-seeding. The medic plots self generated in early April, and a good stand was established.

Root disease inoculum levels were assessed in March.

What happened?

Initial soil tests were taken to characterise the N12 soil (Table 1). The organic C was low for this soil considering it had not been grazed and all stubbles had been returned to the soil over the last 20 years. Mineral N was relatively low with a total of 61 mg nitrate-N/kg soil in the profile and Colwell P levels were moderate (average 18 mg/kg). The calcium carbonate and boron levels are low until deeper in the profile compared to other local soils which can have higher levels in the top layers of the soil profile.

Rhizoctonia inoculum was below detection for all rotations except the sulphate of ammonia treatment which was low risk. Urea and medic had medium risk. Pratylenchus thornei was present in low levels in all treatments tested. Take all was also detected at low to medium levels in most plots.

Soil moisture at seeding was the same for the control, fallow, peas or medic treatments. Spray topped medic, peas and urea treatments all had higher soil mineral N levels than the control (Table 2).

Table 1 Soil characteristics for MAC N12, February 2008

Soil	Depth (cm)	pH $CaCl_2$	Boron (mg/kg)	Org C (%)	Nitrate N (mg/kg)	Colwell P (mg/kg)	$CaCO_3$ (%)
MAC N12	0 - 10	8.1	1.3	1.1	18	27	0.9
	10 - 20	8.1	1.6	0.8	28	17	1.7
	20 - 40	8.1	2.0	0.6	5	7	9.3
	40 - 60	8.2	2.8	0.4	3	4	14
	60 - 80	8.3	9.0	0.3	3	4	22
	80 - 100	8.3	16.9	0.3	4	4	28

Table 2 Soil profile mineral N (kg N/ha) for selected treatments in MAC N12, February 2009

Treatment	kg N/ha
Wheat - Control	44
Wheat - Sulphate of Ammonia @ 120 kg/ha (split)	51
Wheat - Urea @ 60 kg/ha (split)	59
Fallow	49
Peas	58
Medic spraytopped	83
LSD (P=0.05)	*8*

The trial established and grew well in 2009. There were no visual differences in Rhizoctonia disease between treatments. Harvest dry matter was lower in the control wheat than in wheat after fallow treatment (Table 3). The mown medic treatment, as a simulation of having sheep within the system, produced half the shoot dry matter of the spray topped medic.

The treatments with extra fertiliser nitrogen had better growth, and both yielded higher than the control plots indicating nitrogen was a limiting factor in 2009 (Table 3). Wheat after medic yielded higher than the control but not as good as the wheat after fallow treatment. The added fertiliser nitrogen treatments also had higher grain protein levels than the other plots. All screenings were within the acceptable range.

At head emergence, wheat after medic was more variable in height and vigour than the other treatments. As a consequence, plant roots and soil of wheat after medic, wheat after fallow and wheat after wheat were assessed for presence of root disease inoculum. However, similar levels of pathogen inoculum were found in all sampled treatments. Plant roots had higher levels of Rhizoctonia and Pratylenchus thornei than soil. Wheat after medic showed a high risk of Blackspot of peas due to the fungus Phoma medicaginis being present on the wheat roots. The uneven head emergence in the wheat after medic treatments is possibly due to interactions between microbial population changes and nutritional effects.

What does this mean?

Soil moisture at seeding was similar between the control, fallow, peas or medic plots, possibly due to substantial autumn rainfall. At the start of the 2009 season there were differences in soil mineral nitrogen levels in the selected treatments tested, with the spray topped medic being the greatest with 63 kg N/ha and the wheat control the least with 44 kg N/ha.

Previous research on EP by Damien Adcock showed clay content of the soil was important in mineralisation of N, and he showed that mineralisation was greater in a Minnipa soil with higher clay content than in Rudall or Cungena soils. Work by Damien at Rudall estimated that medic plots fixed 12 kg N/t DM in 1999 and 22 kg N/t DM in 2002; vetch was 13 kg N/t DM and 18 kg N/t DM respectively. Other research indicates medic can fix up to 25 kg N/t DM, therefore in this good season the medic spray topped treatment might have fixed up to 125 kg N/ha.

It is anticipated that large differences in soil mineral nitrogen will influence the soil microbial population and the level of Rhizoctonia next season. This trial will be over-sown with barley next season as barley shows Rhizoctonia patches more obviously than wheat. Next year will involve intensive monitoring of root disease, soil mineral N, nutrition and yield.

Acknowledgements

Thank you to SAGIT for funding this project.

Table 3 Dry matter and yields from MAC N12 Increasing N trial, 2009

Treatment	Seeding Rate (kg/ha)	Dry Matter at Harvest (t/ha)	Yield (t/ha)	Protein (%)	Screenings (%)
Wheat - Control	60	10.9	4.5	9.4	4.7
Wheat - Sulphate of Ammonia @ 120 kg/ha (split)	60	12.6	5.4	10.0	3.5
Wheat - Urea @ 60 kg/ha	60	12.2	5.6	10.1	4.6
Wheat after medic	60	11.1	4.8	9.3	4.8
Wheat after fallow	60	13.7	5.2	9.6	4.2
Peas	100	12.0	2.8		
Medic spray topped	10	5.2			
Medic with grass	10	4.9			
Medic mown	10	1.9			
LSD (P=0.05)		*2.5*	*0.5*	*0.6*	*ns*

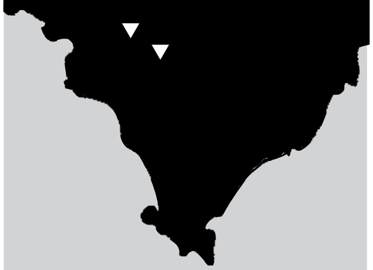
Investigating the Impact of Carbon Inputs on Disease Suppression

RESEARCH

Amanda Cook, Nigel Wilhelm and Wade Shepperd

SARDI, Minnipa Agricultural Centre

Searching for answers



Location: Poochera
I & J Gosling

Rainfall
Av. Annual: 324 mm
Av. GSR: 245 mm
2009 Total: 418 mm
2009 GSR: 336 mm

Yield
Potential: 5.4 t/ha (W)
Actual: 2.9 t/ha (W)

Paddock History
2009: Pasture/trial treatments
2008: Wheat/trial treatments
2007: Oats

Soil
Grey calcareous loam

Plot size
40 m x 4 reps

Location: Minnipa
B and K Heddle

Rainfall
Av. Annual: 325 mm
Av. GSR: 236 mm
2009 Total: 421mm
2009 GSR: 333 mm

Yield
Potential: 5.2 t/ha (W)
Actual: 3.9 t/ha (W)

Paddock History
2009: Wheat
2008: Wheat
2007: Medic

Soil
Brown calcareous sandy loam

Plot size
40 m x 4 reps

Key messages

- **Differences in C input (dry matter production plus any additions) between the treatments were 24 t/ha at Minnipa, and 31 t/ha at Poochera over the last two seasons.**
- **Wheat at Minnipa produced between 0.5 t/ha of stubble in a poor season (2008) and 8.8 t/ha in a good season (2009).**
- **Doubling the seeding rate of wheat at Minnipa produced 1.4 t/ha extra stubble compared to the wheat control in 2009.**
- **Barley and vetch brown manures produced the lowest dry matter at both sites.**

Why do the trial?

This research is the second year of a SAGIT funded project which aims to understand the impact of soil carbon and nitrogen cycling on disease suppression. The 2009 season again showed the impact of Rhizoctonia within our farming systems, with late sown crops having significant yield losses to the disease.

Trials have been established on two calcareous soils to see if disease suppression can be stimulated by increasing carbon inputs into farming systems under local conditions. The dynamics of disease suppression to Rhizoctonia is not fully understood but increased microbial activity and increased competition with Rhizoctonia is an important factor. Vibrant microbial populations need lots of carbon (as a food source) for maintenance and growth in the soil.

The impact of different amounts of carbon inputs over two years will be assessed on rhizoctonia infection in barley in year 3 (2010).

How was it done?

Identical trials were established on a grey calcareous soil at Poochera and a red calcareous soil at Minnipa, to manipulate carbon input into soil with different crops and management practices. Treatments were: extra cereal stubble added as chaff (5 or 10 t/ha); wheat, barley or canola at high seeding rates with fluid fertiliser (to encourage high dry matter production) and wheat, Wyalkatchem @ 60 kg/ha with DAP @ 60 kg/ha as a control. The fluid fertiliser used was APP and UAN at the same nutrient rate as granular (12 kg P/ha and 10 kg N/ha). Barley and vetch was included as a brown manure treatment sprayed out at late tillering. Zinc was drilled below the seed on all treatments except the fallow as a fluid at 1 kg Zn/ha.

The stubble treatment was added to the soil surface a month before seeding. The Minnipa trial was sown on 5 May in 2009 under ideal conditions and the Poochera trial was sown on 6 May into reasonable moisture. Trials were started in 2008 with identical treatments applied to the same plots in 2009.

In 2010, each trial will be seeded with barley and the impact of the prior carbon inputs on Rhizoctonia assessed.

What happened?

The trial sites were chosen for high Rhizoctonia disease levels and low production. Initial soil tests were taken to characterise the soils at each site (Table 1). Soil pH down the profile is similar for both soils. The Minnipa site has higher boron at a depth of 20-40 cm compared to Poochera. Organic carbon levels at the sites are typical for the upper EP; being relatively low in the surface profile and decreasing with depth. The Poochera site had a much higher level of nitrate-N throughout the profile (total of nearly 400 kg N/ha compared to Minnipa at 180 kg N/ha). Soil Colwell P levels were only moderate for the highly calcareous soils at Minnipa and Poochera. These sites have high levels of calcium carbonate (free lime) throughout the profile.

Soil water contents were the same for all treatments before seeding and at harvest. There was no difference in total soil profile nitrate N sampled in March (range was 59 to 74 kg N/ha at Minnipa and 72 to 88 kg N/ha at Poochera), although the distribution was more even down the profile at Poochera and mostly in the top 20 cm at Minnipa. The barley treatments at both sites showed higher levels of Rhizoctonia patches early in the season.

Early dry matter production at the Poochera site was highest with the 10 t/ha added stubble treatment having greater growth (0.96 t/ha) than the control treatments (0.57 t/ha), despite no differences in soil moisture before seeding, This difference in growth was carried through to late DM and resulted in a higher grain yield (Table 2).

The Minnipa site produced greater total dry matter in 2009 than Poochera, the opposite of 2008 (Table 2 and Table 3). This has resulted in overall amounts of total dry matter production over the two seasons being similar for the various treatments at both sites. The difference in dry matter production and addition between the greatest (added 10t/ha stubble) and least (barley vetch brown manure) of the treatments over the two seasons was 24 t/ha at Minnipa, and 31 t/ha at Poochera. The added stubble treatments at Poochera have 25 t/ha extra dry matter input than the control wheat plots, and 23 t/ha at Minnipa.

There were no differences in grain yield at Minnipa, possibly due to the exceptional season. Grain quality was acceptable at both sites except for a high level of screenings in the high seeding rate barley treatment. Grain protein levels were low which would be expected in a good season due to a dilution of the grain protein level as extra carbohydrates are accumulated in the seed.

Wheat sown at 60 kg/ha at Minnipa produced 0.5 t/ha total dry matter in a poor season (2008) and 8.8 t/ha in a good season (2009), while Poochera produced 2.3 t/ha and 6.9 t/ha in 2008 and 2009 respectively. The barley and vetch brown manure, sprayed out at late tillering provided the lowest dry matter input at both sites. Doubling the seeding rate of wheat at the Minnipa site produced an extra 1.4 t/ha total dry matter than the control wheat treatment in 2009.

We are only measuring the dry matter accumulation and input above the ground, as it is much easier to measure, but plant roots are also contributing additional carbon to the soil pool (possibly another third).

Table 1 Soil characteristics at Minnipa and Poochera trial sites, February 2008

Soil	Depth (cm)	pH $CaCl_2$	Boron (mg/kg)	Org C (%)	Nitrate N (mg/kg)	P (mg/kg)	$CaCO_3$ (%)
Minnipa	0 - 10	8	2.7	1.3	43	24	29
	10 - 20	8	5.5	0.9	44	8	32
	20 - 40	8.1	18.8	0.7	13	5	41
	40 - 60	8.3	18.5	0.6	7	2	55
	60 - 80	8.2	19.2	1.1	5	4	57
	80 - 100	8.1	21.2	0.4	4	4	55
Poochera	0 - 10	7.9	1.4	1.2	29	25	49
	10 - 20	7.9	2.3	1.2	22	10	52
	20 - 40	8.1	2.4	0.6	40	6	48
	40 - 60	8.3	4.7	0.5	39	3	46
	60 - 80	8.8	6.9	0.4	22	3	50
	80 - 100	8.7	6.5	0.4	17	3	53

Table 2 Dry matter and yield results from Poochera

Treatment	Seeding Rate (kg/ha)	Dry Matter at pre-harvest 2009 (t/ha)	Total Dry Matter accumulated 08 and 09 (t/ha)	Yield (t/ha)	Protein (%)	Screenings (%)
Barley DM*	120	8.80	10.77	2.61	11.93	5.14
Barley & Vetch	50 + 15	1.53	3.24	-	-	-
Control wheat	60	6.99	9.32	2.30	10.24	3.26
Canola*	10	3.70	6.40	**	-	-
Wheat DM*	120	7.88	10.77	2.47	10.33	2.97
Stubble 5t	60	8.07 (+5)	20.15	2.57	10.11	4.19
Stubble 10t	60	8.13 (+10)	34.38	2.90	10.10	4.03
LSD (P=0.05)		*1.12*	*2.18*	*0.21*	*0.19*	*1.19*

**Fluid fertiliser treatments and these treatments accidentally received double fertiliser rates in 2008*
*** Accidentally but selectively grazed by 4 fat lambs over 3 days*

Table 3 Dry matter and yield results from MInnipa

Treatment	Seeding Rate (kg/ha)	Dry Matter at harvest 2009 (t/ha)	Total Dry Matter accumulated 08 and 09 (t/ha)	Yield (t/ha)	Protein (%)	Screenings (%)
Barley DM*	120	10.49	9.25	3.54	12.32	12.19
Barley & Vetch	50 + 15	1.89	8.93	-	-	-
Control wheat	60	8.78	9.30	3.57	9.98	3.77
Canola*	10	5.62	9.31	1.13	-	-
Wheat DM*	120	10.21	8.37	3.86	10.23	3.33
Stubble 5t	60	9.01 (+5)	17.91	3.83	10.09	4.03
Stubble 10t	60	8.90 (+10)	32.81	3.65	10.30	4.31
LSD (P=0.05)		*0.60*	*2.18*	*1.49*	*0.80*	*4.30*

**Fluid fertiliser treatments*

What does this mean?

A great season at Minnipa in 2009 has resulted in similar total dry matter production being achieved at both sites over the two years. The treatments have produced different amounts of carbon inputs to the soil which will provide a range of levels of food sources for soil microbes.

Next year all treatments will be sown to barley, the crop which shows the most obvious visual symptoms of Rhizoctonia. Further monitoring of soil carbon and nitrogen, microbial activity and changes in Rhizoctonia inoculum and infection levels will give us a better understanding of the soil biology in our low rainfall farming systems, and whether it is possible to increase the microbial populations. In turn, the impact of these changed populations on Rhizoctonia will be assessed.

Both trials are now in very good shape to test the impact of organic matter inputs from two growing seasons on rhizoctonia in 2010.

Acknowledgements

Thank you to SAGIT for funding this project. Thanks to Goslings and Heddles for allowing us to have trials on their property.

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SAGIT

Better Prediction and Management of Rhizoctonia Disease in Cereals

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Searching for answers

Location: Streaky Bay
B Goosay
Streaky Bay Ag Bureau

Rainfall
Av. Annual: 340 mm
Av. GSR: 274 mm
2009 Total: 311 mm
2009 GSR: 275 mm

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

Paddock history
2007: Barley
2006: Wheat
2005: Pasture

Soil
Highly calcareous grey loamy sand

Plot size
60 m x 1.48 m

Other factors
Early moisture stress, strong winds, polyphrades.

Key messages

- **Rhizoctonia solani AG8 inoculum levels were reduced over summer and this may be associated with summer rainfall events.**
- **Crop rotation does affect Rhizoctonia inoculum levels i.e. levels were lowest immediately after canola compared to that after wheat.**
- **The incidence and severity of Rhizoctonia bare patch disease in cereals depend on the amount of pathogen inoculum, soil microbial community activity and crop/root vigour.**
- **Seed treatments did not reduce rhizoctonia levels in 2009 trials undertaken on EP and the Mallee.**
- **To reduce risk of yield loss caused by Rhizoctonia:**
  1. **Control summer weeds to stop build-up of inoculum,**
  2. **Encourage early seedling vigour, sow early,**
  3. **Cultivate deep sow shallow (avoid disc seeders).**
- **Canola can help reduce inoculum for the following wheat crop.**
- **Barley and wheat are the most intolerant crops.**
- **Minimise N deficiency at seeding, particularly for cereal on cereal rotations where summer rainfall has been low, by deep banding N and minimising stubble incorporation at seeding.**

Why do the trial?

Rhizoctonia continues to be an important but unpredictable disease in the southern agricultural region, especially in the Eyre Peninsula soils. This is the second year of a national project funded by GRDC to improve the long term control of Rhizoctonia by increasing the understanding of the interactions between disease inoculum and natural soil suppressive activity and to improve the prediction and management of disease. As part of the project a three year trial was established at Streaky Bay in 2008. Disease inoculum levels were also monitored over the 2008/09 summer in four EP paddocks.

How was it done?

Rhizoctonia disease control and inoculum levels are being compared with three different tillage systems; conventional cultivation (1 April - wide sweeps; 30 April - narrow points), strategic cultivation (12 May - narrow points), no-till and several rotations. The trial was sown on 22 May into reasonable moisture but strong winds followed.

Correll wheat was sown at 70 kg/ha with DAP @ 60 kg/ha and Urea @ 35 kg/ha. Cobbler canola was sown @ 5 kg/ha with MAP @ 150kg/ha and Urea @ 70 kg/ha (resown at 7 kg/ha with no fertiliser). Herald medic was sown @ 2.5 kg/ha ha with MAP at 35 kg/ha. Both the canola and medic had poor establishment for the second season due to strong winds and the plots were resown on June 25. The trial area received 1.5 L/ha of Sprayseed and 1.5 L/ha of Treflan pre seeding, 1.5 L/ha of Lorsban post sowing and 500 ml/ha of Astound and 400 g/ha of Achieve later in the season. The canola plots also received 1.5 L/ha of Atrazine and 200 ml of Lontrel.

Sampling included soil characterisation, soil moisture, pathogen DNA levels, root disease infection, dry matter, soil microbial populations and grain yield.

Paddock monitoring was also undertaken at different times over the 2008/09 summer in four EP paddocks, on a heavy red soil, a red sandy soil and two grey calcareous soils.

Similar data was also collected at other southern Australian sites to determine changes in Rhizoctonia inoculum levels during non-cropping period.

What happened?

The 2009 trial results show that the previous rotation does affect Rhizoctonia inoculum levels (Figure 1). Levels were lowest immediately after canola, medic pasture and fallow, and the highest following wheat. These differences in Rhizoctonia inoculum were correlated with amount of disease in the following wheat crop (Figure 2) although soil nutrition differences contributed to differences in grain yield.

The reduced inoculum levels following canola, medic pasture and fallow were associated with increased yield (Figure 3). Cultivation prior to sowing reduced inoculum levels, but the level in the trials was still high. Inoculum levels are reduced by summer rainfall in weed free plots, but increases as the soil dries out. The results from the farmer paddocks which were monitored in the 08/09 summer also reflected similar results as a reduction in inoculum over summer after rainfall events was also observed.

Seedling assessments revealed minor rhizoctonia damage to the seminal roots, however the crown roots were often severely affected (Figure 2). This is probably due to the seminal roots escaping the disease by rapidly growing through warm soil while the crown roots emerged into cold soil with re-establishment of the rhizoctonia hyphal network following soil disturbance at seeding.

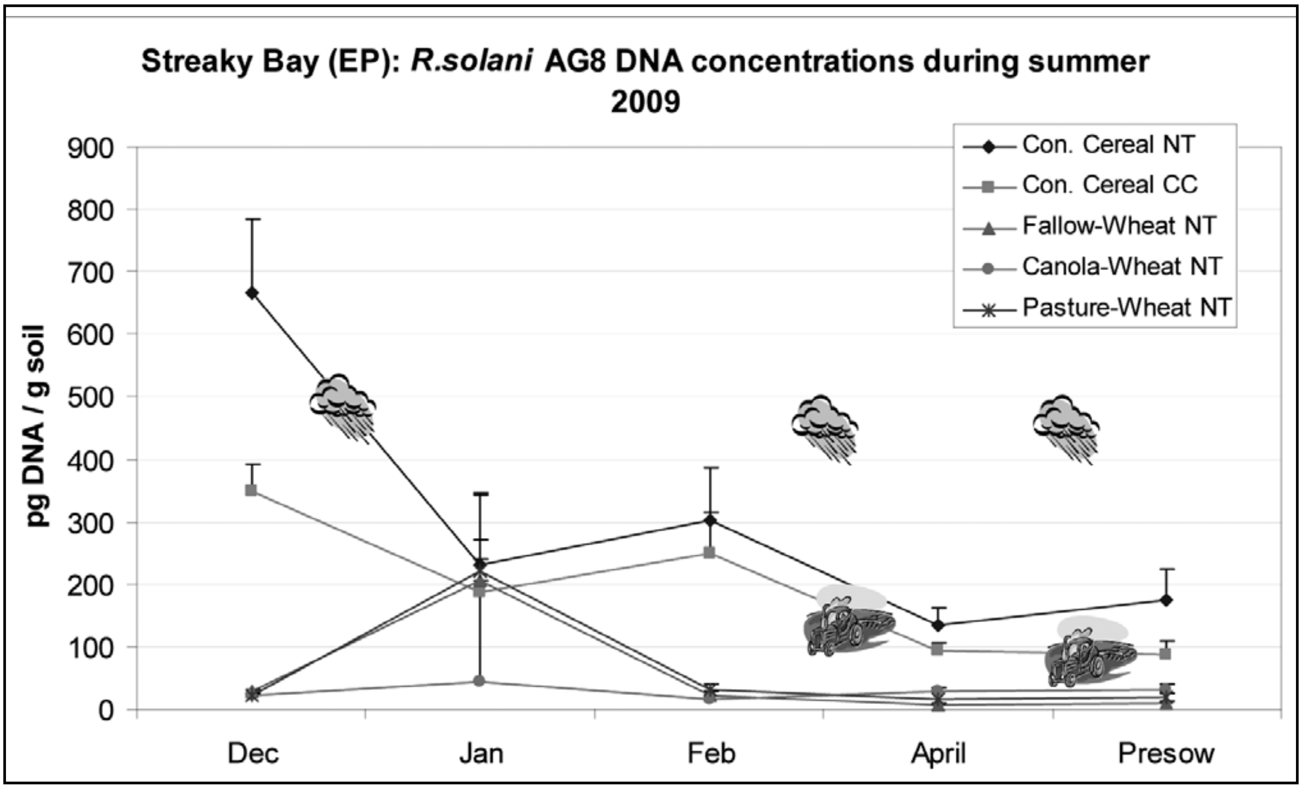

***Figure 1** Changes in the amount of Rhizoctonia solani AG8 DNA in the surface soil under different rotation and tillage treatments during summer of 2009 at Streaky Bay*

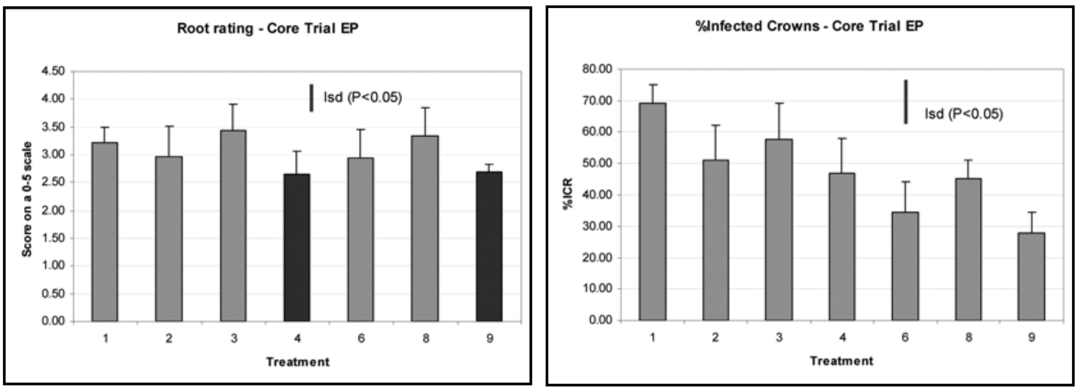

***Figure 2** Rhizoctonia disease rating on wheat roots during 2009 (Selected treatments are; 1 - Cereal NT, 2 - Cereal Cult, 3 - Cereal Strategic Cult, 4 - Fallow/Wheat, 6 - Canola/Wheat, 8 - Pasture/Wheat NT, 9 - Pasture/Wheat Cult). Root rating was done on a 0-5 scale; 0 = no infection and 5 = high infection. % infected crowns represent % of crown roots infected with Rhizoctonia.*

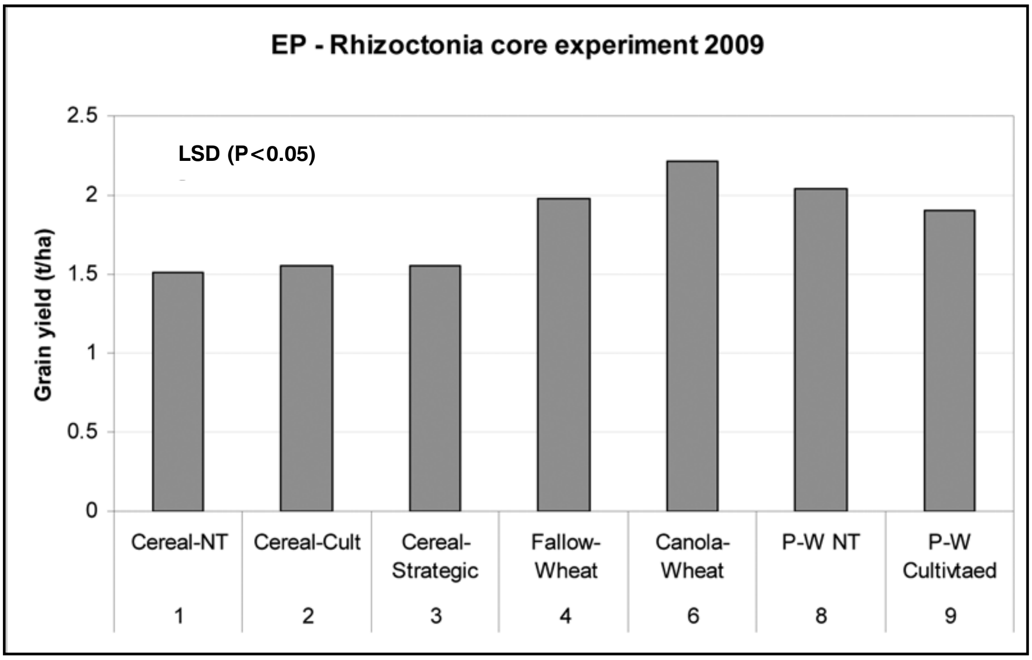

Figure 3 ***Wheat grain yields in 2009 as influenced by rotation and tillage treatments***

Seed treatments

In trials to evaluate seed treatments on Eyre Peninsula and in the Murray Mallee, we were not able to show either a significant reduction in Rhizoctonia damage or an increase in yield of wheat or barley.

What does this mean?

The risk of yield loss caused by Rhizoctonia can be reduced by controlling summer weeds to stop build-up of inoculum, encouraging early seedling vigour by sowing early and using quality seed with good nutrition.

In paddocks with high risk of Rhizocontia cultivate deep and sow shallow (avoid disc seeders), canola can help reduce inoculum for the following wheat crop so may be used in problem paddocks. Barley and wheat are the most intolerant crops to Rhizoctonia. Minimise nitrogen deficiency at seeding, particularly for cereal on cereal rotations where summer rainfall has been low, by deep banding N and minimising stubble incorporation at seeding, as it will tie up available nitrogen. No seed treatments reduced Rhizoctonia levels in trials in 2009.

Acknowledgements

Thank you to GRDC for funding this project. Thanks to the Williams and Goosay families for allowing us to have trials on their property.

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Long Term Disease Suppression Trial at Streaky Bay

Amanda Cook[1], Vadakattu Gupta[2], Nigel Wilhelm[1] and Wade Shepperd[1]

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

RESEARCH

Searching for answers

Location: Streaky Bay
K, D and K Williams
Streaky Bay Ag Bureau

Rainfall
Av. Annual: 298 mm
Av. GSR: 243 mm
2009 Total: 356 mm
2009 GSR: 323 mm

Yield
Potential wheat: 4.4 t/ha
Actual: 2.7 - 4.9 t/ha

Paddock History
See Table 1

Soil
Highly calcareous grey loamy sand

Plot size
60 m x 1.48 m

Other factors
Disease
Rhizoctonia
Livestock
Trial has not been grazed since established in 2004
Economic
Cost of adoption risk: No income from livestock enterprise

Key messages

- **The higher input brassica break system had higher cereal yields than the other systems in 2009.**
- **Rhizoctonia inoculum levels were higher under the continuous cropping systems compared to the medic pasture and brassica break crops.**
- **The different rotations and fertiliser systems have resulted in differences in the microbial community (number) and microbial diversity (their ability to use different sources of carbon).**
- **Disease suppression is still the same in all rotations.**

Why do the trial?

This long term trial was established at Streaky Bay in 2004 to determine if disease suppression against rhizoctonia is achievable in a grey highly calcareous soil using alternative rotational systems and crop inputs in an upper EP environment and if soil microbial populations can be influenced by rotation and fertiliser inputs.

How was it done?

This trial was established in 2004 with the fertiliser treatments and rotations listed in Table 1. In the 2009 season all treatments were sown with Wyalkatchem wheat at 60 kg/ha on 22 May with different fertiliser treatments. The trial received 1.5 L/ha each of Roundup and Sprayseed pre-seeding, and 400 g/ha Achieve (for ryegrass and barley grass control) and 250 ml Lontrel during the season.

Soil was collected in March for RDT (Root Disease Testing) and soil mineral N levels. Soil samples were also collected for the disease suppression bioassay and a sample also sent to CSIRO to measure the functional diversity of the microbial community using carbon substrate utilisation. A soil sample containing soil microbes is added to an assay with 31 different types of carbon. The amount of CO_2 released and the type of carbon used is measured as the microbes break down the carbon substrates. The catabolic potential or the amount of carbon the microbes can use, and the catabolic diversity or the ability of the microbes to use different types of carbon substrates, is measured.

Plants were collected at 6 weeks to score plant roots for Rhizoctonia and early dry matter. Late dry matter cuts were taken before harvest, and grain yield and quality were assessed.

What happened?

District Practice treatments in 2008 had very poor medic growth, almost a fallow, due to poor establishment and strong winds, and possibly due to Midas residues still being present from 2007. This may have resulted in increased soil moisture under these treatments.

The risk in all treatments was low for all diseases except Rhizoctonia. At the start of 2009 district practice and brassica breaks had low to medium risk of Rhizoctonia. Both continuous cereal treatments had a high risk of disease. Rhizoctonia disease on plant roots was substantial but similar for all treatments on seminal roots. Infection on crown roots was much lower than on seminals but highest in high input continuous cereal (Table 2).

Early plant growth was greater in the high input brassica break system resulting in the highest yield. There was no difference in yield this season between the district practice, which was almost a fallow with a little medic, and the district practice brassica break.

Table 1 Rotations and treatments used in the Long Term Disease Suppression trial

Rotation	Fertiliser each season	2004	2005	2006	2007	2008	2009
District Practice	14kg P/ha and 16 kg N/ha applied as DAP @ 60 kg/ha	Excalibur Wheat @ 55 kg/ha	Keel Barley @ 60 kg/ ha	Angel Medic @ 5 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	Herald Medic @ 5 kg/ha	Wyalkatchem Wheat @ 60 kg/ha
Intensive Cereal - District Practice Inputs	14kg P/ha and 16 kg N/ha applied as DAP @ 60 kg/ha	Excalibur Wheat @ 55 kg/ha	Keel Barley @ 60 kg/ha	Angel Medic @ 5 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	Herald Medic @ 60 kg/ha	Wyalkatchem Wheat @ 60 kg/ha
Intensive Cereal - High Inputs as fluids	20 kg P/ha applied as APP, 18 kg N/ha as UAN and TE (Zn, Mn, Cu)	Excalibur Wheat @ 55 kg/ha	Keel Barley @ 60 kg/ha	Ticket Triticale @ 60 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	Clearfield Janz Wheat @ 60 kg/ha	Wyalkatchem Wheat @ 60 kg/ha
Brassica Break - District Practice inputs	16 kg P/ha applied as MAP @ 60 kg/ha	Rivette Canola @ 5 kg/ha	Keel Barley @ 60 kg/ha	Stubby Canola @ 5 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	44C73 Canola @ 5 kg/ha	Wyalkatchen Wheat @ 60 kg/ha
Brassica Break - High Inputs as fluids	20 kg P/ha applied as APP, 18 kg N/ha as UAN and TE (Zn, Mn, Cu)	Rivette Canola @ 5 kg/ha	Keel Barley @ 60 kg/ha	Stubby Canola @ 5 kg/ha	Clearfield Stiletto Wheat @ 60 kg/ha	44C73 Canola @ 5 kg/ha	Wyalkatchem Wheat @ 60 kg/ha

This result is similar to trials at Miltaburra where growing a brassica and fallow treatment resulted in similar yields of barley the following season despite increased soil moisture under the fallow plots (EPFS 2008 Summary, p 122).

The high input system uses APP as the base of the fluid fertiliser which has increased the cost of this system significantly. The continuous cereal district practice system had the lowest yield. Grain protein was higher at this site than in other areas, but the high levels of screenings indicate the hot week in November may have impacted on grain filling.

Microbial communities depend on carbon input from roots and stubble, and the breakdown of these influence plant available nutrients. The soils from the treatments were tested for microbial catabolic potential and diversity. Figure 1 shows the catabolic potential of the different treatments and both the higher input fluid fertiliser systems show greater catabolic potential meaning the microbes under these systems can use more carbon or have greater microbial activity.

Figure 2 shows the catabolic diversity of the treatments or the ability of the microbes to utilise a variety of carbon substrates. The treatments which are closer together show greater similarity in microbial communities, compared to treatments which are further away indicating greater diversity. The microbial community diversity under high input treatments is different from the district practice treatments and brassica high input system has a different grouping of microbes again.

Soils from the rotation and fertiliser treatments were assessed for potential disease suppression in 2006 and 2009 using the pot bioassay. Disease suppression in the pot bioassay is still the same in all rotations.

Table 2 Soil, disease and quality data collected from the Long Term Disease Suppression trial, 2009

Rotation	Rhizo RDT level pg DNA/g soil	Rhizo Infection of Seminal roots	Rhizo Infection of Crown roots	Soil N kg N/ha (0-120 cm)	Early DM (g/plant)	Late DM (t/ha)	Harvest Index	Protein	Screen-ings (%)	Test wgt (g/hL)
District Practice	36 (Low risk)	1.78	0.49	65.6	0.26	8.9	0.49	10.5	8.6	84.7
Intensive Cereal District Practice Inputs	319 (High risk)	1.31	0.47	51.3	0.19	7.5	0.43	11.3	12.7	82.9
Intensive Cereal High Inputs	418 (High risk)	2.02	0.56	49.4	0.29	10.0	0.52	11.1	11.3	84.1
Brassica Break District Practice Inputs	12.5 (Low risk)	1.35	0.44	70.2	0.25	9.8	0.51	11.0	6.9	83.8
Brassica Break High Inputs	65 (Medium risk)	1.31	0.47	67.6	0.38	9.9	0.55	11.0	7.1	84.5
LSD (P=0.05)		*ns*	*0.06*	*ns*	*0.09*	*ns*	*ns*	*0.3*	*4.6*	*ns*

Table 3 Historic yields for the trial and yield, input costs and fertiliser margins of rotations in 2009

Rotation	2005 Yield (t/ha)	2006 Yield (t/ha)	2007 Yield (t/ha)	2008 Yield (t/ha)	2009 Yield (t/ha)	2009 Input Costs ($/ha)	2009 GM ($/ha)	Overall GM ($/ha)
District Practice	0.88 All Keel Barley	*not harveted* Angel Medic	0.65 All Cleafield Stilleto Wheat	*Not Harvested* Herald Medic	3.95 All Wyalkatchem Wheat	142	739	597
Intensive Cereal District Practice Inputs	0.81	0.23 Ticket Triticale	0.77	1.39 Clearfield Janz	2.74	142	512	370
Intensive Cereal High Inputs	1.16	0.42 Ticket Triticale	0.73	1.61 Clearfield Janz	4.06	410	410	349
Brassica Break District Practice Inputs	2.08	0.03 ART - Stubby Canola	0.77	0.43 44C73 Canola	3.88	142	726	584
Brassica Break High Inputs	2.43	0.05 ART - Stubby Canola	0.64	0.57 44C73 Canola	4.93	410	922	512
LSD(P=0.05)	*0.16*	*0.03*	*ns*	*0.11*	*0.30*			

GM calculated using prices - Wheat $140/t and Canola $302/t for 2004, Barley $126/t for Feed 1 in 2005, Triticale $220/t and Canola $480/t for 2006, AH $377/t for 2007, Wheat $276/t and Canola $520 for 2008 delivered to Port Lincoln (less $30/t freight), 2009 Wheat $217/t delivered to Port Lincoln (less $22/t freight). Cost taken from Rural Solutions 2009 Farm Gross Margin guide. No income estimated for the pasture phases.

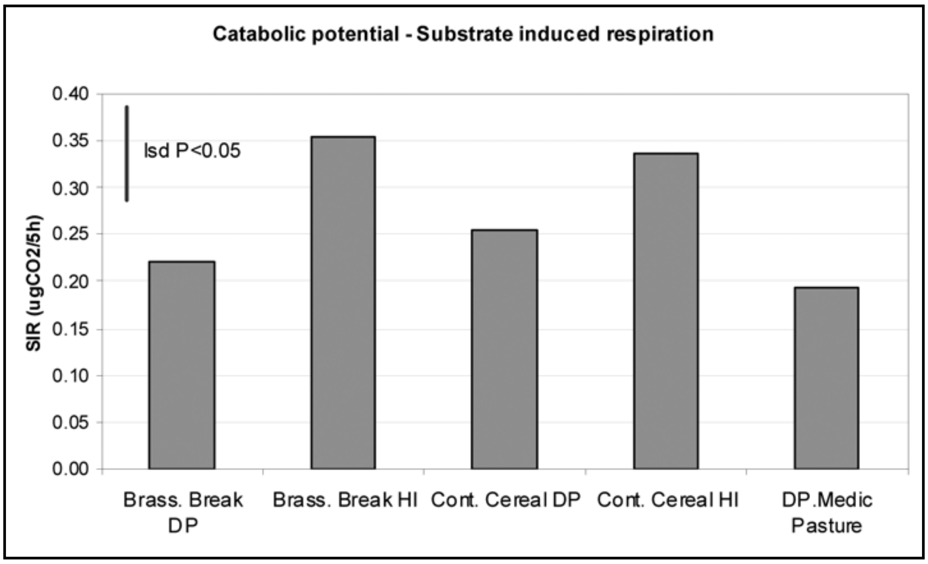

Figure 1 Catabolic potential of the rotation and fertiliser treatments of the Long Term Disease Suppression trial at Streaky Bay, 2009

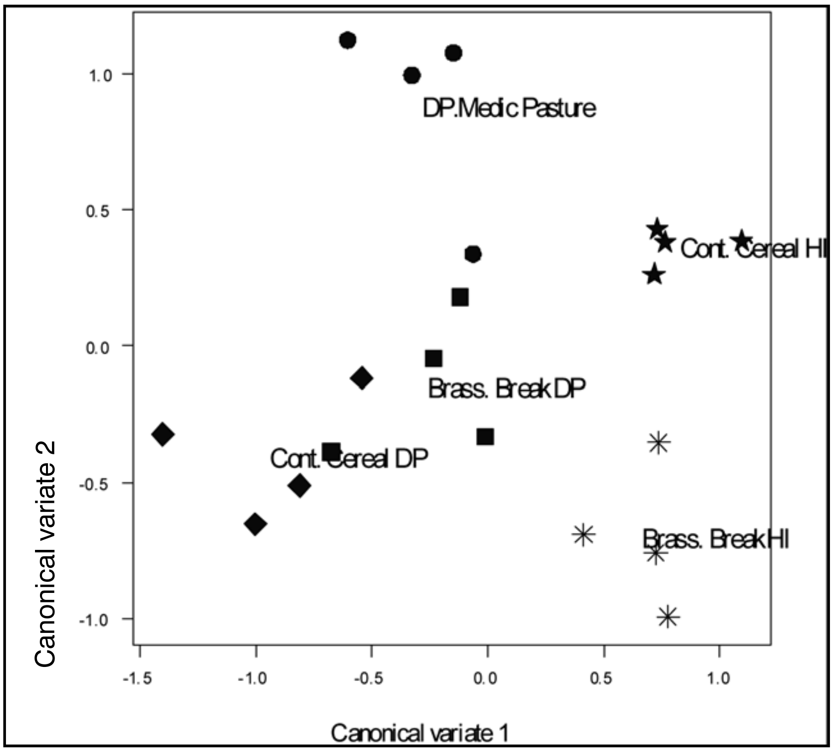

Figure 2 Catabolic diversity of the rotation and fertiliser treatments of the Long Term Disease Suppression trial at Streaky Bay, 2009

What does this mean?

The higher input brassica break system yielded higher than the other rotations this season, and the Rhizoctonia inoculum levels were lower under the brassica break and medic/fallow phase compared to the continuous cropped systems. These results are similar to the Miltaburra brassica trials which showed we can decrease Rhizoctonia inoculum levels for one season using a grass free canola crop or a chemical fallow.

The different rotations and fertiliser systems have resulted in differences in microbial community (number) and microbial diversity (ability to use different sources of carbon) but the level of disease suppression measured using the pot bioassay has not increased.

The high input system uses APP as the base of the fluid fertiliser which has significantly increased the cost of this system. A similar result may be achieved using phosphoric acid at a much lower cost, or increasing the rate of fertiliser we are using in our current farming systems. The continuous cereal district practice system has the lowest yield indicating that our fertiliser management was inadequate to exploit a very good season at this site.

Acknowledgements

Thank you to SAGIT for funding this project. Thanks to Agrichem for suppling some fluid fertiliser products used in the trial. Thanks to the Williams family for allowing us to have trials on their property.

Disease

Is Carbon on the 'Menu' for Microbes in EP soils & Will it Help to Suppress Rhizoctonia Root Rot?

Sjaan Davey[1], Annie McNeill[1], Steve Barnett[2] and Vadakattu Gupta[3]
[1]University of Adelaide, Waite, [2]SARDI, Waite, [3]CSIRO, Waite

Searching for answers

Location:
Kimba, Mount Damper, Port Kenny

Key messages

- **Recent carbon inputs positively influence the ability of a soil to suppress Rhizoctonia.**
- **Adding carbon as stubble or roots to Eyre Peninsula soils reduced infection of wheat seedling roots by Rhizoctonia solani AG-8.**
- **DNA of potentially suppressive microbes tended to increase in the soil after stubble or root addition and the effect was often greater from roots.**

Why do the trial?

Soil organic carbon is considered one of the main drivers of biological disease suppression by providing food or energy that allows an increase in microbes that can suppress disease. Low soil organic carbon for many Eyre Peninsula soils could be an issue for management of disease suppression. Key carbon inputs in farming systems are stubbles and roots. They contribute different types of carbon to soil but there is little information about how these influence disease suppression. Research at SARDI and other places has identified specific microbes that appear to be important in soils suppressive to rhizoctonia, although it is not known how widely these microbes occur in Eyre Peninsula soils.

So, a pot experiment was done to:

- test whether addition of carbon to soil as stubbles or roots suppressed rhizoctonia severity in a following cereal,
- investigate whether the effect of stubbles carbon was similar or different to root carbon, and
- measure the presence of specific suppressive microbes.

How was it done?

Three soils were collected from farm paddocks on upper EP; a slightly calcareous dark reddish brown loam fine sand from near Kimba (2% organic carbon), a non calcareous clay loam from Mount Damper (1.4% organic carbon) and a calcareous grey-brown loam from Port Kenny (2.6% organic carbon). Two types of carbon inputs (either wheat roots or wheat stubble) were added to these three soils, either at rates equivalent to 6 tonnes dry matter per hectare, and another set of soils had no addition of carbon. The soils were incubated under moist conditions for six months. After this a sub-sample of soil from each treatment was taken for extraction and quantification of DNA from three soil organisms potentially involved with suppression (Pantoea agglomerans, Microbacterium and Trichoderma Group A). The soils were then used for a pot bioassay to measure disease severity on wheat seedlings after inoculation and incubation with the pathogen Rhizoctonia solani AG-8.

What happened?

Addition of carbon as roots or stubble to the three soils did suppress rhizoctonia infection in roots of wheat seedlings (see Figure 1). Percent root infection ranged from 60-85% in the soils with no carbon inputs to 36-57% where carbon had recently been added. Stubble addition seemed to suppress rhizoctonia more than roots in the soils from Mount Damper and Kimba but it was the opposite for Port Kenny soil with less rhizoctonia infection after addition of roots than stubble.

Potentially suppressive microbes (measured as DNA) often increased when carbon was added but not always, the effects depending on the specific microbe and the soil. Microbacterium increased in all three soils where roots had been added, Pantoea agglomerans increased where roots or stubble were added but only in the soil from Kimba and Mount Damper. Trichoderma Group A appeared less sensitive to carbon input and only increased in the Kimba soil with addition of roots. The most calcareous soil was Port Kenny, this had very small amounts of Trichoderma compared to the other two soils and Pantoea was low also.

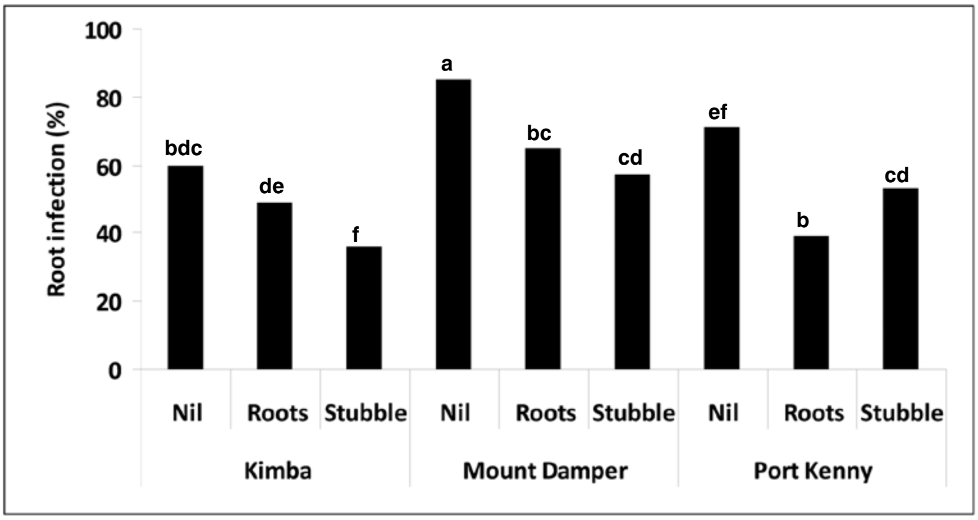

Figure 1 Rhizoctonia infection (%) for roots of young wheat plants grown in three Eyre Peninsula soils without carbon input (nil) or after addition of carbon as roots or stubble. Bars within each soil with different letters above them indicate significant difference.

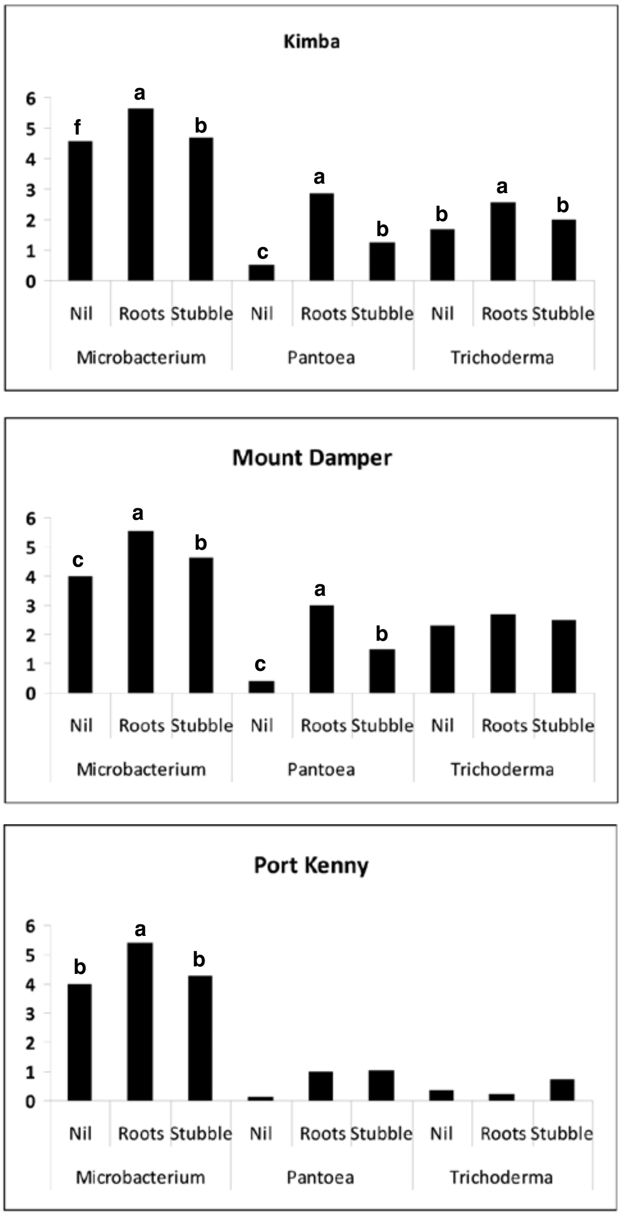

Figure 2 DNA amounts for three potentially suppressive organisms in Kimba, Mount Damper and Port Kenny soil either without carbon input or after addition of carbon as stubble or roots. Bars within each group of three with different letters above them indicate significant difference

What does this mean?

Overall the work demonstrates that carbon from stubbles and roots is an important input for increasing the potential for suppression of rhizoctonia in these Eyre Peninsula soils. The results also show that specific microbes generally thought to contribute to suppression of rhizoctonia are encouraged to increase when carbon is on the menu and that roots seem to be more 'tasty' to the microbes. The rates of dry matter and amounts of carbon added in this laboratory experiment were larger than achieved in an average season on the EP and so the effects may not be as marked under field conditions, but the importance of retaining inputs is clear.

Acknowledgements

Thank you to GRDC for funding this project and the growers for allowing us access to paddocks for sampling. Also Amanda Cook for the use of her data to select soils, Wade Sheppard for collecting soil, Simon Anstis for the Rhizoctonia inoculum.

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Cereal Leaf Disease Update SA 2009

EXTENSION

Hugh Wallwork
SARDI, Waite

Variation in net form net blotch (NFNB)

Variation in NFNB is on the increase and making resistance ratings for varieties more complicated. After the demise of Skiff in 1999 only low levels of the disease were observed in barley crops, mainly on Barque on the lower Yorke Peninsula, and apparently only one pathotype was present. At the end of 2009 we have identified at least 5 strains with quite different patterns of virulence based on adult plant testing although two of these were most probably quite localised. The principal changes in virulence observed are:

- Increased virulence on Keel, which first appeared in 2007 and is now common throughout the Mid and Lower North,
- A Maritime virulent strain that swept down the West Coast in 2009 and caused significant damage to Maritime crops across the Eyre Peninsula and lower Yorke Peninsula,
- A new pathotype collected from a hotspot in a Fleet crop at Ungarra has shown increased virulence on Fleet, Keel and Commander but is not virulent on Maritime or Barque,
- A further pathotype, picked up in a barley trial at Bordertown has shown increased virulence on Keel and Schooner.

Additional minor differences have been observed between a number of isolates that are virulent on Maritime and Keel but this may be an artefact of adult plant tests run in growth rooms which can show some differences not apparent in the field. Hindmarsh for example seems to perform worse in growth room tests than it does in the field. A large number of isolates were collected in 2009 and a comparison of these on the principal varieties grown in SA is ongoing in SARDI (Table 1).

Given that NFNB goes through a sexual stage, there is every probability that we will continue to see new virulence combinations in the future in regions where these pathotypes overlap. Fleet or Schooner crops are not expected to show much susceptibility in 2010 except in limited areas where virulence was observed in 2009, but growers will need to be aware that this situation could change quite rapidly because of the potential for the pathogen to change.

Table 1 Results of virulance testing of selected NFNB isolates on adult plants grown in controlled environment growth rooms

Variety	Isolates				
	Mallala	**Crystal Brook**	**Urania**	**Ungarra**	**Bordertown**
	Skiff	**Keel**	**Maritime**	**Fleet**	**Fairview**
	1998	**2009**	**2009**	**2009**	**2009**
Barque	S	S	MR	MR	S
Keel	MS	S	MS	S	S
Maritime	R	R	S	R	R
Fleet	R	R	R	MS-S	MR
Schooner	MS	MR	MR	MR	S

Given the amount of NFNB in crops in 2009 there will be high levels of inoculum in barley that are virulent on Maritime and Keel for the start of the 2010 season. This will lead to earlier and high levels of initial infection of crops and, depending on seasonal conditions, may require much earlier crop sprays than in 2009.

Seed tests on infected samples from commercial Maritime and Keel crops with NFNB infection have shown that few of them are likely to lead to seed borne transmission of the disease to young crops. Considering the high levels of stubble borne inoculum that will be present in SA in 2010, seed treatment for NFNB may provide little benefit this season. Seed transmission requires infection of the embryo and not just the husk but the reasons for the low level of seed transmission in 2009 samples is not yet apparent.

Variation in barley leaf rust

Barley leaf rust was widespread in SA in 2009 with perhaps two or more different sources of initial inoculum. A principal early source was rust that developed on the alternate host Star of Bethlehem on the lower Yorke Peninsula. Rust from this source rapidly spread east and northwards and resulted in widespread use of foliar fungicides on the Yorke Peninsula.

At least two different populations of leaf rust with contrasting patterns of virulence were observed in NVT trials on the Yorke and lower Eyre Peninsulas. Across the Yorke Peninsula the varieties Buloke, Commander, Flagship, Fleet, Keel, Schooner and SloopSA all showed susceptible to very susceptible reactions in trials at Arthurton, Brentwood and Warooka. However at Cummins a different rust population was observed so that Buloke, Commander, Flagship and Fleet showed useful partial resistance. These resistances are provided by minor adult plant resistance genes which are not detectable in seedling tests; hence they are not used in pathotyping of strains. These differences within the rust population therefore go unnoticed in annual surveys conducted by the University of Sydney but can lead to very significant differences in crop damage.

The occurrence of the Star of Bethlehem in paddocks on the lower Yorke Peninsula means that barley leaf rust goes through sexual recombination each year, leading to a diversity in rust strains that is not observed to the same extent in the wheat rusts.

Notes on other foliar diseases

Frequent rains in spring meant that conditions were very favourable for the development of scald in barley as well as yellow leaf spot and septoria tritici blotch in wheat. Inoculum of each of these pathogens will be present at higher levels in stubbles for 2010. However as there were no confirmed sightings of septoria in 2009, this pathogen is unlikely to be a problem this coming year.

For further information contact:

Tel: 08 8303 9382. Email: hugh.wallwork@sa.gov.au

GRDC Project code: DAS00099

Disease

Table 2 Leaf rust disease ratings from NVT trials on the Yorke and Eyre Peninsulas in 2009

Variety	NVT trial sites			
	Artherton	Brentwood	Warooka	Cummins
Barque	MS-S	MS	S	MS
Keel	VS	VS	VS	VS
Schooner	S-VS	S-VS	VS	S
Sloop SA	S-VS	S	VS	S-VS
Buloke	S-VS	S-VS	S-VS	MR-MS
Commander	MS	S-VS	S-VS	MS
Flagship	S-VS	MS-S	S-VS	MR-MS
Fleet	S	S-VS	S	MR
Hindmarsh	MS-S	MS	MS-S	MR-MS

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Cereal Variety Disease Guide 2010

EXTENSION

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Summary of 2009 season and implications for 2010

The most damaging diseases of cereals in 2009 were net form net blotch and Rhizoctonia due to new pathogen strains and previous dry conditions respectively. The cool, wet spring also allowed prolonged development of the stripe rust epidemic and favoured development of yellow leaf spot and scald. There will be a significant increase in the amount of inoculum and disease risk from net form net blotch, yellow leaf spot, scald and take-all going into 2010.

Net form net blotch (NFNB)

In July-August a new strain of NFNB with virulence on the barley variety Maritime, moved with great speed down from the Far West Coast to the Lower and Eastern Eyre Peninsula and across to the Yorke Peninsula. Almost all crops of Maritime were sprayed with fungicides but where they were not applied yield losses of up to 70% occurred.

NFNB with increased virulence on Keel was again observed but mainly on the Northern Yorke Peninsula and in the Mid and Lower North regions. The Keel and Maritime pathogen populations were spatially separated to a large degree during 2009. However they are likely to overlap much more in 2010 and this may lead to new strains with merged virulences on both varieties in the future. Given the favourable season for NFNB development in 2009 there will also be high levels of inoculum in barley for the start of the 2010 season.

Virulence on Fleet was observed at one location near Ungarra. This has been confirmed in controlled environment tests at SARDI. These tests indicate this strain was not virulent on Maritime but did have increased virulence on Keel and Commander. Whilst these tests are good indicators of field performance they cannot reliably predict the rating of all varieties in the field. One exception is Hindmarsh which has shown susceptibility to several NFNB isolates in controlled environment tests but has shown good field resistance in NVT trials.

Tests of seed from commercial Maritime and Keel crops with NFNB infection have indicated that few, if any of them, are likely to give rise to seed borne infection of young crops. Use of seed treatment for NFNB may therefore provide little benefit in 2010, especially considering the high levels of stubble borne inoculum that will be present in SA.

Rhizoctonia

Rhizoctonia was more severe than normal across SA including in higher rainfall areas where this disease traditionally causes less damage. The high incidence was a result of a run of seasons with below average rainfall which resulted in reduced microbial competition against the pathogen. Where there was good rainfall in 2009, Rhizoctonia inoculum levels will have been lowered and this should reduce the risk of disease in 2010. However, care should be taken in intensive cereal paddocks with high stubble loads, particularly where summer rainfall has been low and there has been insufficient moisture for net N release from the residues prior to sowing. The resulting temporary N deficiency can enhance

Rhizoctonia damage. To reduce risk, minimise incorporating stubble in the soil at seeding and deep band N below the seed to encourage rapid early growth.

Stripe rust

Stripe rust was first observed in SA in the first week of August.

Over the next two weeks stripe rust was found in many crops across the Mallee, Mid-North, Eyre and Yorke Peninsulas. The rust was a mixture of two different strains both derivatives of the original WA pathotype. One, the Jackie pathotype (134E16A+J+), was a first recording for SA whilst the second was the Yr17 attacking pathotype (134E16A+Yr17+) that had only been identified at one SA location in 2008. Most likely the rust was brought into SA on a weather system from northern NSW where both strains had been developing much earlier. There is no evidence that stripe rust had survived through summer in SA.

In the 2010 Disease Guide we have presented the response of wheat varieties to the Yr17 virulent pathotype since this is currently the most damaging pathotype on bread wheat varieties. If the Yr17 virulence is not present in 2010 then the varieties with a # in the table will be resistant as they have the Yr17 resistance gene. With the exception of varieties carrying the Yr17 gene there is no evidence that wheat varieties react differently to these two strains. For triticales the response of varieties is to the Jackie pathotype as this pathotype is more virulent on several triticales.

The cool spring conditions in SA in 2009 favoured development of stripe rust on leaves and later in heads leading to many varieties with higher levels of rust than expected in a more typical year. Wyalkatchem, in particular, showed little sign of its adult plant resistance throughout the season.

Higher infection in some varieties raised concerns that new virulence changes may have occurred but there is no evidence that this was the case. With improved data there have been a few changes in disease ratings in the table. Mace is now rated as S-VS and Catalina MS. Axe has been upgraded to R-MR.

Leaf and stem rust

Stem and leaf rust were observed at the end of August on the Far West Coast having most likely survived on summer volunteers in the region. The initial host for both rusts was thought to be Excalibur. Stem rust remained fairly localised within the region but leaf rust spread more widely, including to the Adelaide Plains late in the season. Whilst all varieties grown should have adequate resistance to both these rusts, it is particularly important that good resistance is deployed along coastal areas where rust is more likely to survive and build up early in crops.

Other wheat foliar diseases

Frequent rains in spring meant that conditions were very favourable for yellow leaf spot and septoria tritici blotch development in 2009. There is likely to be increased amounts of yellow leaf spot inoculum in wheat stubbles in 2010 so where wheat is to be sown into wheat stubbles Frame, Yitpi and Correll should be avoided. Axe, Guardian, CLF Janz and Pugsley are also quite susceptible and should only be used with great caution in these situations.

Despite favourable conditions septoria tritici blotch was not observed in crops. This would be largely due to the very low levels of inoculum following several years of unfavourable seasons. Many varieties have poor levels of resistance to this disease so, should inoculum levels increase in coming years, there is a good chance of some serious damage occurring. New data suggests that Axe is particularly susceptible and so caution should be taken with this variety in the higher rainfall districts should the disease become more common.

Other barley foliar diseases

Barley leaf rust developed early on the alternate host Star of Bethlehem on the Lower Yorke Peninsula, rapidly spread east and northwards and resulted in widespread use of foliar fungicides. Keel is particularly susceptible to the current strains of rust and allows the rust epidemic to develop rapidly. On the Yorke Peninsula, Schooner, Sloop SA, Commander, Fleet and Buloke were all susceptible to very susceptible whilst a different rust population was observed in the Cummins NVT trial on the Lower Eyre Peninsula where Fleet and Buloke showed moderate resistance.

Leaf scald was observed at high levels in some early sown crops in the Mid North. Inoculum levels for this disease will be higher in barley stubbles following the wet spring and the fungus will likely spread to early sown crops in 2010. Scald is highly variable and so disease levels in crops may differ from those suggested in this Guide if alternative strains occur.

Powdery mildew was less of a problem than in previous years most likely due to improved coverage of crops with effective seed treatments.

Take-all

The wet spring of 2009 will have favoured infection of cereals and grasses with take-all and this will lead to potentially higher levels of inoculum for 2010, particularly where barley grass was poorly controlled in 2009. Where summer rainfall events above 25 mm have occurred however, the level of inoculum will have been greatly reduced due to competitive growth of microbes in the stubbles.

Explanation for Resistance Classification

- **R** - The disease will not multiply or cause any damage on this variety. This rating is only used where the variety also has seedling resistance.
- **MR -** The disease may be visible and multiply but no significant economic losses will occur. This rating signifies strong adult plant resistance.
- **MS -** The disease may cause damage but this is unlikely to be more than around 15% except in very severe situations.
- **S -** The disease can be severe on this variety and losses of 15-50% can occur.
- **VS -** Where a disease is a problem this variety should not be grown. Losses greater than 50% are possible and the variety may create significant problems to other growers.

This classification based on yield loss is only a general guide and is less applicable for the minor diseases such as common root rot, or for the leaf diseases in lower rainfall areas, where losses are rarely severe.

Other information

This article supplements other information available including the SARDI Sowing Guide 2010 and Crop Watch newsletters. Cereal Leaf and Stem Diseases and Cereal Root and Crown Diseases books (2000 editions) are also available from Ground Cover Direct or from Hugh Wallwork in SARDI.

Disease identification

A diagnostic service is available to farmers and industry for diseased plant specimens.

Samples of all leaf and aerial plant parts should be kept free of moisture and wrapped in paper not a plastic bag. Roots should be dug up carefully, preserving as much of the root system as possible and preferably kept damp. Samples should be sent to the following address:

SARDI Diagnostic Centre
Plant Research Centre
Hartley Grove
Urrbrae SA 5064

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

Wheat	Rust			CCN		*Septoria tritici* blotch	Yellow leaf spot	Powdery mildrew	Root lesion nematodes			Common root rot	Flag smut	Black point ‡	Quality in SA
	Stem	Strips #	Leaf	Resistance	Tolerance				*P. neglectus* Resistance	*P. thornei* Resistance	Crown rot				
Axe	MS	R-MR	MR	S	-	S-VS	S	MR	MS	MS	S	MS-S	S	MS-S	AH
Barham	MR	#MS-S	MR-MS	MS	-	MS-S	MS-S	MR-MS	MR	MS	S	MS-S	MR-MS	MS	Soft
Bowie	S	#S	MR-MS	MR-MS	MT	MS	S	-	MR	MS	S	S	-	MR-MS	Soft
Catalina	MR-MS	MS	R-MR	R	-	MS	MS-S	MR-MS	MS	MS-S	S	MR-MS	R-MR	S	AH
Chara	MR-MS	MS-S	MR-MS	R	MI	MS	MS-S	-	MS-S	MR-MS	S	S	MR	MS	AH
Correll	MR-MS	MR-MS	MS	MR	-	MR-MS	S-VS	R	S	MS	S	MS	R	MS	AH
Derrimut	MR	#MS^	R	R	-	MS-S	MS-S	MS	S	MS-S	S	S	R	S	AH
Espada	R-MR	#MR-MS	R-MR	MS	-	S	MR-MS	-	MS	MS-S	S	MS-S	MR-MS	MS	APW
Frame	MS	MR-MS	MS	MR	MT	MS	S-VS	R	MS-S	S	S	S	MR	MS	APW
Gladius	MR	#MR-MS	MS	MS	-	MS-S	MS	MR-MS	MS-S	MS-S	S	MS	R-MR	MR-MS	AH
Guardian	R-MR	MS	MS	R	-	MS-S	S	MR-MS	MS-S	MS	S	MS	S	-	APW
CLF Janz	R-MR	MS-S	MS	S	I	MR-MS	S	MS	MS-S	S	S	MS-S	R	S	AH
Katana	MS	MR-MS	MS	S	-	MS	MR-MS	-	S	MS	S	MS	S-VS	MS	Specialty
Kukri	MR-MS	MR-MS^	MS α	S	I	MR-MS	MS	-	S	MS	MS	S	MS	MS	AH
Lincoln	MR	R	MR	S	-	S	MS	-	S	S	S	MS	R-MR	MS	AH
Mace	MR	#S-VS	R	MR-MS	-	MR	MR-MS	-	MR-MS	-	S	MS-S	S	MS	APW/AH
Magenta	R-MR	MS	MR-MS	MS-S	-	MS	MR-MS	R	MS	S	S	S-VS	S-VS	S	ASW
Peake	MR-MS^	MR-MS^	R^	R	-	S	MS-S	MS	S	MS	S	S	MR-MS	MS-S	AH
Preston	MS-S	R	R	S	-	MR	MS-S	-	S	MR-MS	S	MS	S-VS	MR-MS	-
Pugsley	MS	#S	MR	MS	MI	MS	S	MS	S	-	S	MS	MR	MS	APW
Ruby	MR-MS	R-MR φ	R	S	-	MS	MR	MS	-	-	S	MS	S	MS	ASW
Scout	R-MR	MS-S	R	R-MR	-	MS	S	-	-	-	S	-	MR	MS-S	APW
Scythe	MR	MS-S	MS	S	-	MS	S	R	MS	MS-S	S	MS	S-VS	MR	APW
Sentinel	R	R-MR	R	S	-	MS-S	MR-MS	R	S	MS	MS-S	S	MS-S	MR	ASW
Wyalkatchem	MS	S ε	R	S	MI	MR	MR	S	MR-MS	-	S	S	S-VS	MS	APW
Yitpi	S	MR-MS	MS	MR	MT	MS	S-VS	-	MS-S	-	S	MS	MR	MS	AH
Young	MR	#MS^	MR-MS	R	-	MS	MS	R	S	MS	S	MS-S	MS	MR	AH

- The stripe rust ratings are for the WA Yr17 strain prevalent in SA in 2009. Varieties with a # have the Yr17 (VPM) seedling resistance and so will be resistant to the WA Jacki strain
^ - Some susceptible plants in mix

ε - Wyalkatchem shows stronger stripe rust resistance at higher temperatures

φ - Ruby has the resistance gene Yr27 which is not effective to a rust strain found in NSW in 2008

α - Kukri and Treat have a resistance gene (Lr13) which is not effective to a leaf rust (Mackellar) strain found in NSW

Durum	Rust			CCN		Septoria tritici blotch	Yellow leaf spot	Powdery mildrew	Root lesion nematodes		Crown rot	Common root rot	Flag smut	Black point ‡	Quality in SA
	Stem	Strips #	Leaf	Resistance	Tolerance				*P. neglectus* Resistance	*P. thornei* Resistance					
Caparoi	R-MR	MR	R	-	-	R	MR	-	-	-	-	-	R	MS-S	Durum
Hyperno	R	MR	R	MS	-	R-MR	MS-S	-	MR-MS	-	VS	MR-MS	R	MS	Durum
Kalka	R-MR	MR	R-MR	MS	MT	MS	MR	-	MR-MS	R	VS	MS	R-MR	S-VS	Durum
Saintly	R-MR	MR	MR-MS	MS	-	MR-MS	MR	-	MR-MS	-	VS	MS	R	MS	Durum
Tamaroi	R-MR	MR	R-MR	MS	-	S	MR	-	MR-MS	R	VS	MS	R	MS	Durum
Triticale															
Bogong	R	MR-MS	R	-	-	-	-	-	-	-	-	-	-	-	Triticale
Canobolas	R	MS-S	R	-	-	-	-	-	-	-	-	-	-	-	Triticale
Hawkeye	R-MR	MR ^	R	R	-	-	-	-	-	-	-	-	-	-	Triticale
Jaywick	R-MR	MR-MS ^	R	R	-	-	-	-	-	-	-	-	-	-	Triticale
Kosciuszko	R	S-VS	MR	S	T	-	-	-	-	-	-	-	-	-	Triticale
Rufus	R-MR	MR-MS	R	R	T	-	-	-	R-MR	R-MR	-	-	-	-	Triticale
Speedee	R	S-VS	R	S	T	-	-	-	R-MR	-	S	-	-	-	Triticale
Tahara	R-MR	MS	R	R	T	R	R	-	R-MR	R	S	MS	R	-	Triticale
Treat	R	MR	MR α	MS	T	-	R	-	MR-MS	-	S	MS	R	-	Triticale

The stripe rust ratings for the tritcales is for the WA ‘Jackie’ strain common in SA in 2009

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

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

Disease

Barley	Scald	Spot form net blotch	Net form net blotch	Leaf rust	Powdery mildew	CCN		Root lesion nematodes		Barley grass stripe rust	Covered Smut	BYDV	Common root rot	Black point
						Resistance	Tolerance	*P. neglectus*	*P. thornei*					
Barque	S-VS	MR	MS-S	MS-S	MR	R	T	R-MR	MR	MR	S	S	S	S
Baudin	MS-S	S	MS	S-VS	S-VS	S	T	-	-	MR	S	MR	S	MS
Buloke	MS	MS-S	MR	S-VS	MR	S	T	-	-	R	MR	S	MS	S
Capstan	MR#	MS-S	MS	MS	MR	R	T	MR	-	MR-MS	MR	S	S-VS	MS
Commander	S	MS-S	MS	S	MR	R	T	-	-	R	R	S	S	S
Finniss	R#	S	MS	R	VS	R	T	-	-	-	S-VS	S	S	-
Flagship	MS	MS	MR-MS	S	MR-MS	R	T	R	MR-MS	MR	MR-MS	S	S	S
Fleet	MR-MS	MR	MR	S	MR-MS	R	T	-	-	MR	MR	S	MS-S	S
Gairdner	R#	S-VS	MR-MS	MS-S	MR	S	T	MR	MR-MS	R	-	MR	MS-S	MR
Hindmarsh	R#	S	MR	MS-S	MS	R	T	-	-	R	MS	S	S	-
Keel	MS	MR	MS	VS	MR-MS	R	T	MR	MR	MS	R	S	S	S-VS
Maritime	MS-S	MR-MS	VS	MS	S	R	T	MR	-	S	MS	S	S	S
Oxford	MS	S	MR-MS	R	R	S	T	-	-	-	-	S	-	-
Schooner	MS-S	MS-S	MR-MS	S-VS	S	S	T	MR-MS	R	R	MR	S	S	S
Sloop SA	S	S-VS	MR	S-VS	S	R	T	MS	R	R	R	S	S	MS
Yarra	S-VS	MS-S	MS	R	S	R	T	-	-	R	MS	S	S-VS	S-VS
WI4262	R#	MR-MS	MR	VS	-	R	T	-	-	MR	MS-S	S	S	-
VBHT0805	MS	MS-S	MR	S-VS	MR	S	T	-	-	R	MR-MS	S	MS	S

# These varieties may be susceptible if strain is present.
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T = tolerant, - = uncertain

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

Key to symbols used
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Section 4

Farming Systems

Eyre Peninsula Farming Systems 3 Project – Responsive Farming Systems

A five year (2008-2013) GRDC funded project 'Eyre Peninsula Farming Systems 3 – Responsive Farming Systems' is aiming to assist farmers to understand what their land is capable of producing under a range of conditions and how to tailor inputs to get the most profitable outcomes.

On upper Eyre Peninsula (EP) farmers have always had to cope with a wide range of seasons, including runs of several years with below average growing season rainfall. One of the main factors affecting farm viability and profitability in these difficult seasons has been risk created by a mismatch of inputs and production. Looking forward, farmers will continue to face several challenges including a predicted increase in season variability, higher input costs, managing grain price volatility, and changing agronomic factors. Increasingly farmers need to understand exactly what their land is capable of producing under a range of conditions and how to tailor inputs or alter management to run low risk and flexible systems – 'responsive farming systems'.

Three "focus sites" have been established across upper EP on 3 major soil types;

- Minnipa (Minnipa Agricultural Centre), red sandy loam
- Mudamuckla (Mudabie), grey calcareous loamy sand
- Wharminda, siliceous sand over sodic clay

Collective groups of farmers, researchers and consultants will set goals and make decisions about the management of these sites. Field days will then be held to showcase the innovative ideas and hold discussions with farmers.

The following series of articles are from trials undertaken so far on the three focus sites:

- Responsive Farming for Soil Type at Minnipa
- Responsive Farming for Soil Type at Mudamuckla
- Responsive Farming for Soil Type at Wharminda
- Farming to Soil Potential on the Upper Eyre Peninsula: How Accurate was In-season Yield Prediction in 2009?
- Responsive Farming Using Wheat Agronomy
- Responsive Farming Using Very Early Maturing Barley

Responsive Farming Using Variable Rate Sowing at Minnipa 2009

Cathy Paterson, Roy Latta and Wade Shepperd
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RESEARCH

Location: Minnipa Ag Centre
Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2009 Total: 421 mm
2008 GSR: 333 mm
Yield
Potential: 5.2 t/ha (W)
Actual: 2.5 –3.3 t/ha (W)
Paddock History
2008: Wheat
2007: Wheat
2006: Pasture
Soil Type
Sandy loam to sandy clay loam
Soil test
Outlined in article
Diseases
Rhizoctonia
Plot size
Paddock trial
Yield Limiting Factors
Rhizoctonia
Environmental Impacts
Soil Health
Soil Nutrients: Needs to be monitored
Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, NO_2, methane): Standard
Social/Practice
Time (hrs): Standard
Clash with other farming operations: Standard
Labour requirements: Standard
Economic
Infrastructure/operating inputs: VRT technology
Cost of adoption risk:
Low if improving returns

Key messages

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

Why do the trial?

It is important that our low rainfall farming systems are low risk, flexible and responsive - paddock inputs need to balance the best agronomic and economic advice with the need to ensure reliable outcomes at low cost. At Minnipa the focus is on managing risk through variable rate technology using different inputs over variable soil types and testing the use of Yield Prophet to match plant available water and nutrition with modelling of climatic conditions, knowing that we can have unpredictable finishes to seasons.

Variable rate technology (VRT) offers farmers the ability to adjust sowing and fertiliser rates during the seeding process, allowing the opportunity to change inputs according to the production capability of different paddock zones or soil types. Previous research investigating crop canopy size effects on crop growth and yield on different soil types has shown that in a good season (2005) reduced canopy size reduced yield on all soil types (EPFS Summary 2005 pp 25-26), while in a poor season (2006) grain yield increased with smaller canopies on heavy/shallow soil types (EPFS Summary 2006 p 91-92). In 2007, another poor season, VRT applied in paddock N2 was as profitable as standard practice (EPFS Summary 2007 p 106-108).

To further evaluate variable rate sowing as a tool to improve paddock profitability in low rainfall upper EP farming systems, a broad acre trial began in 2008 and has been continued in 2009.

How was it done?

Paddock N1, at Minnipa Agricultural Centre, was segregated into 3 zones in 2008 using a combination of yield, EM38 and elevation maps to produce 3 distinct production zones (good, medium and poor). Soil chemical analysis was also performed within these zones (Table 1) to understand the chemical restraints which existed. Seed and fertiliser inputs for each zone were adjusted to reflect farmer input rates across upper EP which have tended to decrease in response to the tough economic situation and the poorer seasons being experienced over the past few years. Nil fertiliser, standard input and high input were sown in alternating strips across the paddock using Wyalkatchem wheat on 5 May (Table 2), in the same positions as those treatments in 2008. Foliar N was applied on 27 July at growth stage 41.

The paddock received standard weed management across all zones.

Early tillering, anthesis and maturity dry matter, harvest index, grain yield and quality and soil water measurements were taken. Gross margin analyses of treatments within each zone were used to compare different system approaches.

What happened?

Soil samples were collected prior to sowing to assess nutrition status. Soil in the poor zones had higher reserves of N than the good and medium zones, although P levels were similar (Table 1). N and P levels were similar between 2008 low, standard and high treatment strips, despite differences in inputs.

The higher sowing rate increased establishment numbers and coupled with the application of P and N (standard and high inputs) produced more biomass at tillering in the poor zone. Biomass was higher at maturity in the medium and good zone than the poor zone. The standard and high inputs increased the biomass in the poor zone at tillering and anthesis. There was no measured benefit from doubling the fertiliser with the high input compared to the standard input treatment. There were no differences between zones in plant establishment, dry matter production at tillering or anthesis (Table 3). The harvest index was similar irrespective of zone or input.

The poor zone produced lower grain yield than the medium zone but with higher protein content than the medium and good zones (Table 4). The 3 variable crop inputs produced similar grain yields within the zones but increasing fertiliser rates increased the protein content. Screenings were <1% and test weight >81 g/hectolitre irrespective of treatment or zone (data not presented). The medium zone generated the most income per hectare, while the poor zone generated the least in 2009. The low input strategy generated the highest gross income.

Table 1 Soil characteristics for zones in paddock N1, Minnipa 2009

	Good	Medium	Poor
Colwell P 0 - 10cm (mg/kg)	36	41	37
Total Mineral N 0 - 60cm (kg/ha)	142	158	231
*Depth to soil $CaCO_3$ >25% (cm)	60	40	20
*Depth to B > 15 mg/kg (cm)	100	60	80
*Depth to Cl > 1000 mg/kg (cm)	80	60	40

** 2008 data*

Table 2 Sowing inputs in paddock N1 at Minnipa, 2009

Paddock Zone	Paddock Area (%)	Inputs	Seed Rate (kg/ha)	DAP (kg/ha)	Foliar N (kg/ha of N)
Good	55	High	55	60	20
		Standard	55	30	10
		Low	40	nil	0
Medium	20	High	55	60	20
		Standard	55	30	10
		Low	40	nil	0
Poor	25	High	55	60	20
		Standard	55	30	10
		Low	40	nil	0

Table 3 Plant establishment, biomass at tillering, anthesis and maturity and harvest index from the 3 paddock zones for each input strategy, 2009

Zones	Inputs	Plants/m²	Dry matter (t/ha)			Grain/Biomass (%)
		Establish-ment	Tillering	Anthesis	Maturity	Harvest Index
		7 July	7 July	1 Sept	19 Nov	
Zone x input						
Good	High	144	0.38	5.7	5.9	50
Good	Standard	159	0.35	4.5	5.9	49
Good	Low	135	0.29	4.2	5.6	48
Medium	High	161	0.37	5.5	5.4	49
Medium	Standard	152	0.47	5.3	5.9	49
Medium	Low	134	0.30	5.6	5.0	50
Poor	High	152	0.54	6.3	4.3	45
Poor	Standard	165	0.56	6.1	4.8	45
Poor	Low	133	0.31	4.8	4.4	44
LSD (P=0.05)		*26*	*0.20*	*2.0*	*1.0*	*ns*
Zone only						
Good		146	0.34	4.8	5.8	49
Medium		149	0.38	5.5	5.7	49
Poor		150	0.47	5.7	4.5	45
LSD (P=0.05)		*ns*	*ns*	*ns*	*0.8*	*ns*
Input only						
	High	152	0.43	5.8	5.2	48
	Standard	159	0.46	5.3	5.7	47
	Low	134	0.30	4.9	5.0	47
LSD (P=0.05)		*16*	*0.06*	*ns*	*ns*	*ns*

Table 4 Grain yield, grain quality and gross income from the 3 paddock zone with low, medium and high inputs

Zones	Input	Grain yield (t/ha)	Grain protein (%)	Gross income[1] ($/ha)
Good	High	3.0	11.5	589
Good	Standard	3.0	11.4	621
Good	Low	2.9	10.9	636
Medium	High	3.3	11.8	656
Medium	Standard	3.2	11.5	666
Medium	Low	3.3	11.2	725
Poor	High	2.6	13.0	499
Poor	Standard	2.5	12.5	509
Poor	Low	2.5	12.3	547
LSD (P=0.05)		*0.6*	*1.0*	
Good		2.9	11.3	
Medium		3.3	11.5	
Poor		2.6	12.6	
LSD (P=0.05)		*0.59*	*0.98*	
	High	3.0	12.1	
	Standard	2.9	11.8	
	Low	2.9	11.5	
LSD (P=0.05)		*ns*	*0.31*	

[1] Gross income is yield x price of APW less seed and fertiliser costs delivered to cash pool on 2 December 2009, Pt Lincoln. $350/t used for seed value

Treatments applied to VRT combinations used for gross income analysis are outlined in Table 5. These two VRT combinations were then compared to the gross income if the different treatments had been applied to the whole paddock (Table 6) taking into consideration the paddock area percentage outlined in Table 2.

The 'Go for gold!' aim is to increase overall profitability by reducing inputs on areas with poorer yield potential and increasing on high potential areas. The VRT – 'Hold the gold!' treatment keeps inputs at standard (good zones) and low (medium and poor zones), an approach to reduce risk.

In N1 both VRT treatments were more profitable than if you were to apply the high and standard inputs across the whole paddock in 2009. However when fertiliser inputs were reduced to zero gross income was maximised due to reduced input costs and the run of poor years previously (2006-08) that has resulted in adequate residual nutrition being available to the crop.

What does this mean?

In 2009 a conservative approach was still more profitable. This was at least partly due to the run of poor seasons prior to 2009 resulting in high levels of available soil nutrition. These production outcomes match the predictions from the soil analyses with sufficient P and N to grow a 2-3 t/ha wheat crop. The measured soil water contents at seeding and harvest indicated that there was some stored water still within the medium zone soil profile.

The conservative VRT approach (Hold the gold!) offers farmers the opportunity to reduce inputs on poorer performing areas of paddocks where nutrition is generally higher because of years of fertiliser application exceeding plant requirements, but still applies some inputs on the better areas of paddocks to assist crops to perform well in those zones. This approach aims to operate at a much lower level of risk, even if it might mean some production is foregone.

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

Current research will continue to determine the extent of any yield penalty when seed and fertiliser rates are reduced. It is intended that these treatments are applied to this paddock for the next 2-3 years to track the long term impact of changing inputs, how the different zones respond to different treatments in different seasons, and how the overall economics stack up.

Table 5 Treatments applied to VRT gross income analysis for N1, Minnipa 2008

	N1	
Paddock Zone	**VRT - Go for gold!**	**VRT - Hold the gold!**
Good	High	Standard
Medium	Standard	Low
Poor	Low	Low

Acknowledgements

Special thanks to Brett McEvoy and Trent Brace for their assistance sowing, managing and harvesting the trials and to Willie Shoobridge, Kay Brace and Cilla King for their technical assistance with the trials. Thanks to Alison Frischke for setting up the trial.

Table 6 Comparison of the gross income of different sowing regimes vs. VRT rates across the whole 61 ha paddock

Treatment	Gross Income[1] 2008 ($/ha)	Gross Income[2] 2009 ($/ha)	Accumulated Gross Income ($/ha)	Accumulated Gross Income compared to standard input treatment ($61/ha paddock)
VRT - Go for Gold!	90	616	706	183
VRT - Hold the Gold!	109	623	732	1,041
High input	72	579	651	-3,172
Standard input	102	601	703	0
Low input	114	631	745	2,562

[1] Gross income is of yield x price (with quality adjustments) less seeds and fertiliser costs delivered to cash pool at 1 December 2008, Wudinna. $350/t used for seeds value.
[2] Gross income is of yield x price delivered APW less seeds and fertiliser costs delivered to cash pool on 2 December 2009, Pt Lincoln. $350/t used for seed value.

Responsive Farming for Soil Type at Mudamuckla

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

RESEARCH

Location: Mudamuckla
Muddy/Nunji/Wirrulla Ag Bureau

Rainfall
Av. Annual: 293 mm
Av. GSR: 219 mm
2009 Total: 292 mm
2009 GSR: 229 mm

Yield
Potential: 3.0 t/ha (W)
Actual: 1.3 t/ha (W)

Paddock History
2008: Wheat
2007: Self sown barley
2006: Barley

Soil test
Outlined in article

Diseases
Rhizoctonia

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

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

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

Key messages

- **In a good growing season, wheat performed equally well in zones identified as good, medium or poor however they achieved only 50% of their yield potential water use efficiency.**

Why do the trial?

It is important that our low rainfall farming systems are low risk, flexible and responsive - paddock inputs need to balance the best agronomic and economic advice with the need to ensure reliable outcomes at low cost. At Mudamuckla, the focus is managing risk through variable rate technology using different inputs over variable soil types, and testing the use of Yield Prophet to match plant available water and nutrition with modelling of climatic conditions, knowing that we can have unpredictable finishes to seasons.

Changing inputs according to the production capability of different paddock zones or soil types provides an opportunity to improve gross margins for the whole paddock.

How was it done?

Paddock 8 at Mudamuckla was segregated into zones of good, medium and poor production zones in 2009 using 5 years of yield maps. Four sites were selected in each of those production zones and soil cores taken to conduct a soil chemical analysis (see Whitbread et al article 'Farming to Soil Potential on the Upper Eyre Peninsula: How Accurate was In-season Yield Prediction in 2009?'). The paddock was sown with Gladius wheat and phosphoric acid on 6 May using variable rate technology (VRT). The paddock received standard weed management across all zones.

All crop measurements were taken in strips where the sowing rate of Gladius was 50 kg/ha and the phosphoric acid rate was 4 kg P/ha. A detailed analysis of the different input rates will be completed during 2010. Measurements included dry matter at early tillering, anthesis and maturity, soil water measurements (sowing and harvest), grain yield and quality.

What happened?

Total mineral N was very high in all zones, especially the poor zone, due to a history of good medic based pastures and fertiliser applications exceeding crop requirements. The poor zone had toxic levels of boron at 40 cm and chloride at a depth of 20 cm. These constraints will restrict productivity, except in wet years when frequent rainfall events may leach some of the hostile elements deeper into the soil profile, enabling the crop to perform well on the moist upper layers.

Plant establishment was lower in the poor zone than the medium and good zones (Table 2). Dry matter was less at tillering in the poor zone than both the medium and good but only less than the good zone at anthesis and maturity. Harvest indices were similar irrespective of zone.

Although the emergence was lower in the poor zone, grain yields were similar in all zones and grain quality was excellent in all 3 zones.

What does this mean?

The 2009 growing season was an average year for rainfall, and all zones performed well. However monitoring on this property by Jon Hancock has indicated that tailoring inputs to the production zone has the potential to improve profitability (EPFS 2007 p 106). The first year of monitoring at this focus site has established the relative performance and constraints associated with each zone. Phase 2 will be to impose variable rates on those points to measure whole of system benefits from targeting inputs to expected economic outcomes.

Acknowledgements

Thanks to Peter Kuhlmann for the opportunity to use this paddock as part of EPFS III and 'Jock' Rhynne and Andre Eylward for sowing the paddock and all their help during the year. Thanks also to Willie Shoobridge, Trent Brace, Kay Brace and Cilla King for all their technical help, and Alison Frischke for setting up the trial.

Table 1 Soil chemical analysis for paddock 8, Mudamuckla 2009

	Good	Medium	Poor
Colwell P (mg/kg) 0 - 10 cm	38.5	42.7	43.2
Total Mineral N (kg/ha) 0 - 60 cm	142	158	231
*Depth to B > 15 mg/kg (cm)	n/a	n/a	60
*Depth to Cl > 1000 mg/kg (cm)	n/a	n/a	40

Table 2 Plant establishment, biomass at tillering, anthesis and maturity and harvest index from the 3 paddock zones

Zones	Plants/m²	Dry Matter (t/ha)			Grain/Biomass (%)
	Establishment 17 July	Tillering 17 July	Anthesis 26 Sept	Maturity 05 Nov	Harvest Index
Good	150	0.56	3.3	3.50	47
Medium	146	0.27	2.1	2.40	50
Poor	99	0.13	1.7	2.10	49
LSD (P=0.05)	*19*	*0.13*	*1.21*	*0.98*	*ns*

Table 3 Grain yield and grain quality from the 3 paddock zones

Zones	Grain yield (t/ha)	Grain protein (%)	Screenings (%)	Test Weight (g/hL)
Good	1.4	12.5	0.8	80.3
Medium	1.3	12.8	0.6	85.0
Poor	1.4	12.8	1.4	79.9
LSD (P=0.05)	*ns*	*ns*	*ns*	*ns*

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GRDC Grains Research & Development Corporation

Mudamuckla Focus Paddock 2009

Peter Kuhlmann
Farmer, Mudabie

EXTENSION

Searching for answers

Location: Mudamuckla
Rainfall
Av. Annual: 290 mm
Av. GSR: 216 mm
2009 Total: 292 mm
2009 GSR: 262 mm
Paddock History
2008: Wheat - Gladius 0.43 t/ha
2007: Self sown barley
2006: Barley – Barque 0.38 t/ha
Soil Type
Grey calcareous sandy loam

Key messages

- **Wheat varieties respond differently to increasing rates of fluid phosphorus.**
- **The season suited Gladius and Yitpi over the very short season variety Axe.**
- **Mace yielded 5% better than Wyalkatchem.**
- **Seeding rate did not affect yield in 2009.**

Why do the trial?

Commercial scale strips were sown in a paddock at Mudamuckla .This paddock is the 'Focus Paddock' for the region as part of the EP Farming Systems 3 - Responsive Farming project. This project is GRDC funded and will focus on increasing water use efficiency (WUE). The strips were sown to develop a better understanding about management options across different production zones in the paddock. With the combination of monitoring of the soil resources in each zone, interrogation of the yield maps in each cropping season and small plot research, we hope we can develop more responsive and low risk farming systems for this environment.

A summary of other activities in this paddock in 2009 are provided in articles by Cathy Paterson et al 'Responsive Farming for Soil Type at Mudamuckla', Sean Mason 'Improving Phosphorous Management on Upper EP using the DGT Soil Test' and Anthony Whitbread 'Farming to Soil Potential on the Upper Eyre Peninsula: How Accurate was In-season Yield Prediction in 2009?'.

How was it done?

Strips were sown the length of the paddock using different phosphorus rates (delivered as fluids), wheat varieties, seeding rates and times of sowing. All strips were harvested with a commercial header using a yield monitor to record wheat yields. These large strips utilised the technologies of yield monitors and mapping, prescription maps, variable rate and autosteer coupled with monitoring and comprehensive soil analysis. The various treatments resulted in 37 different strips being sown and yield data being collected within the 200 ha paddock.

The varieties used were Axe, Gladius, Yitpi, Mace and Wyalkatchem. The seeding rates ranged between 30 to 70 kg/ha. The rates of P were 0 kg/ha, 4 kg/ha, 6 kg/ha, 8 kg/ha and 16 kg/ha. The dates of sowing were 30 April, 6 May, 9 May, 16 May and 31 July.

What happened?

When seeded on 6 May and under the same fertiliser regimes and seeding rates, all varieties produced grain which made H2 grade, but Gladius was the highest yielding at 1.25 t/ha, followed by Yitpi at 1.18 t/ha (95% of Gladius), mixed varieties (1/3 of each) at 1.17 t/ha (94%) and Axe at 1.00 t/ha (80%).

Mace was the best yielding variety at the site (sown on 9 May) at 1.37 t/ha and out-yielded Wyalkatchem by 5%.

Increasing the seeding rate of Gladius from 30 to 70 kg/ha when seeded on 6 May did not affect yield or quality. However, the lower rates appeared to have more grass and were falling over more than the higher rates. This will have implications for the weed seed bank in this paddock.

Only Axe appeared to respond strongly to P fertiliser, increasing in grain yield by 300 kg/ha or 30% (Figure 1). The other wheat varieties showed no clear response to fluid P, even though they generally yielded higher than Axe. Axe appeared to require at least 5 kg P/ha before yielding better than with no P fertiliser and 8 kg P/ha boosted yields even higher.

Sowing Gladius on 30 April yielded 4% higher than the main part of the paddock which was sown on 6 May, despite not having a knockdown or trifluralin applied at the earlier seeding. A very late sowing on 31 July (later than had been intended due to machinery problems) only yielded 34% of the main sowing date of 6 May. Wyalkatchem sown at the end of July yielded 0.51 t/ha compared to Gladius at 0.41 t/ha sown on the same day.

Detailed analysis of yields at different seeding and fertiliser rates within each zone has not yet been completed. However, the wet spring improved yields on the medium and poor zones above those expected because normally the lower water holding capacity of soils in these two zones severely restrict grain yields.

Acknowledgements

Nigel Wilhelm, Anthony Whitbread, Roy Latta and Cathy Paterson.

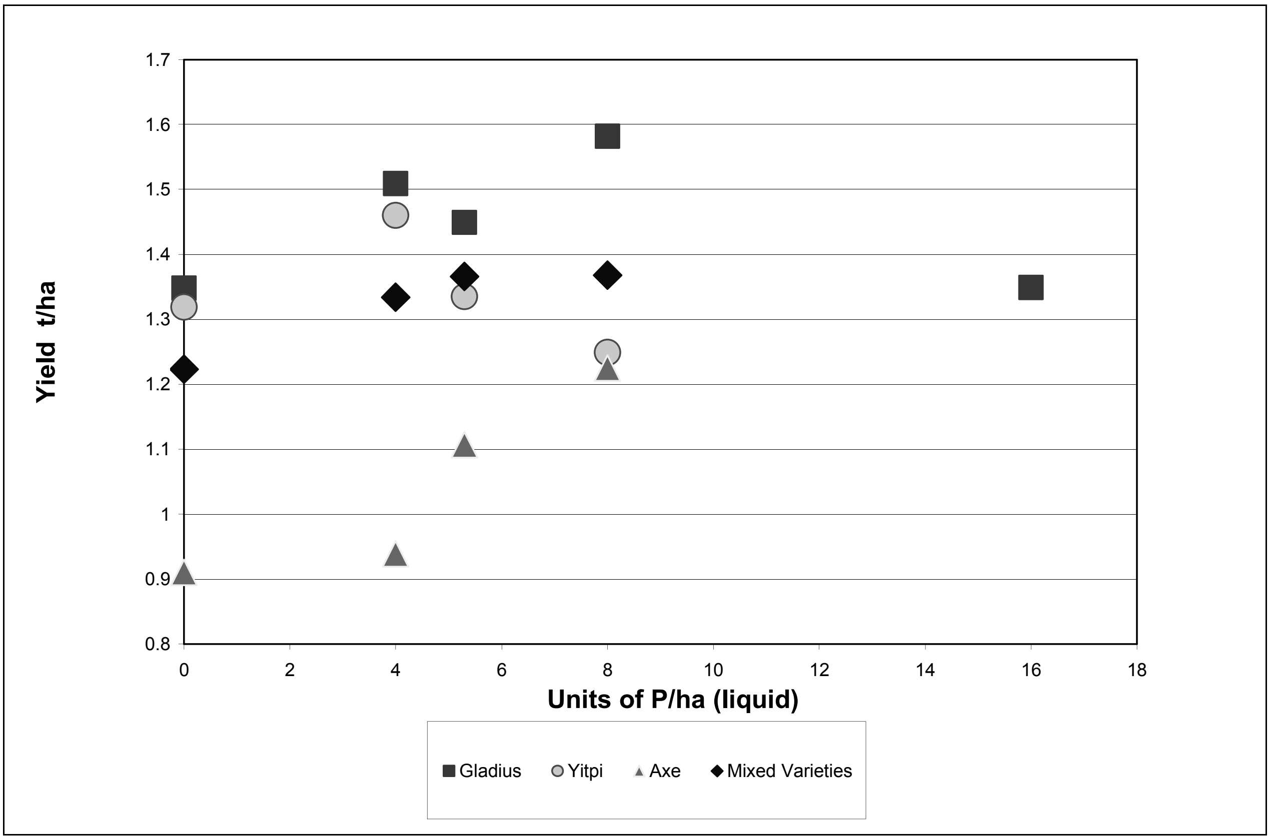

***Figure 1** Variety response to P fertiliser, Paddock 8 Mudabie 2009*

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Responsive Farming for Soil Type at Wharminda

RESEARCH

Cathy Paterson[1], Roy Latta[1], Ed Hunt[2] and Wade Shepperd[1]

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

Searching for answers

Location: Wharminda
Ed Hunt

Rainfall
Av. Annual: 322 mm
Av. GSR: 222 mm
2009 Total: 283 mm
2009 GSR: 245 mm

Yield
Potential: 2.7 t/ha (W)
Actual: 1.4 t/ha (W)

Paddock History
2008: Pasture
2007: Pasture

Diseases
Rhizoctonia

Yield Limiting Factors
Late sowing

Key messages

- **Sowing in early June 2009 resulted in wheat yields on 3 soil types being similar but only achieving 50% of potential water use efficiency.**

Why do the trial?

It is important that our low rainfall farming systems are low risk, flexible and responsive, paddock inputs need to balance the best agronomic and economic advice with the need to ensure reliable outcomes at low cost. At Wharminda the focus is on managing risk through variable rate technology using different inputs over variable soil types and testing the use of Yield Prophet to match plant available water and nutrition with modelling of climatic conditions, knowing that we can have unpredictable finishes to seasons.

The Wharminda soil was chosen as a focus site for the Eyre Peninsula Farming Systems 3 Project (EPFS III) as the non-wetting sands represent approximately 455,000 ha on the EP. These sands present farmers with unique challenges; non-wetting sands that "wet up" slowly and unevenly at the beginning of the growing season which can result in uneven germination, increasing the likelihood of wind erosion. There are also a range of EP common factors preventing crops from reaching their yield potential include insufficient nutrition, disease, weed competition, delayed sowing dates and restricted access to soil water due to chemical constraints.

Changing inputs according to the production capability of different paddock zones or soil types provides an opportunity to improve profitability for the whole paddock.

How was it done?

A paddock on Ed Hunt's property at Wharminda was selected and zoned according to soil type - deep sand over clay, shallow sand over clay and loam. Four representative sampling points were then selected and soil samples taken for chemical analysis and potential water holding capacity. This paddock was then sown with Wyalkatchem wheat @ 60 kg/ha and N @ 11 kg/ha and P @ 5 kg/ha on 6 June 2009. The paddock received standard weed management across all zones.

Measurements taken during the growing season were wheat establishment, dry matter at early tillering, anthesis and maturity, soil water at sowing and harvest, and grain yield and quality.

What happened?

The Wharminda district had a late break to the season; however the growing season rainfall was above average.

Soil fertility and chemical restraints were sampled just after seeding (Table 1). Total mineral N was high in the deep sand and loam zones and moderate in the shallow sand indicating a history of good medic based pastures and low crop productivity in recent years. The shallow sand and loam zones had a Colwell P level that indicates these zones might be P responsive. The electrical conductivity levels in the shallow sand and loam zones are at levels that may restrict root growth at >0.2 m and certainly below 0.4 m in the soil profile. No zones had toxic levels of boron or chloride in the 0-0.6 m soil profile, however soil samples were not collected below 0.2 m in the loam soil zone due to rock.

All zones had similar plant establishment numbers, however dry matter production was lower in the deep sand zone at early tillering and anthesis compared to the loam soil type (Table 2). The percentage of grain compared to crop biomass (harvest index) was similar irrespective of the paddock zone.

Grain yields and quality were similar across the zones. Screenings and test weights were excellent but grain protein levels were low (Table 3).

Table 1 Soil chemical analysis for Wharminda 2009, immediatey after seeding

	Deep Sand	Shallow Sand	Loam
Colwell P (mg/kg) 0 - 0.1 m	34	22	24
Total Mineral N (kg/ha) 0 - 0.6 m	125	82	149

Table 2 Plant establishment, biomass at tillering, anthesis, maturity and harvest index from the 3 paddock zones

Zones	Plants/m^2	Dry Matter (t/ha)			Grain/Biomass (%)
	Establishment 20 July	Tillering 20 July	Anthesis 29 September	Maturity 9 November	Harvest Index
Deep sand	108	0.07	2.0	2.8	46
Shallow sand	127	0.16	2.8	3.1	44
Loam	138	0.19	3.0	2.8	43
LSD (P=0.05)	*ns*	*0.09*	*0.8*	*ns*	*ns*

Table 3 Grain yield and grain quality from the 3 paddock zones

Zones	Grain yield (t/ha)	Grain protein (%)	Screenings (%)	Test Weight (g/hL)
Deep sand	1.3	10.0	0.8	79.1
Shallow sand	1.4	9.2	0.3	81.3
Loam	1.4	10.1	0.3	79.6
LSD (P=0.05)	*ns*	*ns*	*ns*	*ns*

What does this mean?

The late break to the season delayed sowing, resulting in slower crop growth and a lower grain yield. Only half of the potential yield was achieved in 2009 despite the above average total growing season rainfall. Dry matter production was greater at tillering and anthesis in the shallow sand and loam zones than the deep sands, but this did not equate to higher yields in 2009.

The soil analysis results suggest a variation in the productive capacity of the three soil zones within the paddock. A plant available soil profile of <0.4 m would restrict production in many years due to water deficiency. The high available soil N measured in the shallow loam soil may also impact on production; however this was not the case in 2009 with low screenings percentages measured. The non-wetting deep sand zone did not produce a yield loss compared to the heavier soil types, this may have been as a result of the above average consistent rainfall conditions.

All measurements taken in 2009 will be used to baseline production prior to management of this paddock under a VRT strategy as one of the three focus paddocks for the EPFS III project. Direction on how to maximise production in each zone in 2010 will be discussed with farmers involved in the Focus Site Discussion Group.

Acknowledgements

Thanks to the Hunt family for the opportunity to use this paddock as part of EPFS III. Thanks also to Willie Shoobridge, Trent Brace, Brenton Spriggs, Kay Brace and Cilla King for all their technical help.

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Farming to Soil Potential on the Upper Eyre Peninsula: How Accurate was In-season Yield Prediction in 2009?

Anthony Whitbread[1], Alison Frischke[2], Cathy Paterson[2], Naomi Scholz[2], Roy Latta[2] and Peter Kuhlmann[3]
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RESEARCH
EXTENSION

Farming Systems

Almost ready

Location: Mudamuckla, near Ceduna, Peter Kuhlmann.
Paddock N1 at Minnipa Ag Centre, Mark Klante

Rainfall
Mudamuckla
Av. Annual: 293 mm
Av. GSR: 219 mm
2009 Total: 292 mm
2009 GSR: 229 mm
MAC
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Yield
Potential 2009 Mudamuckla: 3.04 t/ha (W)
Potential 2009 MAC: 5.2 t/ha (W)

Soil Type
Constrained sandy loam, Mudabie heavy (APSOIL#379)
Unconstrained grey calcareous sandy loam, Mudabie loam (APSOIL#374)
Constrained grey calcareous sandy loam, MAC heavy (APSOIL #353)
Unconstrained red light sandy clay loam, MAC loam (APSOIL#354)

Key messages

- **Using crop growth models to quantify the season to season yield performance on different soil types and predict in-season potential yield can be a very useful tool for managing risk and inputs.**
- **Given the high spatial variability in soils and grain yield, mapping paddocks into zones of similar soil and yield potential enables farmers to better target input levels as well as understand crop yield potential in different seasons.**
- **Information about the capacity of a soil to hold water, the water and mineral N levels at sowing are the basic information needed to use Yield Prophet - given this information, grain yield can be accurately predicted.**

Why do the trial?

Managing high levels of climatic variability and business risks on farms with highly variable soil types and conditions pose difficult challenges to most farmers in the lower rainfall regions of Eyre Peninsula. The responsive farming systems approach adopted by the latest GRDC EP Farming Systems 3 project aims to build resilience into EP farms by understanding the interactions between soil potential, climate and management. By running lower risk flexible systems that are more responsive to seasonal indicators such as commodity pricing, weather forecasts etc, farmers are more likely to make better decisions more often. At the focus sites at Mudamuckla and Minnipa, we tested whether knowledge of soil potential, soil variation and in-season predictions of grain yield with Yield Prophet could be useful to improving management.

How was it done?

Zoning and characterising the focus paddocks

Mudabie: Paddock 8 was zoned into areas of good, medium and poor performing areas based on several years of yield maps (cereal yields in 2002, 2004, 2005, 2007, 2008) and an elevation map. Soil samples from 4 points within each zone were taken in increments (0-10, 10-20, 20-40, 40-60, 60-80, 80-100 cm) to depth to determine soil moisture prior to sowing (4 May 09). Soil chemical analysis was also undertaken on these soils to 60 cm depth. Several soils had been previously characterised at Mudabie, with 2 profiles from an adjacent paddock (#10) selected to represent soils within the poor (constrained sandy flat - APSOIL#379) and good zones (grey calcareous sandy loam - APSOIL#374) of the 2009 focus paddock (Paddock #8). (APSOIL is a database of over 500 soil profiles characterised for water holding capacity for use in APSIM modelling - www.apsru.gov.au.)

MAC: Paddock N1 was zoned into areas of good, medium and poor performing areas based on several years of yield maps and an elevation map. Soil samples from 4 points within each zone were taken in two depth increments (0-10, 10-60 cm) to determine soil moisture prior to sowing (4 May 09). Soil chemical analysis was also undertaken on these soils to 60 cm depth. Soil characterisation on this paddock had been undertaken in previous work with a MAC heavy (grey calcareous sandy loam - APSOIL #353) representing an average soil in the poor zone and a MAC loam (red light sandy clay loam - APSOIL#354) representing an average soil in the good zone.

Paddock trials

Wheat was sown on 6 May 2009 at both sites (Mudabie cv. Gladius and at MAC cv. Yitpi). At Mudabie, the seeding rate was 35 kg/ha on the poor zones and 50 kg/ha on the medium and good zones with phosphoric acid applied at sowing at 0, 4 and 8 kg/ha of P/ha to the poor, medium and good zones, respectively. No other fertiliser was applied at this site.

At the MAC N1 paddock 3 treatments (seeding and fertiliser rates) laid out in strips across the entire paddock were imposed at planting in 2008 (Frischke et al, EP Farming Systems Summary 2008, p 77-80). This was repeated on the same strips with seeding rates of 40, 50 and 55 kg/ha and DAP fertiliser rates of 60, 40 and 0 kg/ha on the low, standard and high treatments, respectively in 2009 (Paterson et al, 'Responsive Farming Using Variable Rate Sowing'). An application of liquid N was applied to the crop on 23 July at rates of 0, 10 and 20 kg/ha N to the low, standard and high treatments, respectively. At both sites, plant cuts at early tillering, anthesis and maturity were taken to determine biomass at all 4 soil sampling points. On the final maturity cut, grain was threshed from the samples to determine grain yield. While there was a small plot header used to collect a larger grain sample from around these points as well as commercial header yield monitoring, the hand plant cuts were used as the reported grain yield in this article.

Predicting potential yield through the season with Yield Prophet®

APSIM is a crop-soil model that simulates the major processes that occur while crops and pastures grow. These include the nitrogen and carbon dynamics in soil, soil water balance (including evaporation, drainage, leaching and runoff), crop growth and interactions with daily temperature, radiation and rainfall. Yield Prophet is an on-line crop production model (based on APSIM) designed to provide grain growers with real-time information about the crop during growth. To assist in management decisions, growers enter inputs at any time during the season to generate reports of projected yield outcomes showing the impact of crop type and variety, sowing time, nitrogen fertiliser and irrigation. Using Yield Prophet for the poor and good soil types, crop reports were generated several times during the growing season to provide predictions of potential yield.

What happened?

Zones and soils

Mudabie: The areas of the paddock that had performed consistently poorly represent about 15% of the paddock and are dominated by heavy flats. Rooting depth is shallow on these soil profiles due to high concentrations of salt, boron and/or rock (Table 1) and as a consequence, the plant available water capacity (PAWC) is small (37 mm, Fig. 1a).

The areas zoned medium cover about 45% of the area and are located mostly in the midslope areas. The soils in these zones were not characterised for PAWC and it is assumed that the PAWC of these soils would fall between the heavy and good soil types.

The good zones represent 40% of the paddock and contain the best sandy soils (PAWC=50 mm, Fig. 1b), low sub-soil chemical constraints (Table 1) with roots able to reach 70 cm depth.

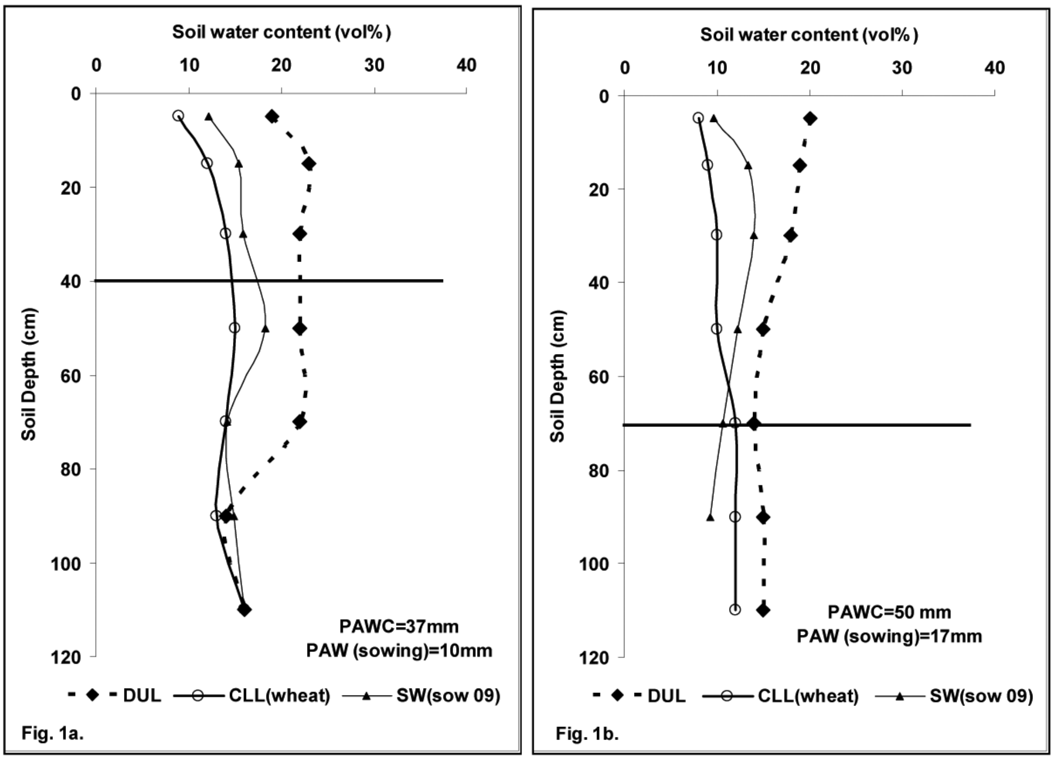


***Figure 1** The plant available water capacity (PAWC) obtained by characterising the crop lower limit (CLL) of wheat and drained upper limit (DUL) of a constrained sandy loam termed 'Mudabie heavy' (Fig. 1a) representing an average soil in the poor zone and an unconstrained grey calcareous sandy loam termed 'Mudabie loam' (Fig. 1b) representing an average soil in the good zone. Plant available water (PAW) measured at sowing is also plotted.*

MAC: The areas of the paddock that performed consistently poorly represent about 25% of the paddock are dominated by heavy flats. Again rooting depth is shallow on these soil types due to high concentrations of salt, boron and/or rock (Table 2) and as a consequence, the PAWC is small (47 mm, Fig. 2a). The areas zoned medium cover about 20% of the area and are located mostly in the midslope areas. The soils in these zones were not characterised for PAWC and it is assumed that the PAWC of these soils would fall between the heavy and good soil types. The good zones represent 55% of the paddock and contain red light sandy clay loam soils referred to as MAC loam with a PAWC of 93 mm (Fig. 2b). The rooting depth of the MAC loam is approximately 60 cm with similar toxic concentrations of salt below this depth as displayed in the MAC heavy soils (Table 2).

Soil moisture and available nutrients at sowing time

Mudabie: Sowing took place on 6 May after 17 mm of rain fell in the last week of April. This rainfall, and the contribution of 46 mm rain that fell in March resulted in 11 to 17 mm of plant available water (PAW) stored in the profile at sowing, depending on the soil type (Fig. 1a and 1b). Soil mineral N measured on soil cores was very high in all zones (Table 1) reflecting a history of good medic pastures and 3 previous years of cereal yield below 0.5 t/ha. As expected, salinity (EC), boron and chloride reached very high readings at depths grater than 40 cm in the soil of the poor zone.

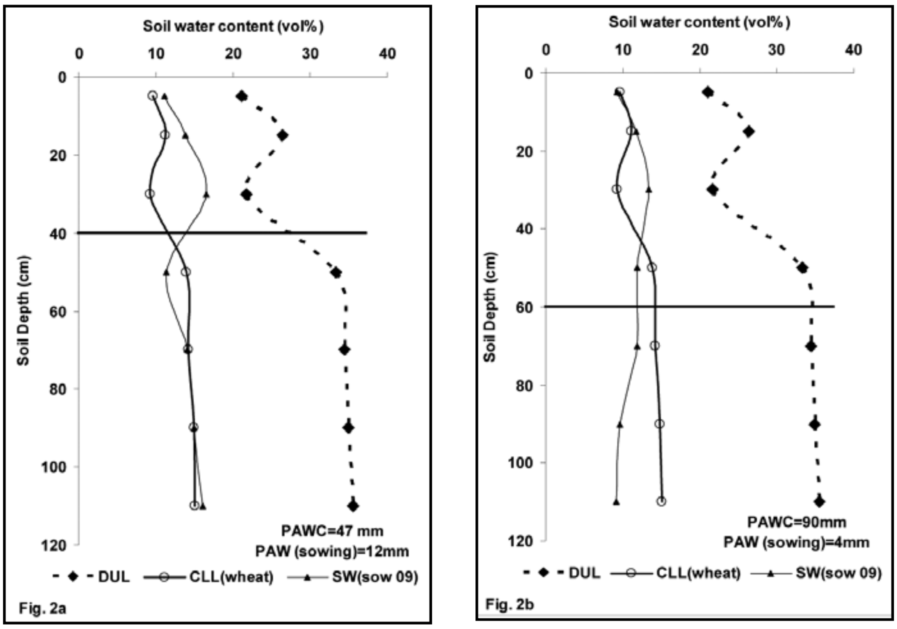


Figure 2 The plant available water capacity (PAWC) of a constrained grey calcareous sandy loam termed 'MAC heavy' (Fig. 2a) representing an average soil in the poor zone and a red light sandy clay loam termed 'MAC loam' (Fig. 2b) representing an average soil in the good zone. Plant available water (PAW) measured at sowing is also plotted.

Table 1 Soil chemical analysis on paddock 8 at Mudabie on soils sampled May 5 (the average of 4 soil cores within each zone)

Zone	Depth	Nitrate N	Ammonium N	Total mineral N	P	EC	pH	Boron	Chloride
		(mg/kg)	(mg/kg)	(kg/ha)	(mg/kg)	(dS/m)	(pH)	(mg/kg)	(mg/kg)
Poor	0 - 10	44	1.3	59	43	0.61	7.9	2.3	730
	10 - 20	32	1.8	44		0.54	8.1	4.8	612
	20 - 40	26	1.5	71		0.87	8.1	12.9	1059
	40 - 60	21	1.3	59		1.26	8.5	21.1	1457
		Total mineral N (0 - 60)		231					
Med	0 - 10	27	1.8	38	41	0.32	7.8	1.5	264
	10 - 20	25	1.0	34		0.39	8.0	2.3	366
	20 - 40	16	1.0	43		0.49	8.1	4.5	481
	40 - 60	15	1.3	43		0.65	8.1	7.1	711
		Total mineral N (0 - 60)		158					
Good	0 - 10	25	1.3	33	33	0.16	7.8	1.1	40
	10 - 20	24	1.5	33		0.21	7.9	1.4	66
	20 - 40	12	1.8	36		0.24	8.0	1.9	155
	40 - 60	14	1.5	40		0.45	8.1	5.0	447
		Total mineral N (0 - 60)		142					

MAC: Sowing took place on 6 May after 25 mm of rain fell in the last week of April. This rainfall, and the contribution of 62 mm rain that fell in March resulted in 12 mm of plant available water (PAW) stored in the profile of the poor soil at sowing (Fig. 2a), but only 4 mm of plant available water (PAW) stored in the profile of the good soil at sowing (Fig. 2b). Soil mineral N measured on soil cores was very high in the poor and medium zones (Table 2), and moderate in the good soil.

Yield Prophet Prediction for 2009 - Mudabie

The first YP reports for good and poor soils were generated on 9 July corresponding with GS30-31 (Figure 3). For both soils, the range of possible yield outcomes was wide ranging from 0.6 to 5 t/ha with the available soil N reserves. Subsequent reports up to and including the 24 August report indicated that the lowest yield likely based on historical weather records was about 1.4 t/ha for the good soil (1.1 t/ha for the poor soil) with the highest yield being around 3.7 t/ha (3 t/ha for the poor soil). Between 24 August and 2 September, the highest potential yield decreased by over 1 t/ha on both soils due to high water stress during mid to late August corresponding with flowering and the start of grain fill. The 30 September report indicated a final yield prediction of 2.1 and 1.6 t/ha for the good and poor soils, respectively. These predictions were close, but just below the observed paddock yields (Table 3) of 2.47 and 1.68 t/ha on the good and poor soils respectively.

Yield Prophet Prediction for 2009 - MAC N1

The YP reports generated on 22 July corresponding with GS 32 indicated that yield was severely limited by available N in the soil profile of the good zone (Figure 4) i.e. the comparison between the solid and non N limiting dotted line. Because there was a high probability of an economic response to additional N application (YP also provides N profitability reports to test such scenarios), additional N was applied on 23 July. The simulations below do not include this topdressing. Due to high soil N available in the profile of the poor soil, there was very little difference between the yield outcome with the actual N and the simulated yield outcomes with unlimited N (similar to the Mudabie grain yield outcomes in Figure 3). In the period between 21 August and 15 September, there was low rainfall (22 mm) and the crop experienced high water stress in the early to mid Sept period on both soil types. In the good soil, this resulted in 60% of seasons with unlimited N now yielding in the range of only 2.1 and 2.5 t/ha and less than 10% of seasons yielding greater than 3 t/ha. The grain yields predicted at maturity (mid October) were all in the best 5 to 10% of seasons corresponding with the decile 9 rainfall received during the growing season at Minnipa.

Measured vs predicted wheat growth

Mudabie: The biomass measurements made at early tillering were very low and reflected the high stress conditions following germination (low rainfall and hot winds) that affected the crop during its first 6 weeks of growth (Table 3). At this time, the biomass predicted by Yield Prophet were more than 1 t/ha higher than measured and indicate that the simulation failed to recognise the water stress during this time. Predicted biomass continued to be higher than measured at the next two sampling times but grain yield was somewhat lower than measured, resulting in very low harvest index. The modelled crop growth was unable to represent the effects seen in the sown crop resulting from water and heat stress and consequently low tillering and biomass.

Table 2 Soil chemical analysis on paddock N1 at MAC on soils sampled 23 April (the average of 4 soil cores within each zone)

Zone	Depth	Nitrate N (mg/kg)	Ammonium N (mg/kg)	Total mineral N (kg/ha)	P (mg/kg)
Poor	0 - 10	33	2.0	35	37
	10 - 60	40	1.8	208	
		Total mineral N (0 - 60)		244	
Med	0 - 10	23	1.8	25	40
	10 - 60	35	1.8	186	
		Total mineral N (0 - 60)		211	
Good	0 - 10	11	2.0	14	33
	10 - 60	19	1.4	103	
		Total mineral N (0 - 60)		117	

Figure 3 Predictions of grain yield outcomes for Mudabie for soils in the good and poor zones (Wheat cv. Gladius sown May 6)

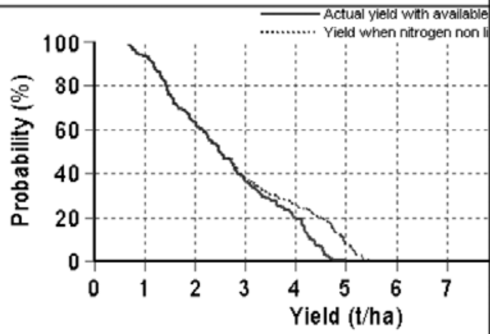
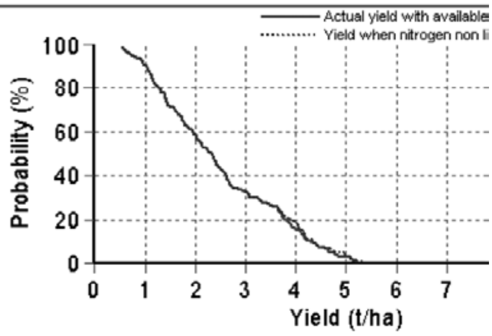
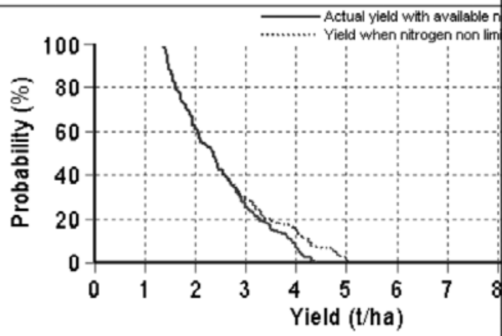
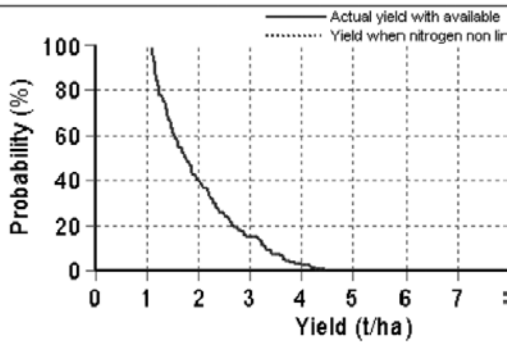
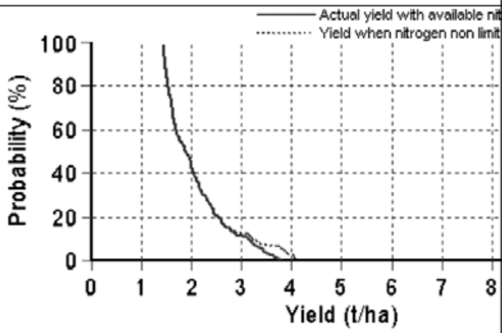
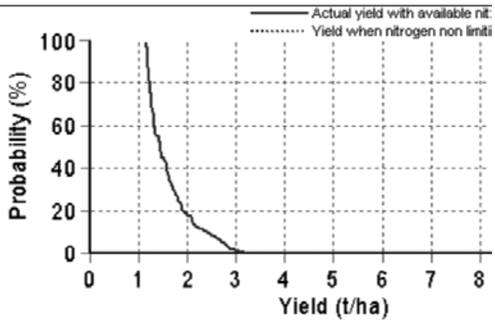
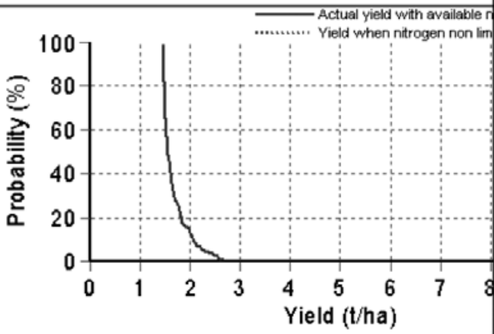
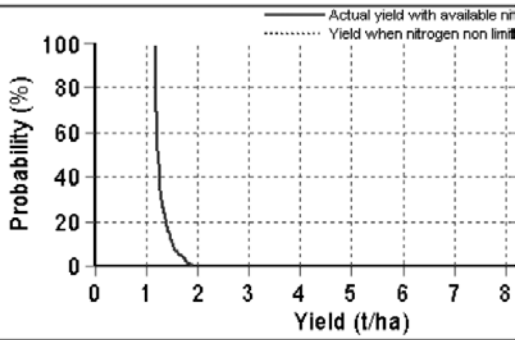
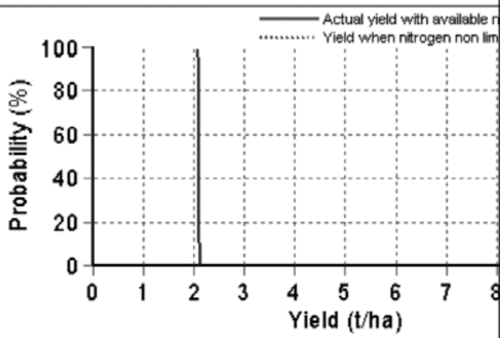
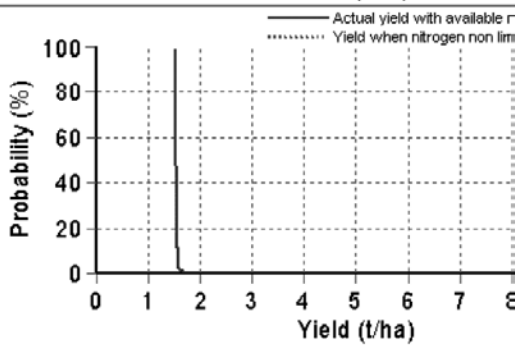
Date of report/ Growth stage/ GSR (from May 6)	Good zone	Poor zone
9 July GS31 - 1st node GSR 60 mm		
6 Aug GS45 - mid boot GSR 123 mm		
24 Aug GS65 - anthesis GSR 134 mm		
2 Sept GS75 - mid dough fill GSR 143 mm		
30 Sept Maturity GSR 193 mm		

Figure 4 Predictions of grain yield outcomes for MAC N1 for soils in the good and poor zones (Wheat cv. Yitpi sown May 6)

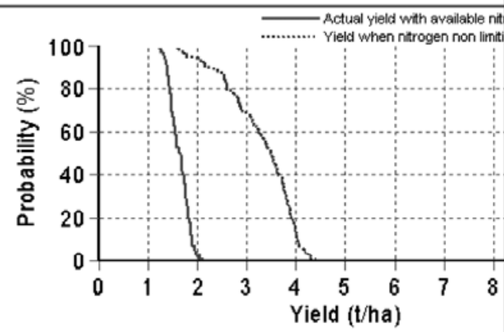
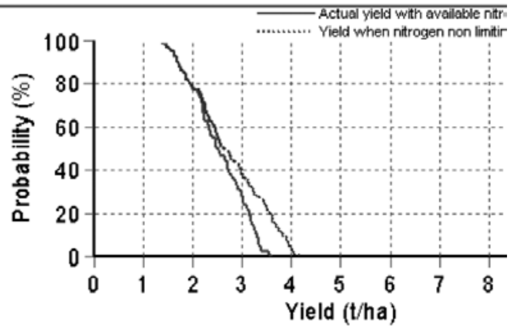
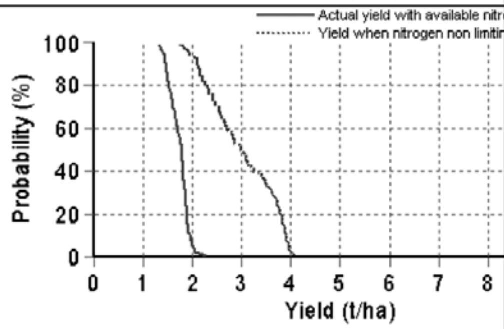
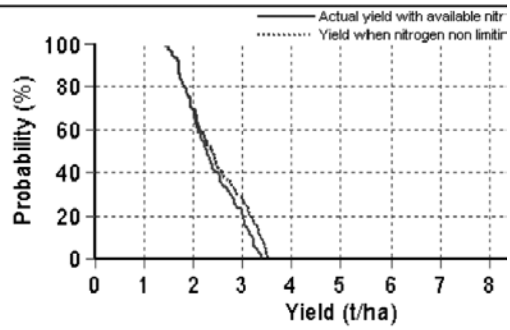
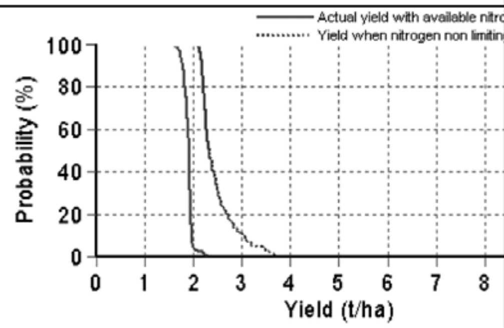
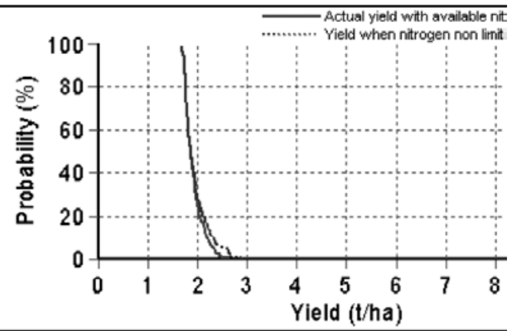
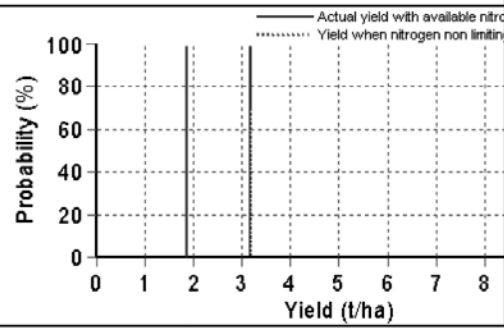
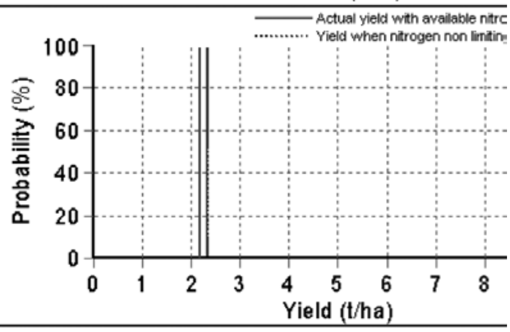
Date of report/ Growth stage/ GSR (from May 6)	Good zone	Poor zone
22 July GS32 2nd Node GSR 192 mm		
21 Aug GS55 mid head emergence GSR 214 mm		
15 Sept GS75 - mid dough fill GSR 236 mm		
20 Oct Maturity GSR mm		

Table 3 Observed dry matter, grain yield and harvest index averaged from 4 sampling points within zones sampled at early tillering, anthesis and maturity and predictions made by Yield Prophet for the good and poor zones at Mudabie

		Biomass Early tillering 17 July (t/ha)	**Biomass Anthesis 26 Sept (t/ha)**	**Biomass Maturity 5 Nov (t/ha)**	**Grain yield (t/ha)**	**Harvest Index**
Observed	Poor *SED*	0.13 *(0.03)*	1.66 *(0.25)*	3.21 *(0.88)*	1.68 *(0.42)*	0.52
	Medium *SED*	0.27 *(0.02)*	2.11 *(0.42)*	3.63 *(0.18)*	2.00 *(0.25)*	0.55
	Good *SED*	0.56 *(0.08)*	3.28 *(0.23)*	5.31 *(0.17)*	2.47 *(0.05)*	0.47
Predicted	Poor	1.67	4.98	5.35	1.60	0.30
	Medium					
	Good	1.67	5.96	6.62	2.00	0.30

SED = Standard error of the mean calculated from 4 sampling points

Table 4 Observed dry matter, grain yield and harvest index averaged from 4 sampling points within zones sampled at early tillering, anthesis and maturity and predictions from Yield Prophet for the good and poor zones at MAC

		Biomass Early tillering 17 July (t/ha)	**Biomass Anthesis 14 August (t/ha)**	**Biomass Maturity 16 Nov (t/ha)**	**Grain yield (t/ha)**	**Harvest Index**
Observed	Poor *SED*	0.54 *(0.10)*	4.19 *(0.09)*	4.35 *(0.24)*	1.96 *(0.13)*	0.45
	Medium *SED*	0.37 *(0.04)*	3.65 *(0.44)*	5.38 *(0.39)*	2.63 *(0.18)*	0.49
	Good *SED*	0.38 *(0.05)*	3.78 *(0.37)*	5.90 *(0.23)*	2.94 *(0.10)*	0.50
Predicted	Poor	0.24	4.42	5.46	2.10	0.38
	Medium					
	Good	0.24	5.27	6.65	2.40	0.36

SED = Standard error of the mean calculated from 4 sampling points

MAC: (Table 4) This wheat crop grew in an exceptionally good year (decile 9). The Yield Prophet reports do suggest crop potential was reduced because of moderate water stress experienced in the period between 21 August and 14 September when only 23 mm of rainfall was received. Predicted biomass at maturity was higher than measured while predicted grain yield was similar to measured on the poor zone and 0.54 t/ha under predicted in the good zone.

What does this mean?

The Yield Prophet system is a tool that integrates the multiple drivers of crop growth (soil moisture, soil nutrition, crop stage, seasonal outlook and soil potential) into the prediction of in-season grain yield outcomes. This has been achieved by combining a complex soil-crop simulation model with real time soil, crop and weather information and some seasonal forecasts. Provided that soils are accurately characterised APSIM can accurately predict cereal yields on the upper EP (see Whitbread et al EP Farming Systems Summary 2007 p 95-102). At the 2 sites presented in this article, prediction of crop performance of the good and poor soils was consistent with the measured data, although grain yields were up to 0.54 t/ha under-predicted at MAC. There was also a much lower harvest index resulting from the overestimation of biomass. While additional soil characterisation could improve these predictions, the aim here was to apply Yield Prophet using representative soil characterisations which were modified with additional site specific soil data.

The question posed by this work was whether predicting crop performance in-season could be useful in the management of responsive faming systems. In addition to the grain and hay yield outcomes presented in this article, there is information contained in the Yield Prophet reports such as predicted dates of crop stages, frost and heat risk assessment and yield predictions for years where SOI has an influence on rainfall. This information is useful in planning crop-stage dependent herbicide applications, or understanding the drivers of crop performance for instance.

In highly risky environments, such as the upper EP, predictions made at GS31-32 (first and second node) of crop response to additional N inputs are of limited value as the range of seasonal outcomes from that point forward is still so wide.

The range of grain yield outcomes in the Yield Prophet reports became tighter around anthesis – while this is of limited value in forward selling decisions, it may be useful in making decisions about the application of rust sprays or planning for harvest.

The long term yield performance and season to season yield variation of different soil types is critical information in designing lower risk farming systems. This may include deciding on areas most suitable for various landuses (continuous cereal cropping, season responsive rotations, permanent pastures) and for designing robust paddock zones in precision agriculture applications.

The provision of regular in-season Yield Prophet reports for a range of soil types across several regions of the upper EP may be the most time and cost effective method of using this technology. While the starting soil conditions are not standard and comparable from paddock to paddock, in the low input marginal environments of EP understanding soil potential and seasonal variability is the critical information that farmers should be aware of for their particular farm.

Acknowledgements

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Responsive Farming Using Wheat Agronomy

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RESEARCH

Location
Minnipa Ag Centre
Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm
Yield
Potential: 5.2 t/ha (W)
Actual: 5 t/ha Wyalkatchem local TOS1
Paddock History
2008: Wheat
2007: Wheat
Soil Type
Sandy loam to sandy clay loam
Soil test
Presented
Diseases
Moderate Rhizoctonia
Plot size
9 x 1.48 m
Yield Limiting Factors
Nil
Water Use
Water use efficiency:
Early sowing better
Runoff potential: Nil
Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, NO_2, methane): Standard
Social/Practice
Time (hrs): Standard
Clash with other farming operations: Nil
Labour requirements: Standard
Economic
Infrastructure/operating inputs: Standard
Cost of adoption risk: Standard
Market stability risk: Standard

Key messages

- **The early to mid season varieties Wyalkatchem and Mace performed well if sown early, while Axe performed well against the other varieties if sown later, facing a shorter growing season.**
- **Matching wheat variety selection with sowing date and soil type can help to maximise returns.**

Why do the trial?

It is critical in a region of low and variable rainfall, and a time of high input costs and fluctuating commodity prices, that water use efficiency (WUE) is maximised to get the best possible yield and economic outcome for a crop. It is considered that early maturing wheat lines perform well under low rainfall situations in field trials. Trials were established to see how the commonly grown varieties with a range of maturities respond to seasonal conditions, soil type and sowing time, i.e. to evaluate how they can best fit into the farming system.

How was it done?

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

Small plot trials were established on 3 sowing dates (4 May, 26 May and 18 June) to compare wheat lines with a range of maturity dates, Axe (early), Wyalkatchem sourced from Roseworthy, Mace and a local Wyalkatchem seed line (early to mid season), Gladius (mid season) and Correll (mid to late season). Plots received typical weed management. The two lines of Wyalkatchem were selected to compare if any yield potential was lost by using seed saved from drought years.

Soil moisture was measured at anthesis and harvest of the mid season variety Wyalkatchem at each time of sowing (TOS) treatment. Biomass of each line was sampled at their specific anthesis date, and plots were harvested and grain samples collected for yield and quality on 5-6 November, 16 November and 25 November for TOS 1, 2 and 3 respectively.

What happened?

The first rain for the growing season was late April, with 25 mm allowing TOS 1 to go ahead on 4 May. TOS 2 was sown on 26 May immediately following 30 mm of rain. TOS 3 was sown on 18 June following 60 mm rain over 6-16 June. A total of 35, 90, 100, 29 and 42 mm of rain fell in May, June, July, August and September respectively. There was no recorded temperature below 2°C from April to October.

Soil water content at anthesis and harvest for each TOS in the 0-0.4 and 0.4-1 m soil profiles for both the medium and good soil types is presented in Tables 1a and 1b.

Time of sowing 1 had more available water in the 0–1 m soil profile at anthesis in both the medium and good soil types. All TOS soil water contents were similar at harvest which meant there was more water utilised post anthesis in TOS 1 than TOS 2 and 3.

Table 1a Effect of TOS on soil water content on medium soil, N1 MAC, 2009

Sowing time	Gravimetric soil water content (mm)			
	Anthesis	Harvest	Anthesis	Harvest
Soil depth	**0 - 0.4 m**	**0 - 0.4 m**	**0.4 - 1 m**	**0.4 - 1 m**
TOS 1	31	13	43	29
TOS 2	25	14	37	33
TOS 3	23	14	33	33
LSD (P=0.05)	*4.9*	*ns*	*6.8*	*ns*

Table 1b Effect of TOS on soil water content on good soil, N1 MAC, 2009

Sowing time	Gravimetric soil water content (mm)			
	Anthesis	Harvest	Anthesis	Harvest
Soil depth	**0 - 0.4 m**	**0 - 0.4 m**	**0.4 - 1 m**	**0.4 - 1 m**
TOS 1	30	18	37	27
TOS 2	22	21	29	24
TOS 3	26	15	31	25
LSD (P=0.05)	*6.8*	*ns*	*6.7*	*ns*

Table 2a Wheat production on medium soil N1 MAC, 2009

TOS	Variety	Grain yield	Grain protein	Screenings	Test weight
		(t/ha)	(%)	(%)	(g/hL)
TOS only					
1		4.7	12.3	1.3	79.8
2		3.9	12.2	1.5	84.1
3		3.3	12.6	1.4	79.7
	LSD (P = 0.05)	*0.16*	*0.5*	*ns*	*1.07*
Variety only					
	Mace	4.2	11.4	1.5	81.7
	Wyalkatchem	4.2	12.1	0.9	81.8
	Axe	3.7	12.6	0.9	82.0
	Gladius	3.8	13.2	1.4	80.9
	Correll	3.7	13.2	2.6	78.7
	Wyalkatchem - local	4.2	11.8	1.0	82.0
	LSD (P = 0.05)	*0.16*	*0.25*	*0.5*	*1.06*
TOS x Variety					
1	Mace	5.0	11.3	2.3	78.7
1	Wyalkatchem	5.0	11.8	1.0	81.1
1	Axe	4.4	12.8	0.3	80.2
1	Gladius	4.5	13.3	1.5	79.8
1	Correll	4.4	13.1	2.0	78.1
1	Wyalkatchem - local	5.1	11.4	1.0	69.6
2	Mace	3.9	11.4	1.3	81.0
2	Wyalkatchem	4.1	11.9	1.0	85.0
2	Axe	3.6	12.3	1.5	84.8
2	Gladius	3.9	12.9	1.8	84.6
2	Correll	3.8	13.4	2.3	84.0
2	Wyalkatchem - local	4.1	11.7	1.0	81.8
3	Mace	3.6	11.5	1.0	73.7
3	Wyalkatchem	3.5	12.6	0.8	84.5
3	Axe	3.2	12.7	1.0	81.5
3	Gladius	3.1	13.6	1.0	79.8
3	Correll	2.9	13.1	3.5	81.3
3	Wyalkatchem - local	3.5	12.2	1.0	79.0
	LSD (P = 0.05)	*0.28*	*0.60*	*0.83*	*2.11*
LSD (P = 0.05) within TOS		*0.28*	*0.43*	*0.86*	*1.90*

Table 2b Wheat production on good soil N1 MAC, 2009

TOS	Variety	Grain yield	Grain protein	Screenings	Test weight
		(t/ha)	(%)	(%)	(g/hL)
TOS only					
1		4.6	11.6	1.5	82.0
2		3.6	11.7	1.0	82.0
3		2.9	11.4	1.4	80.0
	LSD (P = 0.05)	*0.1*	*0.2*	*0.1*	*1.4*
Variety only					
	Mace	3.8	11.1	1.3	82.6
	Wyalkatchem	3.8	11.1	0.8	82.2
	Axe	3.5	12.2	0.9	81.4
	Gladius	3.7	12.0	1.4	81.1
	Correll	3.6	12.2	2.5	79.0
	Wyalkatchem - local	3.9	11.0	0.8	82.4
	LSD (P = 0.05)	*0.2*	*0.3*	*0.3*	*0.9*
TOS x Variety					
1	Mace	4.9	11.1	1.5	83.7
1	Wyalkatchem	4.7	11.0	0.9	82.7
1	Axe	4.3	12.6	1.0	80.8
1	Gladius	4.7	12.0	1.6	81.8
1	Correll	4.4	12.3	2.7	79.7
1	Wyalkatchem - local	5.0	10.8	1.0	82.6
2	Mace	3.6	11.3	1.3	82.1
2	Wyalkatchem	3.8	11.4	0.5	83.0
2	Axe	3.3	12.3	0.7	82.3
2	Gladius	3.6	12.2	1.1	81.3
2	Correll	3.7	12.2	1.8	80.2
2	Wyalkatchem - local	3.8	11.1	0.6	83.2
3	Mace	3.1	10.9	1.2	82.1
3	Wyalkatchem	2.8	10.9	1.0	80.8
3	Axe	3.0	11.7	0.9	81.1
3	Gladius	2.8	11.9	1.5	80.0
3	Correll	2.8	12.2	3.0	77.2
3	Wyalkatchem - local	2.9	11.0	0.8	80.4
	LSD (P = 0.05)	*0.27*	*0.44*	*0.6*	*1.73*
LSD (P = 0.05) within TOS		*0.28*	*0.43*	*0.0056*	*1.48*

When comparing the 6 lines over the 3 TOS and using the local Wyalkatchem seed line as the control:

- Mace produced comparable yields but lower grain protein content except at TOS 3 medium soil. Screening % similar or lower but generally below 2%, similar or higher test weight and similar 1000 grain weight.
- Wyalkatchem produced a lower grain yield at TOS 3 on the good soil.
- Axe produced lower grain yields in both soil types at TOS 1 and 2 but higher protein contents at all 3 TOS.
- Gladius produced lower grain yields at TOS 1 in both soil types but higher protein contents at all 3 TOS.
- Correll produced lower grain yields at all 3 TOS in the medium soil type and at TOS 1 in the good soil type. It produced higher grain protein contents at all 3 TOS.

Table 3 Quality, yield and gross income data for wheat varieties sown with different sowing time and sowing rates, on medium and good soil, N1 MAC, 2009

Variety	TOS	Medium soil		Good Soil	
		Grade	Gross Income[1] ($/ha)	Grade	Gross Income[1] ($/ha)
Axe	1	H1	1022	H2	950
Correll		H1	1026	H2	978
Gladius		H1	1050	H2	1048
Wyalkatchem		APW1	1051	APW1	984
Wyalkatchem - local		APW1	1075	APW1	1053
Mace		APW1	1052	APW1	1029
Axe	2	H1	824	H2	713
Correll		H1	877	H2	811
Gladius		H1	901	H2	787
Wyalkatchem		APW1	850	APW1	783
Wyalkatchem - local		APW1	852	APW1	785
Mace		APW1	806	APW1	734
Axe	3	H2	689	H2	642
Correll		H1	653	H2	598
Gladius		H1	705	H2	597
Wyalkatchem		APW1	716	APW1	559
Wyalkatchem - local		APW1	695	APW1	584
Mace		APW1	739	APW1	627

[1] Gross Income is yield x price (with quality adjustments) less seed costs delivered to cash pool on 2 December 2009, Port Lincoln. Grades were adjusted for each variety according to screenings and test weight. $350/t used for seed value.

TOS 1 produced a higher average grain yield than TOS 2 which produced a higher average grain yield than TOS 3 in both the medium and good soil types (Table 2a & 2b). Mace and Wyalkatchem produced higher grain yields and lower protein contents than Axe, Gladius and Correll on the medium soil type when the averages of the 3 time of sowings were calculated. Mace and Wyalkatchem produced higher grain yields and lower protein contents than Axe and Correll on the good soil type.

Tables 2a and 2b present the comparative crop production results from the 3 time of sowings and the six wheat lines.

What does this mean?

These trials demonstrate the importance of early sowing, even in an above average year as experienced at MAC in 2009. The results showed the benefits in 2009 of more available water at the TOS 1 anthesis with a much higher grain yield achieved. The medium soil also had a higher average yield for all sowing dates due to the higher water holding capacity of loamy soils compared to sandy soils.

The results from the above average rainfall season of 2009 do not differ from the outcomes from trials conducted in 2008 (EPFS 2008, p 89-91), which was a season of considerable moisture deficit. The 2009 trials continued to demonstrate the benefit of early sowing. On both soil types the early to mid season varieties (Wyalkatchem and Mace) were best in the early sowing treatment, while a shorter season variety (Axe) improved with a later sowing date.

These results continue to show that matching variety selection with sowing date can help to maximise profits.

Acknowledgements

We thank GRDC for funding this work, Amanda Cook, Brenton Spriggs, Cilla King, Kay Brace and Trent Brace for their help during the year with sampling and harvesting the trial. Thanks to Alison Frischke for setting up the trial.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

GRDC Grains Research & Development Corporation

Is Time of Sowing as Important in a High Decile Season?

Linden Masters
SARDI, Minnipa Agriculture Centre

Location
Minnipa Ag Centre
Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm
Yield
Potential: 5.2 t/ha (W)
Actual: 2.8 - 5 t/ha Wyalkatchem local TOS1

Key messages

- **Minnipa Agriculture Centre results showed significant yield advantage with earlier sowing in trial data even in a great season.**
- **Weeds can have a large effect on early sown crops, but most farmers try to have some paddocks set up to sow early.**
- **If early sowing is an option take advantage of it.**

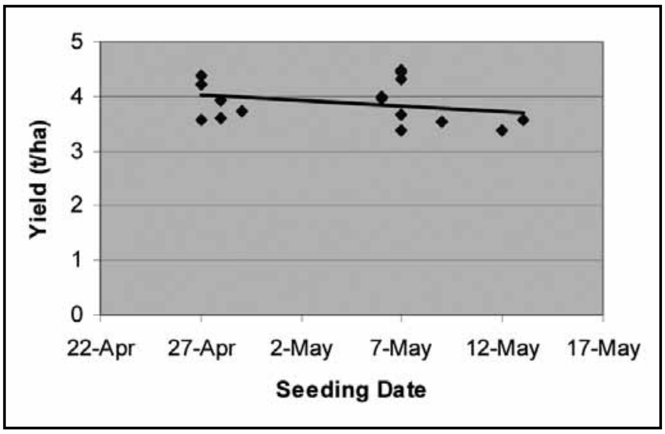

Figure 1 MAC Seeding date and yield (t/ha) 2009

Why do the trial?

After debate amongst the MAC researchers on the importance of time of sowing in a high decile season, the yield data for the Minnipa Agricultural Centre farm and time of sowing for 2010 were collected. The data from the time of sowing trial for Wyalkatchem was also analysed. Wyalkatchem wheat was selected as it is the main variety grown and has an early-mid maturity range.

How was it done?

Minnipa Agricultural Centre Farm data

The farm yield data for paddocks sown with 50 kg/ha Wyalkatchem wheat were collected. Seeding dates ranged between 27 April and 13 May.

Minnipa Agricultural Centre Time of Sowing Trial

The Wyalkatchem data only is used in this section and was taken from the Time of Sowing trials conducted at MAC which included five varieties and two different soil types (see article 'Responsive Farming Using Wheat Agronomy' for more information).

The first rain for the growing season was 25 mm in late April, allowing TOS 1 to happen on the 4 May. TOS 2 occurred following 30 mm of rain on the 26 May. 60 mm of rain fell between 6-16 June with TOS 3 taking place on 18 June.

What Happened?

Minnipa Agricultural Centre Farm data

The farm paddock data shows a trend of a yield decline in paddocks even within a 3-4 week sowing period (Figure 1).

Minnipa Agricultural Centre Time of Sowing Trial

The results show even in a high rainfall season there was a significant yield penalty with later sowing. The early sowing resulted in the highest yield on both the good and medium soil type (Table 1 and Figure 1)

Farmers on the upper Eyre Peninsula were asked if they experienced any yield variation this season due to time of sowing. As this season was good many farmers felt the time of sowing was not as important and were happy with the yields. Many were able to sow the entire crop in a three to four week period and in some cases Wyalkatchem was sown within a week. Several could not quantify any difference or were not aware of any significant difference as other agronomical issues could have been factors. Weed control of Brome and Barley grass was cited as a real issue in some early sown crops (see article 'Barley Grass, an Emerging Weed Threat' – the impact of barley grass at time of sowing reduced yield from 4.16 t/ha to 2.53 t/ha).

Table 1 Medium soil type

Date sown	Yield (t/ha)	Protein (%)	Screenings (%)
4 May	5.0	11.8	1.0
26 May	4.1	11.9	1.0
18 June	3.5	12.6	0.8
Average Yield	4.2	12.1	0.9

Table 2 Good soil type

Date sown	Yield (t/ha)	Protein (%)	Screenings (%)
4 May	4.7	11.0	0.9
26 May	3.8	11.4	0.5
18 June	2.8	10.9	1.0
Average Yield	3.8	11.0	0.8

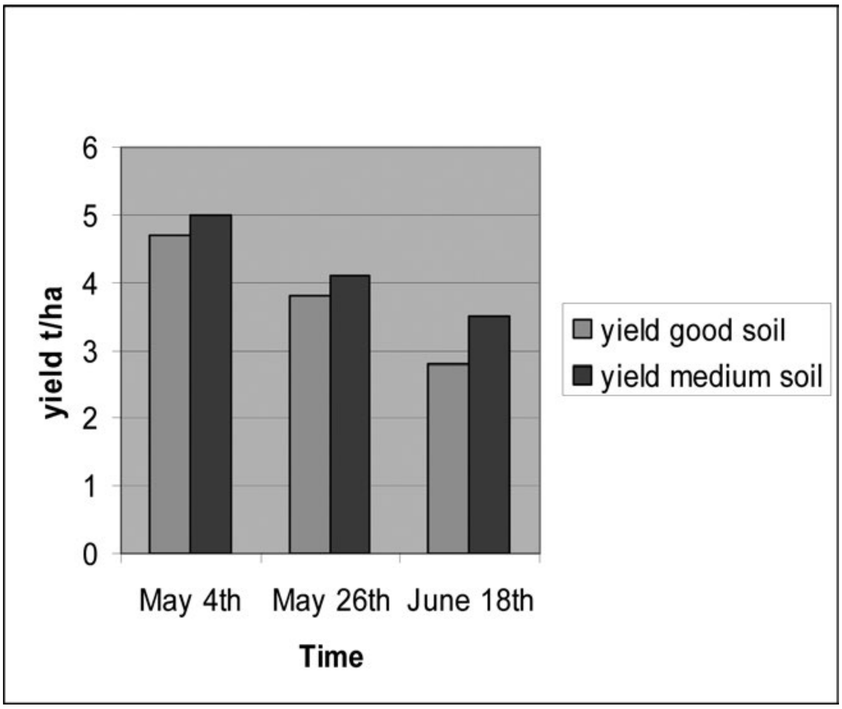

Figure 1 Time of sowing of Wyalkatchem, Minnipa 2009

Comments from different areas and individual farmers

Coorabie: Early March rains in the west created subsoil water and allowed earlier sowing than normal. Crops sown towards the end of April were still the highest yielding even though good follow up rains were sufficient throughout the year for crops sown into May.

Lock: “No significant difference. Sowed one farm first, the later had higher yielding crops but different soil type”. “Earlier sown crops had a definite advantage with yields ranging from 4 t/ha (early sown) to 2 t/ha although the last sown was not the worst. This year was less stubble than expected for yield. Extra nitrogen was needed to realise full yield potential on continuous cropped ground.”

Buckleboo: “We now include Axe and Gladius in the mix so wholesale sowing of Wyalkatchem has been reduced. In this situation timing not so much of an issue as the Wyalkatchem is sown in a few days.” Rather an awareness of sowing varieties to capture their potential has become a focus.

Wharminda: “Early sown crops, weeds were an issue and impacted on yield. Clean crops produced best yields, early sowing wasn’t the issue”. “Early sown weeds can be an issue but try to set up a portion of cropping land that can be sown early. Overall this season not a lot of difference in time of sowing compared with the last three”.

Wudinna: “The first paddock was the worst as it had a greater weed burden than anticipated. Overall the crops were reasonably even but would always advocate early sowing where possible.”

Minnipa: “I deliberately sow Wyalkatchem first even though touted as a shorter season variety it adjusts with better seasons. Sowing early doesn’t limit yield potential in a good season. I started sowing on 26 April and finished sowing on 10 May. Wyalkatchem was sown first and gave the best crop with a yield decline experienced from 4.3 to 3.7 t/ha from early to late sown (there could be some other agronomic factors with this as well)”. “With Wyalkatchem out-yielding Axe in the last 2 seasons poor and good it has been suggested Wyalkatchem will remain a prominent variety.”

What Does This Mean?

Although it was hard for farmers to quantify specific yield advantages many saw the early sown crops still had an advantage even with better growing conditions. Weeds were cited as a problem not only in the early sown crops, as weed germination continued to occur over a long period regardless of sowing date. Understanding the size and type of the weed seed bank, potential root disease, soil nutrition status and varieties all need to be considered before sowing.

The ability of many farmers to sow large quantities of hectares in a short period allows a greater optimum sowing time. The question “how early?” remains relevant and indications are that even in a better season the earlier sown still performed the best.

Responsive Farming Using Very Early Maturing Barley

Cathy Paterson[1], Stewart Coventry[2] and Jason Eglinton[2]
[1]SARDI, Minnipa Agricultural Centre, [2]University of Adelaide, Adelaide

RESEARCH

Searching for answers

Location: Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm
Yield
Potential: 5.6 t/ha (B)
Actual: 4.2 t/ha (Keel barley)
Paddock History
2008: Wheat
2007: Wheat
2006: Pasture
Soil Type
Red sandy loam
Plot size
12 x 1.48 m x 4 reps
Yield Limiting Factors
Net form of net blotch
Water Use
Water use efficiency:
improved by some breeding lines selected for early maturity

Key messages

- **WI3806-1 is an early maturing line equivalent to Keel in the good years and better in the bad ones.**
- **Very early maturing barley varieties will provide farmers with more cropping options.**

Why do the trial?

In environments where drought occurs with high frequency, early maturing varieties are an important management option and offer more flexibility for the farming system. Early maturing varieties also offer an option for more diverse weed management by late sowing in selected paddocks. A risk-minimisation approach which breeds for reliable performance in 'bad conditions' runs counter to the current approach of breeding for high yield potential in good conditions, with the aim of growing enough in the good seasons to 'ride out' the bad ones. In environments of the upper EP where yield is rarely above 3 t/ha, having a very early variety to capitalise on early moisture and provide a more reliable yield and reasonable grain quality even in extremely tough growing conditions is important. A very early maturing barley with good yields and high grain quality would be advantageous over current feed quality crops on the EP; ultimately a very early maturing export malting barley would be desirable.

A trial was sown to compare very early maturing feed and malting barley lines selected from the University of Adelaide Barley Program advanced yield trials. This trial is to compare these varieties with other adapted and current varieties, and to evaluate their specific adaptation to the upper EP environment. The lines ranged in maturity from equivalent to Schooner through to significantly earlier than Keel.

How was it done?

A medium (sandy clay loam) soil zone in paddock S1, MAC, was chosen to represent a typical district soil type. The plots received typical weed control and a fungicide was applied to control net form of net blotch. A small plot trial was sown on 26 May to compare very early maturing barley lines with other released varieties. Lines were sown at 55 kg/ha with 60 kg/ha DAP. Plots were replicated 4 times. Grain yield and quality were assessed.

What happened?

The trial was sown after 30 mm of rain on 25 May, with good follow up rains and a very soft finish to the season. Consequently the yields of most barley lines were above 3 t/ha with protein, screenings and test weight low. This trial showed the upper yield limits for these lines at Minnipa which can be compared to their specific adaptation to the low rainfall year of 2008.

In 2009 Keel was the highest yielding variety (Table 1). However WI3806-1, which performed the best under the 2008 drought conditions (EPFS Summary 2008 p 92), also performed well in 2009 in both yield and grain quality. There were some yield losses due to net form of net blotch in some varieties, especially in the susceptible varieties such as Maritime, despite a single fungicide spray. Most of the top performing lines were feed quality, with only WI4502 and BX04S;09MM1_2-004 yielding about the same as Keel. The latter line has putative frost tolerance but it also had lower test weight than Keel. Parent19 had the lowest test weight. In 2008, an extremely tough test for grain yield, the feed barley WI3806-1was the only line with higher yield than Keel. This means that WI3806-1 can yield as well as any of the best current feed barleys but is superior in very tough finishes.

The results of this trial are supported by previous data from Minnipa and nationally as shown in Table 2. This data shows that WI3806-1 has similar yield potential to current feed varieties but higher yields relative to other varieties as the seasons get tougher.

Table 1 Grain yield of very early maturing barley lines and released varieties at MAC in 2009 and 2008

Variety	2009 Yield (t/ha)	2009 Test weight (g/hL)	2008 Yield (t/ha) /description ^	2009 Zadoks[B]
Keel	4.24	74.7	0.26/E	59
WI4502*	4.19	73.6		53
WI4531	4.15	74.2		54
WI4541	4.15	74.7		53
BX04S;092MM1_2-004 ^ *	4.14	71.6	0.20/E	
WI4588 ^	4.12	72.2		53
WI3806/1	4.09	73.6	0.50/E	
WI4530	4.07	74.7		55
Hindmarsh	4.05	73.8	0.20/E	55
VB0828	4.05	73.9		55
Fleet	4.02	71.9	0.16/E	55
WI4484	4.00	71.8		52
WI4580	3.97	74.8		53
WI4587	3.96	73.7		54
WI4215	3.90	75.3	0.32/E	
VB0704	3.87	74.1	0.22/E	
WI4584	3.83	73.8		52
WI4540	3.84	74.8		52
WI4552	3.83	73.4		52
WI4468 ^ *	3.80	72.7	0.11/H	
WI4583 ^ *	3.80	72.1		54
Schooner	3.79	75.3	O.12/E	55
Parent19	3.77	64.5		
WI4465	3.73	75.0		56
WI4565 ^	3.65	73.1		51
WI4485	3.63	74.6		54
WI4582 ^ *	3.57	70.6		52
WI4534 ^ *	3.55	72.1		50
WI4438*	3.52	73.4	0.29/E	57
Yagan	3.44	71.3	0.34/F	
WI4025*	3.35	73.7	0.17/F	
Maritime	3.29	72.3		
WI4441 ^ *	2.97	72.4	0.04/H	
WI4506*	2.80	73.2	0.28/E	56
WI4440 ^ *	2.49	71.8		
Unicorn	1.61	72.8	0.12/F	
LSD (P = 0.05)	*0.60*	*1.9*	*0.09*	

*^ indicates lines with putative frost tolerance, *indicates malting quality lines. [A] Maturity score at MAC 2008: E = early, before flag leaf emergence, F = flag leaf emerged, H = head emerged [B] Zadok scores of lines in advance yield trials at Wagga*

Analysing a subset of national trials represented by <2 t/ha environments, WI3806-1 has superior yield, 1000-grain weight, screenings and grain plumpness, and these traits are stable in these environments. This national trend was also reflected in the trials at Minnipa in 2002 and 2003. However, WI3806-1 has lower test weight due to its large grain size. The reliability of these results and specific adaptation to the upper EP will be tested again in 2010.

Table 2 presents a comparison of yield and productivity of WI3806-1 and conventional barley varieties against check varieties during tough seasons at Minnipa in 2002, 2003, 2008 and contrasting them with a good year in 2009.

Table 2 Comparison of W13806/1 productivity and yield vs conventional barley line

Variety	**Yield Potential 2009**	**Productivity trait in <2 t/ha environments**				
		2008	**2002**	**2003**	**^ Performance**	***Stability**
WI3806 - 1	4.09	**0.50**	**2.20**	**1.42**	**2.24**	0.37
Keel	**4.24**	0.26	2.10	1.41	1.78	-1.88
Fleet	4.02	0.16	2.04	1.23	1.31	0.31
Schooner	3.79	0.12	1.73	1.09	0.67	0.33
Maritime	3.29		1.75	0.99	-0.14	**0.28**
WI3806 - 1			41.8	**44.6**	**1.76**	-0.35
Keel			35.3	33.6	0.85	-0.66
Fleet	**1000 - Grain weight**		**43.8**	42.0	0.97	1.30
Schooner			35.7	34.7	-0.88	**0.04**
Maritime			43.0	40.3	0.76	1.06
WI3806 - 1			68.0	68.2	0.09	0.30
Keel			69.5	69.3	0.93	-0.50
Fleet	**Test Weight**		68.3	68.1	0.65	-1.07
Schooner			**73.7**	**71.7**	**1.59**	0.42
Maritime			71.3	70.2	0.64	1.08
WI3806 - 1			**88.2**	**92.0**	**1.66**	0.95
Keel			80.9	90.7	1.27	0.80
Fleet	**Grain Plumpness**		76.1	68.2	0.92	-0.28
Schooner			64.9	58.9	0.27	-0.93
Maritime			**92.7**	**86.6**	**1.80**	**-0.24**
WI3801 - 1				**2.9**	-1.11	-0.24
Keel				4.1	-1.01	**-0.06**
Fleet	**Screenings**			**2.4**	-0.87	-0.32
Schooner				11.1	**0.06**	-0.58
Maritime				11.1	-0.81	-0.74

^ Performance and *Stability are relative values calculated from a genotype X environment analysis of 13 locations across Australia with site mean yield <2 t/ha from 1999-2004. Stable genotypes have stability value close to zero. Bold varieties and trait values represent those with superior productivity traits in short season environments.

What does this mean?

Growing very early maturing varieties does not maximise profit in good seasons because conventional varieties can outperform them, but they are likely to maintain better cash flow (and perhaps some profitability) even under extreme moisture stress as experienced in 2008. The 2009 season was an excellent production year and showed that the yield potential of the very early maturing lines may not be far behind the current varieties. The breeding line WI3806-1, a sister line to Fleet (pedigree = Mundah/Keel//Barque), is an excellent example; it has superior productivity (yield + grain quality) in low yielding environments and yield potential equivalent to Keel. WI3806-1 achieves this with the same early maturity as Keel. For now the early maturing line WI3806-1 is the current benchmark for productivity in the marginal environments. WI3806-1 has been subject to extensive field evaluation but has not been commercially released due to a lower level of resistance to net blotch compared to Fleet. Growing interest in using varieties as part of a risk management program for cropping enterprises may support the release of more early maturing varieties in the future. A barley variety specifically adapted to low rainfall environments will provide farmers more choice in their farming systems.

This trial will be repeated in 2010, but the number of lines will be reduced and time of sowing will be investigated to compare how varieties respond to delayed sowing time. This will enable a thorough investigation of yield stability and performance of these early maturing varieties with delayed seeding. Are they lines which are more suited for late breaks or for those paddocks in your program which are last sown? The best early maturing feed and malting lines, some with putative frost tolerance, will also be evaluated.

Acknowledgements

Thanks to Alison Frischke for setting up the trials and Wade Shepperd, Willie Shoobridge and Cilla King for technical assistance.

Row Direction and Stubble Cover

Amanda Cook and Wade Shepperd
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location: Minnipa Ag Centre
Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2009 Total: 421mm
2009 GSR: 333 mm
Yield
Potential: 5.2 t/ha (W)
Actual: 3.3 t/ha
(73% potential yield – N limiting)
Paddock History
2007: Barley
2006: Wheat
2005: Wheat
Soil
Red sandy loam

Key messages

- **E-W sowing direction yielded 0.24 t/ha higher than N-S on 18 cm row spacing in the 2009 season, despite consistent trends in the opposite direction over the last 4 years.**
- **Burning stubble (2005-08) yielded 0.2 t/ha higher than retained stubble at 3 t/ha, and had higher protein levels, also an opposite trend to previous years.**
- **Rhizoctonia was similar in all stubble treatments.**

Why do the trial?

A trial has been running at Minnipa since 2005 to investigate the effects of row direction, row spacing and stubble cover on grain yield and quality. The effect of row direction and stubble removal only on disease levels and yields was observed in 2009.

How was it done?

The trial at Minnipa Agricultural Centre has been sown with identical treatments from 2005 to 2008. The trial has three treatments, sowing direction (north-south vs east-west), row spacing (18, 23 and 30 cm) and stubble cover (retained vs burnt). In 2009 treatments were over-sown with 50 kg/ha of Clearfield Janz) with 50 kg/ha of 18:20 on 1 May all on 18 cm row spacing, as opposed to the previous 18, 23 and 30 cm row spacing treatments. Along with the comparative production from row direction and stubble removal the effect of carbon removal (burning) on the level of disease, mainly Rhizoctonia, was assessed as differences were observed in this trial in 2007 when the trial was sown to barley.

Visual disease levels were scored at 8 weeks, plots were harvested at maturity and grain quality was recorded.

What happened?

Do you really want to know – especially those who have moved to N-S sowing? In the 2009 season E-W sowing direction at 18 cm row spacing yielded higher than the N-S sowing direction (Table 2). The opposite has happened in a good season compared to the results in the run of poor seasons (Table 1). The burnt stubble system has also yielded higher than the retained stubble system and there were no visual differences in Rhizoctonia disease levels this season (Table 3).

Grain quality data showed protein and moisture was higher in the N-S sown grain compared to the E-W. Burning the stubble increased the grain protein level and decreased the screenings (Table 4).

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

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

Table 2 Effect of row direction on grain yield (t/ha) at Minnipa, 2009

Year	Row Direction		Yield Advantage of Sowing N-S	
	N-S	E-W	(kg/ha)	(%)
2009*	2.99	3.23	-240	-7.4
LSD (P = 0.05)	*0.13*			

**Sown at 18 cm spacing*

Table 3 Effect of stubble on grain yield (t/ha) at Minnipa, 2009

	Stubble Retained	Stubble Burnt
2009	3.02	3.19
LSD (P = 0.05)	*0.13*	

Table 4 Effect of sowing direction and stubble on grain quality at Minnipa, 2009

Row Spacing all 18cm		Protein (%)	Screenings (%)	Moisture (%)
Sowing Direction	N - S	9.45	2.9	10.48
	E - W	9.21	3.1	10.42
LSD (P=0.05)		*0.21*	*ns*	*0.04*
Stubble	Burnt	9.25	2.5	10.45
	Retained	9.20	3.4	10.44
LSD (P=0.05)		*0.21*	*0.5*	*ns*

What does this mean?

This season has been exceptional at Minnipa with an unusually wet growing season. The losses of soil moisture by evaporation this season has not been as critical as the previous 4 seasons. This season other factors such as increased light interception may have impacted on plant growth, final yield and grain quality.

The higher grain yield, increased protein and decreased screenings in the burnt stubble system is explained if nitrogen was the most limiting factor. The microbial population would also require nitrogen to breakdown the stubble carbon resulting in less being available for plant uptake. In the paddock next to this one, MAC N12, nitrogen was the limiting factor on yield with the added nitrogen treatments having the highest yields. The visual symptoms of Rhizoctonia were not significant this season but the crop was wheat, sown due to possible chemical residues after the low rainfall in 2008. Wheat does not show Rhizoctonia symptoms as readily as barley, which will be sown in 2010.

The 0.24 t/ha yield advantage of sowing E-W in the good season of 2009 has neutralised the yield advantage of sowing N-S in poor seasons. This data indicates the advantage in direction of sowing will depend on the season, the paddock shape and direction of sand hills.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Grains Research & Development Corporation

Responsive Farming Using VRT: Strip Grazing Barley at MAC 2009

Roy Latta and Mark Klante
SARDI, Minnipa Agricultural Centre

DEMO

Try this yourself now

Location: Minnipa Ag Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Paddock History
2008: Wheat

Soil Type
Red sandy loam

Plot size
Broadacre demonstration

Yield Limiting Factors
Nil

Livestock
Enterprise type: Self replacing merino
Stocking rate: 41 – 57 DSE/ha

Environmental Impacts
Soil Health
Soil structure: More even grazing
Compaction risk: Low

Social/Practice
Time (hrs): Set up fence
Clash with other farming operations: Standard management
Labour requirements: Labour to shift sheep

Economic
Infrastructure/operating inputs: Electric fence, portable trough
Cost of adoption risk: Low

Key messages

- **In 2009 47 ha of barley sown for feed at the break of the season sustained 300 ewes and lambs for 3 months during the period of late autumn-winter, a traditional period of pasture deficit.**
- **Hay freezing the forage crop ensures grass weeds are controlled.**
- **Use of strip grazing better utilises feed on hand and helps control erosion (especially around watering points).**

Why do the demonstration?

The aim of this demonstration was to provide early feed for stock in autumn, a time of year when pastures haven't established properly, and get ewes and lambs out of the confinement feedlot and onto good quality feed as soon as possible. The sheep had been agisted after the poor 2008 season as there was no paddock feed.

The paddock was sown to Maritime barley that was to be hay frozen in late winter, providing a grass freeing opportunity and a break in the rotation. There was no intent to harvest the crop. The demonstration measured the response in early feed production and utilisation to increased seeding rates and applied nitrogen.

The demonstration built on previous Eyre Peninsula Grain & Graze research and extension, highlighting the use of sown cereals for early feed, strip grazing and the importance of feed testing (EPFS Summary 2007, pg 75 and pg 84).

How was it done?

Paddock North 2 (area 55 ha) on Minnipa Agricultural Centre was the site. Barley was sown on 24 April at the commencement of 20 mm of rain over the period 23-28 April. Two treatments were applied to previous 2008 treatments in 9 m seeder strips across the whole paddock; 2008 high input – 2009 Maritime barley sown @ 90 kg/ha with DAP @ 30 kg/ha and 2008 standard and low input – 2009 Maritime barley @ 60 kg/ha with no fertiliser. Barley was direct drilled on 30 cm spacings with 12 inch sweeps and press wheels.

The paddock was split into three approximately equal sections using three wires of electric fencing to best utilise forage. Pasture cuts were taken prior to sheep being rotated into new sections from both the pre and post grazed sections to measure pasture growth rates and utilisation.

Three hundred lactating merino ewes with similar lamb numbers (approximately 3 DSE) were rotated between the 3 sections from 13 May until 9 August 2009. The paddocks were then sprayed to freeze grass seed set.

What happened?

Sheep were moved to another section once they had evenly grazed the section they were in. The sections were not completely grazed out, but had enough left to allow rapid plant recovery.

There were 140 barley plants/m^2 established in the high input treatment, 100 plants/m^2 in the low input. Total biomass produced until hay freezing (early August) was 6 t/ha in the high input strips and 4 t/ha in low input strips, an average growth rate of approximately 75 and 50 kg DM/ha/day respectively. The amount the animals utilised up to that point is presented in Table 1.

Table 1 Barley utilisation by 300 ewes and lambs in paddock N2 from 13 May until 19 August 2009

		2 June	29 June	18 July	9 August	Total
High input	Utilisation (t/ha)	0.6	1.2	1.7	1.7	5.2
Low input		0.3	0.7	1.4	1.3	3.7

Table 2 Gross margin summary of paddock N2 Minnipa Agriculture Centre, 2009

Section	High input	Low input
Area (ha)	13	27
Cost of pasture/ha ($/ha)*	50	30
DM utilised/ha	5.2	3.7
Grazing value (DSE/ha)	57	41
Gross Margin ($/ha)**	306	226

**Pasture costs included sowing inputs, herbicides and machinery expenses. Barley was valued at $200/t.*
***Grazing value was calculated by multiplying the DSE (based on 1kg DM/DSE/day) by $25 (estimated annual value/DSE) and dividing by 4 to adjust to proportion of year (3 months).*

Farming Systems

The positive gross margins in response to the high stocking rate show the opportunity to sustain a sheep flock over the winter feed gap.

What does this mean?

Sowing a paddock early to a cereal feed crop provided a valuable feed supply and gave the other pastures their best opportunity to establish themselves and have grass management before being utilised for grazing. Hay freezing the forage crop still ensured grass weed seed set was controlled.

The seasonal conditions provided the catalyst for the high production levels in 2009 but the general relationship remains between inputs and outcomes irrespective of the season.

Electric fencing was an effective means of dividing the paddock up for strip/controlled grazing. The stocking pressure was dramatically increased and, with close management, strip grazing was a more effective grazing strategy as selective grazing was reduced, feed was more evenly grazed and hence feed utilisation improved.

References

Grain & Graze, Free Food for Thought, Grazing Winter Crops Roadshow Workshop Notes
Eyre Peninsula Farming Systems Summary, 2007

Acknowledgements

Thanks to Brett McEvoy and Trent Brace for site management.

SARDI
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Grain & Graze Profit through knowledge EYRE PENINSULA

GRDC Grains Research & Development Corporation

The Impact of Livestock on Paddock Health

Roy Latta and Mark Klante
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location: Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm
Yield
Potential: 5.2 t/ha (W)
Actual: 4.5 t/ha (W)
Paddock History
2008: Wheat
2007: Wheat
2006: Wheat
Soil Type
Red sandy loam
Soil test
Organic C%: 1.18
Phosphorus: 28 mg/kg
Boron: often >12 ppm between 40-60 cm
Diseases
Low levels Rhizoctonia
Plot size
8 sowing widths across paddock
Yield Limiting Factors
Nil
Livestock
Enterprise type: Self replacing merinos
Stocking rate: District practice
Environmental Impacts
Soil Health
Soil structure: Stable
Disease levels: Med – High Rhizo, Low Crown Rot
Tillage type: No-till
Compaction risk: Low
Ground cover or plants/m^2: Grazed to 1 t/ha straw residue
Perennial or annual plants: Annual
Grazing Pressure: Low

continued next page...

Key messages

- **A long term trial was established at Minnipa Agricultural Centre (MAC) in 2008 to test whether general soil health and fertility can be increased under a higher carbon input system with well managed grazing.**

Why do the trial?

A well run mixed farming enterprise of cropping and livestock can be as profitable as a continuous cropping business for most districts across Eyre Peninsula, but carries less risk, as shown by a profitability analysis in the Eyre Peninsula Grain & Graze and Farming Systems projects. However, as livestock graze they remove large amounts of plant biomass which would otherwise have been ground cover then decomposed into the soil and thus contributed to the carbon pool.

In high rainfall areas the benefits of retaining stubble have been shown to improve soil carbon levels and microbial health. In low rainfall areas stubble retention helps reduce erosion and can help plant establishment in poor moisture conditions at sowing, but in an environment where biomass production, soil moisture and microbial activity levels are lower, a clear relationship with soil health is still to be established. Value adding to stubbles by grazing is usually regarded to be of greater economic value.

A broadacre trial was established on MAC to test whether soil health and fertility can be improved under a higher carbon input system with well managed grazing. This system is being compared against a more traditional ley (low input grazed) system, as well as ungrazed high input and low input systems.

How was it done?

Paddock South 7 on MAC was divided into 4 sections prior to seeding in 2008 (each 8 seeding runs wide) (Figure 1) and soil sampled at 4 points in each section; 0-60 cm for soil nutrients, constraints and water holding capacity, 0-10 cm for RDTS analysis, and 0-30 cm for carbon fractions (see Table 1 for treatments).

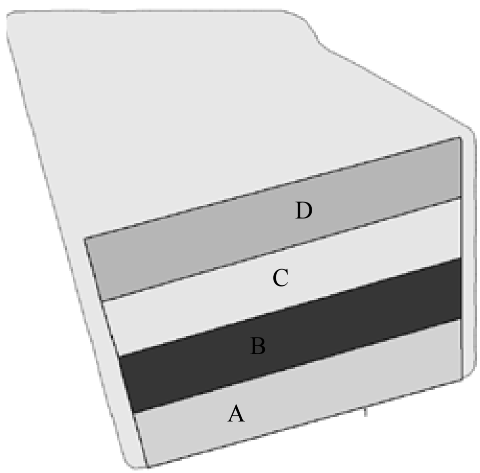

Figure 1 Paddock plan of carbon trial, south 7 MAC, 2008

Water Use
Runoff potential: Low
Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, NO_2, methane): Cropping and livestock
Social/Practice
Time (hrs): No extra
Clash with other farming operations: Standard practice
Labour requirements: Livestock will require supplementary feeding and regular checking
Economic
Infrastructure/operating inputs: High input system has higher input costs
Cost of adoption risk: Low

The intention at the start of 2009 was that treatments A and D would be grazed prior to sowing, however biomass production was so low in 2008 that any grazing would have constituted an erosion risk. It was decided to re-sow to wheat in 2009.

All treatments were direct drilled on 7 May 2009, with Wyalkatchem wheat. All sections received standard weed management throughout season. During the season quadrat cuts were taken at each sample point to assess early dry matter (DM) production and retained crop residue following harvest.

The trial was harvested using the farm header. Yields for each section were determined using yield map data, and grain samples were retained for quality analysis.

What happened?

2009 was the second year of the trial but the grazing treatments are yet to be instituted. The 4 treatments presented in Table 2 represent only traditional and high input systems as no grazing has occurred. The high input system has been more productive in all measured variables. Early DM 2.7 vs 2.1 t/ha, grain yield 4.5 vs 4.1, protein 9.8 vs 9.6, crop residue 4.2 vs 3.2 t/ha.

What does this mean?

The 2009 production has provided the opportunity for grazing over the 2009/10 summer to commence comparative grazing treatments.

Over the next few seasons appropriate analysis will be carried out to measure any changes to soil or crop performance in the farming systems, followed by financial assessment to evaluate the merits of each system.

Acknowledgements

We gratefully acknowledge the help of Wade Shepperd, Trent Brace and Brenton Spriggs for their technical assistance.

Table 1 Treatment applied at South 7 carbon management trial, MAC 2009

System	Wheat Sowing Rate (kg/ha)	Nutrients Applied in 2008 (kg/ha)
Traditional ley system - grazed (A)	50	7 kg N, 8 kg P applied as 40 kg/ha DAP
Traditional ley system - ungrazed (B)	50	
High carbon input system - ungrazed (C)	70	25 kg N, 12 kg P applied as 60 kg/ha DAP + 67.5 kg/ha Ammonium Sulphate
High carbon input system - grazed (D)	70	

Table 2 Crop performance in carbon management trial, 2009

System	Early DM (t/ha)	Grain Yield (t/ha)	Protein (%)	WUE* (kg/ha/mm)	Crop residue (t/ha)
Traditional ley system - grazed (A)	2.1	4	9.8	18	2.9
Traditional ley system - ungrazed (B)	2.1	4.1	9.3	19	3.5
High input system - ungrazed (C)	2.4	4.4	10.1	20	4.7
High input system - grazed (D)	2.9	4.5	9.5	20	3.6

** WUE, water use efficiency figures do not take into account available stored soil water utilised.*
Screenings from all treatments were < 2% and test weights > 83 kg/hL.

Minnipa Farming Systems Competition

DEMO

Michael Bennet[1], Andy Bates[2] and Bruce Heddle[3]

[1]SARDI, Minnipa Agricultural Centre, [2]Consultant, Streaky Bay, [3]Farmer, Minnipa

Best Practice

Location: Minnipa Ag Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Yield
Potential: 5.2 t/ha (W)
Actual: 4.6 t/ha (W)
Potential: 13.5 t/ha (hay)
Actual: 5.3 t/ha (hay)

Soil Type
Red clay loam

Plot size
2.5 ha

Yield Limiting Factors
Poor agronomy!

Key messages

- **District Practice beat the farmers for grain yield and profit!**
- **Researchers may blitz the field yet, just watch this space…**
- **Oh, and by the way, the farmers are still winning, just.**

Why do the trial?

The Farming Systems Competition, sponsored by Glencore Grain, was inaugurated in 2000 to compare the impact of four different management strategies on production, profitability and sustainability at the Minnipa Agricultural Centre.

How was it done?

The competition is divided in to four separate teams, local heroes (researchers), local growers, local consultants and district practice. Each team has been allocated a separate 2.5 hectare paddock to assign management as the team sees fit.

What happened?

What happened? Hmm, well it rained, and quite a bit really! Finally the competition was run in a season above decile 1. Actually it was closer to decile 10, which was an exciting change from the previous run of seasons. However, low risk strategies (except for the researchers) were the name of the game again. The consultants proceeded with a low input hay crop, whilst the district practice and farmer plots were sown to wheat. Being bold, the researchers put their necks on the chopping block AGAIN and let their paddock regenerate Angel medic.

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.

For many farmers in this area, 2009 was the year of a lifetime and due to some good luck we were able to capitalise on a rare opportunity.

What did we learn last year?

After a copybook start, we managed to establish a wonderful crop of barley grass before the wheat even had a chance to emerge, so a bit of a gamble with some glyphosate and the prickle chain turned out to be very profitable. Growing extraordinary crops with no or low inputs after three droughts, with modest weed burdens, almost no disease, low residue burdens, excellent soil moisture reserves and high levels of accumulated fertility didn't really pose much of a challenge – it just happened.

2010 Plans

This season will need a different approach – grass burdens will be harder to manage, the residue burden is enormous and will consume a significant amount of nitrogen, at this stage we have no moisture reserve and it seems we'll have to live with depressed commodity prices. To persevere with a continuous cereal system will require serious commitment, and if we get it wrong it will be very easy to squander the bonus of the crop just gone. So this year, we will delay our decision making for as long as possible. At least we have some accumulated reserves to allow us to be flexible. Never before has the 'KISS' principle seemed so attractive – 'keep it simple stupid'.

Perhaps more pressing than deciding our approach to the year ahead is the job of reviewing the records from the last ten years and taking another set of soil health measurements. Maybe hidden in those records are some very major lessons about the challenge of achieving profitability with sustainability and the role of sheer luck in farming!

Table 1 Farming Systems Competition Summary 2001 - 2009

Year	Date	Farmers	Consultants	Researchers	District Practice
2001		Yitpi wheat Yield: 2.75 t/ha GM = $600/ha	Yitpi wheat Yield: 2.77 t/ha GM = $572/ha	Frame wheat Cut for hay GM = $207/ha	Yitpi wheat Yield: 2.79 t/ha GM = $575/ha
2002		Krichauff wheat Yield: 1.48 t/ha GM = $316/ha	Krichauff wheat Yield: 1.25 t/ha GM = $231/ha	Bargue barley Yield: 1.36 t/ha GM = $195/ha	Grazed pasture GM = $4/ha
2003		Krichauff wheat Yield: 1.21 t/ha GM = $163/ha	Krichauff wheat Yield: 0.99 t/ha GM = $118/ha	Rivette canola Yield: 0.50 t/ha GM = $90/ha	Yitpi wheat Yield: 0.85 t/ha GM = $117/ha
2004		Wyalkatchem wheat Yield: 1.01 t/ha GM = $84/ha	Keel barley Yield: 1.35 t/ha GM = $67/ha	Yitpi wheat Yield: 1.25 t/ha GM = $132/ha	Krichauff wheat Yield: 0.82 t/ha GM = $41/ha
2005		Toreador medic 793 grazing days GM = $11/ha	Kaspa peas Yield: 1.57 t/ha GM = $ 83/ha	Wyalkatchem wheat Yield: 1.98 t/ha GM = $108/ha	Regenerated pasture 764 grazing days GM = $53/ha
2006		Wyalkatchem wheat Yield: 0.71 t/ha GM = $26/ha	Wyalkatchem wheat Yield: 0.81 t/ha GM = $22/ha	Angel Medic GM = $166/ha	Wyalkatchem wheat Yield: 0.60 t/ha GM = $1/ha
2007		Wyalkatchem wheat Yield: 0.86 t/ha GM = $215/ha	Wyalkatchem wheat Yield: 1.22 t/ha GM = $345/ha	Angel Medic GM = $0	Wyalkatchem wheat Yield: 0.52 t/ha GM = $78/ha
2008		81 small squares of barley grass hay GM = $119/ha	180 Grazing Days GM = $52/ha	0.46 t/ha Gladius Seed GM = $70/ha	49 small squares of canola hay GM = $70/ha
Running gross margin after 2008		$1477/ha	$1364/ha	$573/ha	$921/ha
2009	1 Feb	Paraquat @ 800ml/ ha + Oil 100ml/ha	Paraquat @ 800ml/ ha + Oil 100ml/ha	Paraquat @ 800ml/ha + Oil 100ml/ha	Paraquat @ 800ml/ha + Oil 100ml/ha
	1 April		Paraquat @ 800 ml/ha		Paraquat @ 1 L/ha + oil @ 100 ml/ha
	30 April	Roundup powermax @ 600 ml/ha	Diuron @ 300 g/ha		Trifluralin @ 800 ml/ha
	30 April	Gladius @ 50 kg/ha + 18:20 @ 35 kg/ha	Winteroo Oats @ 70 kg/ha		Wyalkatchem @ 50 kg/ha + DAP @ 45 kg/ha
	8 May	Roundup powermax @ 600 ml/ha + Prickle Chained (1 day later)			
	22 June	Zinc Sulphate @ 3 L/ha		25 g/ha Broadstrike + 0.5% Uptake	MCPA LVE @ 500 ml/ha + Affinity @ 50 g/ha + Zinc Sulphate @ 3 L/ha
				300 ml/ha Select + 0.5% Hasten	
	4 Sept		Cut for Hay	Grazed by 230 hoggets for 14 days	
		Gladius wheat Yield: 4.39 t/ha, Prot: 10% ASW GM = $620/ha	40 Rolls of hay Yield: 5.37 t/ha GM = $461/ha	1325 Grazing days/ha GM = $58/ha	Wyalkatchem Wheat Yield: 4.61 t/ha, Prot: 10% ASW GM = $631/ha
Running gross margin after 2009		$2,097/ha	$1,825/ha	$631/ha	$1,552/ha

Farming Systems

TEAM 2

The Consultants (De$parately $eeking $olutions)

Team Motto: If we get trounced, please blame Ed Hunt.

What did we learn last year?

2009 was a grass control year for the consultant paddock. In fact, 2008 was meant to be the grass control year, but staffing, sabotage and communication issues resulted in our oaten hay being left standing in the paddock with zero grass seed set control. This was unfortunate as we missed an opportunity to sow wheat in a very productive season.

Oaten hay was once again chosen as the most appropriate tool to achieve a high level of grass control. After the hay was removed from the paddock, a non-selective herbicide was applied to prevent seed set in the surviving barley grass. Medic is considered at low density in this paddock. It was "encouraged" to set seed in the hay crop to boost seed reserves so that a pasture option can be utilized in the future.

2010 Plans

Any stored soil moisture will be conserved through appropriate summer weed control, especially if the rain falls after early February.

Barley grass will still be an issue in 2010. No seed set control occurred in 2008, so seed reserves are still at high levels in the paddock.

It is likely that wheat, possibly Mace, will be sown after excellent grass control at the start of the season. Input costs will be carefully monitored, especially if poor commodity prices are predicted. Depending on summer rainfall, some soil testing for N and P may take place to help guide fertiliser application.

TEAM 3

The Researchers (Starship Enterprise)

Team Motto: Boldly going where no man has gone before.

What did we learn last year?

Just for something different, the researchers allowed their Angel medic to regenerate again to have one last crack at a profitable medic pasture. A half respectable stand of medic germinated with the rain in March, although the decision to keep the medic (and not spray it out for sowing wheat) was not made until a subsequent germination of medic came through with the ANZAC day rain. Plenty of "Boo and Hiss" was endured by the author during the growing season. "What were you thinking, why didn't you sow wheat" was asked plenty of times at the smoko table!

Marshmallow proved very difficult to control within the pasture phase. The application of 25 g/ha Broadstrike was only successful in slowing the weed down unfortunately. An earlier timing could have allowed for better control of the difficult weed.

The paddock produced a very good stand of medic pasture which kept 230 hoggets fed for two separate grazings of 7 days. The ultimate aim of the exercise was to harvest the paddock for pasture seed. Our resident medic expert Roy Latta estimates the paddock yielding between 300 and 500 kg/ha of pure seed. This could prove a profitable exercise, now all we need to do is harvest the stuff…

2010 Plans

Harvest huge amount of medic seed, watch paddock drift while booking the overseas holiday.

Agronomically, the discussion began at smoko on the first working day of 2010 as what to do with the paddock. The senior management at MAC are keen to use a canola crop to soak up some of the abundant nitrogen which our medic should have produced. The author (and the rest of the MAC staff) however, is keen for a cereal crop to start to return the paddock back to good soil cover levels and hopefully kill the pig with profitability! Time will tell who prevails!

Acknowledgements

This competition would not be possible without the work of the long suffering farm staff, Mark Klante, Brett McEvoy and Trent Brace. Special thanks to Glencore Grain for helping financially support the ailing teams (i.e. researchers) keep their operations in the black!

Crop Sequencing Initiative in Southern Australia

INFORMATION

Nigel Wilhelm and Geoff Thomas
GRDC funded Low Rainfall Collaboration Project

Farming Systems

Background

In low rainfall regions of south-eastern Australia broad-leaf crops make up only a very small proportion of the total area of sown crops. In the Victorian, South Australian and New South Wales Mallee regions with <350 mm of annual rainfall, less than 5% of farmers grew grain legumes or oilseeds. Although pulse and canola cropping has declined, 65-70% of grain producers in the southern region still grow pastures in rotation with crops. Many of these pastures tend to have variable and low legume contents, are currently dominated by annual species (grasses and weeds), may be of little benefit to following crops and can support many major cereal diseases.

Farmers have increasingly adopted continuous cereal cropping strategies as non-cereal crops are perceived as riskier than cereals due to greater yield and price fluctuations. Generally higher input costs have reduced all cropping gross margins. Reduced profitability and interest in livestock enterprises have also increased cropping intensities. There is a need for non-cereal crop and pasture options to provide profitable rotational crops, disease breaks and weed control opportunities for cereal production. The current alternative to cereals, poor performing volunteer annual grass dominant pastures, are havens for cereal pests and disease and often seen as having a negative impact on subsequent cereal yields and quality.

GRDC have recognised that there are many paddocks throughout the cropping zone of Australia which must be rotated away from cereals for a sustainable industry, but viable alternatives are not clear in many environments. GRDC want to improve on-farm crop sequencing decisions across the grain belt through a combination of tactical and strategic farming systems RD&E.

The two key objectives of this program are:

1. To achieve quantitative and measurable improvements in crop production, farm profitability and resource condition by appropriate crop sequencing within five years.
2. To facilitate capacity building and empowerment of the agricultural community across the region to participate in RD&E, access information and training and benefit from the full spectrum of GRDC-supported research.

The GRDC is looking to invest up to $9 million over the next 5 years in projects under this initiative, targeted at identifying the specific farming systems questions associated with managing complex crop sequencing regimes and aligning the focus of the RD&E work to address and support the associated decision making process. This program of new activities will commence in mid 2010 and the program will operate for five years (some projects however may be of shorter duration).

The GRDC will manage its investments as a suite of integrated projects, and project teams will be required to meet regularly to share skills, data and ideas and to present and discuss their findings. Seven projects are now being developed up across the nation to address this issue. A coordinating position will also be funded to facilitate the development of strong and effective linkages between all projects and integrate findings for the benefit of all regions, not just those under direct investigation.

The Low Rainfall Collaboration project submitted one of these successful proposals for investigations across the low rainfall zone. The project will be managed by the low rainfall collaborative project but will be a collaborative effort between all Low Rainfall Farming System groups. The outcome from the successful conduct of this proposal will be more reliable and more productive low rainfall farming systems through the increased use of less risky broad leaved break phases. This will be achieved through the promotion of the following outputs from the proposal in low rainfall regions of south eastern Australia:

1. More reliable management strategies for the production of broad leaved phases.
2. Identification of more reliable break phase options.
3. Guidelines to identify trigger points for when, for how long and which break phases to use for improved farming systems outcomes.
4. Reliable estimation of risks with break phases as well as their total impacts on following cereal crops.

Acknowledgements

GRDC are providing the primary funding for this initiative.

GRDC Grains Research & Development Corporation

Section Editor:
Roy Latta
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Section 5

Tillage

No-Till on Stony Soils

Michael Bennet
SARDI/SANTFA, Minnipa Agricultural Centre

RESEARCH

Almost ready

Location: Lock
Rex Glover
Lock Ag Bureau

Rainfall
Av. Annual: 340 mm
Av. GSR: 260 mm
2009 Total: 356 mm
2009 GSR: 315 mm

Yield
Potential: 4.2 t/ha (W)
Actual: 2.1 t/ha (W)

Paddock History
2008: Wheat

Soil Type
Calcareous clay loam and shallow limestone ridge.

Plot size
80 m x 1.5 m x 4 reps

Yield Limiting Factors
Late sowing

Key messages

- **Wheat established by no-till yielded at least as well as full cut sowing on stony soils in 2009.**
- **Seed scattered on soil surface germinated at Lock in 2009!**
- **Hydraulic tines, K-Hart discs and Canadian designed points are excellent options for no-till on stony soils.**

Why do the trial?

No-till crop establishment in stony soil can be difficult, particularly when using knife point systems with spring tines. Maintaining the balance between optimal seed placement, whilst minimising damage to machinery over stony reefs is a challenge. This is the third in a series of trials investigating options for no-till sowing in stony soils. Previous results can be found in EPFS 2007, p 174 and EPFS 2008, p 51.

How was it done?

The trial was sown at Lock using a 6 row plot seeder set on 254 mm row spacing. Wyalkatchem wheat was sown at 60 kg/ha with 60 kg/ha of DAP banded with the seed.

The trial was sown into excellent moisture conditions on 27-28 May over a limestone ridge and a calcareous clay loam, so a comparison of seeding systems could be made over both soil types.

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

Similar treatments were used in 2009 as in the 2008 trial at Port Kenny. They included the K-Hart disc, Rock Hopper, Agpoint, Agmaster, 250 mm Sweeps, Conservapak and DBS systems. Three Canadian designed front delivery points, the standard Atom-Jet, Atom-Jet Mallee point and the Bourgault front delivery point were also tested.

The sowing system of Agmaster points and Agmor Boots was used as a standard control, with which several sowing variations were trialled, working shallow, working deep, using snake chains, using Agmaster wing points and sowing at 10 km/h.

All treatments were sown at 6 km/h however two contrasts were made with the disc and knife point system to see if sowing at 10 km/h would have any adverse effects to seed placement.

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

What happened?

The crop established well with excellent moisture at sowing. The conditions were moist enough after sowing that seed which was scattered on the surface when the tines were breaking out was able to germinate, establish a root system and a viable plant.

Most sowing systems maintained sowing depth greater than 20 mm in the stony soil. The Agpoint + Agmor system was shallower due to incorrect setup of the Agmor boot, which was rectified in the subsequent treatments. The Agmaster wing point + Agmor boot, Agmaster point + Agmor boot, Agmaster point + Agmaster Flexi-boot, and Atom-Jet Mallee point all had shallower seed placement in the stony soil. All other systems were able to maintain similar seed placement in both soil types.

There were no significant differences in crop emergence measured on the deeper soil. On the stony soil, however there were some differences observed. The Agpoint + Agmor boot system was one of the poorer emerging treatments, most likely due to shallow seed placement from incorrect boot setup. K-Hart discs at 10 km/h, Agmaster points + Agmor boots at 10 km/h, Rock Hopper + Agmor boots, Agmaster points + Agmor boots, Agmaster wing points + Agmor boots, Agmaster points + Agmor Boots + snake chains, Agmaster points + Agmor boots working shallow, sweeps + harrows, Atom-Jet and DBS had higher levels of crop emergence on the stony soil than the remaining treatments (Table1).

Increasing sowing speed from 6 to 10 km/h with the K-Hart disc and Agmaster and Agmor systems did not have any impact on seed placement or crop emergence, however the faster sowing speed resulted in a much more violent breaking out of tines over stone. This would have a significant impact on machinery maintenance. The disc system yielded the same with both sowing speeds, however the Agmaster + Agmor system suffered a yield penalty for faster sowing speed on the deep soil, but not on the stony soil.

In terms of grain yield achieved on the stony soil, the DBS system performed better than the Conservapak, Agmaster points + Agmor boots, Agmaster points + Agmor boots @ 10 km/h, Agmaster points + Agmaster Flexi Boot, Atom-Jet Mallee point and sweeps + harrows treatments (Table 1).

The DBS system and Agmaster point + Agmor boot working deep treatments yielded more than the Atom-Jet Mallee point system and the sweeps + Agmor boot systems.

Shallower working of the Agmaster + Agmor system (i.e. lifting machine out over stony reefs) resulted in seed placement on the stony soil reducing from 30 mm to 17.8 mm. There were no differences in crop emergence for the shallower seed placement or final grain yield.

There were no benefits or penalties for working the points deeper in either soil type.

The addition of snake chains did not increase seed depth or contribute to any difference in crop emergence. Using snake chains, however did result in a yield reduction on the deep soil, however there was no differences on the stony soil.

The K-Hart discs performed as well as the tine treatments for crop establishment on both soil types. The slower sowing speed resulted in a lower grain yield than the best tine systems on the deep soil, but the discs performed as well as the best tine systems on the stony soil. At the faster (more typical) travel speed, the discs grew as much grain as the best tine systems on the deep soil type.

What does this mean?

All of the no-till treatments yielded at least as well as the full cut treatment, which by default guarantees some soil on the top of seed in stony soil which can be an advantage.

The Atom-Jet concept of a front delivery point system has the most merit on stony soils. The shallower working depth is ideally situated for sowing in to stony soils, as less steel is in the ground. The standard Atom-Jet point and the similar Bourgault design yielded similarly to the highest yielding treatments in the trial on stony soil.

The K-Hart disc performed well in 2009, which is a viable option for growers to reduce their downtime at seeding, increase their overall work rate with faster travel speed, as well as reduce the amount of stone brought to the surface by tines.

Table 1 Seeding system impact on wheat performance on stony and deep soil at Lock, 2009

Opener	Technology	Other sowing treatments	Emergence Depth (mm)		Emergence (plants/m^2)		Grain Yield (t/ha)	
			Soil	Stone	Soil	Stone	Soil	Stone
K-Hart		6 km/h	30	28	155	121	1.85	1.12
K-Hart		10 km/h	26	30	172	157	1.91	1.14
Rock Hopper	Agmor		19	23	143	147	1.89	1.13
Agpoint	Agmor		23	19	137	90	1.62	1.09
Agmaster	Agmor	Wing Point	44	29	150	142	1.96	1.11
Agmaster	Agmor		48	30	148	144	2.08	1.04
Agmaster	Agmor	10 km/h	42	34	157	149	1.52	1.01
Agmaster	Agmor	10mm Snake Chains	43	39	169	141	1.79	1.19
Agmaster	Agmor	Work Deep	39	28	176	115	1.73	1.23
Sweeps	Agmor	Star Harrows	53	54	140	138	1.68	0.98
Agmaster	Agmaster Flexi-Boot		48	32	118	122	1.60	1.01
Agmaster	Agmor	Work Shallow	31	17	152	141	1.89	1.16
Atom-Jet	Front delivery boot		46	35	165	126	2.05	1.17
Atom-Jet Mallee	Front delivery boot		43	29	165	109	1.60	0.99
Bourgault	Front delivery boot		54	43	172	114	1.92	1.10
Conservapak			54	49	129	105	1.62	1.05
DBS			29	34	156	123	2.10	1.28
LSD ($P \leq 0.05$)			*13*		*ns*	*39*	*0.22*	

Hydraulic tines are an obvious choice for growers looking to optimise their seeding success in stony soils. The DBS system utilises hydraulic tines, which was one of the higher yielding treatments sown. Growers have overcome serious delays at seeding time through downtime with the use of hydraulic tines. Whilst searching for a suitable site for the stony soils trials, the author saw some rocky country which is sown with knife points and hydraulic tines (with minimal breakdowns) which must have been a horrible nightmare with spring tines.

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

Regardless of seeding system chosen for stony soil, it is critical to optimise seed placement on deep soil as well as provide adequate backfill on shallow ground to maintain seed depth so that an acceptable result can be achieved on all soil types. The seeding system also needs to be robust enough to take the wear of sowing into stone. This can be a challenge and is where the advantage of a hydraulic tine or disc system is greatest.

Acknowledgements

Thanks to SANTFA sponsors, CASE IH, Flexi-Coil, Agmaster, K-Hart, Atom-Jet, Agpoint and Kelbro Machinery for trial equipment. Thanks to Matthew Cook for braving his spring tines in the stony conditions again! Thanks to Jack Desbiolles for help with trial design. Thanks to Brenton Spriggs, Wade Shepperd, Liam Cook and Willie Shoobridge for trial assistance. Special thanks to Rex Glover for the use of his land for the trial. Thanks also to all the growers who had input in to the treatments for this trial.

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SANTFA SOUTH AUSTRALIAN NO-TILL FARMERS ASSOCIATION

CARING FOR OUR COUNTRY

Improving Fertiliser Utilisation in No-till Systems

Michael Bennet
SARDI/SANTFA, Minnipa Agricultural Centre

RESEARCH

Almost ready

Location: Port Kenny
Nathan Little
Mt Cooper Ag Bureau

Rainfall
Av. Annual: 375 mm
Av. GSR: 305 mm
2009 Total: 393 mm
2009 GSR: 354 mm

Yield
Potential: 4.9 t/ha
Actual: 3.2 t/ha

Paddock History
2008: Wheat
2007: Barley
2006: Wheat

Soil Type
Grey calcareous loam

Plot size
24 m x 1.5 m x 4 reps

Yield Limiting Factors
Nitrogen deficiency

Key message

- **No measured improvement in phosphorus uptake through low seed bed utilisation systems.**

Why do the trial?

The price of fertiliser over the past four seasons is not something which has escaped the attention of the farming industry. Necessity being the mother of invention, the concept of increasing fertiliser uptake within the cropping system is attractive to growers everywhere.

Seed Bed Utilisation (SBU) is the seed and fertiliser spread width within the crop row divided by the row spacing. It refers to the relative spread of the crop row and the width of the inter-row where no crop is sown. In high SBU systems, the seed and fertiliser are spread over a larger area and fertiliser toxicity is unlikely. Lower SBU systems, however, concentrate the seed and fertiliser into distinct rows which are subject to fertiliser toxicity constraints.

Generally as SBU increases, yield increases. A trend towards lower yield will be generally found when SBU is decreased in the absence of other agronomic constraints such as stubble handling, pre-emergence herbicides and sowing speed. As SBU increases, however, concentration of fertiliser granules in the crop row decreases.

As farmers have been reducing fertiliser inputs over the past few years, the risk of fertiliser toxicity has declined, providing an opportunity to use low SBU systems. The trial concept was to use the increased concentration of fertiliser granules in low SBU systems to measure any advantage of fertiliser uptake. Although the crop will uptake much of its nutrient requirements from historical phosphorus application, if the fertiliser concentration within the row is increased, then a greater opportunity for the crop to access the nutrition is possible.

How was it done?

The SBU combinations were accomplished by using three planting options with differing levels of seed spread. Seed spread of 40 mm and 65 mm was achieved using knife points and Agmaster boots. 5 mm seed spread was achieved using Yetter wavy coulters and K-Hart v-paired discs. The three sowing systems were each set on 203 mm, 254 mm and 304 mm row spacing to provide a range of SBU ratings from 3 to 32 %.

Triple super (0:20:0) was used to deliver 5 and 10 kg/ha of phosphorus. Triple super was chosen as the product for the trial to avoid confounding the results with nitrogen rates when fertiliser rates were increased to the 10 kg/ha P level. Wyalkatchem wheat was sown at 50 kg/ha for a target population of 150 plants/m^2.

Comparisons of 5 and 10 kg/ha were made for all seeding systems and row spacing combinations, however 0 kg/P was only compared at 254 mm row spacings.

A grey calcareous soil with high yield potential was chosen at Port Kenny for the trial. The soil test returned a value of 38 mg/kg of Colwell P. The trial was sown into adequate moisture conditions on 19-20 May.

Dry matter assessments were made on 18 August, to see if the SBU and P rates had an impact on early vegetative growth.

What happened?

Of the seeding systems, the K-Hart had the best early vigour and looked promising throughout the season, producing the most early dry matter/ha. The K-Hart system yielded more than the knife point systems, and the 40 mm closer plate system yielded more than the 65 mm closer plate system.

Row spacing had an influence on early dry matter results (Table 1). 304 mm and 254 mm row spacing resulted in more dry matter/ha than the 203 mm treatments (Table 2). Following through to final grain yield, the 254 mm treatments yielded more than the 202 and 304 mm treatments. The 304 mm treatments did not follow the early dry matter through to final grain yield and yielded less than the narrower row spacings.

A comparison between 0, 5 and 10 kg/ha P was only made on 254 mm row spacing. No differences were measured in early crop growth or final grain yield (Table 3).

Table 4 summarises the seeding system and row spacing interactions to final grain yield. No trends related to row spacing and seeding system (SBU) were observed. The 65 mm closer plate seeding system yielded less than most systems when used on 203 or 304 mm row spacing.

Table 1 Seeding system effect on grain yield and dry matter

	Early DM (t/ha)	Grain Yield (t/ha)
K-Hart	1.63	3.12
40 mm	1.12	2.99
65 mm	1.18	2.90
LSD (P=0.05)	*0.13*	*0.09*

Table 2 Row spacing impact on grain yield and dry matter

Row Spacing (mm)	Early DM (t/ha)	Grain Yield (t/ha)
203 mm	1.20 b	2.99 b
254 mm	1.35 a	3.11 a
304 mm	1.39 a	2.89 c
LSD (P=0.05)	*0.09*	*0.06*

Treatments followed by the same letter are not significantly different

Table 3 Seeding systems and P response on grain yield at 254 mm spacing

Sowing System	Nil P (t/ha)	5 kg/ha (t/ha)	10 kg/ha P (t/ha)
40 mm	3.03	2.93	3.15
65 mm	3.02	3.13	3.24
K-Hart	3.10	3.05	3.19

Table 4 Row spacing and seeding system effect on grain yield

Row Spacing (mm)	Seeding System	Grain Yield (t/ha)
254	65 mm	3.18 a
203	K-Hart	3.13 a
254	K-Hart	3.12 a
304	K-Hart	3.09 a
203	40 mm	3.04 a
254	40 mm	3.03 a
304	40 mm	2.88 b
203	65 mm	2.80 bc
304	65 mm	2.70 c
LSD (P=0.05)		*0.15*

Treatments followed by the same letter are not significantly different

What does this mean?

The yield differences measured between treatments was not due directly to increased P efficiency within the crop row, unlike the original hypothesis suggested. This may be due to various factors, the site did run out of nitrogen later in the season, as the low (9%) grain protein indicates. This may have made nitrogen the limiting factor and the crop was only able to utilise the P until it ran out of nitrogen.

The concept of reducing SBU may simply not add enough efficiency to make a discernable difference in final grain yield, however given the poor response to the three P rates across all treatments, it is difficult to draw conclusions yet. Like all good research, it requires further work!

Acknowledgements

Thanks to Nathan Little for the use of his land. Thanks to Brenton Spriggs for his untiring help, especially at seeding time (3 days in one paddock is a little much)! Thanks to SANTFA sponsors CASE IH, Yetter, K-Hart, Flexi Coil and Agmaster for supplying equipment for the trial. Thanks to Jack Desbiolles from AMRDC, Uni SA for his input in to the trial.

Managing Water Repellent Sands

Michael Bennet
SARDI/SANTFA, Minnipa Agricultural Centre

RESEARCH

Almost ready

Location: Wharminda
Tim Ottens
Wharminda/Arno Bay Ag Bureau

Rainfall
Av. Annual: 322 mm
Av. GSR: 222 mm
2009 Total: 283 mm
2009 GSR: 245 mm

Yield
Potential: 2.7 t/ha (W)
Actual: 1.4 t/ha (W)

Paddock History
2008: Medic pasture
2007: Wheat
2006: Medic pasture

Soil Type
Deep siliceous sand
24 m x 1.5 m x 4 reps

Yield Limiting Factors
Late sowing and nitrogen deficiency

Key messages

- **Incorporating seed behind press wheels resulted in the best crop establishment and one of the higher yields.**
- **A split application of seed, some broadcast in front of the seeder and some sown through the seeding boots shows promise.**
- **Soil wetters were ineffective for increasing emergence or grain yield.**

Why do the trial?

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

This is the fourth season of sowing systems research at Wharminda investigating methods for successfully establishing crops in a single pass to reduce erosion potential and improve productivity. Previous results can be found in EPFS 2006, p 176, EPFS 2007, p 177, EPFS 2008, p 67.

How was it done?

The trial was sown on 8-9 June with 50 kg/ha Wyalkatchem wheat and 50 kg/ha DAP banded with the seed. The site received a knockdown spray, but no pre emergence herbicide. The site was monitored for crop emergence post sowing. Grain was harvested using a small plot header with samples kept for grain quality assessment. Brome grass seeds were graded out to assess levels of contamination in the grain sample.

The majority of treatments were sown on 254 mm row spacing, however due to strong interest from local growers, 203 and 152 mm row spacings were included as additional treatments.

More high seed bed utilisation (SBU) systems were included in the trial design in 2009. Incorporating seed behind press wheels is a treatment which has been included in trials sown since 2006 and the Anderson boot has been included in trial work since 2007, with the Anderson disc levellers (rolling shields) also included to the Anderson treatment in 2008. The new concepts explored in 2009 were the Morris N10988 spreader boot, which gives full SBU when sowing with 200 mm sweeps on 203 mm row spacing. The other new idea was to "split" the application of seed, broadcasting some in front of the seeder, but still sow the rest through the seed boots. This was achieved by utilising all the outlets from the airseeder head and directing 40% of the seed to be broadcast at the front of the seeder bar and the remainder sown through the seed boots on the tines.

Soil wetters were applied through fluid fertiliser tubes attached behind the press wheels.

What happened?

Wharminda missed out on the early opening rains that other regions on Eyre Peninsula had benefited from. The trial was sown in the second week in June while showers were still falling sporadically.

The crop established with no wind erosion, which was a good change from 2008! The crop was generally slow growing, due to the colder conditions which prevailed after sowing. A lack of nitrogen was also apparent and reflected in the low protein levels achieved in the crop.

Incorporating seed behind the press wheels gave the best crop establishment in the trial. The next best establishment was achieved with knife points and press wheels on 152 mm and 203 mm row spacings and the high SBU systems; sweeps + Morris spreader boot, Anderson system and the broadcast seed + sow through seed boots treatment.

Getting seeding depth right on 21 different seeding systems is quite a challenge, especially when trying to find seed in sandy soil under torch light!

The shallowest systems were in the 24-31 mm range, such as incorporating seed behind press wheels, knife points and press wheels set to sow shallow, broadcast seed + sow through seed boots, knife points and press wheels working shallow and sowing through the deep banding boot and knife points and press wheels sowing on 152 mm row spacing. Almost half the treatments were in the 40-47 mm range. The deepest sown plots were between 61 and 68 mm; the Atom Jet Mallee point and the knife points and press wheels working and sowing deep.

The Atom Jet points, sweeps + rotary harrows, 100 mm sweeps + press wheels and knife points + press wheels working and sowing deep were the poorest emerging plots.

The highest yielding treatments in the trial were, incorporating seed behind press wheels, knife points and press wheels on 152 mm row spacing, broadcast seed at the front of the seeder + sow through seed boots, and knife points and press wheels sowing shallow.

The poorest yielding treatments were 100 mm sweeps and press wheels and the Atom Jet Mallee points. These treatments emerged from 60 and 69 mm depth respectively.

Brome grass contamination within the grain sample was highly variable, however the worst treatment for brome grass contamination in the grain sample was the 100 mm sweeps + press wheels system.

Screenings ranged from 3.3% to 1.1%. The highest screenings were in the plots sown with 100 mm sweeps and press wheels.

Test weight ranged from 82 to 77 kg/hL, while protein ranged from 8.7 to 10 %.

Soil wetters were ineffective for increasing crop emergence or grain yield. Wetter TX and Wettasoil were used at rates of 0.5, 1 and 1.5 L/ha with a total fluid volume of 40 L/ha (data not presented).

***Table 1** Seeding systems impact on seeding depth, crop establishment, brome grass contamination, grain quality and yield*

Tmt No.			Depth (mm)	Emergence (plants/m^2)	Brome (seeds/kg)	Screenings (%)	Test weight (kg/hL)	Protein (%)	Grain Yield (t/ha)
1	KPPW	152 mm row spacing	31	138	561	1.4	79.8	9.2	1.41
2	KPPW	203 mm row spacing	43	122	456	1.2	80.8	9.0	1.32
3	Sweeps + RH	Morris spreader boot 203 mm row spacing	46	124	952	2.0	79.9	9.1	1.05
4	Sweeps + RH		56	60	1231	2.3	79.1	9.4	0.92
5	Sweeps + RH	100 mm row spacing press wheels	60	55	2485	3.4	77.3	10.0	0.77
6	KPPW	12 mm point	43	83	584	1.4	79.0	9.6	1.23
7	KPPW	wing point	49	93	695	1.3	79.5	9.3	1.23
8	KPPW		40	95	843	1.9	79.2	9.2	1.14
9	KPPW	Snake Chains	48	90	945	1.8	79.0	9.5	1.08
10	KPPW	Chain	46	87	863	1.7	80.1	9.2	1.23
11	KPPW	broadcast seed at front + sow through seed boots	29	126	459	1.2	81.2	8.8	1.38
12	KPPW	work and sow deep	61	49	1384	1.8	78.4	9.5	0.88
13	KPPW	sow shallow	28	100	355	1.1	79.8	9.2	1.36
14	KPPW	work shallow & sow through deep band boot	31	111	498	1.3	80.0	9.2	1.28
15	KPPW + RH		44	97	886	1.4	79.5	9.4	1.23
16	KP + RH		46	94	653	1.3	80.1	9.2	1.21
17	KPPW + RH	Incorporation of seed behind press wheels	24	171	247	1.2	80.9	8.8	1.48
18	Atom Jet		56	58	1500	2.2	78.2	9.8	0.91
19	Atom Jet	Mallee Point	69	66	1403	2.3	77.8	9.7	0.70
20	KPPW	Anderson System (165mm seed spread)	46	123	910	1.9	79.4	9.2	1.12
21	K-Hart disc		49	83	597	1.5	79.7	9.3	1.10
LSD	*P=0.05*		*8*	*22*	*705*	*0.6*	*2.0*	*0.5*	*0.15*

**KP = Knife Points, PW = Press wheels, RH = rotary harrows, K-Hart = wavy coulter + v-paired discs + press wheel. All knife points used in trial were 16 mm unless otherwise indicated.*

What does this mean?

Incorporation of seed behind press wheels with rotary harrows was very effective; it resulted in the highest plant establishment and one of the higher yielding treatments. If this system can establish crops quickly without emergence delays, then the potential erosion risk of using harrows may be offset by good crop growth to provide surface cover.

Of the new concepts trialled the split application of seed; broadcasting some of the seed at the front of the seeder, which is incorporated by the sowing pass, while also sowing with knife points and press wheels shows significant promise. It is a low disturbance system which should reduce wind erosion potential, however the main benefit is the distribution of the seed. Seed depth on the inter-row ranged from 5 to 20 mm, while the crop row can be placed as deep as required. It's a bit like having a bet each way for intercepting moisture. How the system handles pre-emergence herbicides is not resolved at this point.

The split application of seed idea came from Tim Ottens, the grower hosting the trials, who set his machine up in this manner in 2009. He has a double shoot delivery from his airseeder, but has gone away from deep banding fertiliser. The deep banding air kit was sent to the front of the airseeder and directed to a series of deflector plates to spread the seed across the width of the bar. Tim directed half of his seed to the front of the bar, while sowing the rest through his seed boots on the tines. It's not precision seeding, but Tim was very happy with the results.

The Atom-Jet points performed poorly for crop establishment and final grain yield, however the seed placement was still too deep (56-69 mm). This is most likely the fault of the operator than the point design itself.

Brome grass contamination in the sample was a factor of crop competition within the plot. The plots with better emergence competed well and generally the more competitive wheat plots resulted in higher grain yields. Unlike 2008, no trend for increased brome grass seed contamination with higher disturbance systems was apparent. Some of the full disturbance systems resulted in high levels of brome grass contamination. The high disturbance systems which established well were able to compete with the brome grass comparably with the low disturbance systems.

The relative performance of these sowing systems may be different when pre-sowing herbicides such as Trifluralin are used. It is likely however that the downsides of Trifluralin damage may be less than the impact of poor emergence due to water repellent sands.

The soil wetter trials were completely ineffective for the fourth consecutive season and excuses as to why are fast running out. The wetters are banded in a stream behind the press wheels. Perhaps a full fan nozzle may produce a beneficial result.

The current no-till project which is funded through the Federal Government's Caring for our Country program will be finishing in June 2010. Hopefully further funding can be secured to see this type of work continue in the future.

Acknowledgements

Tim Ottens for the use of his land and coming up with the idea of a "split" application of seed. Can't beat farmer innovation! SANTFA, Caring for Our Country and SARDI for funding the work. Brenton Spriggs, Liam Cook and Willie Shoobridge for technical assistance. Thanks to SANTFA sponsors, CASE-IH, Flexi-Coil, K-Hart, Atom-Jet and Agmaster for trial equipment. Thanks to Jack Desbiolles from the University of SA for trial equipment assistance.

Spreading Sand on Heavy Soils

Michael Bennet[1] and Dean Willmott[2]

[1]SARDI/SANTFA, Minnipa Agricultural Centre, [2]Farmer, Koongawa

DEMO

Searching for answers

Location: Koongawa
Rainfall
Av. Annual: 320 mm
Av. GSR: 235 mm
2009 Total: 340 mm
2009 GSR: 265 mm
Yield
Potential: 3.1 t/ha (W)
Actual: 3.1 t/ha (W)
Paddock History
2008: Wheat
2007: Wheat
2006: Pasture
Soil Type
Red clay loam
Plot size
30 m x 4 m

Key message

- **Spreading sand on heavy flats resulted in a yield increase of up to 0.7 t/ha in 2009.**

Why do the trial?

Heavy soil types can be extremely frustrating in dry seasons, they store moisture very well, but too close to the surface, leaving it very susceptible to evaporation. Ray Willmott decided that the concept of spreading sand on transient salinity “magnesia” patches could be equally effective in improving the performance of heavy soils. Dean Willmott expected that the sand could have a mulching affect, reducing the evaporation off good water holding capacity heavy soil.

How was it done?

The trial was planned as a split plot design, with sand spread on one side of the controlled traffic lanes, with a nil control on the other side. EP clay spreaders used their scraper to spread three rates, 200, 300 and 600 tonnes per hectare of sand gathered from a nearby sand hill and replicated the process across a section of the paddock. The paddock was sown with Gladius wheat using a DBS no till seeder two days after the sand spreading was completed, on 3 May.

What happened?

The crop was visually healthier in the areas spread with sand throughout the season. The treatments spread with 600 t/ha did suffer from wind erosion which cut the emerging crop off, however with follow up rainfall, the crop recovered.

Growing season rainfall was well above average and the plots without sand yielded 2.34 t/ha. Over the 2006-2008 period, the heavy soil types have been the poorest yielding zones on the property.

All sand spreading rates increased grain yield over the nil treatment. The higher sand rates of 300 or 600 t/ha did not translate to a significant increase of yield over the lower rate (200 t/ha), however different seasons may highlight greater differences between the treatments.

The grain size (1000 grain weight) was higher for the 600 t/ha sand rate than any of the other treatments. The 200 and 300 t/ha rates did not improve grain size above the nil treatment.

What does this mean?

This is a perfect example of farmer innovation, which may offer a solution for growers who suffer the issues associated with heavy clay soils in low rainfall environments. The heavy soil types have excellent soil water holding capacity, however quite often fail to realise potential. It is not likely to be a broad scale solution to stabilising yield on the problematic heavy flats; however it is an extremely encouraging result.

This initial trial raises more questions than answers. What is the correct rate of sand to spread? Are all sands equal? Will water repellence become a problem? Will the sands have inherent nutritional problems? How far can you move the sand before it becomes uneconomic? How long does the effect last? Will zero till discs work better than knife points for leaving the sand on the surface? Does it matter if the sand is mixed in to the top soil? What changes have occurred to plant available water compared to the normal heavy soil?

The concept of spreading sand on heavy flats may be limited to areas where a deep sand lies next to some less productive heavy country. It needs testing to see how long the benefit will last and whether it is a concept which warrants wider application.

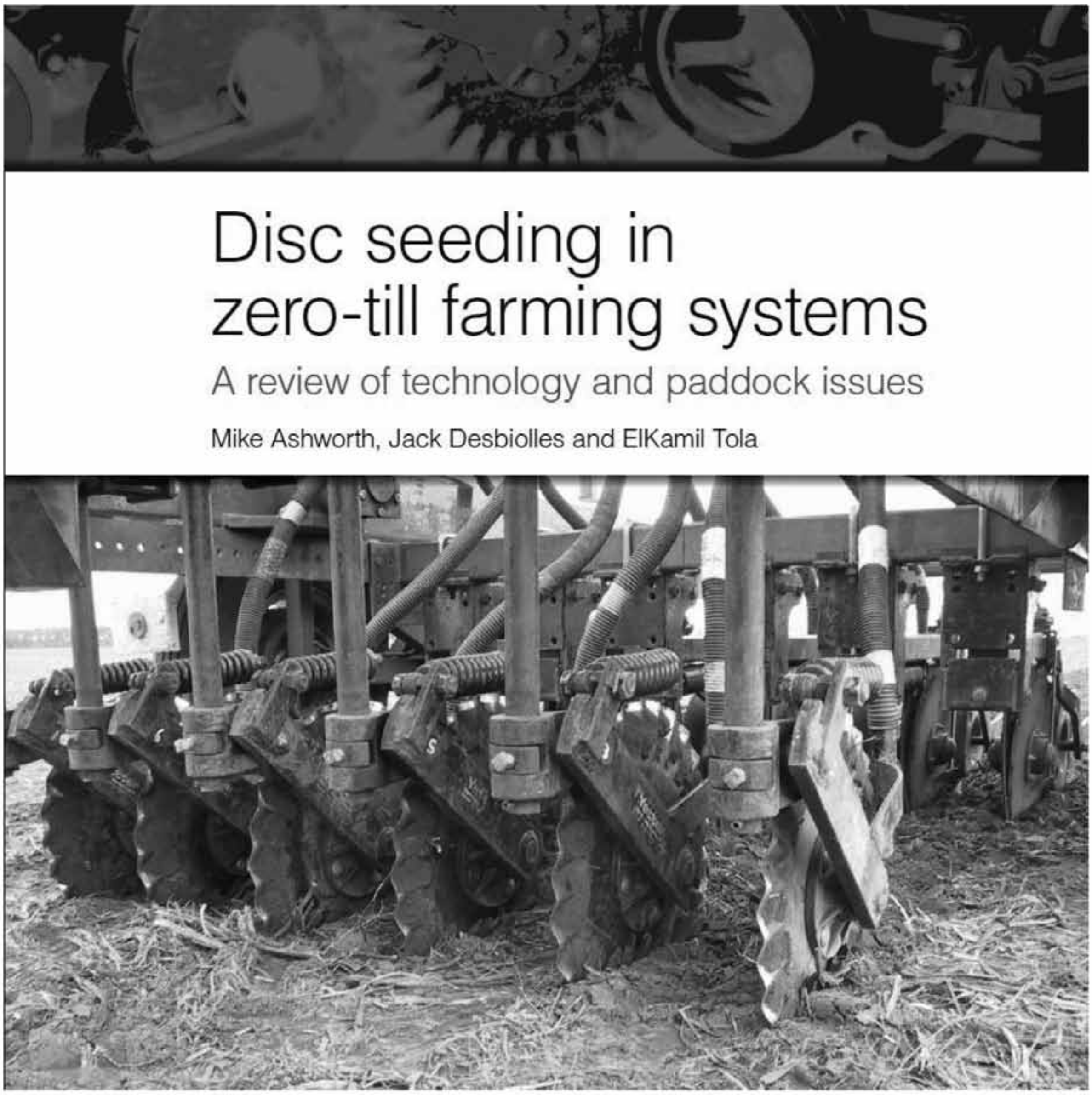
Acknowledgements

Thanks to Ray Willmott for coming up with the idea and giving it a go; Dean Willmott for following the concept through and designing an excellent replicated trial; EP Clay Spreaders for their work; Willie Shoobridge and Brenton Spriggs.

Table 1 Grain yield and quality for soil spread with the sand at Koongawa, 2009

Sand Rate (t/ha)	Grain Yield (t/ha)	1000 Grain Weight (g)	Test Weight (kg/hL)	Protein (%)
nil	2.34	43.0	82.1	11.1
200	2.79	44.1	81.4	11.2
300	3.03	44.7	82.1	11.4
600	3.12	49.1	82.4	11.6
LSD ($P \leq 0.05$)	*0.39*	*2.4*	*ns*	*ns*

NEW BOOK HIGHLIGHT



This new book provides an informed look at the issues of selecting and using disc seeders. It reviews the current disc seeding technologies and their components, and explores how their design and features interact with field operation, crop residue, soil conditions and agronomy factors in Australian zero-till cropping systems. It examines the paddock management implications of optimising disc seeder performance, integrating best practice such as controlled traffic and inter-row sowing.

The 236 page – 18 chapter book also includes snapshots on farmer experiences and a suppliers' register for close to 50 identified disc seeder brands available in Australia. It aims to be a practical guide based on research literature to assist with adoption of disc seeders, and optimising the field operations in zero-till context.

It is published by the Western Australian No-Tillage Farmers Association in collaboration with the Institute of Sustainable Systems and Technologies at the University of South Australia and will be available from late February 2010 - see www.wantfa.com.au or contact the authors for further information.

The following article is a condensed excerpt from a chapter dealing with furrow closing devices.

Furrow Closing and Pressing with Disc Seeders

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EXTENSION

Background

There is growing interest in disc seeders because of their ability to significantly reduce soil disturbance in no-till farming. Disc openers can assist seed germination and emergence by conserving seedbed moisture, due to reduced soil disturbance at seeding and lower evaporation losses. This conservation of moisture is further promoted by greater amounts of residue cover.

Correct furrow closing and pressing technologies are equally important for reliable seed germination and uniform crop establishment. The main roles of furrow closing and pressing devices are to:

- complement seeding depth by providing a uniform seed cover; and
- consolidate the soil near the seed zone to promote moisture migration, improve soil-to-seed contact, and facilitate the hydration process of the seed.

Conventional press wheels consolidate the whole furrow, by exerting a top-down force. The optimal level of furrow consolidation is a compromise between a minimum threshold needed to enhance seed germination (by improving soil moisture migration to the seed zone and soil to seed contact) and an upper limit that restricts seedling growth due to mechanical impedance (excess soil strength) and surface crusting.

With many seeding units, the conventional furrow pressing wheel acts as a depth gauge as well, and, particularly in areas of lighter soil or marginal rainfall, it shapes the pressed furrow into a water harvesting channel. Such channels help concentrate small amounts of rainfall and give wetting to a greater depth below the seed zone.

Alternative designs to improve the furrow closing and pressing functions can involve multiple components complementing each other. These include:

- *Seed firming devices*, such as plastic slides or narrow wheels to secure seed-to-soil contact by applying a direct firming action onto the seeds before closing the furrow. They typically run at the base of the furrow and give a more accurate seeding depth by securing seed placement and controlling seed bounce.
- *Furrow closing and pressing finger wheels* designed to close the furrow by placing an adjustable amount of soil over the seed row. These work independently of the furrow opener. Furrow closing wheels exist in various designs and configurations to vary the amount of soil packing, furrow wall crumbling and soil cover gathering actions.

Australian and overseas studies have generally found furrow pressing benefits crop establishment.

Research in different Australian regions and soils has shown significant benefits in winter crop establishment from press wheels in a range of conditions.

On the other hand, in heavy wet clays over-packing has been observed. This can increase surface soil strength and reduce seedling emergence. Canola was found to be the most sensitive, while peas least sensitive to over consolidation. Epigeal crops, such as lupins, were also found to be sensitive to over-pressing.

Research shows that minimal packing has the best overall impact on crop performance and that over-packing is a significant risk for all crops in wet clay conditions and also in silty clay soils. In dry, moist and loose soil conditions, the combined actions of a press wheel and a gauge wheel improves the speed of crop emergence and final population, while in very wet conditions, treatments with no press wheel provided the best emergence results.

Furrow closing and pressing technologies

Single, vertical press-wheels

Single furrow-centred press wheels are a standard feature of many broadacre disc seeders, particularly double disc openers.

These press wheels generally use flat, wedged or ribbed tyre profiles that follow the disc opener. They work by exerting a top-down pressing action onto the soil, directly above the seed row. Furrow-centred press wheels are particularly suited to lighter soil textures and can potentially shape water-harvesting channels over the seed row.

An example seed firming slide (RHS) and Furrow closing/packing wheels (LHS) on a Bertini double disc seeding opener

Bent finger Posi-Close planter wheels from Schlagel Manufacturing, USA, emphasizing greater furrow packing efforts

The Thompson spoked closing wheel (Exapta Solutions Inc.) on a precision planter in high residue conditions (LHS). The thin edged wheels either run parallel to travel and crumble the side walls or include 6 degree toe-out wedges to additionally gather soil over the furrow. RHS: Thompson closing wheel with Hagny high camber spoke (HCS) for improved furrow closing in low residue conditions. The HCS closing system is best used with a preceding seed firming device as it leaves the crumbled soil loose.”

They can, however, produce an over-consolidated surface while applying less pressure at depth. This can lead to surface crusting in compactable soil conditions and/ or a lack of seed-to-soil contact at depth in drier, cloddier soil conditions.

Tyres are of either solid rubber or semi-pneumatic style and come in flat, rounded or banked/wedged profile. Correct matching for specific crop and soil conditions is required for best results. Tyre width and profile provide some ability to match furrow shape and size to effectively consolidate the seed row.

Generally, a pressing action needs to crumble the furrow walls in the process of furrow closing so as to provide sufficient seed zone packing. Press wheel pressures are often insufficient to properly close furrows in compact wet clay conditions. Increased pressures would over-consolidate the furrow and may eventually interfere with disc opener penetration capacity.

Inclined, single and twin press wheels

Inclined press wheels are often fitted behind single disc openers. Single press wheels may incorporate some tilt and/or sweep angle to improve the furrow closing action by simultaneously moving soft soil over the furrow.

Inclined press wheels can have a variety of profiles, including solid cast or with rubber tyres. Small sweep angles provide a sideways furrow closing action and may assist with some degree of self-cleaning to the tyre. The lateral position of the inclined press wheel is important in optimising the furrow closing results.

Inclined press wheels are sometimes paired in opposition to maximise furrow closing capacity and are typically staggered on a swing arm or walking beam arrangement. The staggering of press wheels facilitates a level of soil fracturing of the seedbed and minimises the risk of over-consolidating of the furrow. It also helps to control the risks of soil bridging between the wheels in sticky conditions.

Research indicates that a sideways furrow closing action behind single disc seeders tends to move herbicide-contaminated soil into the seed row. This may contribute to the greater wheat crop sensitivity and damage from soil-applied herbicides when sowing with some single disc openers.

Furrow spading and closing finger wheels

Finger wheels or spike rims may be substituted for a better ‘break-up’ of sidewall compaction and to assist closing without air gaps.

Finger wheels (or spading wheels) are designed to more aggressively break through compacted furrow sidewalls but still gathering soil within the seed row. Depending upon the design, they may exert a more limited consolidation effect in the seed zone. Combining a finger wheel with a conventional press wheel in a V-twin fashion can provide an intermediate effect.

A wide range of furrow closing wheel designs are available, often matching the selection available for row cleaning residue managers.

Furrow closing finger wheels differ from basic twin tyred press wheels

1. They include spikes, teeth or fingers of various length and shape, designed to engage and till into the shoulders of the furrow. This effectively breaks up furrow sidewall compaction by a combination of slicing and tilling actions.
2. The wheels include various combinations of tilt and sweep angles to give different degrees of furrow wall slicing, soil gathering and seed zone consolidation. Their function can range from pure pressing to shallow spading and furrow mounding effects.
3. The wheels may be adjustable in orientation in order to fine-tune their action according to paddock conditions.
4. They may feature a reference depth band (depth gauge) to maintain a packing component similar to a press wheel. Alternatively, their furrow spading action may be combined with separate furrow pressing facilitated by a following single press wheel. In some cases covering drag chains are attached.

Acknowledgements

University of South Australia, Western Australian No-Till Farmers Association.

Section 6

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Roy Latta
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Weeds

Crop-topping Cereals at Cummins

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RESEARCH

Searching for answers

Location: Cummins
Stuart Modra
LEADA

Rainfall
Av. Annual: 422 mm
Av. GSR: 342 mm
2009 Total: 450 mm
2009 GSR: 380 mm

Yield
Potential: 5.5 t/ha (W)
Actual: 5.6 t/ha (W)
Potential: 5.0 t/ha (B)
Actual: 5.0 (B)

Paddock History
2008: Field Peas

Soil Type
Red clay loam

Plot size
10 m x 1.5 m x 3 reps

Yield Limiting Factors
Nitrogen

Economic
Production risk: Grain quality downgrades

Key messages

- **Crop-topping wheat with glyphosate can result in yield loss and grain size reduction if done too early.**
- **Later crop-topping timings can produce grain quality and yield similar to untreated grain.**

Why do the trial?

Annual ryegrass is a significant weed problem, particularly on lower Eyre Peninsula where favourable spring conditions can allow the weed to thrive, causing many headaches for the farming system. Research from the Mid North High Rainfall Zone (MNHRZ) indicated that glyphosate can be applied to wheat during late grain fill as a crop-topping operation to reduce ryegrass seed set with minimal grain damage.

Growers and local agronomists on lower Eyre Peninsula were keen to investigate the impact of glyphosate as a crop-topping operation and the follow-on effects on grain yield and quality.

Physiological maturity of wheat occurs at around 45% grain moisture, which is when grain fill is completed, with drying down the only process left until harvest. By the time the grain has dropped to 45% moisture, the optimum window for grass weed control is likely to have passed. The trial aimed to compare crop-topping timings relative to physiological maturity in wheat and barley.

How was it done?

Wyalkatchem wheat and Keel barley were sown by small plot equipment at the LEADA focus site, south of Cummins on 22 May 2009. A target plant population of 250 and 200 plants/m^2 respectively were sown.

The plots were sown with 100 kg/ha DAP, with 100 kg/ha urea broadcast on 9 July. Roundup PowerMax was applied at 1.2 L/ha through Lechler IDK nozzles producing a medium/coarse droplet spectrum with a water rate of 100 L/ha. Moisture levels at the time of application were assessed by randomly sampling whole heads before spraying plots and drying in a fan forced herbage drying oven at 70^{o}C for 48 hours.

The trial was harvested with small plot harvest equipment and grain quality was assessed using equipment at Minnipa Agricultural Centre.

What happened?

By the time crop-topping window approached, the barley had an infestation of net form of net blotch, which reduced the green leaf area on the barley, reducing potential herbicide uptake.

The wheat was very slow to dry out at Cummins in 2009. This is most likely due to the high levels of available soil moisture during grain fill. The cool conditions during early grain fill also helped to extend the grain fill period, resulting in very large grain in the untreated plots. This extension to the grain fill period also exacerbated the differences in the treatments.

The plots sprayed in the earlier timings looked as if they would not yield any grain at all given the rapid brown out of the crop after the glyphosate was applied. The late timings had less visual effects on the crop, however the glyphosate was useful for evening up crop maturity and potentially allowing for earlier harvest.

Wheat

Glyphosate timing had a severe impact on grain yield (Table 1 and Figure 1). Timing 3 and 4 yielded less than the nil, but more than timing 1 and 2. Timing 2 yielded less than the all the later timings and the nil. Timings 5 and 6 did not suffer any grain yield loss and yielded the same as the untreated plots. The earliest timing, however, provided the most spectacular yield decline, yielding only 23% of the untreated plots.

Glyphosate timing had an impact on the 1000 grain weight, screenings and test weight. The smallest grain in terms of 1000 grain weight was produced from the earliest timing of glyphosate application, with grain size increasing with later timings (Table 1).The two last timings (5 and 6) produced the same size grain as the untreated plots, ranging between 45.1 and 47.3 g/1000 seeds.

Screenings were impacted by the timing of the crop-topping operation. It was more of a cliff face effect than the linear effect on 1000 grain weight. Timing 1 produced the highest screenings (60.6%). The second highest was timing 2 (27.3%). Timings 3, 4, 5 & 6 had similar screenings levels as the untreated plots.

Test weight was affected by the timing of glyphosate application. Timing 5 and 6 produced similar test weight to the untreated plots. Timing 3 and 4 produced lower test weights than the nil, Timing 5 and 6. Timing 2 produced a test weight even lower than Timing 3 and 4, but not as low as Timing 1. The test weight for Tming 2 was below 68 kg/hL, which is the threshold for AGP classification. The bird seed produced by Timing 1 was even below the threshold for Feed 1, (62 kg/hL). This wheat may be able to be sold on the domestic market, however only with a value similar to Feed 2 or 3 barley.

Barley

The grain yield and quality results in the barley trial were not as dramatic as in the wheat. This was in part due to the lower grain moisture at the time of application and also the level of leaf disease in the crop. Timings 3, 4 and 5 all yielded the same as the nil treatment.

Table 1 Effect of crop-topping Wyalkatchem wheat on grain yield and quality, 2009

Spray Timing	Date of Spray	Moisture at application (%)	Yield (t/ha)	1000 Grain weight (g)	Protein (%)	Screenings (%)	Test weight (kg/hL)
Nil			5.68	47.3	10.2	2.5	82.6
1	3 Oct	63	1.35	15.4	15.5	60.6	60.4
2	8 Oct	64	2.32	23.9	13.0	27.3	67.1
3	19 Oct	58	4.29	35.7	11.0	3.6	75.8
4	23 Oct	57	4.66	40.9	10.3	2.2	78.5
5	29 Oct	47	5.33	45.1	10.5	2.0	82.2
6	4 Nov	42	5.63	46.7	9.8	2.6	82.5
LSD ($P \leq 0.001$)			*0.48*	*2.6*	*0.7*	*6.3*	*2.7*

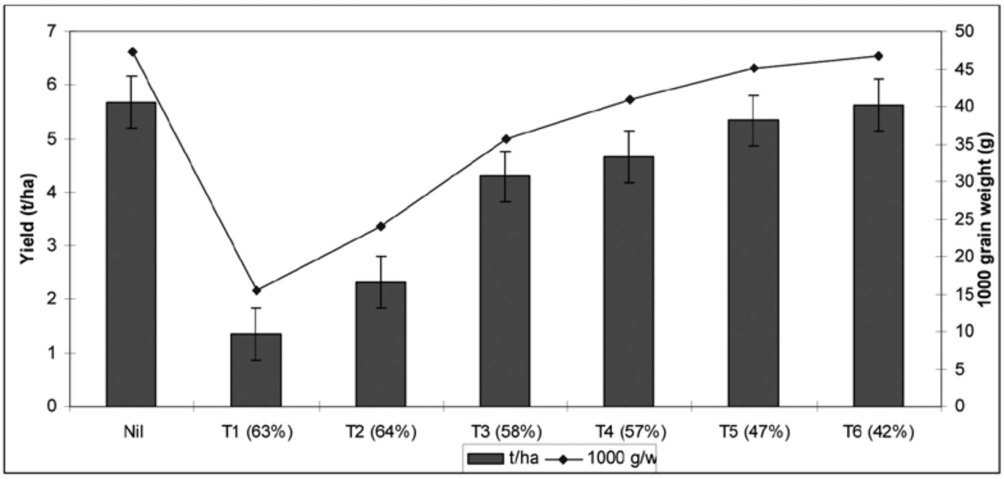

Figure 1 Wyalkatchem wheat yield and 1000 grain weight impact on crop topping timing

Table 2 Effect of crop topping Keel barley on grain yield and quality, 2009

Spray Timing	Date of Spray	Moisture at application (%)	Yield (t/ha)	1000 Grain weight (g)	Protein (%)	Screenings (%)	Test weight (kg/hL)
Nil			5.08	44.1	10.8	3.0	71.0
T1	3 Oct	55	4.21	37.8	11.1	6.9	67.3
T2	8 Oct	51	4.15	39.7	11.1	6.1	68.5
T3	19 Oct	43	4.80	44.0	10.7	2.4	71.0
T4	23 Oct	39	4.68	44.0	10.3	2.5	71.6
T5	29 Oct	22	4.86	43.6	10.8	3.6	70.7
LSD (P=0.05)			*0.44*	*1.21*	*0.32*	*2.08*	*1.32*

Timings 1 and 2 produced lower yields than the later timings and the nil. 1000 grain weight at timing 1 was less compared to all other treatments. Timing 2 produced smaller grain than timings 3, 4, 5 and the untreated plots.

Timing 3, 4, 5 and the untreated plots all produced similar screenings % and test weights. Timing 1 and 2 produced higher screening levels and lower test weights than all other treatments.

The grain quality in the barley was sufficient to see it all reach a grade of Feed 1.

What does this mean?

The optimum timing for crop topping wheat is a compromise between crop damage and ryegrass control. The optimal timing for ryegrass seed set reduction will be around flowering, which can occur before the optimal timing for crop safety in wheat.

In seasons with warmer, drier springs, the crop will dry out faster, however the ryegrass will be going through maturity quicker too, so the compromise will remain similar.

Barley would be the crop of choice for crop-topping due to the earlier maturity. However, there are no glyphosate based products registered for crop-topping barley. Hopefully in the future growers may have the option for crop-topping feed grades of barley, however at this stage glyphosate treated feed barley should not be sold into the export market.

Diquat (Reglone) is registered for pre-harvest weed control in wheat and barley, however the label states that the crop needs to be at full maturity which restricts its usefulness. The other problem with diquat is that it is a contact based herbicide and will offer limited control of weeds below the crop canopy. Diquat is also expensive and tends to have weak activity on grass weeds. Trials conducted at the MNHRZ using Reglone for crop-topping have only achieved 20-30 % ryegrass seed set control on average, with the best result being 60%.

Roundup PowerMax is the only glyphosate product currently registered for crop-topping wheat. The conditions for use restrict its usage to grain moisture levels of 28% or less. Nufarm are currently reviewing the label for Roundup PowerMax in relation to crop-topping and implications on grain yield, grain quality and final quality of bread produced from crop topped wheat.

One area where growers can come "unstuck" with relying on whole head plus grain moisture percentage to assess whether the crop is ready to spray with glyphosate and whether it is dried out sufficiently. If the oven does not dry the samples out satisfactorily, then the calculated moisture levels may be significantly lower than the actual moisture levels. It is worthwhile to make sure that the samples are adequately dried out.

At this stage there are very limited options to get adequate weed control through crop topping and abide within the guidelines of the label. Hopefully in the future this option will be opened through the relevant channels. Until that point, growers should use crop-topping as a tool within the Roundup PowerMax label recommendations.

If a cereal paddock is badly infested with grass weeds, the main objective should be total weed seed set control. Hay cutting and brown manuring are the best methods to ensure that good weed control can result in guaranteeing low weed burdens in the future, crop-topping will not offer the same level of control found with these other options.

Acknowledgements

Thanks to Jeff Braun from Agrilink consultants for his help in trial design and treatment application; Brian Purdie and Ashley Flint for their efforts in applying the treatments, sowing and harvesting the trial, certainly a job well done; Martyn Chandler and the Landmark crew for help with spray timings; Brenton Spriggs for assessing the grain quality. Thanks to LEADA, SANTFA and Caring for Our Country for supplying supplementary funding for the purposes of this trial.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

SANTFA

CARING FOR OUR COUNTRY

Herbicide Options for Controlling Annual Ryegrass in Early Sown Wheat

Sam Kleemann & Gurjeet Gill
University of Adelaide, Waite

RESEARCH

Location: Yeelanna
Wilksch family
(Max, Randall & Jordan)

Rainfall
Av. Annual: 431 mm
Av. GSR: 345 mm
2009 Total: 477 mm
2009 GSR: 392 mm

Yield
Potential: 5.6 t/ha (W)
Actual: 3.2 to 3.6 t/ha (W)

Paddock History
2008: Faba beans
2007: TT Canola
2006: Feed barley

Soil Type
Buckshot loam over clay

Plot size
4 m x 15.2 m x 4 reps.

Key messages

- **New pre-emergence herbicides under knife-points provided good control of annual ryegrass with good crop safety under early sown wheat.**
- **Use of glyphosate for crop-topping ryegrass at the dough development stage of wheat (approx. 55-60% grain moisture content) caused severe reductions in wheat grain yield. Clearly there is a need for further research to establish optimal timing for crop-topping in wheat which can provide large reductions in ryegrass seed production.**
- **Even though the new alternative herbicides provided around 80% control of ryegrass, surviving plants were able to set large amount of seed (~5000 seeds/m^2) which would cause problems for the next crop in the rotation.**
- **Seed biology studies will be undertaken to examine dormancy mechanisms regulating late germination in this ryegrass population.**

Why do the trial?

Increasing frequency of populations of annual ryegrass resistant to trifluralin (Group D) and other selective herbicides (i.e. Group A & B) is of growing concern to farmers across the southern Australian wheat-belt. Furthermore, herbicide efficacy is being placed under greater weed pressure with farmers choosing to sow crops earlier following consecutive poor seasons over the last few years. Given the importance placed on trifluralin and selective herbicides for controlling ryegrass under current farming practices, there is an urgent need to identify alternative pre- and post-emergence herbicide options. Consequently a trial was undertaken to evaluate the efficacy and crop safety of alternate pre-emergence herbicides under a no-till knife point system. Additional treatments examining crop-top applications of glyphosate (Group M) were also examined as a tool for reducing ryegrass seed production.

How was it done?

The trial, established at Yeelanna, was sown to Correll wheat @ 90 kg/ha on 14 May.

Herbicide treatments were:

- Triflur-X @ 1.3 L/ha plus Avadex Xtra @ 1.6 L/ha plus Diuron @ 500 g/ha plus Dual Gold @ 0.5 L/ha
- Boxer-Gold @ 2.5 L/ha
- Boxer-Gold @ 2.5 L/ha plus post-emergence Roundup PowerMax @ 1.2 L/ha
- Sakura (formally BAY-191) @ 118 g/ha
- Sakura @ 118 g/ha plus post-emergence Roundup PowerMax @ 1.2 L/ha
- Nul-1493 @ 0.75 L/ha
- Dual Gold @ 0.5 L/ha
- Untreated (no spray)

Pre-emergence herbicides were applied using a vehicle mounted spray unit at a spray volume of 100 L/ha and incorporated at sowing using a Conserva-Pak knife-point press wheel system on 12 inch (305 mm) row spacings. Crop-topping applications of Roundup PowerMax were applied using a pressurised hand boom calibrated to deliver 80 L/ha when the grain moisture content of wheat was approximately 55-60%. An untreated control was used to determine background weed populations.

All treatments received 50 kg/ha of 18:20 fertiliser (N:P) plus 50 kg/ha of Urea and were sown at 7-9 km/h. As the previous crop was faba beans, stubble levels across the site were low (<2 t/ha).

Assessments of wheat density were made by counting the number of plants in a 1 m length of crop row at three locations in each plot. Ryegrass populations were assessed 6 and 12 weeks after sowing by counting the number of plants in three randomly placed quadrats (60 cm × 60 cm) in each plot. In spring following ryegrass spike emergence, spike density was determined using the method described above. In order to obtain an estimate of re-infestation potential of ryegrass, seed production was determined in November prior to seed shed. This was calculated from a relationship derived between spike length and production of viable seeds (Figure 1). The number of seeds produced per unit area was derived from spike length and spike density, and shown as the number of seeds per m^2. In addition 10 ryegrass spikes were sampled from treatments crop-topped with glyphosate and seeds tested for viability.

What happened?

All herbicide treatments reduced ryegrass emergence (Table 1). However, new pre-emergent herbicides Boxer-Gold and Sakura provided the greatest levels of weed control reducing ryegrass densities by around 80% of the untreated control (182 plants/m^2). In contrast, Nul-1493 provided the least control (62%). These herbicides provided excellent residual control considering a high proportion of ryegrass (>40%) emerged in mid August more than 12 weeks after sowing. Such late emergence in this population was probably the reason for limiting the best control level to around 80%. Seed biology studies will be undertaken to examine the mechanisms controlling dormancy expression for this late germinating population (i.e. is vernalisation required to stimulate germination?).

Boxer-Gold and Sakura were also effective at reducing ryegrass seed production (5916 & 4846 seeds/m^2) in comparison to the untreated control (20,158 seeds/m^2). Such high seed production by late germinating ryegrass in these treatments is an indication of the poor weed competitive ability of wheat. Seed production of this magnitude, (~5000 seeds/m^2) will undoubtedly cause production problems in the next crops in the rotation. Greatest reduction in ryegrass seed production was obtained for herbicide combinations of pre-emergence Boxer-Gold or Sakura followed by crop-top applications of glyphosate (124 & 140 seeds/m^2). Crop-top applications of glyphosate when the grain moisture content of wheat was approximately 55-60%, reduced ryegrass seed viability to <7% as compared to 87% in the untreated control. However, crop-topping with glyphosate caused severe reductions in grain yield (41 to 47%) and grain size (23.2 to 24.8 g/1000 seeds) in comparison to the untreated control (3.2 t/ha; 44.7 g/1000 seeds) (Table 2). Furthermore, this treatment of glyphosate resulted in high percentage of screenings (13.5 to 14.7%) in the harvested grain. Clearly this treatment has an excellent weed control potential and further research is warranted to characterise crop developmental stages when ryegrass seed set can be prevented without affecting wheat yield. Current label recommendations for Roundup PowerMax suggest that wheat should only be crop-topped with glyphosate when the grain moisture content is $\leq$28%, at which point the grain has reached physiological maturity. Even within a single wheat plant, there could be differences in developmental stages between the main stem and the tillers.

Excellent crop safety with pre-emergence herbicides was shown under the Conserva-Pak knife-point system, with no reduction in crop emergence (Table 2). Although Nul-1493 appeared to be safe, this experimental compound developed by Nufarm will not be released for use in wheat because of concerns of crop phototoxicity.

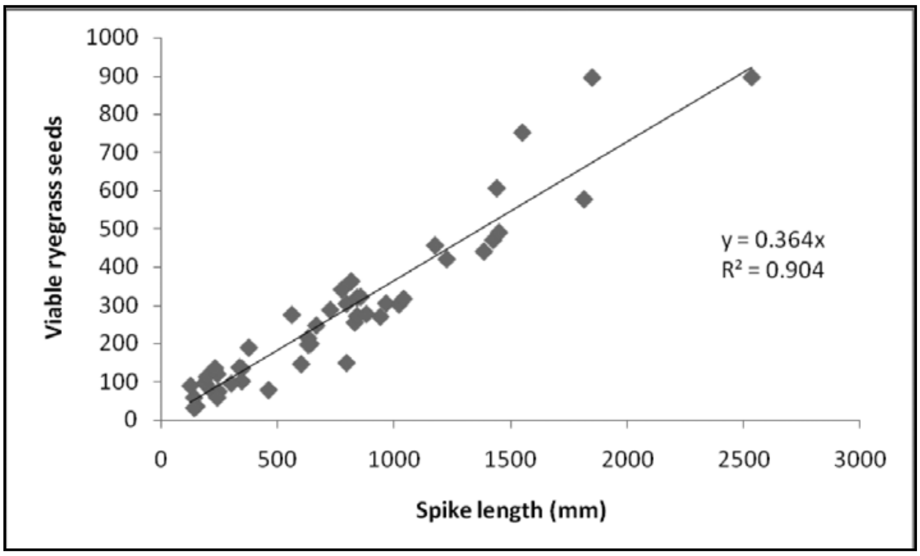

Figure 1 ***Relationship between ryegrass spike length and production of viable seeds. This relationship was used to calculate seed production based on spike length and spike density.***

Table 1 Effect of herbicide treatments on annual ryegrass emergence (% control), spike density, seed viability and seed production at Yeelanna, 2009

*Herbicide treatments	Ryegrass Emergence (plants/m²)	Ryegrass Spikes (no./m²)	Ryegrass Seed viability (%)	Ryegrass Seed production (seeds/m²)
Triflur-X + Avadex Xtra + Diuron + Dual Gold	54 (70)	172	-	10151
Boxer-Gold	36 (80)	98	-	5916
Boxer-Gold + POST Roundup PowerMax	24 (87)	32	7.0	124
Sakura	35 (81)	75	-	4846
Sakura + POST Roundup PowerMax	7 (96)	34	5.9	140
Nul-1493	69 (62)	170	-	11654
Dual Gold	34 (81)	115	-	7451
Untreated (no spray)	182	345	87.2	20158
LSD (P≤0.05)	*55*	*62*	*2.1*	*4090*

**Roundup PowerMax (glyphosate) was applied post-emergence (POST) when the grain moisture content = 55 - 60%*
Values in brackets are percentage (%) annual ryegrass control.

Table 2 Effect of herbicide treatments on wheat emergence, yield, grain size, protein and screenings at Yeelanna, 2009

*Herbicide treatments	Wheat Emergence (plants/m²)	Yield (t/ha)	Grain Size (g/1000 seeds)	Protein (%)	Screenings (%)
Triflur-X + Avadex Xtra + Diuron + Dual Gold	196	3.5	42.8	10.3	1.0
Boxer-Gold	201	3.6	45.3	10.1	0.7
Boxer-Gold + POST Roundup PowerMax	192	1.7	23.2	12.7	13.5
Sakura	204	3.4	45.1	10.2	1.0
Sakura + POST Roundup PowerMax	212	1.9	24.8	12.7	14.7
Nul-1493	201	3.2	43.4	9.9	1.0
Dual Gold	204	3.5	45.0	9.9	0.9
Untreated (no spray)	199	3.2	44.7	9.6	0.9
LSD (P≤0.05)	*ns*	*0.34*	*3.4*	*0.6*	1.9

**Roundup PowerMax (glyphosate) was applied post-emergence (POST) when the grain moisture content = 55 - 60%*

What does this mean?

These results have shown that new pre-emergence herbicides Boxer-Gold and Sakura provided a safe and effective alternative to trifluralin for controlling ryegrass in wheat under a knife-point system. Furthermore, their combination with glyphosate applied as a crop-topping application was extremely successful in reducing ryegrass seed set (>90%). However, slightly earlier than optimal timing of crop-topping in this study resulted in significant penalties in grain yield and quality. Earlier-maturing wheat varieties such as Axe or Wyalkatchem would be better suited to crop-topping than a later variety like Correll used in this study. For further information see the “Crop-topping Cereals at Cummins” article in this chapter.

Boxer-Gold is currently available (released in 2008) with Sakura likely to be available in 2011. Although both these herbicides provide alternative modes of action to trifluralin, they should be used in conjunction with robust management strategies that use a diverse rotation of crops, herbicides and non-chemical strategies (i.e. seed catching) so as to prolong the life of existing and new chemical groups against ryegrass.

Acknowledgements

Thanks to the Wilksch family (Max, Randall & Jordan) for the use of their land for the trial. Australian Centre for International Agricultural Research (ACIAR) for providing project funding. We also thank Michael Bennet, Ben Fleet and Brenton Spriggs for their assistance in trial preparation and Bayer, Nufarm and Syngenta for supplying herbicides.

Cereal Crop Competition vs Ryegrass

Michael Bennet
SARDI/SANTFA, Minnipa Agricultural Centre

RESEARCH

Location: Wanilla
Sean Puckridge

Rainfall
Av. Annual: 490 mm
Av. GSR: 396 mm
2009 Total: 511 mm
2009 GSR: 383 mm

Yield
Potential: 5.4 t/ha (W)
Actual: 4.1 t/ha (W)

Paddock History
2008: Canola
2007: Lupins
2006: Wheat

Soil Type
Buckshot loam over sodic clay

Plot size
10 m x 1.5 m x 4 reps

Yield Limiting Factors
Waterlogging, nitrogen deficiency and ryegrass competition

Key messages

- **Ryegrass is a "pussy" in dry seasons, but a "panther" in wet seasons!**
- **Crop competition does not suppress ryegrass when the soil remains waterlogged.**

Why do the trial?

Annual ryegrass is a weed of concern for growers on all regions across Eyre Peninsula. However it is on lower Eyre Peninsula where the weed is most threatening current farming systems. The trial aimed to compare four locally grown wheat varieties at district practice and high seeding rates to assess their influence on reducing the impact of ryegrass in the whole farming system.

This article follows on from work reported in EPFS Summary 2006, p 182-183 and 2008, p 58-60.

How was it done?

The trial was sown on a paddock with a history of ryegrass at Wanilla on 15 May. Four varieties of wheat; Wyalkatchem, Gladius, Espada and Correll were each sown at 180, 300 and 450 plants/m^2. The trial was sown using Cummins Landmark's DBS plot seeder on 30 cm row spacing.

The trial received a knockdown spray and 1.5 L/ha Trifluralin + 1.6 L/ha Avadex Xtra pre sowing.

What happened?

The wheat emerged well and was quite vigorous when the first assessments were made in mid June. Seasonal conditions had been wet enough in June to allow ryegrass to germinate on the soil surface. An average of 251 plants/m^2 of ryegrass had established across the site. Throughout July and August the wheat was being suppressed by waterlogging, allowing the ryegrass to dominate the wheat. During this time 80 kg/ha urea was broadcast and 30 L/ha UAN sprayed to try and improve the N supply and the wheat competition.

In September the ryegrass had grown above the crop canopy to the point where there seemed little chance of continuing the trial due to potential ryegrass seed set. The grower decided to crop-top the paddock with glyphosate to reduce the contribution of 2009 seed to the ryegrass seed bank.

Due to the paddock being crop-topped with glyphosate, there was no opportunity to assess ryegrass seed set with actual viable seed. Instead samples of ryegrass were collected on 20 October. Potential seed set was assessed by counting the number of spikes (seed heads) per quadrat, then individually counting how many spikelets and seeds per spikelet were on 30 spikelets per plot.

The resulting potential seed set ranged from 177,000 to 277,000 seeds/m^2. This is in the order of ten fold of what has been experienced by University of Adelaide weeds research staff.

Crop competition or variety choice had no impact on ryegrass emergence, spike number and final seed set. Increased sowing rates did lead to higher grain yield, however. Wyalkatchem yielded the most in the presence of immense weed pressure. Wyalkatchem yielded as well at the low seeding rate as any other variety at even the higher sowing rates (Table 1).

Table 1 Grain yield at Wanilla with variety and sowing rates, 2009

Variety	180 plants/m^2	300 plants/m^2	450 plants/m^2
Correll	2.31	2.89	3.13
Espada	1.74	2.57	2.66
Gladius	1.94	2.31	2.94
Wyalkatchem	3.35	3.68	4.16
LSD (P=0.05)	*0.81*	*0.81*	*0.81*

What does this mean?

It is very disturbing to see such a substantial blow out of ryegrass numbers after such a good pre-sowing herbicide combination. Growers on lower Eyre Peninsula report that even the most expensive pre-sowing herbicides "run out of puff" on acidic waterlogging soils well before they do on more neutral pH freely draining soils.

The massive ryegrass seed set may be a one off combination of events, however it is still a staggering seed set. If only half the potential seed set was viable, that is still around four fold the seed set of what has been documented elsewhere. If an aggressive program of weed control manages to control 95% of 177,000 seeds/m^2 (which may take up to three years of total seed set control), the grower is still left with 8,850 seeds/m^2 to deal with.

Previous research in the 2006-2009 period indicated that wheat can be competitive with ryegrass, especially in dry seasons. The sharp finishes of the 2006 to 2008 period saw the ryegrass in some cases die rather than set seed. However, if a favourable spring occurs, the ryegrass can be extremely competitive. If the conditions are shifted in favour of ryegrass through waterlogging, then wheat has little chance of competing. Increasing seeding rates above district practice levels of 180 plants/m^2 can also lead to higher yielding, more competitive wheat crops.

Ryegrass in this situation should NEVER be given the opportunity to set seed. That is unless the grower would like to set up a very productive ryegrass pasture for the next five years. Cutting hay or brown manuring is the best option to make sure that it does not contribute to future weed burdens. Crop-topping is realistically only an option for moderate ryegrass infestations. Successful crop-topping in wheat for ryegrass seed set control will be compromised by late timing to avoid crop damage and to keep within label recommendations.

Roundup PowerMax is the only glyphosate formulation currently registered for crop-topping wheat. Check the crop-topping wheat article in this book and product label for further details.

The acidic waterlogging soil types on lower Eyre Peninsula have some very serious challenges ahead. Ryegrass will increasingly dominate management decisions as herbicide options become more limited. Utilising the ryegrass as a productive pasture may be an attractive option to some growers, however not all. Fundamentally weed management is a numbers game, the rotation needs to be focused on reducing ryegrass seed numbers at every opportunity. Chaff carts have not been attractive for various reasons, however we are running out of tools in the box, so we need to consider all options available to us. Hopefully the long awaited Western Australian Harrington Seed Destructor (rotomill) will be a viable option for the lower Eyre Peninsula growers to apply some non herbicidal pressure on ryegrass.

Acknowledgements

Thanks to Sean Puckridge for use of his land for the purposes of the trial. Special thanks to Cummins Landmark for sowing the trial and finding a "good" ryegrass site. Thanks to Brenton Spriggs for his patience counting thousands of ryegrass spikes and the MAC staff who put up with hay fever as a result of assessing the ryegrass.

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SANTFA

CARING FOR OUR COUNTRY

Barley Grass, an Emerging Weed Threat

RESEARCH

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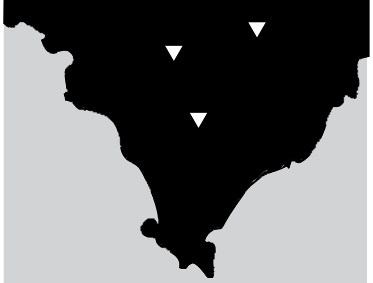
Searching for answers



Location: Minnipa Ag Centre
Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2009 Total: 421 mm
2008 GSR: 333 mm
Yield
Potential: 5.2 t/ha
Actual: 4.3 t/ha
Paddock History
2008: Wheat
2007: Wheat
2006: Wheat
Soil Type
Sandy clay loam
Plot size
20 m x 1.5 m x 4 reps

Location: Buckleboo
Michael & Mary Schaefer
Rainfall
Av Annual: 305 mm
Av GSR: 216 mm
2009 Total: 315 mm
2008 GSR: 247 mm
Yield
Potential: 2.7 t/ha (W)
Actual: 1.8 t/ha (W)
Paddock History
2008: Wheat
2007: Oaten Hay
2006: Oats
Soil Type
Red clay loam
Plot size
14 m x 6 m x 4 reps

Key messages

- **Barley grass is becoming more prevalent in many cropping districts.**
- **The ecology of barley grass has changed making it a more problematic weed in crops.**
- **Herbicides trialled provided various levels of control, with Sakura providing the highest and most consistent control.**

Why do the trial?

Barley grass has historically been a problematic weed in pastures or where crops were sown dry without an effective knockdown. However, a number of growers had suggested that they were now finding barley grass regularly in their crops. This was supported by our recent survey where growers ranked their most problematic weeds currently, compared with 5 years ago. Results from this showed that on Eyre Peninsula barley grass had moved from fifth worst weed to third in the last five years. In the Upper North barley grass now appears at fourth position and is found in the top ten weeds in Lower and Mid North. In the Mallee, while not quite in the top five weeds, it has moved up in ranking significantly over this time. The reasons behind this change in ranking were unknown. This could be due to a run of dry seasons where growers have increasingly used dry and early sowing, resulting in no or ineffective herbicide knockdown. Alternatively the behaviour of barley grass may have changed in response to crop management practices. In addition, some growers reported that barley grass had remained a significant issue, even when paddocks were not dry sown. Following this, investigations have begun to understand why barley grass is becoming more problematic and how it can be best managed.

How was it done?

Barley grass seed was collected, just prior to harvest in 2008, from a number of cropping paddocks across Eyre Peninsula (Yaninee, Minnipa, and Buckleboo), Lower North (Owen and Roseworthy) and Yorke Peninsula (Arthurton). Seed biology of these populations was studied in laboratory tests. Initially, the germination pattern of these populations was studied, to assess seed dormancy. Investigations then followed into the effect of light, seed scarification, plant hormones and temperature on seed dormancy to understand field behaviour of these populations.

Also five field trials were set up at three locations on Eyre Peninsula.

Location 1, Buckleboo:

- Herbicide efficacy trial: two times of sowing (TOS), 22 April and 15 May; see Table 1 for herbicide treatments. Plots were 6 x 14 m in size and herbicide treatments covered a single pass with the air-seeder. Measurements taken included crop density, weed density at two timings, weed seed head density, weed seed production, crop yield, screenings and barley grass contamination of grain.

- Seed-bank study: soil cores taken to track decline in barley grass soil seed-bank when no new seed is added, to establish how many years of control are required to exhaust barley grass seed-bank.

Weeds

Location:
Lock
Andrew & Jenny Polkinghorne

Rainfall
Av Annual: 340 mm
Av GSR: 260 mm
2009 Total: 356 mm
2008 GSR: 315 mm

Yield
Potential: 4.1 t/ha
Actual: 2.3 t/ha

Paddock History
2008: Wheat
2007: Wheat
2006: Peas

Soil Type
Calcareous loam

Plot size
14 m x 6 m x 4 reps

Location 2, Lock:

- Herbicide efficacy trial: as above, but only one TOS (16 May). Set up similarly to above, but plot size 6 x 12 m.

- Seed-bank study: as per Buckleboo.

Location 3, Minnipa

- Herbicide efficacy trial: two times of sowing (22 April and 21 May), herbicide treatments same as other sites (Table 1). TOS-2 also had two seeding system treatments, disc (K-Hart) and Knife point (DBS). Plots were sown with plot seeder and were 1.5 x 20 m in size.

- Seed-bank study: as per Buckleboo.

What happened?

Dormancy studies showed that many of these barley grass populations had high levels of seed dormancy at maturity and in some populations dormancy persisted for a long time (Figure 1). Populations ranged anywhere from 80% germination (Yaninee) in March, as would be expected in barley grass, to populations such as that from Minnipa that did not germinate in the lab tests even though all populations had highly viable seeds. This finding explains why barley grass is becoming a greater problem in crop, as it avoids knockdown herbicide with its dormancy and then germinates in crop where control is far more limited.

The mechanisms of this dormancy have been studied with various influences on dormancy, such as light, seed husk, and cold requirement (chilling). The chilling effect (Figure 2) seemed to be the most influential in the highly dormant populations. This means that the dormant barley grass requires not only moisture, but a period of colder temperatures to germinate. This is also evident when comparing barley grass plant numbers between the first time of sowing and the second at Buckleboo with 376 plants /m2 and 95 plants /m2 respectively. This is a large reduction in barley grass due to about three weeks of cooler moist conditions in late autumn-early winter encouraging a break in dormancy and allowing better control of barley grass with knock down herbicide before seeding.

Barley grass control from herbicide treatments at each field site is shown in Table 2. Barley grass control has been reported as seed set reduction from the control treatment. This has been used to demonstrate reduction in the paddocks barley grass seed bank, and future barley grass infestations. At all the sites, knockdown herbicide alone provided unacceptable barley grass control as shown by seed set/m^2 in brackets. For the post emergent treatments Monza provided higher and more consistent control over Atlantis. This could possibly be due to Monza's longer soil residual, enabling it to have activity on even the later cohorts of barley grass. Out of the lower cost pre-emergent treatments, metribuzin, diuron and Logran mix seemed to give the most consistent control. Sakura provided the highest and most consistent control over all the herbicides trialled. Sakura has not been released onto the market yet, but is expected to be available in 2011.

Table 1 Herbicide treatments at Buckleboo, Lock and Minnipa, 2009

Herbicide Treatments
1. Control (only knockdown herbicide pre-seeding)
2. Trifluralin (480 g/L) @ 1.6 L/ha (immediately before sowing, IBS)
3. Trifluralin (480 g/L) @ 1 L/ha + Logran (triasulforon 750 g/kg) @ 30 g/ha (IBS)
4. Metribuzin (750 g/kg) @ 150* g/ha (IBS)
5. Trifluralin (480 g/L) @ 1 L/ha + Diuron (900 g/kg) @ 500 g/ha (IBS)
6. Metribuzin (750 g/kg) @ 150* g/ha + Diuron (900 g/kg) @ 250 g/ha + Logran (triasulfuron 750 g/kg) @ 30 g/ha (IBS)
7. Monza (sulfosulfuron 750 g/ha) @ 25 g/ha (post emergent, PE)
8. Atlantis (mesosulfuron-methyl 30 g/L)
9. Boxer Gold (prosulocarb 800 g/L, S-metolachlor 120 g/L) @ 2.5 L/ha (IBS)
10. Sakura (pyroxasulfone) @ 118 g/ha (IBS)
**180 g/ha Metribuzin applied at Minnipa due to heavier soil texture Surfactants also applied as per product label The above herbicide treatments are for research purposes and may not be registered*

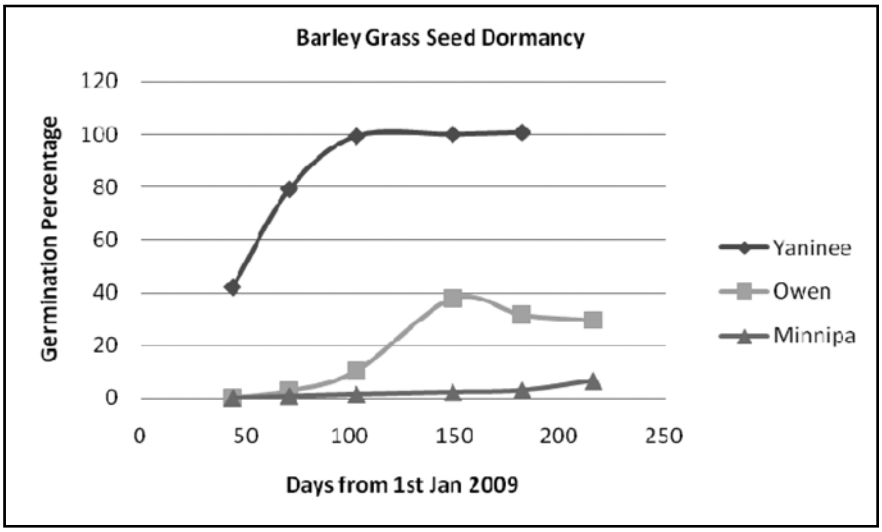


Figure 1 Barley grass seed dormancy

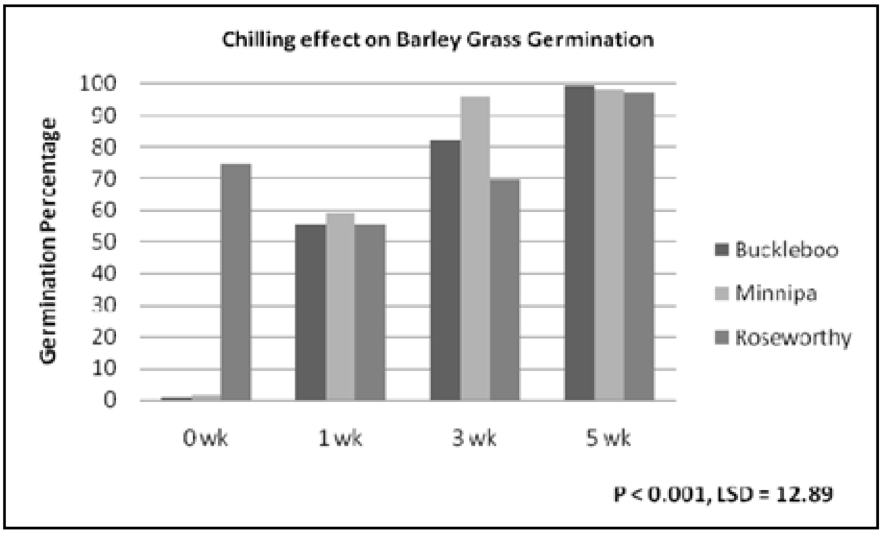


Figure 2 Effect of chilling on germination of three barley grass populations. Cold treatments ranged from no cold treatment to 5 weeks cold treatment

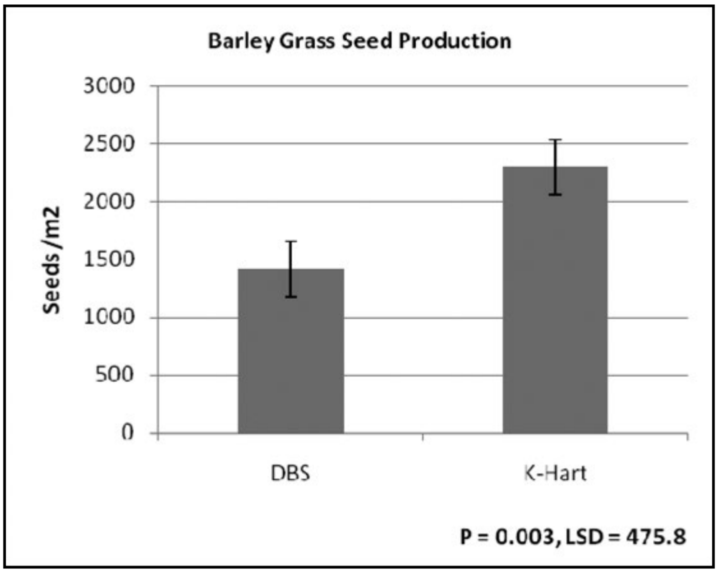


Figure 3 Seeding system effect on barley grass seed production

The Minnipa TOS-2 trial had both herbicide treatments and seeding system treatments. While there were no herbicide treatments that were affected by seeding system treatments, the disc (K-Hart) had 16% more barley grass plants than the knife point (DBS) and resulted in more barley grass seed production as shown in Figure 3. These results indicate that unlike annual ryegrass, barley grass is not disadvantaged by the disc seeding system. Reasons for this are likely to be related to the nature of the barley grass seed. The sterile florets and thick husk would increase the surface area of the seed for water absorption and could protect the seed from fluctuations in moisture and the ability of the seed for self-burial, would make it well adapted to seeding systems that keep seed on the soil surface.

Table 2 Barley Grass control in terms of seed production (%) across field sites, 2009

Herbicide	Buckleboo TOS-1 (22 April)	Buckleboo TOS-2 (15 May)	Lock (16 May)	MInnipa TOS-1 (22 April)	MInnipa TOS-2 (21 May)
Control (only knockdown herbicide)	0 % a (8702 seed/m²)	0 % (1625 seeds/m²)	0 % ***a*** (3059 seeds/m²)	0 % ***b*** (6524 seeds/m²)	0 % ***a*** (4248 seeds/m²)
Trifluralin @ 1.6 L/ha (IBS)	-2 % ***a***	48 %	7 % ***ab***	-27 % ***a***	47 % ***b***
Trifluralin @ 1 L/ha + Logran @ 30 g/ha (IBS)	55 % ***c***	6 %	14 % ***ab***	43 % ***d***	75 % ***d***
Metribuzin @ 150 - 180 g/ha (IBS)	19 % ***b***	46 %	4 % ***ab***	19 % ***c***	42 % ***b***
Trifluralin @ 1 L/ha + Diuron @ 500 g/ha (IBS)	14 % ***b***	-5 %	28 % ***b***	-9 % ***b***	74 % ***d***
Metribuzin @ 150 - 180 g/ha + Diuron @ 250 g/ha + Logran @ 30 g/ha (IBS)	62 % ***d***	53 %	28 % ***b***	35 % ***d***	68 % ***d***
Monza @ 25 g/ha (PE)	54 % ***cd***	47 %	53 % ***bc***	58 % ***e***	64 % ***cd***
Atlantis @ 330 mL/ha (PE)	15 % ***b***	2 %	13 % ***ab***	26 % ***cd***	40 % ***b***
Boxer Gold @ 2.5 L/ha (IBS)	49 % ***c***	61 %	4 % ***ab***	37 % ***d***	57 % ***c***
Sakura @ 118 g/ha (IBS)	92 % ***e***	60 %	64 % ***c***	70 % ***f***	96 % ***e***
Barley Grass seed production as percentage of Control herbicide treatment for each site, Statistical ($P \leq 0.05$) differences displayed with letters for each site					

Wheat yields for each herbicide treatment at each site are displayed below in Table 3. Increased yields seem to be related to improvements in barley grass control. This shows up well when comparing the two sites at Buckleboo, where the herbicide treatments that had higher barley grass control having virtually no difference between TOS-1 and TOS-2. While those with lower levels of control yielded higher in the TOS-2, which had lower barley grass density.

What does this mean?

Barley grass is now a problematic crop weed for many growers. This appears to be due to high levels of seed dormancy in many paddock populations. High dormancy and chilling requirement in barley grass would enable these populations to avoid knockdown herbicides and germinate in crop where control options are far more limited. Herbicides trialled showed variable levels of control, with Sakura providing the highest and most consistent control.

Further barley grass work on the mechanisms behind increased dormancy, seed-bank life and control will continue in 2010.

Table 3 Wheat yields (t/ha) for all field sites, 2009

Herbicide	Buckleboo TOS-1 (22 April)	Buckleboo TOS-2 (15 May)	Lock (16 May)	MInnipa TOS-1 (22 April)	MInnipa TOS-2 (21 May)
Control (only knockdown herbicide)	1.0 *ab*	1.5 *a*	2.2	2.4 *b*	3.9
Trifluralin @ 1.6 L/ha (IBS)	0.9 *a*	1.7 *ab*	2.2	2.0 *a*	4.3
Trifluralin @ 1 L/ha + Logran @ 30 g/ha (IBS)	1.8 *e*	1.8 *b*	2.3	2.9 *c*	4.2
Metribuzin @ 150 - 180 g/ha (IBS)	1.0 *ab*	1.7 *b*	2.5	2.4 *b*	3.8
Trifluralin @ 1 L/ha + Diuron @ 500 g/ha (IBS)	1.0 *b*	1.8 *b*	2.6	2.3 *ab*	4.3
Metribuzin @ 150 - 180 g/ha + Diuron @ 250 g/ha + Logran @ 30 g/ha (IBS)	1.8 *ef*	1.8 *b*	2.3	2.8 *c*	4.3
Monza @ 25 g/ha (PE)	1.7 *e*	1.8 *b*	2.3	2.8 *c*	4.2
Atlantis @ 330 mL/ha (PE)	1.3 *c*	1.8 *b*	2.3	2.6 *bc*	4.0
Boxer Gold @ 2.5 L/ha (IBS)	1.5 *d*	1.7 *ab*	2.4	2.5 *bc*	4.3
Sakura @ 118 g/ha (IBS)	1.9 *f*	1.8 *b*	2.7	2.7 *bc*	4.3
Statistical (P≤0.05) differences displayed with letters for each site					

Recommendations from work done in 2009 include:

- Take barley grass seriously as a crop weed.
- Be sure to achieve maximum control at every opportunity particularly in pasture phases and break crops where high levels of control can be achieved. Consider barley grass control when deciding on herbicides in cereal.
- Assess barley grass escapes in spring and undertake seeding in problem barley grass paddocks right at the end of your seeding program. This approach will not delay overall seeding time for the farm, but gives barley grass longer exposure to chilling conditions, thereby achieving higher germination which can be controlled by knockdown herbicide before seeding.

Acknowledgements

This work is part of a GRDC project into emerging weed threats (UA00105) and we would like to thank the GRDC for their continued funding and support of this work. We would also like to thank Michael & Mary Schaefer, Andrew & Jenny Polkinghorne, and Mark Klante (MAC) for providing field sites for this work. Also we would like to thank Malinee Thongmee, Brenton Spriggs, Kay Brace, Ashley Spiers and Sam Kleemann for their contributions to the project.

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Section
7

Nutrition

Improving Phosphorous Management on Upper EP using the DGT Soil Test

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RESEARCH

Key messages

- **The DGT Soil test can be an accurate predictor of soil P levels in Upper EP soil types.**
- **EP data supports the established DGT critical values for responses to applied P in wheat.**
- **DGT soil P test will be a valuable tool for farmers on EP.**

Why do the trial?

Spectacular fluctuation in fertiliser prices and the increased adoption of variable rate farming techniques have focussed attention on accurate P application at rates that do not compromise yield. Traditional soil tests for P (including Colwell P) struggle to provide accurate estimates of the likely P availability to crops, especially on calcareous soils. However, the Diffusive Gradients in Thin Film (DGT) soil test for phosphorous (developed and modified by Dr Sean Mason) is showing great promise as a tool that is more accurate at predicting P response in wheat than other traditional soil tests, on a range of soil types. Previous lab and field work has shown that more reliable and strategic P fertilisation decisions may be possible if DGT soil test results are utilised as part of the decision making process.

This trial compliments results from replicated field validation trials for the DGT technique across southern Australia. See EPFS 2008, p 150.

How was it done?

Trials sites sown with farmer scale machinery were established across Upper and Central EP to produce paddock scale P response trials. Of the 16 sites, 13 had fertiliser treatments that represented the farmer's standard P rate for 2009, a higher P rate (often double) and a nil P rate. The remaining 3 sites had a standard P rate and nil P strips only. Most of the trial sites (13) were sown to wheat while the remaining sites were sown to barley.

Phosphorus input rates varied from as little as 2 kg/ha P as a fluid fertiliser, up to 28 kg/ha P as a granular fertiliser. Nitrogen and trace elements were balanced on all but 5 trial sites.

Soil samples (0-10 cm) from the nil P strips were taken at sowing and analysed for Colwell P, PBI and DGT.

The cereal crop response to applied P was quantified by taking 3 x 1 m random dry matter plant cuts at late tillering (~GS30) in each of the nil P, standard P and high P strips at each site. Tissue tests at mid – late tillering were performed and analysed for P and other elements.

Grain response to applied P was determined by taking a further 3 x 1 m random plants cuts at maturity and these harvest cuts were threshed to determine grain yield.

Some sites also had yields mapped at harvest to determine if there were any differences with yields obtained by manual harvest. The data obtained by the manual harvest has been reported in this article to provide a uniform method between all sites.

The % relative yield value was used as the measure of response to applied P and is calculated using the following equation.

% Relative yield = Yield (nil plot, 0P)/ Yield (P applied) x 100

If the soil is P responsive, the % relative yield will be less than 90%. The lower the % relative yield the bigger the response and therefore indicating increasing P deficiency.

Table 1 Colwell P and DGT values and associated yield responses to applied P

Site ID	Crop	Colwell P (mg/kg)	PBI	Critical Colwell P* (mg/kg)	CE (DGT) (µg/L)	% Relative yield (~GS30)	% Relative yield (Grain)
Calca	Barley	116	129	33	1025	80	103
Koongawa	Barley	24	83	26	609	84	63
Piednippie Tank	Barley	61	226	38	351	55	NA
Buckleboo	Wheat	42	128	30	1066	57	91
Koongawa	Wheat	29	76	24	731	81	107
Koongawa	Wheat	31	39	15	5328	76	109
Koongawa	Wheat	32	37	15	8007	89	92
Kopi	Wheat	48	97	30	449	54	88
Lock	Wheat	53	132	29	701	57	86
MAC	Wheat	30	91	26	1083	66	81
Mudamuckla	Wheat	25	139	32	394	46	74
Nundroo	Wheat	49	237	38	414	50	97
Piednippie	Wheat	43	200	36	432	69	90
Port Kenny	Wheat	60	208	35	400	56	91
Wirrulla	Wheat	25	163	33	429	45	71
Witera	Wheat	29	109	27	398	58	64

*Calculated from Moody 2007 AJSR
NA - field site not harvested due to severe Rhizoctonia

What Happened?

Early dry matter (~GS30)

By determining the critical Colwell P value using PBI from each site, the Colwell P method predicted that 19% of the sites would have a grain response to applied P, while the DGT test predicted that 69% of the sites would be grain responsive (< 90% RY). The DM cuts revealed that all sites had a positive dry matter response to applied P at mid to late tillering.

From the sites that had two different rates of P applied in addition to the nil strip, it could be determined if the highest P rate was sufficient to maximise yields at both growth stages (GS30 and grain). Out of the 13 sites that had multiple P rates, 8 had a linear response between P rate and yield at GS30 highlighting that insufficient rates of P were used to produce maximum yields. Three sites also had linear grain responses with P rate indicating the problem was highlighted at earlier growth stages. Linear responses to P have also been observed from replicated field trial sites with similar PBI values and similar rates of P used. As relative yield is based on the presumption the maximum yield has been reached, these sites would have lower relative yield values.

Figure 1 shows the relationship between Colwell P test values and % Relative Yield of dry matter at late tillering. The dark circles represent the 2009 EP results and the open circles show the 2006-2009 replicated and field data results. The upper EP data supports the 2006-2009 data in that no significant relationship exists between Colwell P and the response of the crop to applied P (% relative dry matter yield).

Figure 2 shows the significant relationship between DGT and % relative yield dry matter. The EP data supports the results from 25 replicated field trials across grain growing regions in southern Australia. Sites that have had insufficient P rates to maximise yield are highlighted in Figure 2 by having smaller relative yield numbers with respect to DGT values, making these sites fall off the established curve.

Nutrition

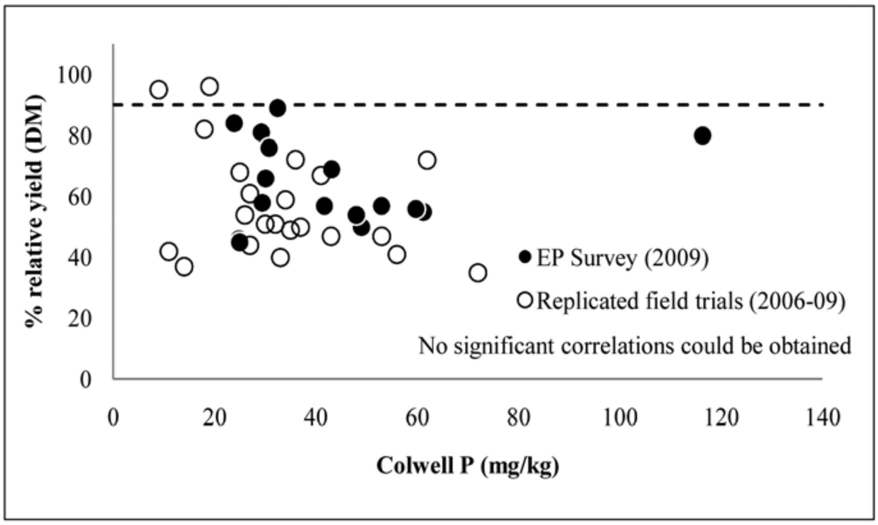


***Figure 1** Colwell P relationship with crop response at GS30 (expressed as % relative yield) for the EP survey and replicated field trial data obtained from 2006 through to 2009 (data obtained at time of writing)*

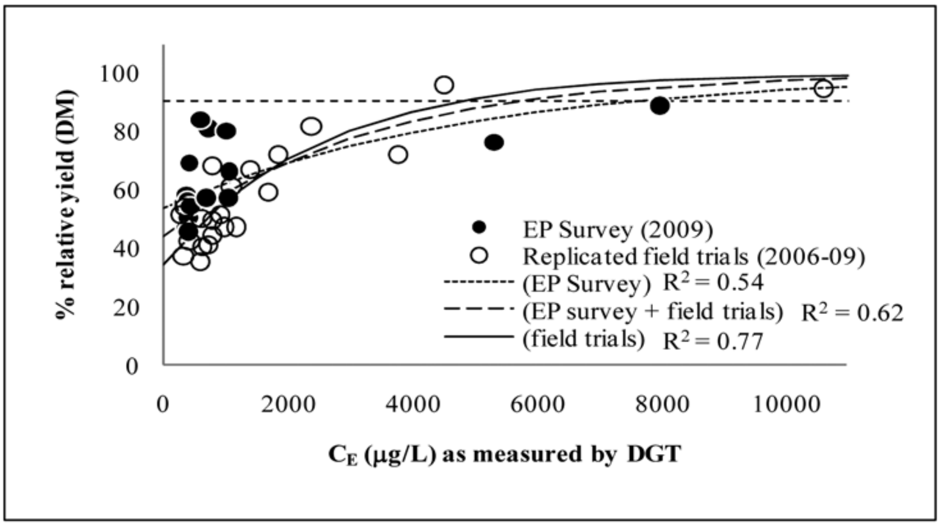


***Figure 2** DGT relationship with crop response at GS30 (expressed as % relative yield) for the EP survey and replicated field trial data obtained from 2006 through to 2009 (data obtained at time of writing)*

Grain

For all sites grain yield responses were lower compared to yield responses obtained at GS30 apart from one site. The Colwell P plus PBI and the DGT test correctly predicted a similar percentage of the yield responses to applied P (73% and 67% respectively). The decreased predictive capability of DGT in respect to grain response compared to replicated field trials could be due to sites not having a high enough P application rate to maximise yields, as shown from cuts taken at GS30, and therefore they have been classified as non-responsive when in fact they are responsive. These sites again are highlighted in Figure 4 by having lower relative yield values at low DGT values compared to the established data set.

Figure 3 shows the poor relationship between the % relative yield of grain and the Colwell P test results, when compared with the results for DGT (Figure 4).

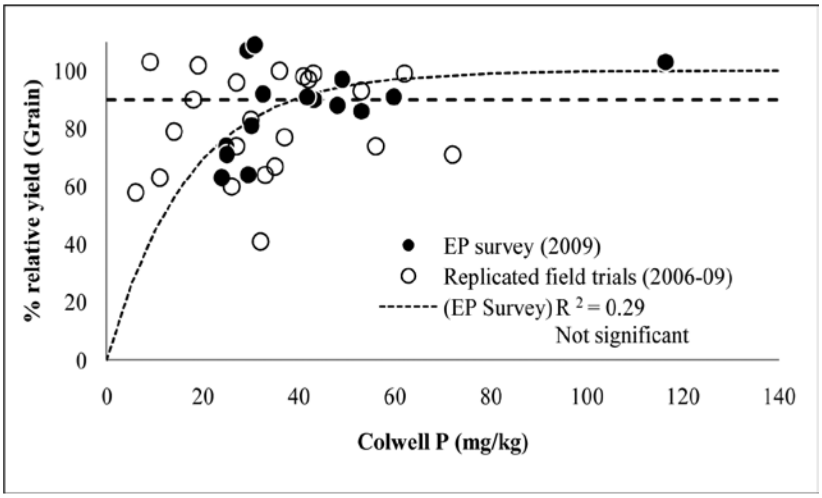


***Figure 3** Colwell P relationship with grain response (expressed as % relative yield) for the EP survey and replicated field trial data obtained from 2006 through to 2009 (data obtained at time of writing)*

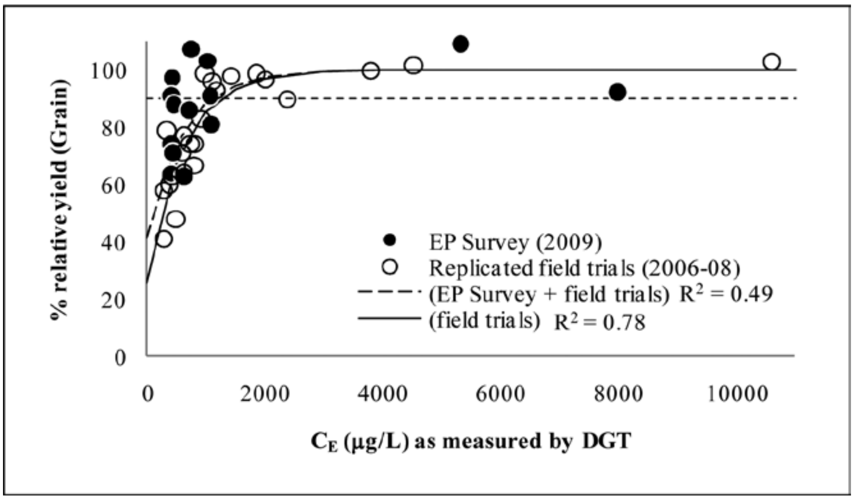


***Figure 4** DGT relationship with grain response (expressed as % relative yield) for the EP survey and replicated field trial data obtained from 2006 through to 2009 (data obtained at time of writing)*

What does this mean?

The early dry matter response to applied P from the 2009 EP sites support results from replicated field trials showing that the DGT test has great promise as a reliable soil test for predicting plant P availability under field conditions when compared with the Colwell P test.

DGT can predict if a soil is P deficient or adequate, and is a valuable tool for assisting the fertiliser P decision process for farmers.

The DGT test cannot specify the rate of P required to maximise yield as fertiliser efficiency is governed by other factors in the soil with the PBI measurement providing a good indication of potential P fixation. Further work is underway to utilise PBI in combination with the DGT test to improve the value of this test to farmers. Preliminary results are encouraging and indicate by combining PBI and DGT measurements the P rate required to maximise yields early on can be predicted.

Additional research is also underway to assess the potential for the DGT test to predict plant responses to other nutrients namely Zn and Mn. The DGT method has also been shown to accurately predict crop response of different crop types (peas, canola and barley) from a small data set. These crop types have shown to have different efficiencies of accessing P in the soil. Results from 2009 trials will help build on these data sets.

GRDC is currently investigating avenues to commercialise the DGT soil test for broadacre agriculture.

Acknowledgements

GRDC is acknowledged for its continued support of the DGT program, and for funding the program on EP in 2009. Thanks also to the famers on EP, including the MAC farm team, who have contributed time and resources, and to Dr Nigel Wilhelm for project support.

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

THE UNIVERSITY OF ADELAIDE AUSTRALIA

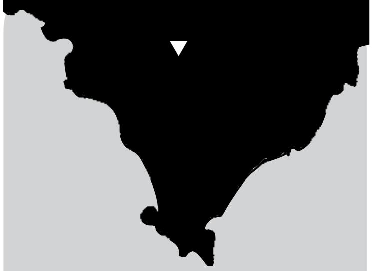
GRDC Grains Research & Development Corporation

Establishing Sustainable P Rates on Varying Soil Types

Cathy Paterson and Roy Latta
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers



Location: Minnipa Ag Centre
Rainfall
Av. Annual: 325mm
Av. GSR: 242mm
2009 Total: 421mm
2009 GSR: 333mm
Yield
Potential: 5.2 t/ha (W)
Actual: 4.6 t/ha (W) (20kg/ha P - low P zone)
Paddock History
2008: Wheat
2007: Wheat
Soil Type
Red sandy loam
Soil test
Organic C%: 0.96-0.99
Phosphorus: 25-35 mg/kg
Diseases
Low levels Rhizoctonia
Plot size
1.4 m x 9 m x 4 reps
Yield Limiting Factors
Nil
Environmental Impacts
Soil Health
Soil structure: Stable
Disease levels: Low – medium Rhizo, low Crown Rot
Tillage type: No-till
Compaction risk: Low
Perennial or annual plants: Annual
Grazing Pressure: Low
Water Use
Runoff potential: Low
Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, NO_2, methane): Cropping and livestock
Social/Practice
Time (hrs): No extra
Clash with other farming operations: Standard practice
Labour requirements: Standard practice
Economic
Infrastructure/operating inputs: High input system has higher input costs
Cost of adoption risk: Medium

Key messages

- **Applying 20 kg/ha of phosphorus (P) increased grain yield and protein content above a replacement P rate, however there was little economic benefit from the extra P on either a deep or a shallow constrained soil in 2009.**

Why do the trial?

Comparing the crop response to applied P rates interacting with soil production potential is important supporting information for the application of variable rate technology. The long term production and economic outcomes from applying P at nil, replacement, average and twice average rates on soils with varying production constraints is an important part of the input decision making process.

How was it done?

A four year trial was established in Paddock North 1 Minnipa Ag Centre in 2009. The trial aims to measure comparative wheat yields in response to varying P applications on 2 soil types. One on a deep, sandy loam soil type (Colwell P, 25 mg/kg) and the second on a shallow sandy loam over clay, lower in the landscape (Colwell P 35 mg/kg).

There were 3 fertiliser treatments applied plus no fertiliser with Wyalkatchem wheat sown at 60 kg/ha. The trial was sown onto the high 2008 VRT treatment. This means it received 10 kg/ha of P and was sown at 60 kg/ha of wheat in 2008. Plots were 9 m x 1.4 m and replicated 4 times.

Table 1 shows P rates applied as DAP with 18 kg/ha of N added to all treatments (adjusted with urea as required). Measurements presented include dry matter at tillering, grain yield and quality. Estimates of gross margins were made. All plots received standard weed management.

Changes in residual soil P for each treatment will be measured over the 4 year period of trial along with the comparative crop performance

What happened?

Table 2 shows early biomass production, grain yield and quality from the 2 soil types in 2009. Screenings were ≤1% and test weights >84 kg/hL for all treatments (data not presented). Biomass production, grain yield and protein contents were either similar or higher for both soil types in response to 20 kg/ha of P applied compared to the nil and replacement P treatments. However the 20 kg/ha of P applied had only a minor advantage in estimated gross margins over the replacement P treatment and a disadvantage over the nil treatment on the deeper soil type.

What does this mean?

The Colwell P levels measured at the commencement of the study suggested that the soil P may be sufficient for the first year of this trial. This almost proved to be the case with some production and economic benefit from P applied on the shallow soil type compared to the nil treatment.

On the deep soil type the incidence of Rhizoctonia reduced yields to the point where the nil treatment provided the highest estimated gross margin through achieving a similar yield to all other treatments. Residual P levels were found to be adequate for the yields achieved.

Table 1 Phosphorus and nitrogen (kg/ha) applied in 2009

Shallow sandy loam over clay Yielded 0.39 t/ha in 2008	P (kg/ha)	DAP (kg/ha)	N supplied (kg/ha)	Urea needed (kg/ha)
0 kg P	0	0	0	39
Replacement P	1.2	6	1	37
10 kg P	10	50	9	20
20 kg P	20	100	18	0
Deep sandy loam Yielded 0.65 t/ha in 2008	**P/ha**	**DAP (kg/ha)**	**N supplied (kg/ha)**	**Urea needed (kg/ha)**
0 kg P	0	0	0	39
Replacement P	2	10	2	35
10 kg P	10	50	9	20
20 kg P	20	100	18	0

Table 2 Crop performance in P replacement trial, 2009

kg/ha applied	Dry Matter (t/ha)	Yield (t/ha)	Protein (%)	Gross income* ($/ha)
Shallow soil				
0	1.7	3.9	10.5	827
Replacement P	1.7	4.3	10.5	910
10	2.2	4.4	10.6	906
20	2.4	4.6	10.9	920
LSD ($P \leq 0.05$)	*ns*	*0.4*	*0.2*	
Deep soil				
0	0.7	2.9	10.5	604
Replacement P	0.6	2.7	10.5	552
10	0.9	2.8	10.6	549
20	1.0	3.1	10.9	585
LSD ($P \leq 0.05$)	*0.3*	*0.3*	*0.3*	

**Gross income is yield x price of APW less seed and fertiliser costs delivered to cash pool on 2 December 2009, Port Lincoln. $350/t used for seed value*

Acknowledgements

We gratefully acknowledge the help of Kay Brace and Cilla King for technical assistance and Brenton Spriggs for his help harvesting the trial. Also thanks to Nigel Wilhelm for his input and advice on this trial. Thanks to Alison Frischke and Wade Shepperd for setting up and managing the trial.

Nutrition

Measuring the Effect of Residual P

Cathy Paterson and Roy Latta
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location: Minnipa Ag Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm
Yield
Potential: 5.2 t/ha (W)
Actual: 4.5 t/ha (W)
Paddock History
2008: Wheat
2007: Wheat
2006: Pasture
Soil Type
Red sandy loam
Soil test
Organic C%: 1.1
Phosphorus: 27 mg/kg
Diseases
Low levels Rhizoctonia
Plot size
12 x 1.48 m x 4 reps
Yield Limiting Factors
Nil
Environmental Impacts
Soil Health
Soil structure: Stable
Disease levels: Low – Medium Rhizo, Low Crown Rot
Tillage type: No-till
Compaction risk: Low
Perennial or annual plants: Annual
Grazing Pressure: Low
Water Use
Runoff potential: Low
Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, NO_2, methane): Cropping and livestock
Social/Practice
Time (hrs): No extra
Clash with other farming operations: Standard practice
Labour requirements: Standard
Economic
Infrastructure/operating inputs: High input system has higher input costs
Cost of adoption risk: Medium

Key message

- **A site with high phosphorus (P) reserves needed no extra P fertiliser to maximise the yield of wheat in 2009 at MAC.**

Why do the trial?

After a string of poor years resulting in low cash flow and an increase in fertiliser prices, many growers struggled to fit their standard fertiliser rates into their budgets, and therefore reduced the amount of inputs at sowing. While we know soil reserves of phosphorus (P) are an important source of P for crops, we do not have a good understanding of how long soil P reserves last or how well fertilisers contribute to soil reserves.

In order to assess the P response from current fertiliser applications, a four year replicated trial was established at MAC. Changes in soil P will be measured annually with Colwell P and the response on crop performance monitored.

How was it done?

A four year replicated trial was established on Paddock South 1, Minnipa Ag Centre in 2009. The trial aims to measure comparative wheat yields in response to P applications over time. There are 10 treatments as shown in Table 1. In 2009 the 5 and 10 kg/ha P were applied as 25 and 50 kg/ha of DAP respectively with an extra 29 and 20 kg/ha of urea applied to equalize nitrogen, applied in total at 18 kg/ha, as per the high input treatment of 100 kg/ha of DAP (20 kg/ha of P, 18 kg/ha N). The Nil P treatment received 39 kg/ha of urea (18 kg/ha N).

All treatments were replicated 4 times and sown in 1.48 x 12 m plots by direct drill on 7 May 2009. Wyalkatchem wheat was sown at 60 kg/ha. Dry matter production was sampled on 4 August (end of tillering). Grain yield and grain quality were measured at maturity. All plots received standard weed management.

What happened?

2009 was the first year of the trial and therefore there were only 4 different P treatments (Table 1) 0, 5, 10 and 20 kg/ha of P applied in fertiliser. Table 2 shows early biomass production, grain yield and quality in 2009. Screenings were $\leq$1%, test weights all >84 kg/hL and protein 9.9 – 10.1%, regardless of treatments.

What does this mean?

Despite the response in early dry matter production there was no benefit from applied P in terms of wheat grain yield. The residual P levels were sufficient for the first year of this trial. Similar dry matter responses, with little or no yield advantage, are reported in the article by Mason and Bates 'Improving Phosphorous Management on Upper EP using the DGT Soil Test'.

Over the next 3 seasons appropriate soil analysis will be carried out to measure any changes in soil P and if there is any impact of differing P regimes on crop performance. The results from this trial will undergo a financial assessment to evaluate the merits of each system in subsequent years.

Acknowledgements

We gratefully acknowledge the help of Willie Shoobridge, Cilla King and Brenton Spriggs for their help during the year with sampling, harvest and processing grain quality samples. Thanks to Alison Frischke for setting up the trial and Wade Shepperd for technical assistance.

Table 1 Phosphorus (kg/ha) applied over the 4 year duration of the trial

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

Colwell P in the top 0 - 10 cm at the site prior to seeding was 27 mg/kg.

Table 2 Wheat performance with increasing rates of fresh P in 2009

Treatment	Early DM (t/ha)	Grain Yield (t/ha)	Protein (%)	Screenings (%)	Test Weight (g/hL)
O P	1.5	4.0	9.9	1.0	84.6
5 P	1.6	3.9	10.0	1.0	85.3
10 P	2.0	4.0	9.9	1.0	85.8
20 P	2.1	4.0	10.1	1.0	84.9
LSD (P=≤0.05)	*0.42*	*ns*	*ns*	*ns*	*ns*

Nutrition

Potential for Foliar Applied Phosphorus in Australian Dryland Cropping: A Glasshouse Study

RESEARCH

T.M. McBeath[1], S.R. Noack[1], and M.J. McLaughlin[1,2]

[1]School of Agriculture, Food and Wine, The University of Adelaide, [2]CSIRO Land and Water

Key messages

- **A yield response to foliar phosphoric acid plus adjuvant was measured in a P responsive soil type. Translocation to grain did not control the yield response but likely due to the increased ability of the tillers to survive and fill grain.**
- **Further evaluation is required of the; soil types, climatic conditions, timing, rate and formulations including adjuvants, in order to determine the best fit for foliar P fertilisation in agricultural systems having variable climate.**

Why do the trial?

It is important to apply some phosphorus (P) to the soil at the beginning of the crop growth cycle to provide essential P for early growth and to replace P exported in previous crops. With low rates of P added at sowing there may be sufficient P reserves to grow crops to tillering, but in seasons of increased yield potential a top-up application of P may be required. Foliar P application can be applied directly to the plant when required and in some cases has been shown to provide benefits for increasing P use efficiency. However, tests of foliar P fertilisation to date have had inconsistent results. Our aim was to accurately measure the ability of foliar P products to increase grain yield and contribute to grain P uptake using a radioactive tracing technique (with 33P) in the glasshouse.

How was it done?

The experiment comprised two soils, seven P fertiliser treatments with one rate of P (equivalent to 1.65 kg P ha^{-1}), replicated three times. The seven P fertiliser treatments were: control of water only, control of water only but extra 1.65 kg ha^{-1} starter P added to soil (to balance extra P applied as foliar P), ammonium polyphosphate plus the adjuvant LI700, Top Up plus LI700, Top Up only, phosphoric acid plus LI700 and phosphoric acid. Solutions were added to the foliage at a water rate equivalent to 120 L/ha. There was a treatment of ammonium polyphosphate only but this is not presented as the concentration of fertiliser was found to not match the other treatments.

After five weeks of growth, at Zadoks growth stage 39, the foliar fertiliser solutions were applied. The fertiliser solutions were labelled with 33P as a radioactive tracer. The fertiliser-33P spikes were applied to plants as 10 μL drops with 21 drops applied to each pot, with drops placed on as many leaves of each plant as possible. The spike rate is equivalent to an application of 1.65 kg P ha^{-1} in 120 L ha^{-1} total volume. The foliar fertilisers were applied mid-morning at 29.5°C and 57.9% relative humidity. Four days after the application of foliar fertiliser, the plants were rated for burn according to the methodology of Stein and Storey (1986) where 1= no effect, 2= slight surface burn on treated area, 3= moderate burn, 4= necrosis on affected area, 5= necrosis on affected area and untreated parts of plant affected. After harvest, plant parts were weighed and digested samples of grain were analysed for P content and 33P radioactivity. All statistics were undertaken using the statistical package Genstat.

What happened?

One week after adding the foliar fertiliser, the leaves were scored for scorch with a rating 1-5. The largest scorch effect was for the lowest pH fertiliser (phosphoric acid) added with adjuvant. However, as indicated in Table 2 this was the highest yielding treatment in the Koppio soil.

The grain and plant yield data indicate that plants grown in the Koppio soil yielded 1.25 times more grain when supplied with foliar P fertiliser in the phosphoric acid form added with adjuvant compared to adding the extra 1.65 kg P to the soil at sowing. Phosphoric acid only yielded similarly to adding extra P at sowing while all other treatments yielded the same as the control (Table 3).

Table 1 Soil Characteristics

Soil Characteristics	Units	Maitland	Koppio
pH	H_20	8.3	6.2
$EC_{1:5}$	dS m^{-1}	0.22	0.13
$CaCO_3$	% w/w	14	0.18
Clay	% w/w	35.2	18.1
TOC	% w/w	2.3	3.9
DGT CE_P	μg L^{-1}	964	1275
Colwell P	mg kg^{-1}	68	29

† EC-electrical conductivity, $CaCO_3$ - calcium carbonate, TOC - total organic carbon, DGT CE_P - diffusive gradient in thin film effective concentration phosphorus.

***Table 2** Foliar fertiliser pH and scorch score for each treatment measured four days after application of foliar fertiliser. Significantly different treatments are appended by a different letter (P<0.001, LSD 0.81). The treatment x soil interaction was not significant.*

Treatment	pH	Scorch Score
Control (water)	5.95	1.0 a
Control (water) + soil P @ 1.65kg P/ha	5.95	1.0 a
Phosphoric acid	1.26	2.8 b
Phosphoric acid + adjuvant	1.27	3.6 b
Top Up	1.88	3.3 b
Top Up + adjuvant	1.89	3.3 b
Ammonium Polyphosphate + adjuvant	6.40	1.5 a

***Table 3** Grain weight (g/pot) and total plant weight (g/pot). Significantly different treatments are appended by a different letter (grain wt; soil x treatment P<0.001, LSD 2.3, total plant wt; soil x treatment P<0.001, LSD 5.3).*

Treatment	Grain Weight (g/pot)	Total Plant Weight (g/pot)
Koppio		
Control (water)	15.7 c	47.0 d
Control (water) + top up soil P	16.9 bc	53.7 bc
Phosphoric acid	19.0 ab	58.7 ab
Phosphoric acid + adjuvant	21.2 a	64.0 a
Top Up	15.0 c	45.6 d
Top Up + adjuvant	15.4 c	48.3 d
Ammonium Polyphosphate + adjuvant	15.1 c	50.6 cd
Maitland		
Control (water)	7.4 d	23.1 e
Control (water) + top up soil P	7.8 d	24.7 e
Phosphoric acid	6.3 d	20.9 e
Phosphoric acid + adjuvant	6.6 d	21.4 e
Top Up	7.8 d	24.8 e
Top Up + adjuvant	6.1 d	20.4 e
Ammonium Polyphosphate + adjuvant	6.1 d	22.5 e

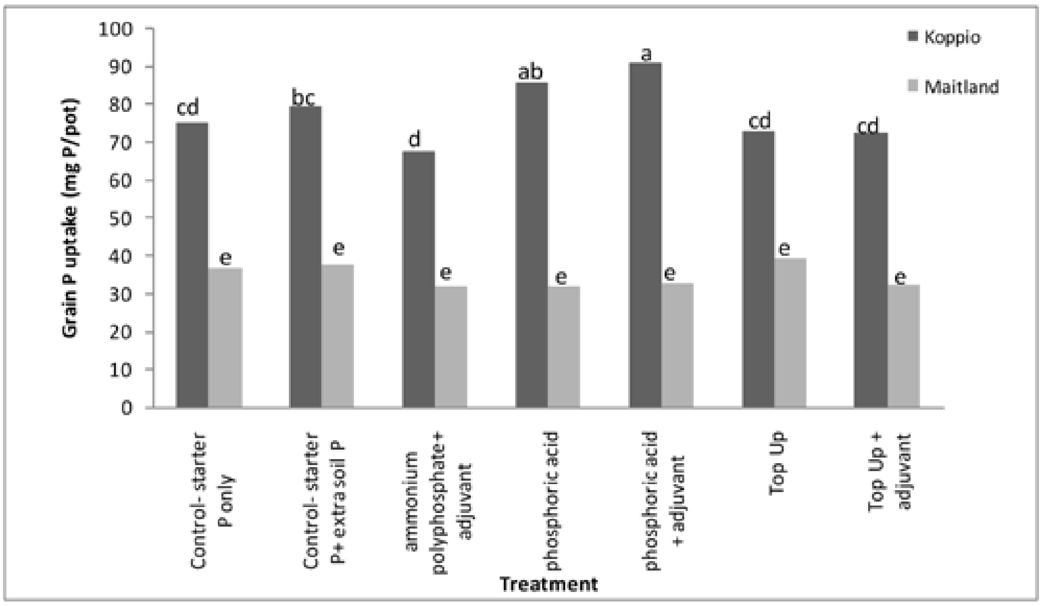


Figure 1 Phosphorus in grain derived from the foliar fertiliser (mg P/pot). Significantly different treatments are appended by a different letter (treatment P=0.042, LSD 0.61).

Despite also having a marginal soil P test value (DGT-P), the Maitland soil did not respond to foliar P application, demonstrating the importance of pre-screening for responsiveness to soil and foliar nutrient of a range of application rates. This lack of responsiveness to foliar P despite low initial soil test results was also observed by Mosali et al. (2006). The reliability of soil P testing methodology is vital for appropriate site selection and P testing is being researched by Mason and McNeill (2008).

The P in grain derived from the foliar fertiliser is a small amount of P (mg) and did not significantly differ between treatments (Figure 1). These data indicate that the foliar P addition does not have a function of loading the grain with P but rather supports the ability of the tillers to fill grain.

In-season P fertilisation prior to the emergence of the head allowed the plant to produce a higher number of fertile tillers per unit area resulting in a higher yield in a number of studies (Batten et al. 1986; Elliott et al. 1997; Goos 1995; Romer and Schilling 1986). In comparison, a P-deficient crop will conserve sufficient P to sustain the survival of just one fertile tiller on each plant (Romer and Schilling 1986).

Acknowledgements

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Top Up – registered product of SprayGro Liquid Fertilizers.

LI700 - registered product of Nufarm Australia Ltd.

Genstat tenth edition is a registered product of Lawes Agricultural Trust.

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Nitrogen Response at Minnipa in 2009

Michael Bennet
SARDI/SANTFA, Minnipa Agricultural Centre

RESEARCH

Best Practice

Location:
Minnipa Ag Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Yield
Potential: 5.2 t/ha (W)
Actual: 4.6 t/ha (W)

Paddock History
2008: Wheat
2007: Wheat
2006: Wheat

Soil Type
Sandy loam

Plot size
10 m x 45 m x 3 reps

Yield Limiting Factors
Nitrogen deficiency

Key message

- **The airport paddock at MAC was starved for nitrogen in 2009.**

Why do the trial?

In late June, the airport paddock at MAC was starting to go a pale green, indicating nitrogen deficiency. The paddock has had a long history of cereal cropping with low protein levels being a characteristic of the grain harvested. The decision was made to measure the response to rates of top-dressed urea.

How was it done?

The urea was broadcast using a snail bait spreader calibrated for delivering urea. The crop was past the tillering stage when the urea was applied on 7 July.

What happened?

The plots were obvious from aerial photographs taken by John Heap with his model aircraft mounted camera in August. The nil plots were still quite pale and the heavier nitrogen rate plots were a darker green. Despite this, even the 100 kg/ha urea plots failed to be as visually green as other paddocks on the Minnipa Ag Centre.

Applying 25 kg/ha urea did not have any impact on grain yield compared to the plots with no urea. 50 kg/ha urea resulted in increased yield compared to the nil plots. 100 kg/ha urea resulted in the greatest increase in yield over the nil and an increase over 25 and 50 kg/ha of urea.

What does this mean?

This season highlighted the importance of nitrogen in the farming system. Over the 2006-2008 period, lacking nitrogen was often a bonus to restrict crop growth and allow the crop to finish on minimal moisture.

The results of 2009 indicate that a base load of nitrogen through legume crops/pastures should be in the soil to help crops to yield well when the wet seasons do occur. Not many growers would be prepared to broadcast 100 kg/ha urea in low rainfall environments, given that the season could still come in hot and dry by the end and show no benefit for additional N.

Crops grown on the heavier soils on MAC possibly leached less nitrogen than the sandier airport paddock with the heavy rainfall in June, however those paddocks also had a strong medic pasture background which contributes to higher starting nitrogen levels.

The 100 kg/ha urea plots failed to raise protein levels above 8% which indicate that the plants were still lacking nitrogen, despite adding an increase in grain yield.

A break crop of field peas or medic pasture for the Airport paddock will help tidy up the increasing grass weed burden as well as add some extra nitrogen to the system.

Acknowledgements

Thanks to Brenton Spriggs and Wade Shepperd for technical assistance.

Table 1 Grain yield and grain response to broadcast urea, Airport paddock 2009

Urea Rate (kg/ha)	Grain Yield (t/ha)	Protein (%)	Test weight (kg/hL)	Screenings (%)
0	2.11	8.6	80.4	0.6
25	2.35	8.4	80.4	0.7
50	2.86	8.2	80.7	0.8
100	3.75	8.2	79.8	0.6
LSD (P=0.05)	*0.46*	*ns*	*ns*	*ns*

Nutrition

Nutrients for Crops in 2010 - How Much Nutrition did you Export to the Silo Last Year and How Much Fertiliser are you Applying This Year?

EXTENSION

Linden Masters[1] & Annie McNeill[2]

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

Key messages

- **Calculate the quantity of key nutrients (N and P) that you removed from your paddocks in grain last year using simple rules of thumb – aim to at least replace this and add more if you can.**
- **Deep N soil test in paddocks where protein was low.**
- **Sow into standing stubbles if possible.**
- **Make more informed nutrient decisions - know your soil organic carbon & PBI.**

The average or better than average crops of last year mean that soil nutrient reserves will be depleted. Realistically no one has had huge budgets for fertiliser with the last 3 poor seasons complicated by high fertiliser prices. Protein in grain delivered in 2009 was down and whilst some of this may be due to soil moisture later in the season it is part of an indicator that crops would have benefited from extra N. Hopefully with grain in the silo and dollars from the grain sold it is time to consider at least replacing what has gone off the farm, back into the soil for the next crop and if there is enough cash flow maybe anticipating another better than average season to come and planning for that!!

Obviously grain quality (protein) will influence the exact amount of N taken off but as a rough guide for each ton of grain sold you have exported 20 units of N/t. So a ten bag/acre or 2 t/ha wheat crop exported 40 units of N equivalent to approx 90 kg of urea or 220 kg of 18:20 fertiliser.

Working on a simple replacement for removal in grain is a reasonable strategy but does not account for the recycling that occurs via organic matter in standing stubbles and the soil. The recycling is important to consider for N because such large amounts are required compared to other nutrients like P and Zn. Although as P fertilisers increase in price we are starting to think about how the soil might supply more P too.

Aside from what you add as fertiliser this year the nutrients for the coming year's crops will come from three other sources in soil: (1) from any residual fertiliser, (2) from last year's stubble input, and (3) from cycling of long term soil organic matter.

1. Residual fertiliser

Likely to be low as the good crops last year will have accessed a large proportion of the applied fertiliser, but even under best conditions 40% of applied fertiliser tends to remain in soil. It may no longer be in a form that plants can access (this especially is true for P and Zinc on alkaline and calcareous soils which can get permanently locked up) or in case of N it may have leached beyond root zone, gone into the atmosphere as a gas or be tied up temporarily in microbes. You can expect some of your fertiliser N tied up in microbes to be released during the season but only a very small % of the original fertiliser application.

2. Nutrients from breakdown of residues (roots & stubble from last year's crop)

Above and below ground residues from last year's crop are the freshest additions to the soil organic matter although most of the information we have is about above ground residues (roots are rarely considered). There are rules of thumb to work out what N you are likely to get from the previous year's residues and it will depend on whether it was a legume or cereal.

For example: Assuming your grain production of 2 t/ha was half of the total dry matter production on the paddock (50% harvest index) then you would have about 2t/ha of cereal stubble. Mature wheat stubble contains less than 0.5% N so your 2 t of stubble will contain at best 10 kg N/ha. Up to 25% of this can be released in the first season of decomposition which gives you at most 2.5 kg/ha available N. Cereal stubbles are considered low quality as they contain a lot more carbon in proportion to nitrogen and so the microbes tend to require N in order to break them down. This means some of the fertiliser N you add will be temporarily used by microbes to break down cereal stubbles. So it is very important to recognise that with high cereal stubble loads there is quite likely to be temporary tie up of N and allow for this in the fertiliser application.

Medic residues as a rule of thumb contain more N (25 kg/t) dry matter although again only some of this N becomes available to plants in the first year of decomposition. Also the residue input will depend on how the paddock was managed during last year and over the summer. Heavy grazing and some mechanical weed control measures will remove a lot of the residue input.

Note: There is a good explanation of this in a PIRSA publication by Michael Wurst called 'Nitrogen Management for Wheat and Malting Barley'. Contact Michael Wurst on (08) 8664 1408 or email michael.wurst@sa.gov.au

3. Nutrients from cycling of long term soil organic matter (organic carbon)

Any rule of thumb for nutrient cycling is highly dependent on soil moisture conditions, soil temperature and biological activity. It also relates strongly to the amount of organic matter in the soil. Do you know your organic matter or carbon contents?? Generally the higher your organic matter base then the more nutrient cycling occurs as the carbon feeds microbes so there are more of them and they work harder and faster. The amount of N released from your long term organic matter build up is very difficult to predict so that a rule of thumb is hard to apply, although often the contribution may be as important as the fertiliser.

Maintain standing stubbles if feasible

Density of stubble may pose handling issues in 2010 for regions that don't normally have this problem. Ideally leaving the stubble standing will have huge benefits:

- Easier to sow into.
- Shades the soil and reduce soil evaporation.
- Allows longer wetter periods for soil biota activity.
- Reduction of wind and water erosion.
- Reduce wicking in Magnesia patches.
- Less N will be needed by soil biota to convert the straw in the first year.
- Provides food for the microbes over the coming 2-3 years.

Deep N test if you can

The dry summer in many places so far has meant that there has been nothing for the microbes to drink and so little opportunity for breakdown of stubbles or soil organic matter cycling. If you have had some summer rains and good weed control then some of your stubble may have broken down and old organic matter may have recycled to available N. A deep N test as close to sowing as possible in early autumn will give an idea of what available N will be there for the start of the season and help you to decide how much N to apply at sowing or during the season.

What about P?

Recent research is showing that the usefulness of Colwell tests for available P can be improved if the phosphate buffering index (PBI) of the soil is also known, but this does not help for many calcareous soils. The new DGT test for available P is currently in the pipeline and should help P fertiliser decisions on many EP soils (see Mason and Bates, 'Improving Phosphorus Management on Upper EP using the DGT Soil Test')

Acknowledgements

Thanks to Gupta (CSIRO) for comments and input.

Table 1 Simple rules of thumb for nutrients removed in the grain of a wheat crop

Element	N	P	K	S	Ca	Mg	Cu	Zn	Mn
kg/t grain	20	3	4	2	0.3	1.5	0.007	0.016	0.04
kg removed in a 2.3 t/ha crop	46	6.9	9.2	4.6	0.69	3.45	0.016	0.037	0.092

Section Editor:
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Section 8

Livestock

Time of Sowing Cereals for Grazing at MAC 2009

Cathy Paterson and Roy Latta
SARDI, Minnipa Agricultural Centre

RESEARCH

Best Practice

Location: Minnipa Ag Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Paddock History
2008: Wheat

Soil Type
Red sandy loam

Plot size
12 x 1.5 m x 4 reps

Yield Limiting Factors
Nil

Environmental Impacts
Soil Health
Soil structure: More even grazing
Compaction risk: Low

Social/Practice
Time (hrs): Sowing pre normal seeding
Clash with other farming operations: Standard management
Labour requirements: Labour to shift sheep

Economic
Infrastructure/operating inputs: Strip grazing benefits requiring electric fence, portable trough
Cost of adoption risk: Low

Key messages

- **Early sowing of cereals, wheat, barley or oats, gave excellent grazing, hay or grain outcomes in 2009.**
- **The barley gave similar or better all round performance than the wheat or oats.**

Why do the trial?

Good early rain in March presented an opportunity to measure the comparative performance of a range of cereals for their potential as multi-purpose grazing, hay or grain options, sown in March, April and May, and their ability to provide early feed options for stock in autumn. Traditionally this is a time of year when pastures haven't established properly, and farmers are looking to get ewes and lambs onto good quality feed as soon as possible.

The aim of this trial is provide data to assist in decision making of using a cereal for grazing, hay and/or grain based on seasonal conditions, while knowing the relative multipurpose performance of the cereal options.

The trial builds on previous Eyre Peninsula Grain & Graze research and extension, highlighting the use of sown cereals for early feed (EPFS Summary 2007, p 75 and p 84).

How was it done?

In paddock North 6 on Minnipa Agricultural Centre eight cereal varieties (Table 1) were sown at 3 times, 16 March (8 days after 38 mm of rain) germination was highly variable, 24 April (following 16 mm over 4 days) and 26 May (following a 30 mm event) at seeding rates calculated to achieve 180 seeds/m^2 (Table 1). Plots were 12 x 1.5 m and replicated 4 times. DAP @ 60 kg/ha was applied at seeding, no further fertiliser and no weed control was applied.

Time of sowing (TOS) 1 and 2 were sampled for biomass on 27 May (Zadoks growth stages from 13 – 65 due to variable emergence and 12 – 13 respectively). They were then mown to simulate grazing. TOS 1, 2 and 3 were sampled for biomass on 29 June (again with wide ranging Zadok growth stages scores, 12 – 41 in all TOS). They were again mown to simulate grazing. Replicate 1 in all 1, 2 and 3 TOS were sampled for biomass following anthesis to simulate potential hay production. All plots were harvested with the experimental Kingaroy harvester and the grain yield calculated as t/ha.

Table 1 Cereal sown and sowing rate (kg/ha) calculated to achieve 180 plants/m²

Cereal Variety	Sowing Rate (kg/ha)
Wyalkatchem	54
Barque HSR	100
Naperoo	46
Axe	46
Gladius	49
Winteroo	51
Barque	60
Maritime	65

Table 2 Dry matter production (t/ha) on 27 May, 29 June and 18 November, and grain yield (t/ha) in 2009

Time of sowing	Variety	Dry matter production (t/ha)			Grain yield (t/ha)
		27 May	29 June	18 November*	
TOS 1	Wyalkatchem	0.22	0.36	11.1	2.4
	Barque HSR	0.22	0.87	6.9	3.0
	Naperoo	0.15	0.68	11.8	2.9
	Axe	0.33	0.21	4.6	1.6
	Gladius	0.36	0.32	6.5	3.0
	Winteroo	0.28	1.26	9.7	2.1
	Barque	0.27	0.80	8.1	3.2
	Maritime	0.45	0.73	8.4	2.8
TOS 2	Wyalkatchem	<0.1	0.19	7.7	3.9
	Barque HSR	<0.1	0.73	7.1	3.0
	Naperoo	<0.1	0.21	6.6	3.5
	Axe	<0.1	0.28	7.9	3.0
	Gladius	<0.1	0.23	11.2	4.0
	Winteroo	<0.1	0.27	8.1	1.9
	Barque	<0.1	0.65	8.4	3.4
	Maritime	<0.1	0.49	7.9	2.8
TOS 3	Wyalkatchem		0.04	9.5	4.3
	Barque HSR		0.16	7.4	2.8
	Naperoo		0.08	8.6	2.8
	Axe		0.06	10.5	3.8
	Gladius		0.05	10.2	4.2
	Winteroo		0.06	8.3	1.6
	Barque		0.12	7.9	2.8
	Maritime		0.10	8.3	2.9
LSD ($P \leq 0.05$)		*0.165*	*0.172*	*n/a*	*0.44*

** The November dry matter figures represent only 1 replicate and should be treated with caution*

What happened?

Rainfall in March initiated germination and establishment of TOS 1, resulting in available forage for grazing in May. Both TOS 1 and 2 (Table 2) provided a further grazing in June prior to an average Zadoks growth stage of 31 whereby potential grain yield would be compromised. TOS 3 presented less grazing opportunities but the same average grain yield as TOS 2.

Table 3 presents the estimated gross margins from sowing cereals for grazing, cutting hay or grain recovery in good seasonal conditions.

Table 3 Gross margin ($/ha) estimates from each component of the multipurpose enterprise

Time of sowing	Variety	27 May ($/ha)	29 June ($/ha)	Hay production ($/ha)	Grain yield ($/ha)
TOS 1	Wyalkatchem	8	18	360	362
	Barque HSR	8	53	227	470
	Naperoo	3	40	385	452
	Axe	16	7	148	218
	Gladius	18	15	213	470
	Winteroo	12	79	314	308
	Barque	12	48	264	506
	Maritime	24	43	274	434
TOS 2	Wyalkatchem	0	6	251	632
	Barque HSR	0	43	232	470
	Naperoo	0	7	215	560
	Axe	0	12	255	470
	Gladius	0	9	365	650
	Winteroo	0	12	263	272
	Barque	0	38	273	542
	Maritime	0	27	258	434
TOS 3	Wyalkatchem	n/a	0	310	704
	Barque HSR	n/a	0	241	434
	Naperoo	n/a	0	280	434
	Axe	n/a	0	340	614
	Gladius	n/a	0	332	686
	Winteroo	n/a	0	270	218
	Barque	n/a	0	258	434
	Maritime	n/a	0	270	362

**The November dry matter figures represent only 1 replicate and should be treated with caution.*
Hay production gross margins based on collecting 65% of total available biomass with a gross margin of $50/tonne.
Grazing value was calculated by multiplying the DSE (based on 1 kg DM/DSE/day) by $25 (estimated annual value/DSE) and dividing by proportion of year, however value may be considered much greater in May and June than in September for example. Grazed cereals calculated as 0.1 t DM/ha retained after grazing.
Grain value calculated as $180/t wheat, $150/t barley and $100/t oats with a cost of $70/ha establishment and harvest, with no further cost.

What does this mean?

Sowing a paddock early to a feed crop provided a valuable feed source. The use of cereals wheat, barley or oats gave excellent multi-purpose outcomes in 2009. The barley gave similar or better all round performance than the wheat or oats.

The exceptional seasonal conditions provided the catalyst for the high production but the principle of early sowing of cereals for forage with the option to use for grazing, hay or grain based on seasonal outcomes on available rain in March or April is a worthwhile option for consideration irrespective of the final seasonal outcomes. Cereals provide a valuable feed source at a time when other medic pastures on the farm were struggling to produce enough dry matter for ewes and lambs. This gives farmers an opportunity to give their pastures their best opportunity to establish and have grass management before being utilised for grazing.

References

Grain & Graze, Free Food for Thought, Grazing Winter Crops Road Show Workshop Notes

Eyre Peninsula Farming Systems Summary, 2007

Acknowledgements

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Annual Medic Pastures at MAC 2009

Roy Latta and Mark Klante
SARDI, Minnipa Agricultural Centre

DEMO

Try this yourself now

Location: Minnipa Ag Centre
Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm
Paddock History
2008: Wheat
Soil Type
Red sandy loam
Plot size
Broadacre demonstration
Yield Limiting Factors
Nil
Livestock
Enterprise type: Self replacing merino
Stocking rate: 10 – 20 DSE/ha
Environmental Impacts
Soil Health
Soil structure: More even grazing
Compaction risk: Low
Social/Practice
Time (hrs): Standard
Clash with other farming operations: Standard management
Labour requirements: Minimal, check sheep and spraying grass and insect pests
Economic
Cost of adoption risk: Low

Key messages

- **A regenerated medic pasture in conjunction with a sown forage crop provided the production to sustain a 1000 DSE flock on 200 hectares in 2009.**

Why do the demonstration?

The aim of this demonstration is to assess the role of annual medics as a break crop in a wheat-sheep mixed farming system, by measuring the biomass produced over the growing season followed by the retention of the pasture residue over the summer autumn period, then subsequently assessing the impact of the pasture in the following cereal phase in terms of yield and grain quality.

The demonstration is also based on concerns related to maintaining groundcover following broadleaf crops, especially legume crop residues that are being grazed following senescence, and the protection of the soil from potential erosion.

How was it done?

Paddock North 4 (area 40 ha) on Minnipa Agricultural Centre had a medic pasture that regenerated following 64 mm in March and established following 25 mm in late April. There was no fertiliser applied, selective chemicals for grass and blue green aphid control were applied in July.

The paddock was stocked during the growing season in June and August (lactating ewes @ 20 DSE/ha), and following pasture senescence during September and October with lambs at 10 DSE/ha.

Pasture cuts were taken from both within and outside exclusion cages each month during the growing season to measure total pasture production and pasture growth rates.

What happened?

There were approximately 200 plants/m^2 medic plants established in June.

The amount of pasture produced and the monthly growth rates are presented in Table 1. In 2009 the annual medic pasture provided a high production quality feed source, a level of production that supported 25 DSE/ha over the late winter spring period.

The 5 + t/ha of medic biomass produced in 2009 and grazed over the spring had 3 t/ha of biomass remaining at the end of the year.

What does this mean?

With approximately 75% of MAC farm being cropped and only ~200 hectares available for grazing over the growing season, the medic in conjunction with a sown forage crop provided enough late autumn and winter feed to sustain a 1000 DSE flock (see Responsive Farming Using VRT article).

Along with the measureable economic grazing resource benefit it will also have produced nitrogen for the subsequent cereal phase along with a disease break as a result of grass control. Based on an estimate of 25-28 kg of N for each tonne of medic biomass produced, the question now is on the impact of the nitrogen input on the cereal phase, what will be the crop production outcomes in 2010 from an extra 150 kg/ha N input?

Table 1 Pasture production (t/ha) and growth rates (kg DM/ha/day)

	2 June	29 June	18 July	4 August	21 August
Cumulative production (t/ha)	1.1	2	2.9	3.9	5.3
Pasture growth rates (kg DM/ha/day)	27	33	47	59	82

Table 2 Pasture residue reduction (t/ha)

	21 August	27 September	31 October	4 December	31 December
Pasture residue (t/ha)	5.3	5.3	3.7	3.0	3.0

Table 3 Gross margin summary of paddock N4 Minnipa Agriculture Centre, 2009

Area (ha)	40
Cost of pasture/ha ($/ha)*	20
Total annual stocking rate (DSE/ha)	6.3
Gross margin ($/ha)**	138

**Pasture costs included herbicides and machinery expenses.*

***Gross margin was calculated by multiplying the total annual DSE/ha (based on pasture utilisation of 1 kg DM/DSE/day) by $25 (estimated annual value/DSE) and subtracting variable costs.*

Matching Nutritional Value of Native Grasses to Livestock Requirements

Michael Wurst, Jodie Reseigh and Daniel Schuppan
Rural Solutions SA

Key messages

- **Native perennial grasses are a significant component of some pastures and work is being done on ways of improving productivity, persistence and utilising out of season rainfall.**
- **Nutritional testing of native grasses showed moderate to high protein, high fibre and moderate energy.**
- **The class of livestock for grazing a paddock should be selected according to their nutrient requirements and the feed on offer.**

Why do the trial?

Minimal research has been conducted on the production and quality of native grasses for livestock production, while increasing vegetative surface cover, particularly in low rainfall agricultural areas of South Australia. Numerous questions have been asked by landholders and extension staff about the nutritional value and mineral content of native pastures and the persistence and productivity of native grass species compared to introduced species such as lucerne. This project aims to answer these questions through a series of plot trials, native grass nutritional analyses and grower case studies.

How was it done?

More than 20 samples of perennial native grasses were sampled four times over the past twelve months (2009/10) with a range of winter active (C3) species and summer active (C4) species tested. Further testing is currently being undertaken.

What happened?

Nutritional analysis results presented in Table 1.

What does this mean?

- These results present some of the first data on nutrition of native grasses in the low rainfall zones of South Australia. Previously information was restricted to the mid-high rainfall zones of the mid North and eastern Australia.
- As a guide a 60 kg dry ewe requires a maintenance diet with a minimum energy content of 7.8 MJ/kg DM and a minimum protein percentage of 8%. There is considerable variation in nutritional quality between different native grass species and the time of season; most native grass pastures will support dry stock.
- The C3 native grasses have the highest feed quality, while actively growing in winter.
- In comparison the C4 native grasses have their highest feed quality when actively growing in late spring or summer.
- Generally all native grasses tested were high in fibre which restricts livestock feed intake.
- Lush green growth exceeds protein requirements for stock growth.
- Native grasses will produce green feed from rainfall events outside of the growing season, providing higher quality feed than dry pastures and stubbles.
- Native pastures are generally made up of a range of grasses, legumes and other plants.
- Under set stocking grazing livestock tend to selectively graze plants with a higher nutritional value to maintain a balanced diet.
- The class of livestock for grazing a paddock should be selected according to their nutrient requirements and the feed on offer.
- Feed tests will be undertaken in different seasons, aiding in the understanding of nutrient values of native grasses over time.

Acknowledgements

Project funding provided by Australian Government through Caring for Our Country: Best practice management grazing systems for native grass pastures in the low rainfall cereal zone, Project No. SA NY MR05, and Department of Water, Land and Biodiversity Conservation.

Feed test figures (summer) reproduced with permission from Foster et al. (2009) An Introduction to the Nutritional Composition of Australian Native Grasses: Forage and Seed.

Upper North Farming Systems landholders for their innovation and interest.

Table 1 Feed test results for common native grasses of the low rainfall areas of South Australia

Plant Samples	Test season	Green: Dry Ratio	Dry Matter (%)	Digestibility % (DMD)	Digestibility % (DOMD)	Energy (ME) MJ/kg DM	Crude Protein (%)	NDF (%)	General comments (based on data in table)
C_3 Grasses									
White top	Summer	100:0	46.2	50.7	49.8	7.1	7.5	69.5	Maintenance feed in summer and winter. High fibre content will restrict intake. Weaners should be supplemented with grain to maintain growth rates of 100 gm/day.
(Austrodanthonia caespitosa)	Winter	50:50	62.4	51.0	50.0	7.2	10.6	65.0	
Desert spear-grass	Summer	100:0	48.0	53.1	53.1	7.5	14.3	64.1	Summer maintenance feed, dry stock may require energy supplement. Good for lactating animals in winter.
(Austrostipa eremophila)	Winter	100:0	28.3	72.0	67.8	10.8	33.3	47.8	
Tall spear-grass	Summer	100:0	42.7	48.0	47.5	6.6	10.6	72.8	Summer maintenance feed, dry stock may require energy supplement. Good for lactating animals and finishing stock in winter. Energy and protein well above requirement.
(Austrostipa nodosa)	Winter	100:0	38.3	69.1	73.5	11.0	21.8	55.2	
C_4 Grasses									
Brush wire grass	Summer	100:0	51.0	52.4	51.2	7.4	10.0	67.5	Maintenance feed only.
(Aristida behriana)	Winter	20:80	60.1	49.1	48.4	6.8	8.6	65.2	
Windmill grass	Summer	100:0	37.1	53.1	51.8	7.5	11.0	62.2	Good for dry stock. Weaners may need some energy supplements. No Winter sample analysed.
(Chloris truncata)	Winter								
Black-heads	Summer	100:0	34.6	49.7	48.9	6.9	12.5	72.6	High in fibre. Dry sheep maintenance feed only.
(Enneapogan nigricans)	Winter	60:40	47.0	49.4	48.7	6.9	9.7	63.9	
Umbrella-grass, Curly Windmill	Summer	100:0	29.8	58.5	56.4	8.5	19.0	65.6	Good summer feed for dry stock or weaners. Winter maintenance feed, supplements required.
grass *(Enteropagan acicularis)*	Winter	0:100	87.4	48.4	47.8	6.7	6.4	69.5	
Kangaroo grass	Summer	100:0	35.5	61.3	58.7	8.9	13.5	63.1	Good summer and winter feed for dry stock or weaners.
(Themeda triandra)	Winter	95:5	40.1	57.2	55.3	8.2	12.1	61.8	

Managing Grassy Ecosystems for Conservation, Biodiversity and Production Outcomes

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RESEARCH

Key messages

- **Landholders on Eyre Peninsula are improving the management of former sheoak grassy woodlands for conservation, biodiversity and production outcomes.**
- **Trial sites have been monitored annually since 2001 for a variety of attributes including: presence of species; numbers of native perennial grass plants; contribution of dominant species to total dry weight of pasture.**
- **Trial results indicate changing trends in the percentage contribution to the pasture biomass, with increases in native grasses and decreases in annual grassy weeds.**
- **It is imperative long term monitoring be continued to determine the nature and most appropriate management strategies to improve native grassy ecosystems in this region.**

Why do the trial?

The project aims to investigate grazing management options for sheoak grassy woodlands in order to improve conservation, biodiversity value and to maintain or improve productivity of perennial native grass grazing systems on the Eyre Peninsula.

Set stocking or sub-optimally managed continuous grazing of livestock on pastures dominated by native grass species has resulted in pastures becoming degraded, predominately with the loss of more desirable plants including Wallaby grasses *(Austrodanthonia species)*, native legumes and native forbs and herbs.

Perennial grasses that persist under set stocking or continuous grazing regimes are often less desirable species as they are often prostrate, small in size and have reduced palatability. Annual grass species such as wild oats, barley grass and undesirable plants such as saffron thistles, geranium/ Stork's Bill have replaced these native perennial grasses. Generally there has been a decline in productivity and biodiversity of these pasture systems as a consequence.

Native grasslands are one of the most threatened native ecosystems in Australia. This project aims to demonstrate that conservation of these systems is possible without compromising productivity. Applying appropriate rotational grazing systems may improve productivity whilst simultaneously increasing biodiversity value, from these areas. This article follows previous articles by Bartel 'Native grassland grazing demonstration sites' published in Eyre Peninsula Farming Systems 2002 Summary, pp 50-51, and Reseigh, Bartel, and Ancell 'Managing sheoak grassy woodlands' published in Eyre Peninsula Farming Systems 2005, p 70-71.

How was it done?

Three properties are included in the grazing trial. Two properties are located in the Elliston area where monitoring began in 2001, and a third property at Louth Bay where monitoring commenced in 2004.

At each property, the trial area was subdivided into smaller paddocks to enable the implementation of a rotational grazing regime. Landholders aim to graze the paddocks at high stocking densities (greater than 150 DSE/ ha) for short periods of time (1-20 days), with appropriate rest periods (overall stocking rate is ~ 1 DSE/ha/annum). The rest period is important in allowing the perennial grass species to recover before being grazed again. Average stocking rates in the rotationally grazed areas are generally similar to, and in some cases higher than, the district average.

At each property a number of paddocks in the trial and a control paddock (a paddock set stocked or continuously grazed) are monitored annually for changes in pasture composition and productivity. This allows comparisons to be made between the trial and control paddocks and to monitor comparative changes over time. Within each paddock a 100 m long transect was established and the following pasture attributes measured.

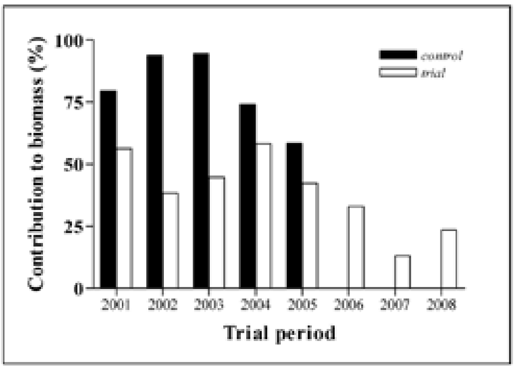

Figure 1 Annual grassy weed contributions to pasture biomass at the Tree property (Elliston) over the trial period 2001-2008.

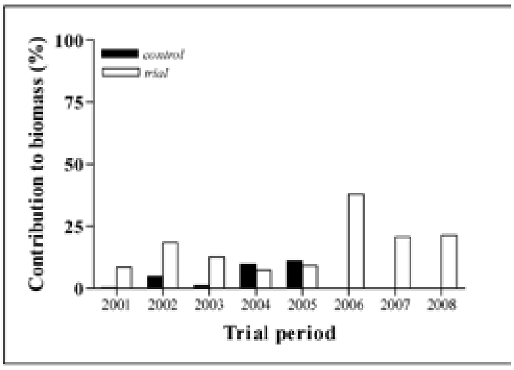

Figure 2 Native grass contributions to pasture biomass at the Tree property (Elliston) over the trial period 2001-2008.

Note control area 2006-2008 results unavailable due to use of control plot by landholder.

Presence/Absence

- At 4.5 m intervals along each transect the presence of all plant species is recorded in a 50 x 50 cm quadrat (15 quadrats). This attribute indicates species frequency and diversity within the paddock.

Number of native perennial grass plants per quadrat

- The number of native perennial grass plants present per quadrat along each transect is recorded. The numbers of native perennial grass plants per quadrat is an indication of the condition of the pasture as perennial grasses provide stability to pastures.

Available pasture mass

- Pasture cuts are taken on each property to determine a pasture height/weight relationship. This information forms a basis for a relationship between pasture height and dry weight. Landholders can then use this information to calculate the available pasture mass from a measure of plant height; this information can assist landholders in determining appropriate stocking rates.

Contribution of dominant species to total dry weight of pasture

- In each quadrat the dry weight rank of the dominant plant species is visually assessed. This will give a measure of species contribution to total pasture dry weight relative to other species in the pasture.

Photo points

- Photo points have been established at each site to monitor visual changes in composition of the pasture.

What happened and what does this mean?

The trial suggests to the present time, landholders on Eyre Peninsula are able to successfully manage former sheoak grassy woodlands for conservation, biodiversity and production outcomes using rotational grazing strategies.

Changes in the contributions to the pasture biomass have been observed in the trial paddocks at the Tree property over the period of the trial. Initially the trial and control area pastures were dominated by annual grasses such as wild oats *(Avena barbata)* and brome grass *(Bromus rubens)*. Over the duration of the trial to date, this contribution to the pasture biomass in trial paddocks has reduced from 56% to 24% (Figure 1). However, the change in the contribution of annual grasses to the pasture biomass in the control area has also declined slightly. Note control area 2006-2008 results are unavailable due to use of control plot by landholder.

Conversely, increases in the contribution of native grasses (Wallaby grass - *Austrodanthonia species* and Spear grass - *Austrostipa species)* have been observed in the trial paddocks with the percentage contribution to pasture biomass increasing from 9% to 21% over the eight years of the trial (Figure 2), with the contribution increasing particularly in the period 2006 - 2008. Note control area 2006-2008 results are unavailable due to use of control plot by landholder.

Any changes in native grassy ecosystems as a result of improved management are likely to be long term. The trends observed in the trial to this point require longer term monitoring to confirm the results and define the detail of the grazing management strategy. Therefore it is important for monitoring to be continued to confirm or dispute the initial trends and explore other changes as a result of grazing management for sheoak grassy woodlands on Eyre Peninsula.

Acknowledgements

This project would not have been possible without the assistance of landholders Arthur Robinson, Keith Tree, Simon Guerin and Dion Lebrun. This project acknowledges the assistance of Eyre Peninsula NRM staff. The project has been funded by the EP NRM Board and the Natural Heritage Trust. Di DeLaine and Brett Bartel (Rural Solutions SA) for their assistance with field work

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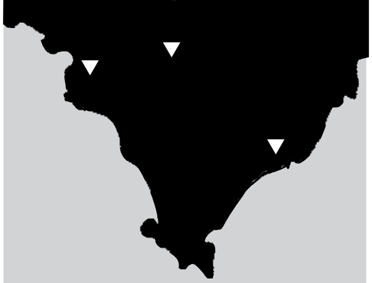
Shrub-based Grazing Systems for Low-Medium Rainfall Zones (Enrich Project)

Neil Ackland
Eyre Peninsula Natural Resources Management Board, Port Lincoln

RESEARCH

Searching for answers



Location: Elbow Hill
Scott Williams
Rainfall
Av. Annual: 280 mm
Av. GSR: 190 mm
2009 Total: 210 mm
2009 GSR: 163 mm
Soil Type
Strongly alkaline clay/loam and highly saline
Plot size
1 ha (50 m x 50 m x 4 reps)
Limiting Factors
Magnesia soil constraints and limited rainfall

Location: Streaky Bay
Tim Hollitt
Rainfall
Av. Annual: 378 mm
Av. GSR: 300 mm
2009 Total: 447 mm
2009 GSR: 400 mm
Soil Type
Strongly alkaline clay/loam and highly saline
Plot size
1 ha (50 m x 50 m x 4 reps)
Limiting Factors
Magnesia soil constraints

Location: Minnipa Ag Centre
Rainfall
Av. Annual: 345 mm
Av. GSR: 260 mm
2009 Total: 421 mm
2009 GSR: 333 mm
Soil Type
Strongly alkaline clay loam
Plot size
1 ha (50 m x 50 m x 4 reps)

Key messages

- **Grazing perennial native shrubs are being trialled on Eyre Peninsula.**
- **Three sites established, Elbow Hill, Streaky Bay & Minnipa.**
- **Perennial native shrubs could potentially help fill the summer-autumn feed gap while providing other benefits such as drought management, nutritional value, reduced soil erosion, carbon sequestration and in some species fodder production in a saline environment.**
- **Increasing ground cover in low-medium rainfall farming systems.**

Why do the trial?

The aim of this trial is to identify alternative grazing systems that are both sustainable and profitable in low-medium rainfall zones where cropping is no longer viable due to high risks and changing climatic conditions. Farming properties in marginal cropping areas are in need of good quality stock fodder reserves that can sustain ground cover over that crucial summer period.

In 2006 the Cooperative Research Centre (CRC) “Flora Search” program, established a site at Monarto, SA using native shrubs to research multi-purpose, healthy grazing systems. Future Farm Industries CRC (FFICRC) approached the Eyre Peninsula Natural Resources Management Board (EPNRM) in 2008 to locate a farming group to fast track and further expand this research into grazing perennial shrubs.

How was it done?

A group of farmers on Eastern Eyre Peninsula was approached in 2008, leading to the establishment of an Enrich site at Scott Williams' property, Elbow Hill, 13km south of Cowell. Extra funding was accessed, enabling two further sites to be established in 2009, one at Tim Hollitt's, Streaky Bay and the other at the Minnipa Agricultural Centre.

From a potential 50 species of native shrubs, already trialled at Monarto, Jason Emms SARDI research officer for FFICRC, selected 15 mainly native perennial shrubs, for each site. The three sites are 1 ha in size, divided into 4 replicated plots of 15 species x 36 plants each.

Sites where sprayed and ripped to facilitate a soft weed free environment for tube stock planting and unlike Elbow Hill in 2008, the sites at Streaky Bay and Minnipa in 2009 had excellent soil moisture at planting, thus improving survival rates.

What happened?

While most areas across EP had good seasonal rains, Eastern EP around Cowell again struggled to produce sufficient stock fodder and ground cover due to a lack of rainfall. This has lead to another year of well below average available soil moisture, further compounding the magnesia (dry saline) affected soils in this area. Most shrubs, however, have survived (up to 80%) through another tough year and due to establishing ground cover in-between the rows earlier in 2009 should not be subject to any more sand blasting as in 2008. Shrub growth range is varied, with species ranging from a stunted 20 mm to 1 metre in height, as indicated by canopy volume (Table 1). This will pose some issues when the trial grazing commences in autumn next year and will need to be closely monitored to avoid some of the shrubs being over grazed.

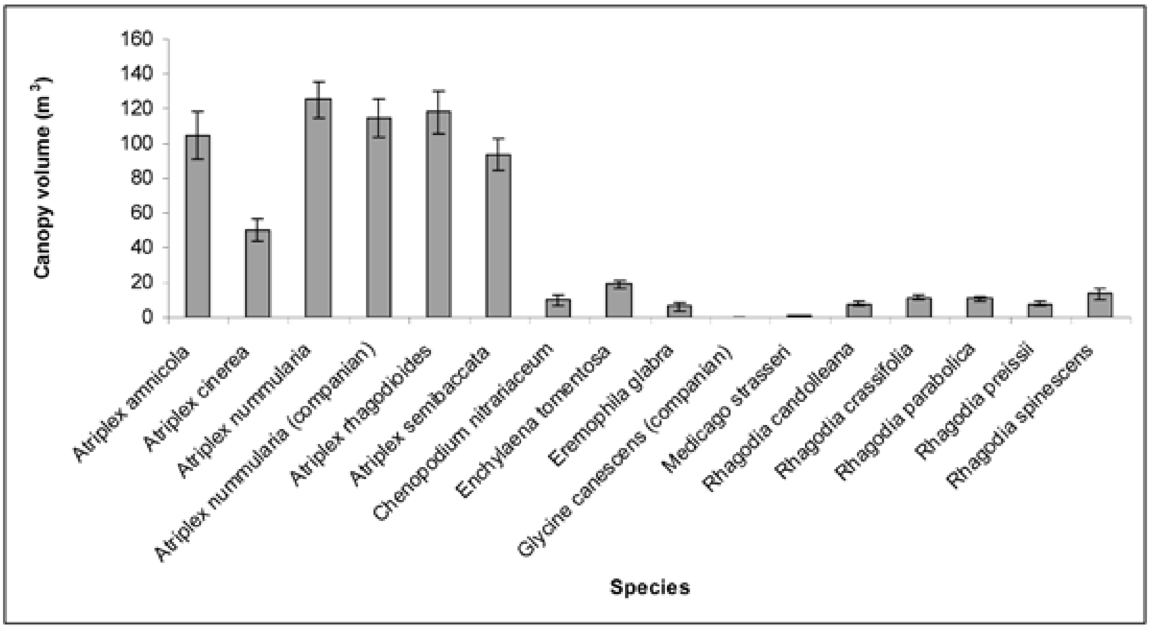


Table 1 Average production (expressed as canopy volume) of the perennial forage species at Elbow Hill in April 2009

Shrub canopy measurements were again undertaken in November 2009, with limited growth on a large variety of shrubs being observed, due to below average rainfall during the growing season.

Standout shrubs to date are most of the *Atriplex* saltbush species.

What does this mean and where to from here?

Shrub measurements and leaf material will be collected to test for nutritive value, anthelmintic (parasite/worm expelling) activity and for effects on rumen fermentation in the anticipation that some of these shrubs may have other secondary grazing attributes. Each plot will be grazed at Elbow Hill in May 2010 to a uniform level, around 80% of their leaf material while at the same time monitoring grazing preferences of each of the species. The other two sites will be monitored throughout the coming year and grazing and measurements of those sites will commence in autumn 2011.

Further evaluation of shrubs will be required before recommendations can be made about what shrubs are suitable for this feed base.

With the development of these and other sites across southern Australia, some of the challenges faced when developing a shrub-based grazing system may be overcome. While shrubs are not the complete answer and livestock require a balanced diet, this research along with other "best practice" land management and farming systems has the potential to increase soil cover, thus reducing erosion on some of EP's more vulnerable soils.

Acknowledgements

Scott Williams, Tim Hollitt, and Minnipa Agricultural Centre for the use of the land for these sites, local landholders for their input and support, FFICRC and Jason Emms (SARDI) for their technical advice and assistance, Roy Latta (Minnipa Ag Centre), Tony Zwar (EPNRM) and funding through the EPNRM Board & the Australian Government.

SARDI

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Eyre Peninsula Natural Resources Management Board

Supplementing Sheep Grazing Medics with La Trobe Pellets to Accelerate Growth

Mary Chirgwin[1] and Daniel Schuppan[2]

[1]PIRSA Animal Health, [2]Rural Solutions SA

RESEARCH

Searching for answers

Location: Minnipa Ag Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Soil Type
Red sandy loam

Plot size
9 ha, split into 2 x 4.5 ha

Yield Limiting Factors
Nil

Livestock
Enterprise: Self replacing merinos

Social/Practice
Labour requirement to feed out supplement, fill up feeders

Key messages

- **No significant differences noticed in sheep supplemented with La Trobe pellets and grazing medic compared to sheep grazing medic only, however the sheep added 8 kg liveweight in 4 weeks.**
- **Trial to be repeated next year earlier in the season on rapidly growing medic with younger animals.**

Why do the trial?

Lucerne and medic, while both being high quality feeds, have been reported to cause red-gut in sheep, particularly lambs, resulting in lower than expected animal growth rates when the pasture is growing rapidly.

In 2007 Grain & Graze in conjunction with Lauren Davis, La Trobe University, conducted a grazing trial on lucerne at Winchelsea in Victoria. They concluded that excessive protein levels in lush lucerne, up to 30% CP (crude protein) was resulting in high levels of ammonia in the gut and could be a contributing factor to the elevated levels of disease and reduced performance seen. To counteract this they added an ammonia sponge to a formulated pellet and used it in the trial. The trial found lambs grazing lucerne and supplemented with the pellet gained significantly more weight than lambs grazing lucerne only. The supplemented lambs also experienced less health problems.

Owing to the similarities between lucerne and medic (Medicago genus), a reduced version of the trial was run at the Minnipa Agricultural Centre in partnership with Sheep Connect SA, Rural Solutions SA, PIRSA Biosecurity - Animal Health and SARDI.

How was it done?

A 9 ha paddock of regenerated medic was divided in two equally sized paddocks using electric fencing. Fifty 1 year old ewes were randomly drafted from a mob of 100 young ewes and 25 grazed on one half of the medic pastures from 28 August to 18 September 2009. The pasture was feed quality tested at the commencement and end of the trial. On Friday of each week the ewes were weighed and kilograms of pasture available per hectare calculated. Twenty-five ewes on half of the paddock were used as the control and the other 25 ewes were given the same pellets used in the La Trobe University trial at a rate of 2.5 grams/kg liveweight/hd/day.

Table 1 Medic biomass (t DM/ha) and feed quality over the 4 week study

	Biomass (t DM/ha)	Dry Matter (%)	Crude Protein (%)	Energy (ME)
28 August	3.3	11	24	9.5
4 September	3.8			
11 September	4.1			
18 September	3.8	28	17	8.5

Livestock

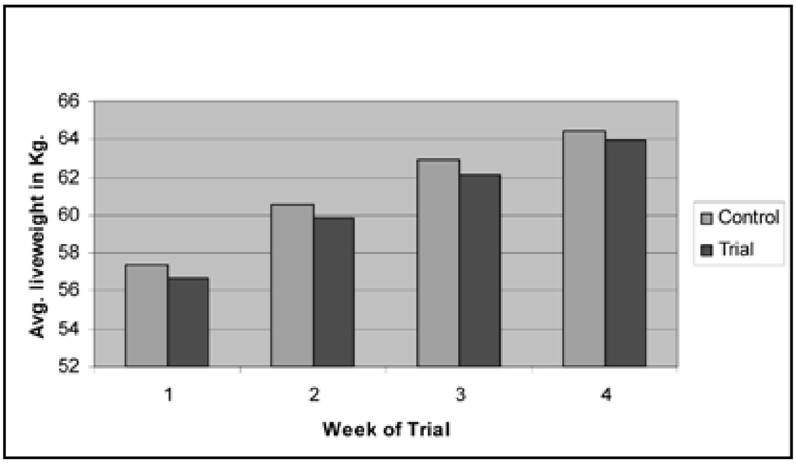

Figure 1 Control & trial mob average liveweight

Figure 2 Average weekly liveweight gain

What happened?

No difference in average live weight or liveweight gain between the 2 groups was found (Figures 1 and 2).

What does this mean and where to from here?

The lack of benefit from the pellets may have been because the growth rate of the medic had already slowed down and the medic had started to flower before the trial started. The feed test also showed that the fibre content was ideal (40% NDF), the digestibility was average and the protein declined from the start to the finish of the trial.

The changes in liveweight and growth rate detected in this trial did not show any advantage to using the pellets. However, the sheep all made excellent growth, an average of 8 kg over 4 weeks, indicating the value of medic as a highly productive feed source.

It is intended that the trail will be repeated next year using younger animals in June/July/August when the medic is growing rapidly, depending on the season. This will enable more accurate assessment of the impact the La Trobe pellet is having on liveweight growth rates and animal health.

Acknowledgements

Minnipa Agricultural Centre for the use of pasture for the trial.

Mark Klante – Farm Manager

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Section 9

Section Editor:
Naomi Scholz
SARDI, Minnipa Agricultural Centre

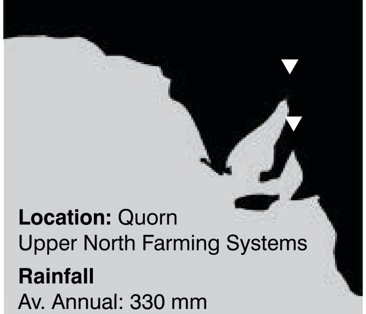
Sharing Info

Soil Type Impacts on Retaining Summer Moisture for Winter Crops

Barry Mudge[1], Anthony Whitbread[2] and Charlton Jeisman[1]
[1]Rural Solutions SA, Jamestown, [2]CSIRO, Waite

RESEARCH

Best Practice



Location: Quorn
Upper North Farming Systems

Rainfall
Av. Annual: 330 mm
Av. GSR: 230 mm
2009 Total: 340 mm
2009 GSR: 243 mm

Yield
Potential: 3.58 t/ha (W)
Actual: 1.52 t/ha (W) (chemical weed control with stubble retained)

Paddock History
2008: Wheat
2007: Wheat

Soil Type
Clay loam over calcareous medium clay

Diseases
Very low crown rot

Plot size
15 m x 5 m x 4 reps

Yield Limiting Factors
Spring rains two weeks too late

Continued...

Key messages

- **The fallow efficiency on lighter soil types was much higher than for heavier soils.**
- **Summer weed control on heavier soils still resulted in significant benefits to subsequent crop yields from more stored moisture.**
- **The cost of summer weed control on both lighter and heavier soils in the trial was covered by yield increases.**
- **The amount of surface cover had little influence on amount of moisture retained.**
- **Soil water balance outputs from the APSIM crop simulation model showed strong correlations with actual measured results.**

Why do the trial?

Many growers in the Upper North of SA have wondered at what point (or after how much rainfall) is it economic to control summer weeds, what soil types give the most benefit and what method of control is best for their system. Some of this work had already been conducted on lighter soil types in the past, however there was little information for heavier soils.

The Upper North Farming Systems project together with the National Water Use Efficiency Initiative (CSIRO) has been measuring soil water responses to a number of management practices on two different soil types in the Upper North of South Australia.

How was it done?

The trials were undertaken over the 2008/09 summer at two sites, Port Germein and Quorn, and the subsequent crop effects were measured during the 2009 growing season. Average annual rainfall for both sites is around 325 mm (winter dominant). Summer rainfall events tend to be irregular and sporadic but can be substantial at times.

Significant rainfall was recorded at both trial sites during November and December 2008, so a trial was designed to monitor the resulting soil moisture over time under various treatments. Weed control treatments included mechanical, chemical or nil and surface cover levels were either stubble, double stubble or bare. The "double stubble" treatments were achieved by raking the stubble from the "bare" treatment onto the adjoining plot.

A second part to the trial included cross referencing the measured soil water data with modelled data from the APSIM crop simulation model in order to help validate APSIM outputs and hopefully enable wider use as a tool in assessing the benefit of controlling summer weeds in different situations.

Location: Pt Germein (Baroota)
Upper North Farming Systems

Rainfall
Av. Annual: 320 mm
Av. GSR: 240 mm
2009 Total: 390 mm
2009 GSR: 279 mm

Yield
Potential: 2.59 t/ha (P)
Actual: 1.55 t/ha (P) (chemical weed control with stubble retained)

Paddock History
2008: Wheat
2007: Wheat

Soil Type
Loamy sand over sandy clay loam

Plot size
15 m x 5 m x 4 reps

Yield Limiting Factors
Spring rains two weeks too late

P = Kaspa peas

What happened?

Port Germein

Soil: loamy sand over sandy clay-loam subsoil, a typical Mallee soil.

Following a dry 2008 harvest, this site received 89 mm in a single rainfall event in mid December, the wetting depth of this event was about 80 cm. From this time, the stubble and weed control treatments were imposed and soil samples taken at 3 times during summer-autumn to monitor soil moisture. The paddock was sown to Kaspa peas in May 2009 and harvested in November to measure any treatment effects.

Summer weed control, whether mechanical or chemical, resulted in significantly more stored moisture compared with no weed control (Table 1). This meant an extra 30 mm of plant available water (PAW) prior to sowing the pea crop. The amount of stubble retained had no impact on soil moisture levels except at the February sampling date (data not shown).

The additional 30 mm of PAW at 22 April meant dry matter at anthesis (flowering) and grain yield at maturity were significantly higher where summer weeds had been controlled (Table 2). This translates into a net economic benefit of $25 to $47/ha (Table 3).

Quorn

Soil: clay loam over calcareous medium clay.

During the November/December 2008 period over 175 mm of rain was received including 66 mm on just one day in December. Some of this rainfall, particularly on the bare fallow treatment would have runoff. Measured soil moisture remained close to crop lower limit and continued to evaporate over the summer period.

Interpretation of residual PAW proved difficult at Quorn due to substantial variation in the results measured across the site. Importantly, and in marked contrast to the lighter soil at Port Germein, the measured soil profile still eventually dried down to below crop lower limit (CLL) irrespective of weed control treatments (Table 4). In common with the results at Port Germein, the level of stubble cover failed to show any influence on conserved moisture at seeding.

There was no difference in conserved soil moisture between treatments at the end of the fallow period however there were benefits from summer weed control as measured in the subsequent wheat crop (Table 5). Other influences such as improved nitrogen availability or microbial activity might have been present.

Table 1 Measured plant available water (PAW) in mm (based on the crop lower limit for wheat) at different sampling dates at Port Germein (light soil)

Weed Control Treatment	20 December 08	22 February 09	22 April 09
Nil	61 a	18 b	10 b
Mechanical	64 a	35 a	40 a
Chemical	65 a	33 a	40 a
LSD ($P \leq 0.05$)	*ns*	*6*	*6.5*

Note: The treatment means followed by the same letter within columns are not significantly different according to least significant difference test at $P \leq 0.05$.

Table 2 Impact of weed control treatments on dry matter production (at anthesis) and final yield of Kaspa peas at Port Germein in 2009

Weed Control treatment	Dry Matter Anthesis 10 August 09 (t/ha)	Grain Yield 5 November 09 (t/ha)
Nil	2.27 b	1.12 b
Mechanical	3.00 a	1.34 a
Chemical	3.06 a	1.48 a
LSD ($P \leq 0.05$)	*0.26*	*0.26*

Table 3 *Economic benefit of weed control at Port Germein*

Weed Control Treatment	Cost of Treatment ($/ha)	Additional Benefit ($/ha)	Net Benefit ($/ha)
Nil	0	0	0
Mechanical	30	55	25
Chemical	43	90	47

Table 4 Measured plant available water (mm) (based on the crop lower limit for wheat) at different sampling times at Quorn (heavy soil)

Weed Control Treatment	8 December 08	10 March 09	23 April 09
Nil	1 a	-18 a	-19 a
Mechanical	11 a	5 b	-6 a
Chemical	13 a	15	-9 a
LSD (P≤0.05)	*ns*	*15*	*ns*

(Note: Negative values indicate measured soil moisture is below the CLL for wheat)

Table 5 Impact of weed control treatments at Quorn on dry matter production (post-anthesis) and yield of Wyalkatchem wheat in 2009

Weed Control treatment	Dry Matter Anthesis 30 September 09 (t/ha)	Grain Yield 5 November 09 (t/ha)
Nil	3.00 a	1.12 b
Mechanical	3.40 a	1.37 a
Chemical	3.22 a	1.33 a
LSD (P≤0.05)	*ns*	*0.11*

Table 6 Economic benefit of weed control at Quorn

Weed Control Treatment	Cost of Treatment ($/ha)	Additional Benefit ($/ha)	Net Benefit ($/ha)
Nil	0	0	0
Mechanical	30	50	20
Chemical	43	42	-1

Weed control treatment costs at Quorn were generally covered by the additional yield benefit. This analysis does not allow for any reduction in grazing benefit arising from not utilising the summer growth for livestock.

Validation with APSIM Modelling
Modelling of the soil water balance at each site was undertaken by CSIRO and compared with the measured data (Figure 1). All the field measurements were basically in line with APSIM projections (Figure 2). This information highlights the potential of the APSIM model to determine at what point it is cost effective to control summer weeds.

What does this mean?

Summer weed control requires consideration of the following factors:

- Timing and size of rainfall events
- Soil type
- Capacity to utilise summer feed growth with livestock
- Cost and effectiveness of weed control options
- Reducing summer weed seed bank

These results highlight the importance of soil type in conserving summer fallow moisture through to the subsequent winter crop phase. The lighter soils in this environment have a relatively high fallow efficiency whereas the heavier soils lose most of their moisture to evaporation over summer. Importantly though, yield gains from summer weed control on both soil types covered costs of control.

The amount of stubble cover has a limited effect in reducing soil evaporation over summer. The short term influence of surface cover retaining moisture will be beneficial if follow-up rainfall events occur close enough to the initial wetting up to allow additional moisture to enter and possibly move further down the soil profile. Surface cover is also critically important to maintaining soil surface structure, reducing erosion and allowing entry of rainfall into the soil. It might also increase the sowing window duration and improve emergence following marginal rain at sowing.

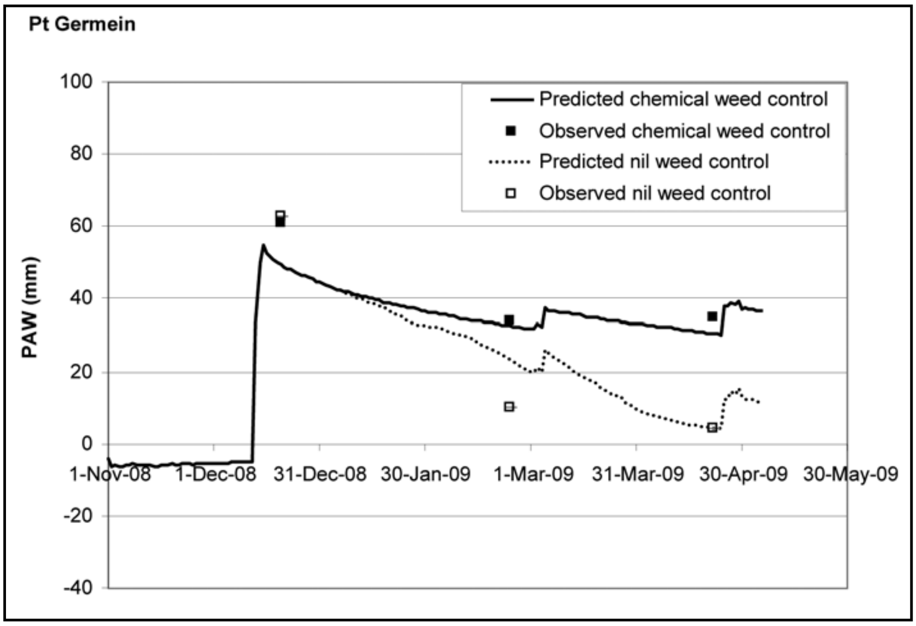


Figure 1 Predicted and observed PAW at Port Germein for chemical and nil weed control

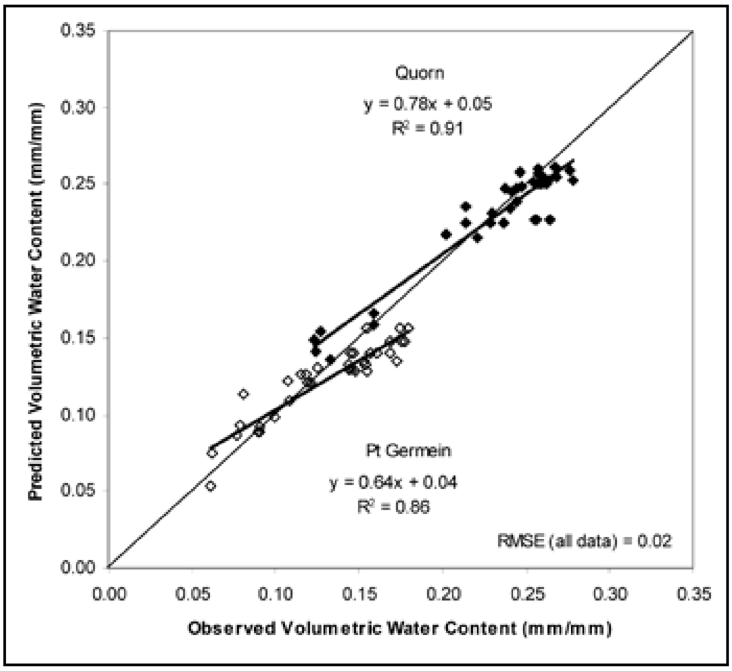


Figure 2 Predicted vs observed volumetric water content (all measurements) at Port Germein & Quorn

Shallow soils and those with substantial sub-soil constraints present further difficulties for retention of soil water. Both the soils tested in this trial were of a deeper nature.

The conclusion reached in this trial was for farmers on these lighter soil types to watch for any rainfall event received during the summer period above approximately 40 mm. This should wet the soil below 30-40 cm and controlling summer weeds is likely to result in some retained moisture for the following winter crop. Rainfall amounts less than 40 mm might still warrant summer weed control but the decisions are largely about controlling vine-type weeds for ease of sowing and possibly retaining additional nutrients.

On the heavier soils in this region, larger rainfall events (above 100 mm) are needed in the early stages of the summer season before summer weed control will actually result in moisture conservation. From late summer (February onwards) smaller rain events will generate benefits due to the much shorter time to seeding.

The APSIM model looks to have an important role in refining these broad recommendations across different soil types and rainfall events.

Acknowledgements

Grains Research and Development Corporation who fund the UNFS project.
CSIRO Sustainable Ecosystems and Plant Industry.

Summary of the 'Biodiversity in Grain & Graze' Project on Eyre Peninsula

Kerry Bridle, Peter McQuillan, Margy Fitzgerald, David Green, Janet Smith, Ted Lefroy, Arko Lucieer, Richard Mount, Tore Pederson and Michael Lacey

University of Tasmania

INFORMATION

Overview

In 2005, forty seven farms became involved with the first national biodiversity survey of mixed farming systems across Australia's sheep-wheat zone. This national biodiversity project was a component of the Grain & Graze program, which aimed to delivering economic, social and environmental outcomes on Australian mixed farms. Nine regions participated in the project, each providing survey data for at least five farms. The Eyre Peninsula region, with its strong Natural Resource Management (NRM) team, provided information on ten farms, including two schools, Cleve Area School (Simms Farm) and Karcultaby Area School (Minnipa Agricultural Centre). This report provides an overview of the project, the results for the region, and future opportunities to promote biodiversity and production outcomes in mixed farming systems.

Introduction

Biodiversity is an abbreviated term for biological diversity, the variety of life ranging from genes to species. It also includes groups of species that create structural diversity in the landscape – trees, shrubs, tussock grasses, mosses, lichens; and functional diversity – groups of organisms working together to provide ecosystem services such as nutrient cycling.

Generally, ecologists (those who study living organisms and their interactions with people, land and landscapes) often work apart from those who are involved in the development of agricultural production. In the Biodiversity in Grain & Graze (BiGG) project, our aim was to combine the skills of ecologists with local research officers to investigate all potential biodiversity benefits across a mixed farm, not just those in the native vegetation component. By documenting what exists in all common land use types in mixed farming systems, will allow us to further develop farming practices that enhance biodiversity outcomes in production systems.

The project was very ambitious and lived up to its name! Four biodiversity surveys (spring and summer 2006, 2007) resulted in the recording of over 500,000 beetles, ants and spiders, more than 180 birds, and over 500 plant species across the 47 participating farms. Highlights are given below.

Methods

Site selection

Originally ten farms were selected by EP staff to be a part of the project, but after one season this number was reduced to nine to reduce the workload on regional biodiversity officers. The farms were spread across Eyre Peninsula from the west to the east (Figure 1), with farms in the south-east receiving the highest rainfall. Farms varied in size from 403-10,000 ha and management practices within farms also varied, from 'traditional' farm management practices to recent approaches such as the adoption of minimum tillage farming. The participating farmers varied in their focus from cropping to livestock production and this was reflected in the relative proportions of crops to pastures.

Four land use classes were selected for each of the farms (crop, rotation, pasture, remnant), and one paddock of each type was used for all four surveys on the farm. Surveys for plants, ground-dwelling invertebrates (beetles, ants, spiders), birds and soils were carried out by EP staff in spring and summer 2006 and 2007. Details of the methods used are given in www.environment.utas.edu.au/documents/BiGGFieldDataManual.pdf

The amount of native vegetation on and surrounding farms was also measured. This information was provided by farmers (paddock boundaries and land use for each fenced area), EP NRM staff (farm maps) and the South Australian Government (maps of native vegetation for the region).

Results

Eyre Peninsula farms are biodiverse, supporting large areas of native vegetation both on and off farm.

Birds

A total of 88 birds, nearly half of the species recorded across all 47 farms, were recorded from surveys across all land use types on EP farms. Three of these were listed species for South Australia (Western Gerygone, Diamond Firetail and Blue-breasted Fairy-wren) and three were introduced species (common starling, skylark and house-sparrow).

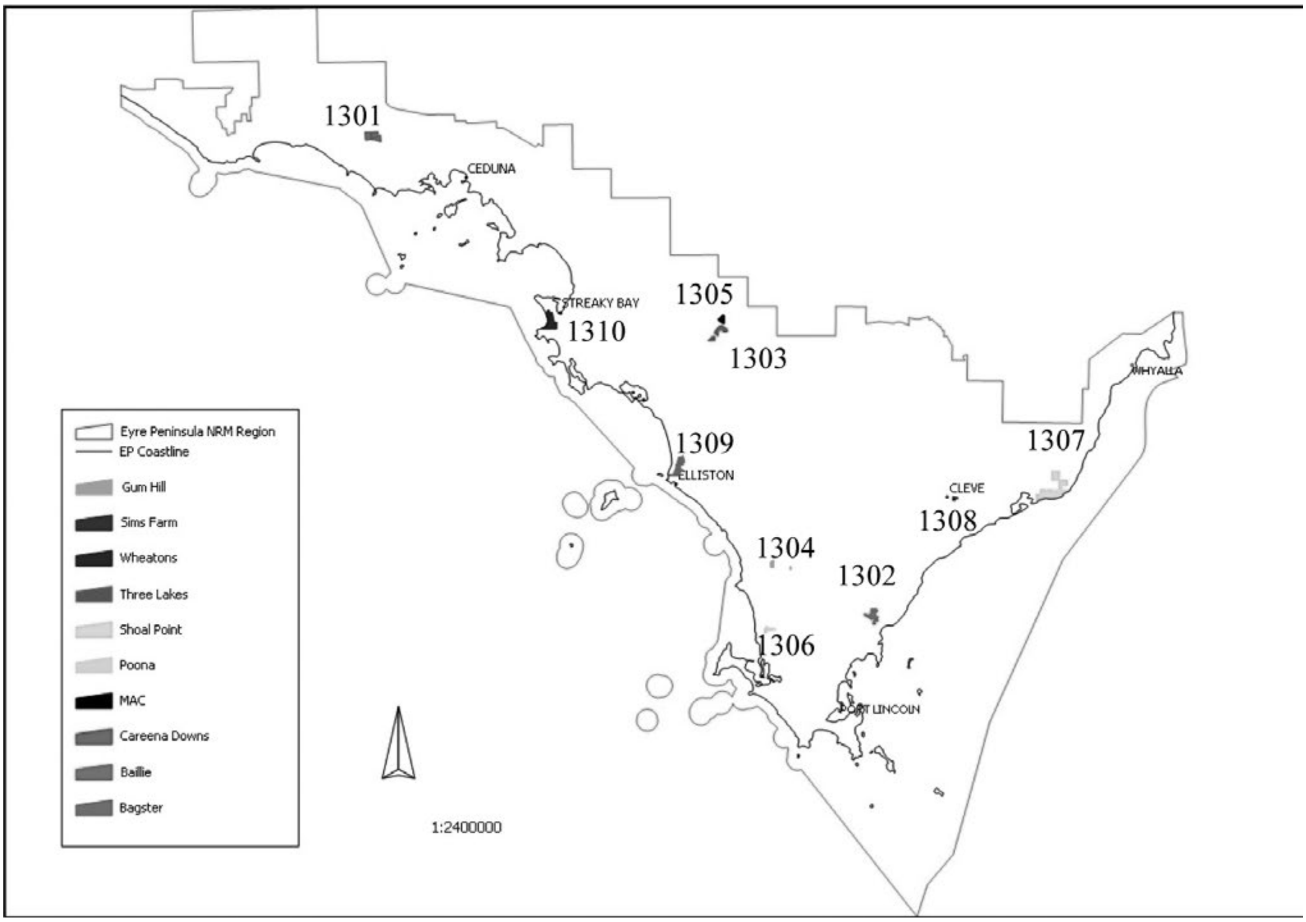


Figure 1 Location of participating BiGG farms on Eyre Peninsula
Source: Eyre Peninsula NRM Project Officers (January 2007)

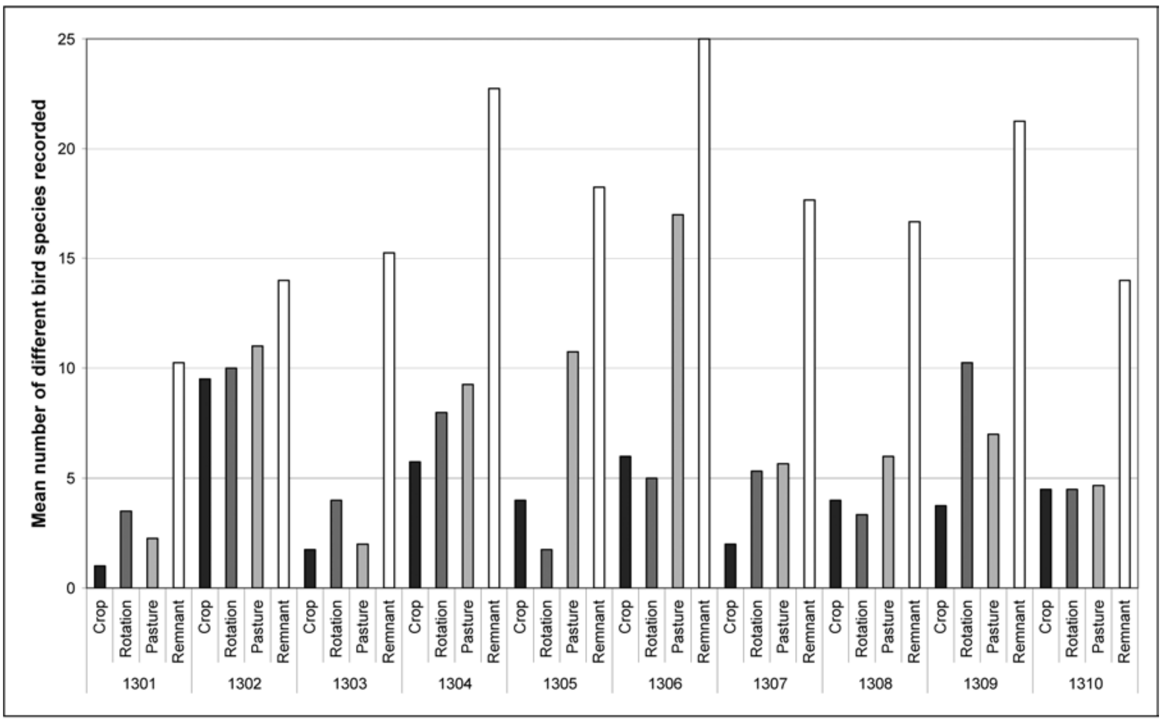


Figure 2 Mean bird species richness for each land use type on each participating farm for autumn and spring 2006, 2007

The number and species of birds found differed between different land uses. The highest number of species was recorded from remnant vegetation (Figure 2). Over 60% of the birds recorded are insectivorous. Many are more common in remnant vegetation than other land use types and are highly likely to be of use in reducing pest numbers in crops and pastures. Farm 1306 was surveyed once in autumn 2006.

Invertebrates

A total of 475 different types of spiders (in 129 sub-families), beetles (in 127 genera) and ants (219 species) were collected from EP farm surveys.

Spiders and some beetles are predatory animals that can be utilised for their pest management services. Ground dwelling spiders and predator beetles were found in most land use types across all ten farms on Eyre Peninsula. Carabid beetles, a common predator, were under-represented on EP farms suggesting that further study is warranted to determine whether the low numbers recorded is due to sampling difficulties (particularly during extremely dry conditions) or due to land management practices.

Eyre Peninsula – a biodiversity hot-spot for Scorpions

Scorpions were caught as 'by-catch' in the invertebrate traps. A total of 90 individuals had been caught on BiGG farms in 2006. Eighteen of these, representing eight species, were found in EP from five locations. Most scorpions were found in remnant vegetation. The sample size is too small to make firm conclusions, but the preliminary results suggest that additional components of biodiversity are more frequent in remnant vegetation than in other land use types.

Vegetation

At a landscape scale, the proportion of native vegetation has been shown to be important for the retention of birds in the region, and for the long-term persistence of native vegetation. Many of the 47 participating farms were isolated from patches of native vegetation on and off the farm. Farms on EP generally had a large proportion of native vegetation (including revegetation) on the property (Figure 3), and were well connected to other native vegetation patches within 5 km of the farm boundary.

Biodiversity and production

Farmer interviews provided information on wheat yields, stocking rates and inputs (pesticides/herbicides/fertilisers). However the data were incomplete, for example only 27 of the 47 interviewees provided information on wheat yields. These data suggest that spider and bird species richness is lower on farms that have higher wheat yields (t/ha), a trend that has also been reported in Europe for birds. Analysis of larger data sets within EP (possibly using BA Birds on Farms data in conjunction with farmer interviews or yield models) may provide more detailed information on this question.

Integrated Pest Management

EP participants were particularly interested in the potential for integrated pest management approaches on farm, to learn to identify beneficial species and to encourage them on farm by providing suitable habitat. The BiGG project demonstrated that beneficial species were present on all farms. Native vegetation acts as a reservoir of beneficial species which may be able to move into crops and pastures if conditions are favourable, that is if broad-spectrum pesticides have not been used. If land managers are sensitive to predators, then it is likely that predator numbers will increase to a level to be more able to control pests (see IPM section in http://lwa.gov.au/products/pr081463).

Good paddock input records (fertilisers, chemical use and grazing records) will help to investigate relationships between land management and pest/predator populations. An ecological knowledge of pests, predators and their habitat requirements will allow land managers to plan agricultural landscapes that encourage beneficial species. For example, many native shrubs such as *Eremophila, Melaleuca* and *Acacia* offer nectar or other resources which help sustain populations of beneficial birds and insects. The Australian Arid Lands Botanic Garden at Port Augusta (http://www.australian-aridlands-botanic-garden.org/) may be able to advise on suitable plants which could be established in different parts of the Peninsula or contact your local EPNRM Officer.

Key messages from participants (farmers, regional and national project officers)

The BiGG project set out to ask questions in order to generate more questions (hypotheses) to guide future biodiversity work on farms. One consistent message was that remnant vegetation is an important component of on-farm biodiversity values. Remnants can be valued for aesthetic and social reasons in addition to current (grazing, shelter) and future (e.g. habitat for beneficial species) production gains.

Suggestions from EP to manage productive and biodiverse farms included:

- To increase knowledge of biodiversity on mixed farms, particularly in relation to soil biodiversity (above and below ground) 'to work with nature… to benefit productivity and have a balance'. This included communication materials such as field guides, web-based tools, newsletter updates on new findings/trials on farm.
- To develop knowledge and skills in integrated pest management and to reduce reliance on chemicals '… we need to know which the good/beneficial bugs are. What do we need to do to manage/maintain them?'

- To diversify farm enterprises either through managing more diverse crops and pastures or by developing complementary enterprises such as ecotourism.
- To report good environmental management to the broader community '… promote ourselves – let people know what we do and the reasons we do it and the benefits for the wider community'
- Farmers felt empowered by what they had learnt about biodiversity on their farms, especially when it supported their implementation of sustainable land management practices. 'Improvement doesn't necessarily mean a big change; it's about understanding what we have and thinking outside the square.'

Management that benefits biodiversity and mixed farming

Adoption of the guidelines below should provide enhanced biodiversity and long-term production benefits through the protection of beneficial predators (birds, invertebrates) and healthy soils (microbial diversity):

- Careful management of existing remnant vegetation to enhance structural complexity (i.e. number of vegetation layers; trees, shrubs, ground cover including litter) will provide more habitats for a range of plants and animals.
- Maintaining ground cover, particularly with perennial species, will increase biodiversity.
- Decreasing soil disturbance across land use types will maintain habitat for ground-dwelling beneficial species such as spiders, beetles and ants.
- Reduction of chemical inputs across the farm will increase biodiversity.

Monitoring is an important component of management, particularly soil, vegetation and water condition and paddock inputs and outputs. Good records allow land managers to assess the impact of different management strategies over time.

Further reading on the project can be found in the Grain & Graze special edition of Animal Production Science, volume 49, issues 9-10, 2009.

Acknowledgements

The Biodiversity in Grain & Graze (BiGG) project included contributions from over 100 people. These included: 47 landholders; Grain & Graze regional project officers and coordinators; students from two schools (Eyre Peninsula); researchers associated with other Grain & Graze projects (national and regional); Birds Australia Atlas volunteers; State and CMA staff involved in providing GIS information; an extensive research group at the University of Tasmania (School of Geography and Environmental Studies, Centre for Spatial Information Science, Centre for Environment, School of Agricultural Science, Tasmanian Institute of Agricultural Research) and the project's Steering Committee.

Data from Eyre Peninsula collected by EPNRM Officers, landholders and school students.

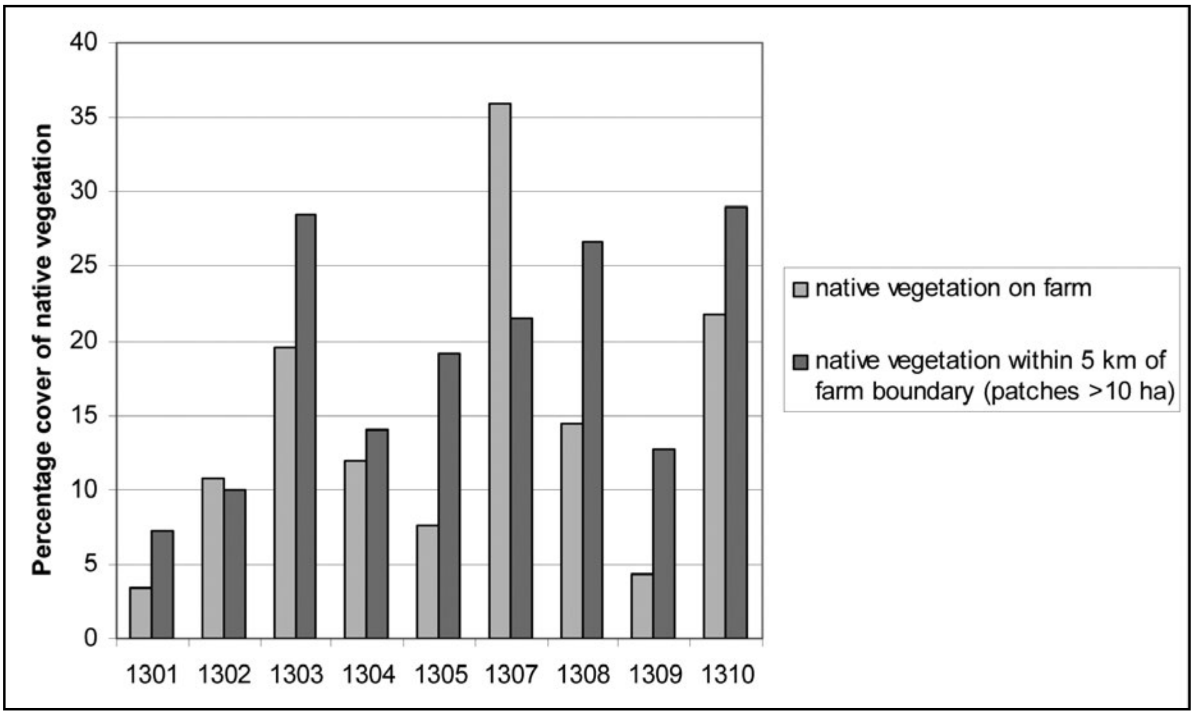


Figure 3 Proportion of native vegetation on EP farms and within 5 km of the farm boundary

Farm Input Price Relief Under Pressure as Global Supply Chain Adjusts

INFORMATION

Adam Tomlinson

Analyst - Commodities, Rabobank Australia & New Zealand

An extract from a recently released Rabobank industry report – **"Farm Inputs: Getting back to Reality."**

Rabobank's dedicated Food & Agribusiness Research team produce a number of industry leading global research reports each year across the varying commodities, with these reports Rabobank aims to provide its clients with insight that will benefit their business.

Strong world economic growth and record-high commodity prices in 2007 and early 2008 provided farmers with incentives to maximise production through the application of farm inputs. This trend pushed global farm input manufacturing capacity to its limits. Supported by favourable seasonal conditions, the grains sector, for example, produced record tonnages in 2008, increasing overall production by over 5% year-on-year and increasing global grain inventories for major food crops from a critically low base. The robust demand for farm inputs resulted in record-high prices for products such as fertilisers and agrochemicals, stimulating substantial investment in the farm input supply chain to sustain the assumed long-term growth in demand.

However, the impact of the global financial crisis weakened demand for agrochemicals and fertiliser products. Around the world, farmers deferred farm input purchases as sharp falls in commodity prices squeezed returns. In 2009 global agrochemical sales fell by around 6.4% (in nominal US dollar terms) and yearly global fertiliser applications by tonnage to mid-2009 are estimated to have dropped by 6.7%. These falls in farm input use are likely to impact the production outlook of major agricultural sectors, such as grains, that are large consumers of manufactured farm inputs.

The lower level of demand has meant that global prices for manufactured farm inputs have remained subdued throughout 2009. Earlier this year manufacturers and distributors of farm inputs were challenged to deal with large stocks of highly priced inventory and production capacities in excess of existing demand. As 2009 progressed, manufacturers of farm inputs wound back production and ran down inventories, placing pressure on earnings and potentially threatening the longevity of the new investments in farm input production capacity.

The global market – what influences farm input prices?

The connection between farm input commodities, agricultural production and energy markets

Over the last decade, prices for manufactured farm inputs have increasingly been led by a strengthening demand for agricultural commodities. In particular, higher levels of farm inputs have been applied to resource intensive crops such as wheat, corn (the major coarse grain) and rice to increase production (Figure 1). Agricultural commodity prices look set to remain at levels above 10-year averages over the coming years as demand increases for agricultural commodities. It is presumed that in order to meet the need to feed a growing global population the overall demand for farm inputs will increase, therefore driving farm input prices to higher levels. During short-term disruptions in demand due to the volatility of crop prices as seen in 2008/09, it is expected that energy markets will play a large role in determining the farm input price floor.

Commodity price falls in late 2008 coincided with reductions in farm input demand and prices. At this time of slumping agricultural commodity prices the farm input price floor was primarily established by the cost of manufacturing and in particular raw materials, which are linked to global energy prices (Figure 2 and 3). However, in some cases, energy price volatility in 2008 and 2009 did drive farm input manufacturers in some regions to sell farm inputs at negative margins in order to maintain market share.

Electricity, petroleum and natural gas prices influence the costs for farm inputs in two ways. Firstly, the cost of raw inputs such as natural gas or petroleum for nitrogenous fertilisers and agrochemicals. Secondly, the cost of manufacturing and distribution of raw inputs, such as phosphate rock and sulphur, that are heavily reliant on energy driven extraction and conversion processes. Typical cost models for two major farm inputs, urea and di-ammonium phosphate (DAP) fertilisers, are shown in Table 1. However, the geographical diversity for the production of most farm inputs means there is never a consistent model for gauging the cost of manufacturing farm inputs.

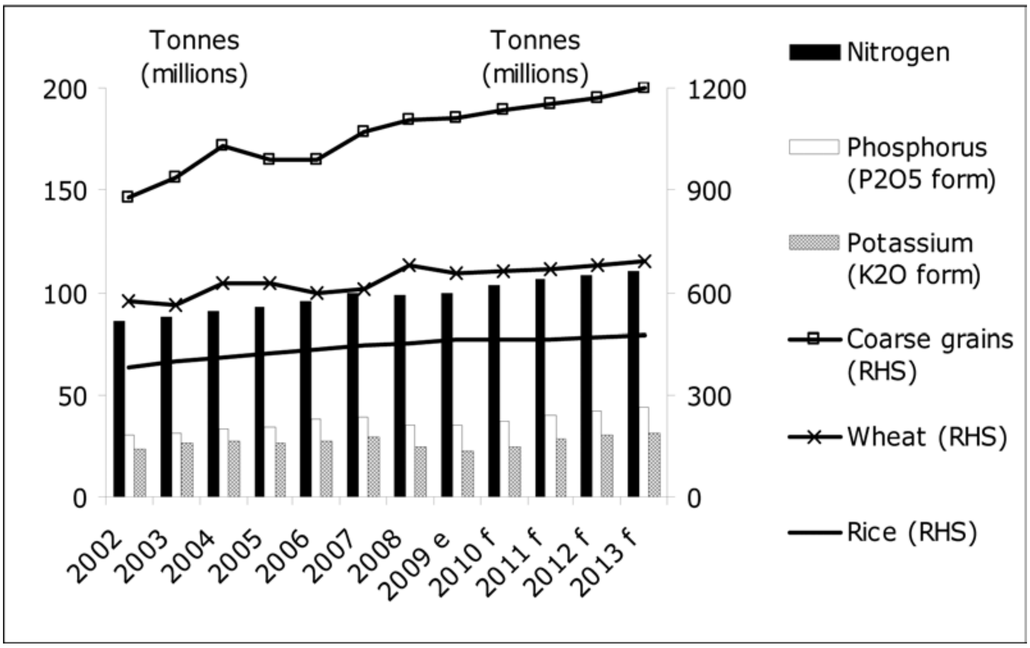


Figure 1 Fertiliser consumption and crop production * e = estimate, f = forecast

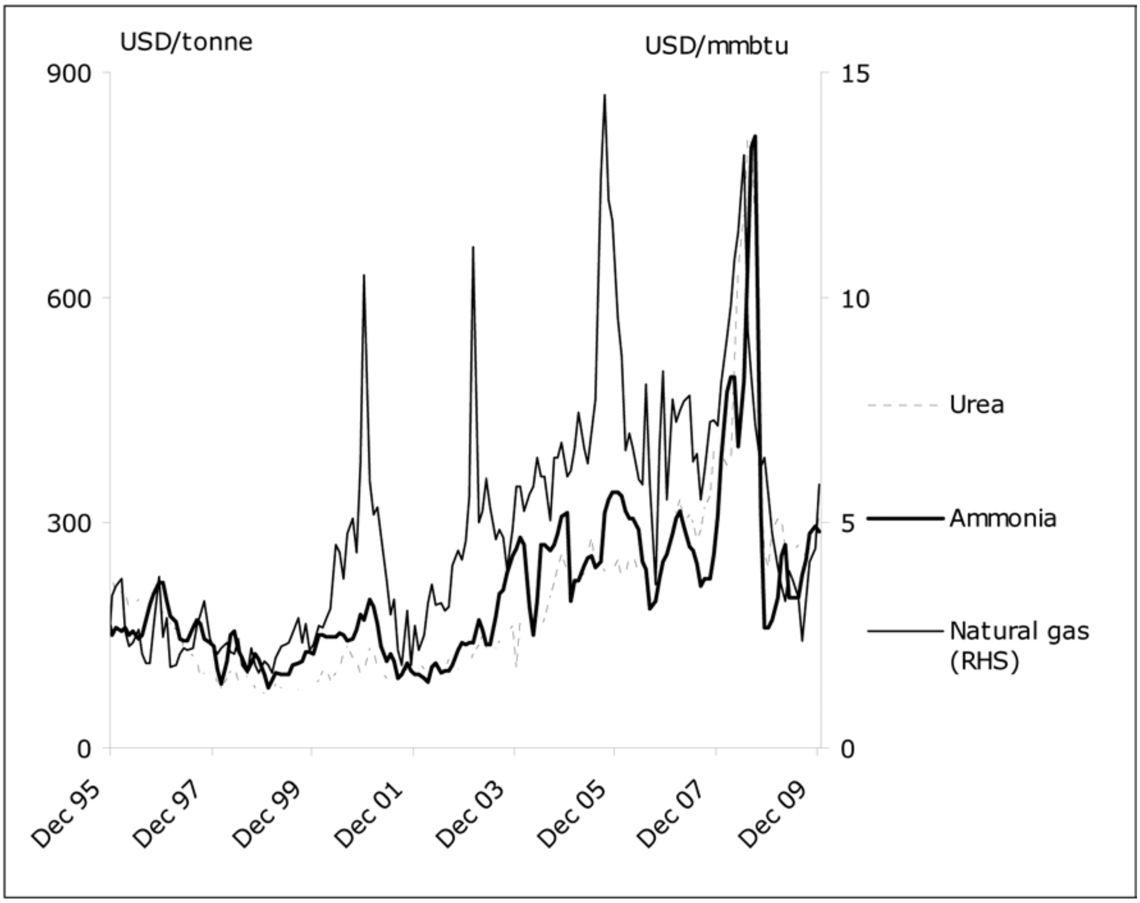


Figure 2 Natural gas, ammonia and urea prices 1995-2009

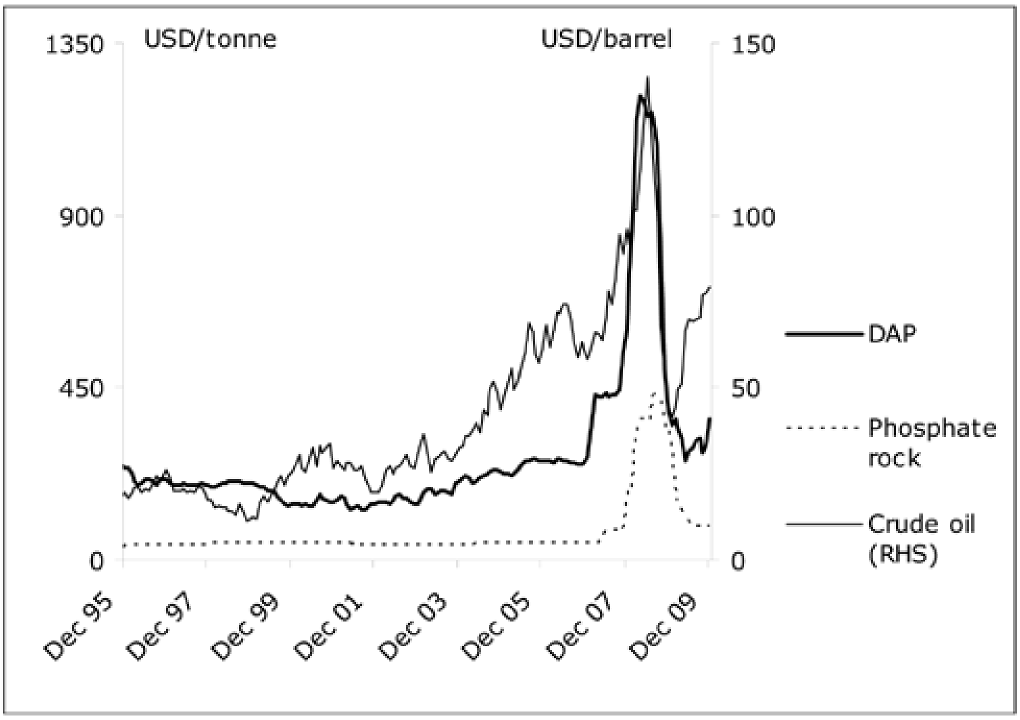


Figure 3 Crude oil, rock phosphate and DAP prices 1995 - 2009

Table 1 Typical fertiliser manufacturing cost models (based on international prices)

Urea

First Step	**Raw USD/ mmbtu***	**Price USD/t**
Natural Gas Conversion	5	180
Production		26
Sub Total (ammonia)		206

Second step	**Raw USD/t**	**Price USD/t**
Ammonia	206	119
Processing		26
Production		22
Manufacturing cost (USD/t)		**167**

Source: Yara/Blue Johnson & Associates, Rabobank estimate.
****Million British thermal units***

DAP

First Step	**Raw USD/t**	**Price USD/t**
Phosphate rock conversions	80	134
Sulpher conversions	30	13
Sub Total (ammonia)		206

Second step	**Raw USD/t**	**Price USD/t**
Phosphate & Sulfur		187
Ammonia	206	45
Production		40
Manufacturing cost (USD/t)		**272**

Source: Fertcon, Rabobank Estimate

The outlook for the global farm inputs sector – adjusting for a new era

In 2010 the agricultural sector is expected to demonstrate resilience in facing the effects of the economic downturn. As most agricultural products are non-discretionary food items, supply fears have prevented many agricultural commodity prices (in international terms) falling below 2006 average levels. For some sectors that are considered to produce more discretionary products, such as dairy and meat, prices have also risen from the low levels experienced at the beginning of 2009.

Similarly, the prices of most manufactured farm inputs have remained above historic average levels. These price levels have also coincided with the run-down on inventories of farm inputs right through the supply chain, due to the lower commodity prices impacting farmers' demands and the global financial crisis impacting credit availability. With many manufacturers of farm inputs operating at reduced capacity utilisation, if a spike in demand for farm inputs occurs due to attractive agricultural product price movements, this will cause the prices for farm inputs to respond accordingly due to logistical constraints. However, a repeat of the 2008 farm input price spikes when capacity utilisation nearly reached 100% is not expected in the short-term.

In the longer-term, forecasts released by the United Nations Food and Agricultural Organisation (FAO) predict the world population will grow by more than 2.4 billion to reach 9.1 billion in 2050. Growth in the consumption of agricultural products will accelerate in the developing world, driven by rising incomes and the demand for more resource-intensive food. The FAO projects that global food production will need to increase by 70% by 2050 to keep pace with increases in global demand.

With limits to the available agricultural resource base, farm inputs such as fertilisers, agrochemicals and biotechnology will play a key role in driving the productivity gains needed to meet global food demand. This will likely underpin a firm price outlook for farm inputs. If Australian farmers are to maintain their international market share for agricultural commodities they will need to continue to improve productivity, and the effective use of manufactured farm inputs will be one important way of doing so.

Australia and New Zealand – continuing to manage global prices with local demand

Farmers' confidence in key sectors driving the farm input supply chain

In Australia, it is estimated that over half of the demand for manufactured farm inputs is driven by farmers' confidence in seasonal conditions in cereal cropping regions and cereal crop markets. The Rabobank Rural Confidence Survey (RCS) measures farmers' confidence levels within each sector on a quarterly basis and can provide useful guidance towards the level of demand for farm inputs. Data from ABARE shows Australia imports over 70% of farm inputs, such as fertiliser as either raw material or finished product. Therefore trends in suppliers' import requirements are expects to have similar trends to those in farmers' confidence levels. Falls in confidence tend to be driven by droughts, low commodity prices, and in recent years, rising farm input costs.

The strong connection that the cropping sector has with the farm input supply chain for both countries respectively was evident in 2009. In Australia the cropping sector was operating with an outlook that was reasonably favourable. This meant that a major portion of the supply chains' farm input inventory was worked through, benefitting the wider agricultural sectors as lower priced international fertiliser could be purchased.

What lies ahead for manufactured farm input costs

The global farm input supply chain has been challenged by capital constraints, volatile commodity prices and exchange rates. In 2009, we have seen manufacturers operate at reduced capacity utilisation and retail suppliers of farm inputs run-down inventories due to weaker than anticipated demand from farmers globally. However, in 2010, as the global economy gathers momentum and agricultural commodity prices shift higher, farm input demand will increase. With increased farm input demand, especially from emerging countries, it is expected that some logistical constraints in both the global and local supply chains over the next six months will occur and place upward pressure on farm input production capacity should prevent a repeat of the 2008 price spikes.

In late 2009, the prices for many farm inputs reached a low point with the Australian dollar index of many farm input products showing prices getting back to 2006 levels. In view of this pending supply constraint, at these price levels farm inputs are considered to be a reasonable value proposition for farmers reviewing requirements in the near term. For Australia, much of the demand for farm inputs will likely occur in the first half of 2010, and will depend on seasonal conditions and the outlook for agricultural commodity prices. However, given the recent dry conditions over much of Australia, and an expectation that El Nino conditions will persist through the first part of 2010, there is a possibility that farmers may defer their purchases for farm inputs. This deferral could result in reduced forward ordering by farm input suppliers, and should orders be forthcoming local supply could be pressured, driving up prices.

Longer-term, Rabobank expect prices for key farm inputs to continue to shift modestly higher. This is due to the growing needs of global food demand, higher average cost levels for energy and raw materials, and the increasing costs associated with reducing the carbon footprint. In response to these higher prices, Australian farmers are expected to increase their focus on utilising farm inputs more efficiently. The developments in precision agriculture and biotechnology will be key strategies providing farmers with new options to manage the manufactured farm input cost component of production.

Rabobank

Oil Mallee on Eyre Peninsula: 2008

Dale Wenham and Noel Richards
PIRSA Forestry, Adelaide

DEMO

Key messages

- **Mallee plantings have the potential to diversify on farm income as well as providing environmental benefits such as soil stabilisation, salt mitigation, stock and crop shelter and increased biodiversity.**
- **Eucalyptus loxophleba subsp lissophloia is currently the best performing mallee species within the 2008 Eyre Peninsula mallee trials, with regard to growth and survival.**
- **Shallow to medium sand over clay provides the best conditions to establish mallee plantings.**

Why do the demonstration?

The oil mallee trials on Eyre Peninsula aim to demonstrate the regional suitability, performance and potential of the 3 most widely grown oil mallee species in Australia.

In the early 1990s, the Western Australian (WA) Government funded plantings of oil mallees to combat salinity in the wheat belt of WA. The area of oil mallee plantings has increased steadily over the past 20 years to approximately 12,000 ha. This has lead to a potential oil mallee industry for WA. In early 2006, a pilot integrated wood processing plant (IWPP) was built. This IWPP is able to produce electricity, eucalyptus oil and activated carbon from harvested mallee and will provide valuable data for the emergent oil mallee industry.

The current focus on climate change and the push toward renewable energy, carbon credits, drought tolerant crops and diversified on-farm income has lead to the research into mallee plantings in South Australia (SA). In 2006 PIRSA Forestry funded Wind Prospects Pty Ltd and the Murray Mallee Local Action Planning Group to establish an oil mallee trial in the Murray Mallee region of SA, to test 7 species of oil mallees. In 2008, PIRSA Forestry also funded oil mallee trials on Eyre Peninsula, through Greening Australia and Free Eyre. PIRSA Forestry hopes that this research will provide useful information with regard to on-farm planning and the development of oil mallees as a rural industry for the future on the Eyre Peninsula.

Mallee species are suited to low rainfall environments and may not be economically viable in higher rainfall regions of the state, due to the competing land uses.

How was it done?

Three demonstration locations at Kimba, Arno Bay and Minnipa were used to cover varied soil types and rainfall. Pre-plant weed control used glyphosate 360 @ 3 L/ha. Seedlings were planted in August 2008 at between 1,000 and 3,000 stems per hectare using a planting machine towed behind a tractor with 3 point linkage. Each site was planted with approximately 1,000 trees of each of the 3 species. Three species of Oil Mallee were planted *E. loxophleba subsp lissophloia, E. polybractea* and *E. kochii subsp plenissima.* Percentage survival and seedling height measurements were taken at 7 months and 14 months of age.

What happened?

A total survival count of all species was undertaken at 7 months of age at all three locations (Figure 1). At 14 months of age a sample % survival was also taken, which provided similar results to 7 months of age. As the 7 month measurement included a total survival count, only this data is presented. *E. loxophleba* has the best % survival and *E. kochii* has the worst % survival at all three locations.

A sample average height was taken at 14 months of age at all three locations for all three mallee species. A total average height was also taken at 7 months of age at all three locations for all three mallee species. There was no consistent difference between the three mallee species heights at 7 months of age over the 3 trial sites, however measurements taken at 14 months of age show a consistent difference between the three mallee species heights over the 3 trial sites as shown in Figure 2. *E. loxophleba* has the best height growth and *E. kochii* has the worst height growth at all three locations.

Results from the 2008 Eyre Peninsula Oil Mallee Trials are similar to that of the 2006 Murray Mallee Oil Mallee Trials in that *E. loxophleba* has the best height growth compared to other tested mallee species, the % survival is also similar however the Murray Mallee trials had other species that performed better with regards to % survival over various locations.

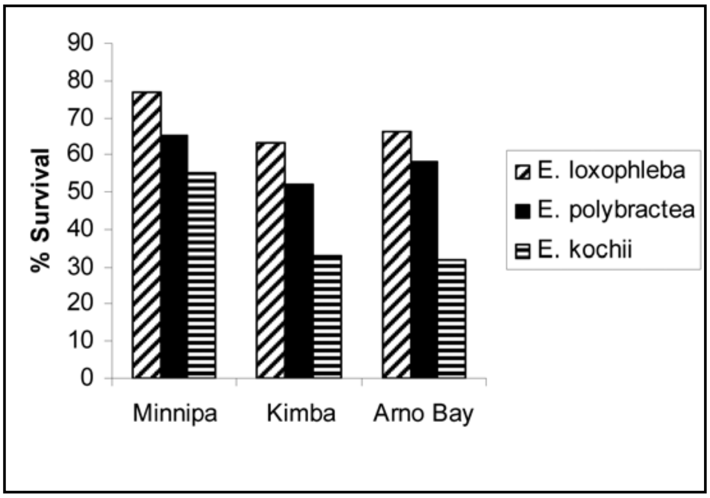


Figure 1 Percentage survival of three mallee species grown at three locations at 7 months of age

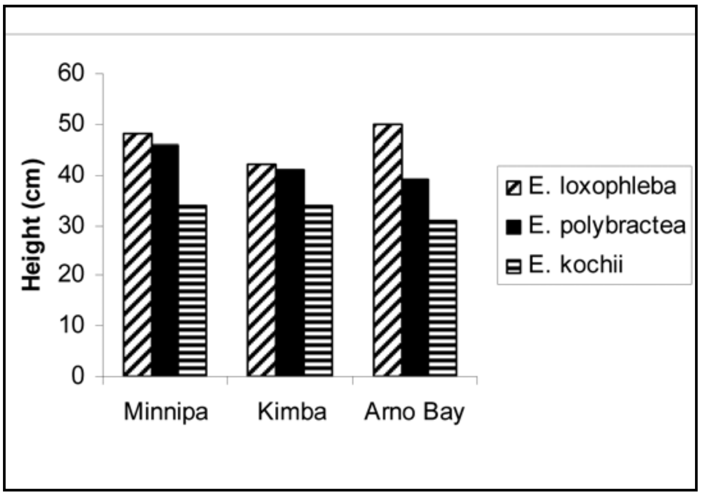


Figure 2 Average height (cm) of three mallee species grown at three locations at 14 months of age

What does this mean?

The data indicates that, so far *E. loxophleba subsp lissophloia* is the best performing mallee species at all three locations on the Eyre Peninsula, while *E. kochii subsp plenissima* has fared the worst. Field observations clearly indicate that seedlings growing on shallow to medium sand over clay performed best with regard to survival and height growth. Seedlings performed worst on non-wetting sands and limestone outcrops where survival was less than 5%. Seedlings growing on heavy soil had less survival and height growth compared to sand over clay soils.

Weed control is crucial in improving survival and growth of mallee plantings within the first and second years of establishment.

Where to from here?

The next step would be to grow the best performing mallee species in large scale plantings on suitable sites, with best establishment practice to determine optimum growth and future potential.

Oil mallee plantings may have the potential to increase or diversify on-farm income and also provide environmental benefits. With the forecast of drier weather, oil mallees may be part of the solution for drought tolerant income. Oil mallees also have the potential to utilise summer rains.

Acknowledgements:

Thanks to David & Leah Jericho, Jeff and Judy Jones and the Minnipa Agricultural Centre for making their land available for these trials. Thanks also to Simon Bey - Greening Australia and Susi Tegen – Free Eyre.

Government of South Australia

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

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

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

LEADA: 2009 achievements and 2010 focus

2009 was another productive year for the Lower Eyre Agricultural Development Association (LEADA) with 13 trial sites being managed on the Lower EP. The issues addressed were improving canola and malting barley agronomy, pest and disease management, grazing cereals and soil amelioration.

The canola blackleg survey was again undertaken with the levels of internal infection being highest on the most commonly grown varieties. Farmers need to be very aware of the risks that blackleg presents. The work LEADA is doing is aimed at avoiding a repeat of the crop devastation due to blackleg which occurred on Lower EP in 2003.

2010 will build on previous work and looks towards another intensive trial and extension year with a continuation of the canola and barley production focus, plus striving to improve the water use efficiency of Lower EP farming systems. Trials will focus on:

- **Barley** – Disease, water logging, nitrogen and canopy management.
- **Canola** – Commercial Vs Farmer kept seed, IPM, harvest (direct heading, windrowing), Diamondback moth management.
- **Pulses** – Best pea alternative, Lupins – time of sowing (TOS), seeding rates, improving harvest index.
- **Wheat** – Pushing yields economically, improving harvest index, disease management and TOS for various varieties.
- **WUE** – soil classification for APSIM and soil amelioration with the Spader (machine for mixing clay and organic matter into topsoil).

Rising Issue

Diamond back moth (DBM) is starting to threaten the viability of canola as a break crop on Lower EP. Farmers in the Mt Hope area are beginning to reassess growing canola as they have no means to control DBM, and have experienced significant losses. In this area canola is the only viable break crop and they have no other options given their soil type and climatic conditions. There are chemicals that can control DBM but they are only registered for the horticultural industry. LEADA will focus on best management with the current available chemicals in addition to pushing for effective chemicals to be available for the broad acre industry. If we can not control this pest, our most profitable crop can be devastated in days!

Dates for the diary:

LEADA Ag Expo – 18 March 2010

Spring Crop Walk – 16 September 2010

LEADA acknowledges and thanks our major sponsors and contributors in 2009

Highlights from the Low Rainfall Collaboration Project

Nigel Wilhelm and Geoff Thomas
GRDC funded Low Rainfall Collaboration Project

Background

The initial low rainfall collaboration project (LRCP) commenced in 2003 with funding from GRDC to link the low rainfall farming systems groups more effectively and help them learn from each other.

GRDC supported a second round of funding from 2006, with a revised structure which had Geoff Thomas as Project Manager (50% FTE), Dr Nigel Wilhelm as Scientific Consultant for 75% of his time and additional expertise contracted as required. It supports five Farm Systems Groups/Projects – Eyre Peninsula, Mallee Sustainable Farming Inc, Central West Farming Systems, Upper North and BCG.

The project has just commenced a third round of funding until 2012, with strong support from GRDC and the Farming Systems (FS) groups.

It seemed timely to now provide a summary of what the project has been doing over these past few years and perhaps, even more importantly, where it is going into the future.

Maintain a newsletter

The project produces a newsletter 4-6 times a year to communicate new developments and current conditions to all the groups and to a long list of interested groups and complementary organizations. It serves not only as a useful means of sharing info but also in building *esprit de corps*. As well as the newsletter a calendar of LRCP and other important events is produced and has resulted not only in better communication but in avoiding clashes.

Conduct an annual workshop

Workshops are organised in conjunction with one of the groups (Eyre Peninsula, Upper North and Birchip in the last 3 years). Each workshop is a mix of group reporting, field visits, technical sessions, group process sessions, informal discussions and having fun. These are a very useful vehicle in providing mutual support which is important when things are tough.

Visits by farmer groups

The LRCP supports groups of farmers visiting other project or regions for their mutual benefit. Guidelines have been established which require goal setting, planning and feedback/reporting. Because of the seasons, the demand in this area has dropped off and the program is now more targeted to younger farmers and attendance at specific events such as the GRDC Adviser Updates.

Sharing of materials

This has been a real area of growth in the project with many articles being prepared and published for the benefit of LR groups. For example, the LRCP produced the "GRDC 2008 Planning Guide for Low-Risk Farming" and the "2009 Planning Guide for Farmers with Limited Finances", which were printed and distributed widely in Ground Cover by GRDC.

Research and development support

A major component of the LRCP is to provide research support to the groups by:

- Bringing expertise together to address issues and provide direction such as in water use efficiency (WUE), soil biology and crop nutrition.
- Identifying and meeting research needs including securing funding such as
    - Summer weed control using PA
    - Canola for low rainfall areas
    - Deep fertiliser placement
    - Lucerne establishment
    - Feeding summer lambs
    - Crop sequencing
    - Crop growth workshops
    - Profit/Risk workshops
    - Providing input into G&G review in preparation for phase II.
- Provision of expert statistical support in the planning and interpretation of projects.
- Involvement in setting R&D directions with research agencies and industry funding bodies eg (in soil biology, plant improvement, crop sequencing and NVT).
- Direct assistance to groups in planning and conduct of their program, especially Upper North and Eyre Peninsula.
- Providing advice and services in establishing research reviews and responding to government decisions (such as closure of Walpeup and Condobolin).
- Reviewing media releases for groups prior to their publication.

Farm systems and business management

Given the difficult seasons in recent years, this has been one of the most challenging areas. It is also an area where most groups appreciate the need but lack capacity.

Several approaches have been taken including:

- Production of two Planning Guides (2008 and 2009) which provide a step by step approach to planning for the next season, with associated technical detail – 13,500 copies were distributed in 2008 and 24,000 copies in 2009. The 2009 guide was specifically for farmers with limited finance. These guides have proven very popular with farmers and with banks and have been used as the basis for regional planning workshops.
- Profitability/Risk Management Project with Ed Hunt, University of Melbourne and BCG.
- Decision Support Tool Evaluation - Masters Project by Bill Long with Charles Sturt University and NSW Department of Primary Industries.
- Negotiation with GRDC to place greater emphasis on this area.
- Arrange a series of articles on risk management for Ground Cover in 2009.
- Forming a Farm Financial Expert Group.

Evaluation of the impact of Farming Systems groups

This is still one of the most difficult areas with groups tending to concentrate on evaluating activities rather than project outcomes.

Nevertheless progress has been made in:

- Developing greater understanding amongst groups of the need for more rigorous evaluation.
- Farmer survey with Upper North Farm Systems which highlights how this approach can be used to understand where farmers are at and what programs they need.
- Leadership in assessing progress towards the GRDC and Grain &Graze goals of increasing WUE and Capacity Building using the three tier approach. This will provide an objective basis for evaluation of group activities based on the adoption of key practices and the impact on farm and regionally.
- The use of profitability/ risk management factors in evaluating the impact and sustainability of projects and in determining future research and extension directions by the groups.

The future

LRCP has now just entered its third cycle of funding with GRDC. While the structure and scope of LRCPIII is very similar to the previous phase, the current project is now taking a more pro-active approach to RD&E support for the groups. This approach has already seen positive outcomes in the form of three expressions of interest, developed and submitted by LRCP, being requested to produce full project specifications by GRDC (Crop sequencing, Crop growth workshops and Profit/Risk workshops). These projects will be conducted by the low rainfall groups for their regions.

The LRCP has also taken a major role in developing the direction for the WUE initiative funded by GRDC, and is responsible for constructing the initial benchmarking survey for this initiative in low rainfall areas. The biometrical support for groups will also be ramped up with increased budget for Chris Dyson's time.

Acknowledgements

GRDC provided the funding for this project with support from SARDI.

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GRDC Grains Research & Development Corporation

Sharing Info

Increase Profit, Reduce Risk and Improve WUE in Low Rainfall Areas

Geoff Thomas
Low Rainfall Collaboration Project

Farmers have been seeking guidance for years about how they can improve the fit of the various components of their farm operation so that they can improve profitability and reduce risk. These needs occur at a number of levels:

- Farming according to land capability which may involve different enterprise mixes on different areas of the farm, including retiring some land from crop production.
- Integration of crop and livestock enterprises so that they are complementary, rather than antagonistic.
- Getting the sequence of crops right within the cropping regime including the use of break crops so that productivity is high and pest/weed burdens low.
- Optimizing the use of different practices for each crop type.
- Coping with increasing frequency of poor seasons.
- Keeping cost structures low so that financial exposure in any one year is minimised.

In the past a lot of research and advisory attention has been placed on agronomic practices and hence a concentration of work on varieties, rates, seeding dates, row spacing and weed and pest control. Similarly with livestock we have seen work on grazing cereals and other crops. While all of this has a place, farmers are now seeking more and more advice on how they fit the various technologies together to best effect and with reduced financial exposure. That "best effect" no longer just means production as it often did in the past – farmers now see profitability, reduced inputs and management of risk as the major drivers.

While these issues might have been highlighted by the recent poor seasons they will continue to be important as margins are likely to remain tight and seasonal variability increases.

Farmers are seeking a greater business approach to research and extension, including information and tools to assist their decision making. A good example of this demand was the popularity of the Profitability/Risk Management Guides produced by GRDC for the 2008 and 2009 seasons.

Farmers intrinsically balance risk and return before arriving at decisions. They arrive at a profit risk profile (i.e. profit and risk assessments over a range of possibilities – or season types or deciles) to aid the decision making process. Simple win/win decisions involve profit in the vast majority of circumstances, against little risk. The more complex decisions involve a balance of risk and profit (e.g. cropping that extra paddock may give good returns if the season is above average but might incur major losses in a poor season and would have been best left out and run with sheep). More objective assessments of these profit/return options would greatly improve the quality of decision making.

Since each farmer and his farm business are different, a "one size fits all" approach is not appropriate. Rather, what is required are guidelines which allow farmers and their advisers to feed in their own figures and ask the "what if" questions appropriate to them. These tools inform their decisions, yet do not make them for the farmer or their adviser, but are not widely used at present or available.

Farming systems groups and consultants also need such tools to evaluate their work and recommendations more comprehensively in financial and risk terms rather than rely on simple approaches such as gross margins as they have tended to do in the past.

How will it be done?

The aim of a new project being funded by GRDC is to build capacity for farmers and for farming systems groups and consultants who work closely with them, even though each of the groups being supported by the Low Rainfall Collaboration Project is in a different stage of development for dealing with profitability/risk management:

- EPFS has done some excellent work with local consultants and farmers and now wants to roll out their program more extensively across their area, partly in conjunction with their focus groups approach.
- UNFS has developed a programme to assess levels of strategic risk and effects of possible changes to individual farmer's systems and are looking to roll this out further through their area and possibly the South Australian Mallee.
- MSF has worked with Mike Krause in the past but the approach has languished in the area and needs revitalising.
- CWFS has done little work on Profitability/Risk management but are keen to get started. They have access to a large data set of farm records from AgnVet which would be of value.
- BCG has been working on a pilot project involving 6 farmers and 2 consultant agronomists, using the experience and expertise of Ed Hunt, a consultant/farmer from Eyre Peninsula and Bill Malcolm from the University of Melbourne. This will be rolled out in 2010.This project has concentrated on one case study farm and has explored in detail the yield potential and performance of the different land capability types of the farm and the opportunities to further reduce costs, at least on some areas. Levels of debt and the capacity to service them has been a major issue as has the opportunities to reduce the capital tied up in machinery. It now remains for the group to bring all the messages together and provide them to the farming community early in 2010.

What does this mean?

The results of this project will be considered along with a number of other approaches as part of a program by GRDC to improve the skills of farmers, consultants and farm systems groups in farm business management.

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Acronyms and Abbreviations

ABA	Advisory Board of Agriculture
ABS	Australian Bureau of Statistics
AFPIP	Australian Field Pea Improvement Program
AGO	Australian Greenhouse Office
AGT	Australian Grain Technologies
AH	Australian Hard (Wheat)
AM fungi	Arbuscular Mycorrhizal Fungi
APSIM	Agricultural Production Simulator
APW	Australian Prime Wheat
AR	Annual Rainfall
ASW	Australian Soft Wheat
ASBV	Australian Sheep Breeding Value
AWI	Australian Wool Innovation
BCG	Birchip Cropping Group
BYDV	Barley Yellow Dwarf Virus
CBWA	Canola Breeders Western Australia
CCN	Cereal Cyst Nematode
CLL	Crop Lower Limit
DAP	Di-ammonium Phosphate (18:20:00)
DCC	Department of Climate Change
DGT	Diffusive Gradients in Thin Film
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
EPNRM	Eyre Peninsula Natural Resources Management Board
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 Collaboration Project
LSD	Least Significant Difference
MAC	Minnipa Agricultural Centre
MAP	Monoammonium Phosphate (10:22:00)
ME	Metabolisable Energy
MLA	Meat and Livestock Australia
MRI	Magnetic Resonance Imaging
NDF	Neutral Detergent Fibre
NDVI	Normalised Difference Vegetation Index
NLP	National Landcare Program
NRM	Natural Resource Management
NVT	National Variety Trials
PAWC	Plant Available Water Capacity
PBI	Phosphorus Buffering Index
PDRF	Premier's Drought Relief Fund
PEM	*Pantoea agglomerans, Exiguobacterium acetylicum* and *Microbacteria*
pg	Picogram
PIRD	Producers Initiated Research Development
PIRSA	Primary Industries and Resources South Australia
RDE	Research, Development and Extension
RDTS	Root Disease Testing Service
SAFF	South Australian Farmers Federation
SAGIT	South Australian Grains Industry Trust
SANTFA	South Australian No Till Farmers Association
SARDI	South Australian Research and Development Institute
SBU	Seed Bed Utilisation
SED	Standard Error Deviation
SU	Sulfuronyl Ureas
TE	Trace Elements
TT	Triazine Tolerant
UNFS	Upper North Farming Systems
WP	Wilting Point
WUE	Water Use Efficiency
YEB	Youngest Emerged Blade
YP	Yield Prophet

Notes

Notes









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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...

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