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About Mallee Sustainable Farming

Mallee Sustainable Farming (MSF) Inc. is a farmer driven organisation delivering research and extension services to the below 350 mm rainfall Mallee cropping regions of New South Wales, Victoria and South Australia. MSF operates within a region of over four million hectares, extending beyond Balranald in the east to Murray Bridge in the west.

MSF Service Area

Our 18 year legacy

MSF Inc. formed in 1997 in response to a recognition that conservation farming practices had not been widely adopted across the region. Therefore, there was a need to identify the issues restricting the adoption of technology that would enhance the development of profitable and sustainable farming systems. During its first 16 years of operation, MSF has achieved a great deal. Increases in farm profitability have been observed as a result of MSF activities, along with environmental and social gains. MSF continues to strive to be relevant to farmers’ information needs, whether in the sphere of cereal cropping or livestock management.

Our members

The Mallee has approximately 2000 dry land farming families whose farming activities include cropping (wheat, barley, vetch, lupins and canola) and livestock (sheep for wool, lambs and cattle for meat). An increasing number of these families are members of MSF, receiving new and timely information on research and best management practices. Such activities include fact sheets, farm walks, trial sites, field days and research compendium publications.
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Preliminary assessment of grain legume nodulation in the South Australian Mallee

Maarten Ryder¹, Matt Denton¹ and Ross Ballard²
¹University of Adelaide; ²SARDI, Waite Campus, Urrbrae
Peer review: Dr David Herridge, University of New England

Why was the project undertaken?
Assessment of nodulation success is a useful exercise to guide future decision making about inoculation of legumes. For inoculated legumes, it is worth checking to see if the inoculation has worked well or not. For uninoculated crops, it is worth checking to see whether or not they should be inoculated in the future. While checking the root systems, you can also see if they are generally healthy. Has there been disease or herbicide damage? For example, you may see a lot of Rhizoctonia “spear tips”, depending on crop, season and paddock history.

How was the project done?
• A small survey of grain legume crops was done on five properties near Karoonda in late July 2014, to assess the level of nodulation by nitrogen fixing root nodule bacteria.
• One vetch, 3 lupin and 3 pea crops were sampled. All had been inoculated with root nodule bacteria at sowing. In two paddocks, additional samples were taken where there was visible herbicide damage to the crop.
• At each paddock, three sets of 10 plants were carefully dug up at approximately 50 metre intervals, starting 20 m from the edge of the paddock to avoid the headlands.
• After sampling, root systems were washed carefully and individual plants were scored as having “adequate” or “inadequate” nodulation compared to a set of photos (nodulation assessment guide, found at www.agwine.adelaide.edu.au/research/farming/legumes-nitrogen/legume-inoculation/). The % plants with adequate nodulation was calculated for each sample location and the numbers were averaged across the three sample locations.
• Overall nodulation was considered good if the average nodulation scores were at least 70% “adequate”.

Key Messages
• Growers are encouraged to take root samples of legume crops in late winter or early spring to assess nodulation. A nodulation assessment guide that includes photos of plants with poor and good nodulation is available online.
• Nodulation of the inoculated legume crops sampled was generally very good: 6 of 9 sets of root samples were rated good to excellent.
• Nodulation was poor where there was metribuzin damage to peas. This adds to observations previously made by other growers in the region about metribuzin damage on sandier soils.
• Poor nodulation of one crop of lupins remains unexplained. Tests are under way to find out whether the use of saline bore water to prepare inoculant was the cause. Clean potable water is recommended for mixing inoculant.
• Serious Rhizoctonia damage was seen on some lupin and pea crops.
Acknowledgements
GRDC National Nitrogen Fixation Program project number UA000138. Landholders who provided sampling sites.
New Vetch varieties for break crop options in the Mallee

Stuart Nagel, Gregg Kirby and Rade Matic
SARDI, Waite Campus

Why was the trial undertaken?
This trial was undertaken to investigate advanced common vetch breeding lines with specific traits best suited to the Mallee areas of South Australia. SAGIT have funded this research to provide a genuine legume break crop option for cereal and mixed farmers in the marginal cropping areas of South Australia. The objective of this research is to investigate material bred in GRDC funded projects, which may not have been suitable for broad scale release, but may be locally adapted to these areas with the potential to be used as new varieties specifically for the local area.

How was the trial done?
The trial was conducted at Karoonda in 2014, at the long term Mallee Sustainable Farming site on Loller’s farm. It was designed to compare the hay/dry matter yields of advanced lines with current released varieties of common vetch. The trial was sown on 15-May and emerged well, showing good early vigour and growth. The paddock where the trial was sown had an application of Logran in 2013 and the residual effect of this became evident on the vetch as the season progressed, suppressing the trial and greatly reducing yields. The site had a mean dry matter yield of 2.0 t/ha, with the best lines reaching 2.5 t/ha dry matter.

Key Messages
- This project commenced in 2014 so results are still preliminary, no conclusions can be drawn from the data due to the residual herbicide issue.
- The trial will be repeated in 2015, looking to data from other trials at Lameroo and Walpeup for indications on what lines did well in the Mallee in 2014.
- When considering break crops care should be taken on paddock selection and herbicide use, consult your local agronomist for the best information on what is applicable in your area/conditions, always observe plant back periods and chemical label recommendations.
- For more information on break crop options in the Mallee see this article by Chris McDonough http://msfp.org.au/vetch-maximises-n-advantage/

Acknowledgements
The National Vetch Breeding Program would like to thank SAGIT, GRDC, RIRDC and SARDI for funding this program and acknowledge the ongoing support and interest provided by Australian farmers. Farmers and not for profit farmer groups and organisations provide trial sites, feedback, advice, recommendations and their wish lists for future varieties to the program all of which are gratefully received and appreciated.
Productive and profitable pulse crops in the Northern Victorian Mallee

Michael Moodie¹, Nigel Wilhelm², Todd McDonald¹
¹Mallee Sustainable Farming Mildura; ²SARDI Waite campus Adelaide
Peer Review: Jason Brand

Why was the project undertaken?
Selecting which break crop to grow is challenging as there is little comparative information on the performance of break crops and varieties in the Northern Mallee. To address this, Mallee Sustainable Farming (MSF) implemented pulse crop demonstration trials at the GRDC funded Low Rainfall Crop Sequencing project site near Mildura. The aim of the trials were to provide farmers with more information on the productivity of legume break crops in the northern Victorian Mallee region.

How was the trial done?
Two separate trials were implemented in 2014 with one trial comparing the productivity of pulse crops with the intention of grain yield and the other trial to compare the productivity of pulse crops with the intention of using as a brown manure.

- **Pulse Trial**: Field Pea (PBA Wharton, PBA Twilight and PBA Pearl), Chickpea (PBA Striker, Genesis 090 and PBA Monarch), Lupin (Narrow leaf: Mandelup, PBA Barlock and Albus: Luxor), Faba Bean (Farah and PBA Samira), Lentil (PBA Bolt).
- **Brown Manure Trial**: Field Pea (PBA Hayman and PBA Coogee) and Vetch (Rasina and Volga)

Key Messages
- Field peas were the standout crop in terms of both dry matter production (5.8-6.5 t/ha) and grain yield (1.7-2.3 t/ha)
- Excellent grain yields were generally achieved for the other pulse crop options; chickpea (1.5-1.6 t/ha), lentil (1.5 t/ha), faba bean (1.4 t/ha) and lupins (0.9-1.2).
- Over two seasons at the site, Kabuli chickpea’s have been the most profitable crop option followed by Desi chickpeas, and field peas. Lentils were the most profitable option in 2014.
- There were no significant dry matter differences between treatments in the Brown Manure trial with all producing about 4.5 t/ha

Acknowledgements
These trials were conducted as part of the Mallee Low Rainfall Crop Sequencing Project which is a collaboration between MSF and SARDI with funding from the GRDC. Thankyou to Jason Brand (DEDJTR) and Michael Lines and Andrew Ware (SARDI) for providing both seed and technical advice for this project.
Two-year breaks profitably reduce agronomic constraints

Michael Moodie¹, Nigel Wilhelm², Roger Lawes³, Peter Telfer², Todd McDonald¹
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Peer Review: Jen Bond, MSF

Why was the project undertaken?
The Low Rainfall Crop Sequencing project commenced in 2011. At that point in time, crop sequences in the low rainfall region were dominated by intensive, continuous cereal cropping and break crops occupied less than 5 percent of the landscape. These intensive cereal cropping sequences were declining in productivity with the emergence of agronomic constraints such as grass weeds, low soil nitrogen and crop diseases. The aim of this project was to test if including one and two-year break phases in low rainfall crop sequences could remove the agronomic constraints and increase the production of subsequent cereal crops. We also explored whether break crops could improve the profitability of the long term crop sequence when compared to maintaining continuous cereal.

How was the trial done?
The Mildura trial was located in the Millewa region of the Victorian Mallee. In 2011, nine different break options were established along with a continuous wheat treatment. In 2012, a second break phase was implemented (2 year break) or the rotation was returned to wheat (1 year break). In 2013, all rotations were returned to either conventional wheat (var. Shield) or Clearfield wheat (var. Grenade). In 2014, all plots were again sown to wheat (var. Grenade). Throughout the trial, agronomic management was varied for each individual rotation to help maximise the profitability of that rotation and to respond to particular issues in each option. For example nitrogen inputs, varieties, sowing dates or herbicide applications were varied depending on the level and type of agronomic constraints in each rotation.

Key Messages
- Including 1- and 2-year break phases in the low rainfall Mallee can significantly increase the productivity of subsequent wheat crops.
- Brome grass population in a long term cereal paddock near Mildura was the most significant driver of the break benefits in a crop sequencing trial.
- Including a two-year break phase in the rotation was up to $90/ha/year more profitable than maintaining continuous wheat over the four year period of the trial.

Acknowledgements
This trial is a collaboration between MSF and SARDI with funding from the GRDC.
Crop sequences address agronomic constraints in a long term continuous cereal paddock

Michael Moodie¹, Nigel Wilhelm², Peter Telfer², Todd McDonald¹
¹MSF Mildura; ²SARDI Waite campus Adelaide,

Why was the trial/project undertaken?
The GRDC Low Rainfall Crop Sequencing project is identifying the effects that different break crops and rotations have on Mallee farming systems. 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. Therefore, it is important to quantify the agronomic benefits that break crops can provide in Mallee cropping rotations so that farmers can be confident of the long term benefits of more diverse crop sequences.

How was the trial done?
In 2011, nine different break options were established along with a continuous wheat treatment. In 2012, a second break phase was implemented (2-year break) or the rotation was returned to wheat (1-year break). In 2013, all rotations were returned to either conventional wheat (var. Shield) or Clearfield wheat (var. Grenade). In 2014, all plots where again sown to wheat (var. Grenade).
Throughout the trial, agronomic management was varied for each individual rotation to help maximise the profitability of that rotation and to respond to particular issues in each option. For example nitrogen inputs, varieties, sowing dates or herbicide applications were varied depending on the level and type of agronomic constraints in each rotation.

Key Messages
- Legume crops consistently increased pre-sowing soil nitrogen in the year following the break.
- Two-year break phases that included a brown manure vetch phase have generally resulted in the highest pre sowing soil nitrogen levels in the subsequent wheat crops.
- One- and two-year break phases reduce Rhizoctonia soil inoculum, however levels increase significantly following the first cereal crop.
- Two-year break treatments generally reduced brome grass populations in the cereal phase, however all rotations relied on Clearfield herbicides for brome grass control by the second wheat crop following the break.
- The benefits from extra soil water following some break phases in this trial have been variable and small.

Acknowledgements
This trial is a collaboration between MSF and SARDI with funding from GRDC. Thank you to Roger Lawes (CSIRO) for undertaking the statistical analysis of this trial.
Wheat response to previous grain legume crop selection and agronomy

Ivan Mock, Dodgshun Medlin Agricultural Management

Introduction
Inclusion of a suitable legume crop in the rotation has been associated with biological processes including nitrogen fixation, disease suppression and potential for improved weed control, which combine to benefit subsequent crops. A range of legume crops were sown with and without bradyrhizobia inoculum at 2 sites in 2013 and resown to wheat in 2014 as a bioassay of the rotational impact of the legumes on the subsequent cereal crop. The performance of the legumes was reported in the 2014 compendium but can be summarised as inoculated field pea and vetch grain yields ranging from 1.52 – 1.94 t/ha while the other legume crop yields were closer to 1.0 t/ha. Chickpea and lupin yields were halved where inoculum was not applied. Wheat production on these sites in 2014 is a focus of this report.

Methodology
Wheat was sown in 2014 where 6 grain legume crops (lentil, chickpea, faba bean, lupin, field pea and vetch) were sown in 2013 in randomised, 4 replicate plot trials at Loxton and Normanville. The 2013 treatments were split into plus and minus the appropriate inoculum.
Wheat was assessed for biomass production (NDVI), grain yield (plot harvester) and quality (100 grain weight and protein content). Nitrogen balance was also determined across both years and fertiliser N input in 2014 limited to a sowing application of 11.5 kg N/ha to assist in detecting any benefits from N fixation from the previous legume crops.

Key messages
- Soil NH₄ or NO₃ at sowing was not correlated to variations in wheat yield or protein despite good rains to promote mineralisation. The soil tests were of limited value.
- Wheat NDVI values at the late vegetative stage indicated relative yield differences which were related to previous legume treatments at each site. This information could potentially guide late N fertiliser applications to boost grain protein.
- Wheat yields at Normanville were approximately 3.5 t/ha with only minor variation due to the preceding inoculated legume crop type. Wheat on uninoculated chickpea and lupin yielded 0.3-0.4 t/ha less and had 0.5% less protein than on inoculum.
- Wheat yields at Loxton averaged 1.6 t/ha with the impact of the previous legume crop type or inoculum use confounded by frost damage.

Acknowledgements
This work was funded by Dodgshun Medlin, Normanville Farm Advancement Group, Caring for Our Country and the GRDC. Thank you to Shannon Blandthorn for his technical input.
Pulse Options for the Northern SA Mallee

Chris McDonough1, Michael Moodie2
1Rural Solutions SA, 2Mallee Sustainable Farming

Why was the trial undertaken?
The use of break crops within intensive cropping systems in low rainfall areas is proving to be extremely important for controlling grassy weeds, reducing root disease and maintaining cereal yields. However, finding suitable and consistently profitable options that best achieve this in areas of less than 200mm GSR is not easy. This trial builds on previous crop sequencing projects, using farmer equipment and paddock length trial strips, to help assess both the profitability and practicality of various pulse options. This helps farmers see these crops growing for themselves, discuss the various issues involved and then better decide what may suit their farming systems best.

How was the trial done?
This trial was conducted on the Worsfolds’ farm at Wunkar (near Loxton) which receives average annual rainfall of approximately 260mm and average GSR of 165mm. The paddock was surveyed using EM38 to allow for a more direct comparison of plot yield results against soil types. This method is used to help account for paddock variation when using farmer scale trials. There was, however, no replication of plots at this site. Three general soil zones were deep soil tested and characterised at the start of the season, ranging from deep sand, to midslopes, to loamy flats. While there is a good soil type range, the subsoils at this site are not high in chemical constraints to root growth and moisture extraction. In 2014 plots were sown with a farmer’s airseeder for the length of the paddock (1km) and 2 passes wide. Varieties used in the trial were Twilight Peas, Blitz Lentils, Genisis 090 Chickpeas, Rasina Vetch and a blend of Jindalee and Mandelup Lupins.

Key Messages
• Chickpeas were consistently amongst the highest yielding pulses at this site across all soil types and EM38 ranges. They produced the highest gross margins on both the deep sand and mid-slope soils.
• Chickpeas appear to be a viable option for northern Mallee farmers, with ease of reaping being a distinct advantage over other pulse options. There is however much to be learnt about the challenges and risks involved in maintaining good seed size and high quality for marketing in these environment. While there may be less disease pressure in low rainfall areas, good agronomic management is still very important, as each decline in grade quality can significantly affect price and profitability. Many of these issues will be sorted out as more farmers grow chickpeas in these areas.
- Vetch produced the highest gross margin on the high EM38 loamy soils, mainly due to its lower input costs due to a lower seeding rate. Vetch remains a relatively safe, easily marketable, versatile break crop option. The brown manured section of the vetch plot will be tested against all other treatments for N contributions in March 2015. Other recent Mallee soil survey work has shown vetch to contribute significantly higher levels of N to the following crops than other pulse options (see [http://msfp.org.au/vetch-maximises-n-advantage/](http://msfp.org.au/vetch-maximises-n-advantage/)).
- Lentils grew very poorly on the sand and only produced a positive gross margin on the loamy flats.
- While the timing of the severe early frosts affected both lupins and pea yields in patches, it is also recognised that peas often grow well in the northern Mallee and their frost risk remains very high in most seasons.

**Acknowledgements**

This project was funded through Caring for Our Country as a part of “Crop options to reduce wind erosion and manage weeds in SA Mallee” project. The authors wish to thank farmers Grant and Stuart Worsfold for their considerable effort in sowing the trial making it all work, as well as Scott Gillett of Wisdom Data and Mapping for constructing yield maps and graphs.
Sowing Strategies to Improve Productivity on Sandy Mallee Soils

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Peer review: Sarah Noack, Hart Field-Site Group

Why was the trial/project undertaken?
Variable productivity on Mallee soil types has been linked to poor crop establishment. In turn this poor crop establishment has been related to the availability of water to the emerging crop, the management and positional availability of nutrients, disease pressure in the early phase of crop establishment and competition with grass weeds. As growers move towards earlier sowing dates, crops are often being sown on marginal early soil moisture. This trial looks at whether the potential benefits of sowing on last year’s crop row to harvest any extra water and nutrition can outweigh risks of increased disease pressure and lead to better crop performance on Mallee soil types.

How was the trial done?
Trials were established at Karoonda (Lowaldie) to test the effects of a combination of sowing date and row position (on the previous crop row compared to between previous crop rows) treatments on the availability of water and nutrients, the density of weeds, the presence of disease, crop establishment and productivity on contrasting Mallee soil types (swale compared with dune).

Key Messages
- There were no measurable differences in 2014 wheat yield in response to two different sowing dates and sowing on-row vs. inter-row.
- On the sandy soil type, there was more plant available water (PAW) in the top 10cm when sowing on-row.
- Rhizoctonia inoculum was higher with on-row compared to inter-row sowing but this did not carry through to an effect on rhizoctonia infection in the crop.
- In a season where the profile PAW was similar for the two sowing dates (April 30 and May 14) crop establishment was better with the earlier time of sowing but ryegrass pressure on the swale was also higher with the earlier time of sowing.

Acknowledgements
Thanks to the Loller family for their generous support in hosting the trial, to Jeff Braun for monitoring and advising on trial agronomy. Funding for this work was from the Stubble Retention initiative (Project MSF00003) and the CSIRO Agriculture Flagship.
Current and New Barley Varieties for the Mallee

Stewart Coventry and Jason Eglinton, The University of Adelaide Barley Program
Peer Review: Simon Craig, consultant

Why was the trial undertaken?
The NVT trial system is designed to benchmark the performance of new varieties nearing commercialisation against existing varieties. The varieties commonly grown in a region form the basis for comparison and extension of information to growers and advisers.

Here we present the NVT yield and retention data for the SA and Victorian Mallee for the current feed and malting varieties and two new varieties suited to the Mallee undergoing malting accreditation: Compass and LaTrobe. These new varieties have up to 10% yield advantage and improved grain size over existing varieties that will ensure improved gross margins for barley in the Mallee.

How was the trial done?
Barley NVT trial data (http://www.nvtonline.com.au) from the SA and Victorian Mallee was interrogated for yield and retention from 2014 and longer term data.
SA Mallee region sites are Cooke Plains, Lameroo, and Paruna.
Victorian Mallee region sites are Birchip, Hopetoun, Manangatang, Murrayville, Rainbow, Ultima, and Walpeup.

Key Messages
- Commander and Scope are internationally accepted malting barleys
- Fleet and Fathom are Mallee adapted high yielding feed varieties
- Compass and LaTrobe are the new high yielding potential malting varieties to watch
- 2014 results highlight varietal differences in grain size

Acknowledgements
GRDC fund the NVT trial network.
Is there a preferred wheat or barley variety to grow in a P deficient soil?

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Why was the trial/project undertaken?
The imperative for efficient use of P in broad acre agriculture is an increasing issue due to the likelihood of increased fertiliser prices contributing to greater production costs in the future. Wheat and barley varieties may vary in their responsiveness to P either by having root traits that increase access to soil P or by more efficient use of the P that is taken up. In combination with different yield potentials, external P requirements and phosphorus use efficiency (PUE) could vary. Previous experiments conducted at Minnipa and Mallala in 2012 and 2013 revealed small significant responses to P applications among various wheat and barley varieties however no significant differences could be obtained for PUE, potentially due to the relatively small yield response obtained. Trials were repeated in 2014 at Condowie and Sherwood where very low P levels were measured, in an attempt to generate greater yield responses to P and identify if there are any significant differences in PUE between varieties.

How was the trial done?
Two replicated field trials using wheat and barley were established at Sherwood in the SE Mallee and Condowie in the mid-North of S.A. Both sites were at similar low levels of available P as measured by either DGT P or Colwell P compared to their respective critical values. The two sites did have contrasting phosphorus buffering index (PBI) values with the heavier soil type at Condowie (neutral pH) approximately double the PBI value of the sandy loam acidic soil type at Sherwood. On 23 May (Sherwood) and 3 June 2014 (Condowie), 6 varieties each of wheat and barley were sown at 5 rates of P: 0, 5, 10, 25 and 40 kg P/ha as triple superphosphate. The varieties sown were selected from a range of current commercial varieties and some old varieties that have been reported to show differences in P responses. The P use efficiency (PUE) is defined as the yield at 0 P relative to the maximum yield. The P requirement was assessed by fitting a curve through the yield response data and the required P rate was estimated as the rate that gave 90% of the overall yield response.

Key Messages
• Yield responses to P were associated with promotion of early crop biomass in both wheat and barley. Compared to N, there appears to be less risk of high P rates adversely affecting yields.
• Compared to differences in yield among varieties, differences in responses to P have been small. At this stage variety selection should be based on potential yield rather than any differences in PUE to achieve the greatest return in investment from P.
• Phosphorus nutrition levels should be continually monitored especially those on replacement P programs and soil types with moderate to high PBI levels. Required P rates for both trials were at least double the calculated replacement P rates.
• More efficient replacement P rates could be obtained if they are adjusted in accordance with PBI levels if they vary significantly within a paddock.
Acknowledgements

The experiments were run with the financial support of SAGIT (project code – UA1201). The trial was managed by Rob Wheeler and the expertise of his team is acknowledged.
Stubble Management to Improve Crop Yield

Chris Korte, Mick Brady, Chris Davies, Dave Monks.
Department of Economic Development, Jobs, Transport and Resources (DEDJTR)
Peer Review: Garry O’Leary, DEDJTR

Why was the trial done?
Over recent seasons adoption of stubble retention has plateaued in the Mallee and some growers are reducing the area of stubble retained until the next growing season. An experiment was undertaken to identify potential improvements in stubble management so this trend could be reversed. The experiment examined how different amounts and types of stubble impact on subsequent water availability and crop yield.

How was the trial done?
The experiment was located at Ouyen using 4.8m by 15m plots, replicated in five blocks. In 2013 different stubbles were generated. In 2014 wheat and canola were grown on the range of stubble treatments. Growing season rainfall at the site was 147.8 mm in 2013 and 115.6 mm in 2014.
In 2013 plots were sown in either Mace wheat or Rasina vetch, each at two fertiliser rates – High input of fertiliser (20kg/ha of N & 6kg/ha of P followed by 20kg/ha of N top-dressed) and Low input of fertiliser (2.7 kg/ha of N & 6kg/ha of P). To further generate differences in stubble, the crops were harvested at two heights in 2013 (<15 cm and >30 cm above the ground). Measurements in 2013 included post-harvest stubbles.
In 2014 plots were sown in either Corack wheat or 43C80 Clearfield canola. In 2014 measurements included pre-sowing stubbles, soil moisture and grain yields.

Key Messages
- For different 2013 treatments, the amount of stubble ranged from 2.4-4.0 t DM/ha at harvest and from 1.6-3.0 t DM/ha at the subsequent sowing. The only statistically significant effect of 2013 treatments on 2014 pre sowing stubble was a difference between wheat and vetch stubble, 2.7 t DM/ha and 2.0 t DM/ha respectively, reflecting faster breakdown of vetch than wheat stubble.
- Despite significant differences in the amount and types of stubble generated in 2013, and remaining at sowing in 2014, there was no statistically significant effect of 2013 treatments on 2014 soil moisture at sowing or 2014 crop yields.
- There were significant differences between crop types in 2014. Significantly more wheat plants established than canola (49 and 15 plants per m² respectively) and wheat had a significantly higher grain yield than canola (1.2 and 0.3 t/ha respectively). Both wheat and canola were affected by the dry spring and associated frosts, plus canola had poor establishment.
• Research conducted previously at Walpeup in the 1980s found that maintaining 2 t/ha stubble increased the amount of water stored in the soil at sowing, at depth 0-140 cm, by 16 mm in 1 year of crop. This increase in soil water availability was not reflected in increased crop yield.
• The recent experiment at Ouyen, together with the previous research at Walpeup, indicate that Mallee crop yields are unlikely to be increased by retaining higher levels of stubble, although there can be benefits of reduced soil erosion.

Acknowledgements
Funding for the experiment was provided by GRDC and DEDJTR as part of the GRDC project “Maintaining profitable farming systems with retained stubble in the Mallee”. Mr Dean and Jarrod Munro of Ouyen are acknowledged for providing the experimental site. Debra Partington is acknowledged for providing statistical analysis.

Reference
Targeted liquid delivery of fungicides: a new tool for Rhizoctonia root rot control

Paul Bogacki1, Jack Desbiolles2, Ray Correll3, Daniel Hüberli4, Bill MacLeod4 and Alan McKay1

1South Australian Research and Development Institute (SARDI); 2University of South Australia; 3Rho Environmetrics Pty Ltd; 4Department of Agriculture and Food, Western Australia (DAFWA)

Why was the project undertaken?
Rhizoctonia root rot caused by the fungus Rhizoctonia solani AG8 continues to be the most yield depleting fungal root disease in the southern and western agricultural regions. The aim of this trial program was to evaluate the efficacy of banding fungicides as an alternative to seed treatments for Rhizoctonia control, which in our trials have increased wheat and barley yields by around 0.07 t/ha or 5% on average. With more growers adopting liquid delivery systems for combined nutrition and disease management, or considering the switch, it was important that fungicides with good efficacy against Rhizoctonia be registered for furrow banding to offer greater flexibility in application.

How was the project done?
We evaluated the efficacy of banding the fungicides Uniform® and EverGol® Prime in field trials conducted in SA and WA from 2011-2013. Uniform® was evaluated in 21 trials (11 wheat/10 barley) and EverGol® Prime in 9 trials (1 wheat/8 barley). The main treatments included banding different rates of fungicide in-furrow 3-4 cm below the seed as a stand alone application or in combination with a surface band (applied behind the press wheel) or seed treatment. The in-furrow and surface bands were aimed to protect the seminal and crown roots, respectively. The efficacy of Uniform® and EverGol® Prime banding treatments was compared to that of seed treatments with Vibrance® and EverGol® Prime, respectively.

Key Messages
- This three year trial program contributed to Uniform® and EverGol® Prime being recently registered for Rhizoctonia root rot control using liquid banding applications. Uniform® (RRP: not set at time of printing) is registered for liquid application in-furrow and on the soil surface, whereas EverGol® Prime (RRP: $145/L) is registered for liquid application in-furrow only.
- Uniform® banding treatments had better efficacy than Vibrance® seed treatment. Banding treatments were associated with more significant and bigger yield responses, with dual banding of Uniform® in-furrow 3-4 cm below the seed and on the surface behind the press wheel giving the most consistent yield and root health responses across seasons.
- Yield responses achieved by banding EverGol® Prime in-furrow were not significantly different from EverGol® Prime seed treatments. However, banding in-furrow combined with seed treatment significantly improved root health compared to banding in-furrow or seed treatment alone.
• Fungicide responses did vary from season to season suggesting there is an environmental component affecting efficacy. Yield responses were generally bigger in the better seasons.

• Growers now have greater flexibility in choosing a method of fungicide application for Rhizoctonia control, which can also offer improved efficacy. Importantly, fungicides still need to be used as part of an integrated management package. Banding will reduce patch incidence and severity but not eliminate patching altogether.

Acknowledgements
GRDC, SAGIT, Syngenta and Bayer CropScience for funding the research. SARDI New Crop Agronomy group for managing weed control and harvesting the SA trials. DAFWA Geraldton, Katanning, Northam and Wongan Hills Research Support Units for seeding and harvesting the WA trials. All the grain growers who kindly collaborated with SARDI and DAFWA conducting the trials on their land from 2009-2014. Liquid Systems SA and Topcon Precision Agriculture for directly supporting the SA research component.

Links and references
GRDC Factsheet March 2012 (will be updated in 2015)
Fluid delivery systems and fungicides in wheat at Warramboo and Streaky Bay

Amanda Cook, Ian Richter and Wade Shepperd, SARDI Minnipa Agricultural Centre
Peer Review: Nigel Wilhelm and Andrew Ware, SARDI

Why was the project undertaken?
A SAGIT Fluid delivery project was funded to update the benefits of fluid delivery systems from previous research and assess the potential of fluid nutrients and disease control strategies in current farming systems. The fluid systems (fertilisers or nutrients) have the potential to increase production through delivery of micro and macro nutrients, reduce cost of trace element delivery, and increase control of cereal root and leaf disease using newer fungicide products, resulting in possible increases in dry matter production and grain yield.

How was the trial done?
Two replicated trials (3 replications with 20m plots) were established in 2014 at Warramboo (2014 total rainfall: 302 mm, GSR 190 mm) on a red sandy soil and Streaky Bay (2014 total rainfall: 441 mm, GSR 277 mm) on a grey calcareous soil. The fluid fertiliser delivery system placed fluid fertiliser approximately 3 cm below the seed at an output rate of 100 L/ha. The fluid system could also be split to deliver fungicide both below the seed at approximately 3 cm, and above in the seeder furrow behind the press wheel in a 1 cm band.
The control treatment was 60 kg/ha of Mace wheat with 50 kg/ha of 18:20:0:0 (DAP). Manganese (Mn) was the main focus trace element, with zinc (Zn) and copper (Cu) also included in the trace element mix. The fungicides Uniform (SYNSIFI in furrow), EverGol and Vibrance (seed dressings) were assessed for Rhizoctonia disease suppression with trace elements, at different rates and in split applications. PredictaB disease inoculum levels (RDTS), plant establishment, Rhizoctonia seminal root score, Rhizoctonia crown root score, green leaf area index, grain yield and quality were measured during the season.

Key Messages
- 2014 trial results showed using phosphoric acid as the phosphorus source compared to granular fertiliser produced a significant response in early dry matter and a 0.13 t/ha yield increase on highly calcareous soil at Streaky Bay.
- Zinc deficiency was present at mid tillering at Streaky Bay but it was corrected with the trace element treatment.
- There were no differences to grain yield as a result of fungicide applications or rates at Streaky Bay which had a high Rhizoctonia inoculum level.
- There were no differences in yield given differing nutrition applications at Warramboo, with DAP and trace elements or phosphoric acid and manganese performing similarly.
- The Warramboo site had medium Rhizoctonia inoculum levels and low disease expression, however there were differences in late dry matter and yield with trace element plus fungicide applications, but there were no differences between fungicide placement or rates.
- Research into fluid delivery for nutrition and fungicides will continue for another two seasons.
Acknowledgements
Thanks to SAGIT for funding this research. A big thank you to Sue Budarick for doing the Rhizoctonia root disease assessments. Thank you to Nigel Wilhelm, Andy Bates and Andrew Ware for input into this trial, and Darren Sampson and Luke Kelsh and families for supporting MAC research by having trials on their properties.
Controlling soil throw with tine seeding: opportunities with bentleg openers

James Barr and Jack Desbiolles, Agricultural Machinery Research Group, University of South Australia

Why was the project undertaken?
Tine seeders are recognised for their greater soil disturbance at seeding, relative to disc seeders. Aspects of soil disturbance at seeding include furrow size and depth as well as the extent of soil movement or soil throw. The lateral soil throw - the sideways movement of soil pushed out of the furrow - is a particularly important parameter to consider in a no-till seeding context. A limited amount of lateral soil throw at seeding is typically desired to mechanically incorporate soil applied herbicides. However, excessive soil throw limits the furrow backfill, reducing soil cover over the seed, and creates interactions (ridging) between adjacent seed rows, resulting in additional soil cover which increases seeding depth and potentially induces crop damage from herbicides.

How was the project done?
A field trial was conducted in a clay-loam soil at Roseworthy in Sept 2014 to validate previous findings regarding soil throw and tine seeding in a field situation (reflecting here a condition of dry-sowing) and investigate the potential for higher speed seeding. A selection of straight and bentleg openers was tested, measuring draft, vertical and side forces, lateral soil throw, as well as furrow backfill at 8, 12, and 16 km/h and at 120 mm operating depth. The two straight openers used encompassed the range of rake angles displayed in commercial narrow knife points, and the two bentleg openers featured a bevelled edge and differed in their shank offset values (45 and 95 mm).

Key Messages
- Soil disturbance caused by tine openers can affect the success of no-till seeding operations, influencing issues such as furrow moisture loss, weed seed germination, seeding depth variability across seed rows, crop safety and pre-emergent herbicide efficacy.
- Research shows that low rake angles increase soil layer mixing and deeper soil delving effects while slightly reducing furrow backfill. A bevel edge at the leading face increases furrow size and reduces lateral soil throw.
- Bent leg openers combined with bevel edge features can mostly cancel soil throw and maximise furrow backfill. They offer an unprecedented ability for high speed-low soil throw no-till tine seeders.

Acknowledgements
Funding from the GRDC, SAGIT and the University of South Australia for previous and on-going seeding system research is gratefully acknowledged.
Summer active perennial grasses influence biological functions in Mallee soils in South Australia

Gupta, V.V.S.R., Kroker, S.J., Hicks, M., Davoren, C.W. and Llewellyn, R.
CSIRO Agriculture Flagship

Why was the project undertaken?
Summer-growing perennial grasses have been recommended to fill the summer-autumn feed-gaps generally faced in the winter rainfall dominated regions of southern Australia. Perennial grasses support extensive root systems and deposit large amounts of carbon (C) into soil through rhizodeposition. In the low organic matter Mallee soils C inputs by the summer active perennial grasses have the potential to influence microbial populations and activities related to C turnover, N mineralization, non-symbiotic (NS) N2 fixation and soilborne plant diseases.

How was the project done?
The replicated field experiment located at Karoonda in South Australia was used for all the biological measurements. The experiment is located on a sandy Calcarosol with 1.04-1.17% organic C and was established in October 2010. Surface 10 cm soil samples collected from perennial grass (*Megathyrsus maximus* Jacq. cv. *Petrie* (Petrie), *Panicum coloratum* L. cv. *Bambatsi* (Bambatsi), *Chloris gayana* Kunth cv. *Katambora* (Rhodes grass)), grass-pasture (Petrie-Crop) and crop plots during the summer and during cereal crop season (2011-13) were analysed for microbial properties related to nutrient availability. *Rhizoctonia solani* AG8 inoculum levels were measured in soils collected during October 2013 and *Rhizoctonia* disease incidence was measured in Pea plants collected in early August 2014.

Implications for commercial practice
- Summer active perennial pasture grasses add above and below-ground carbon inputs that are vital for maintaining and even enhancing biological functions in cropping soils.
- Perennial grasses significantly increased the microbial biomass, activity and N mineralization potential in the surface 20 cm of soil compared to Crop only treatment.
- Rhizosphere and root environments of summer active perennial grasses support significant amounts of non-symbiotic N2 fixation during summer months compared to cropping soils thus contributing biological N inputs into the soil N cycle.
- Soilborne diseases such as rhizoctonia root rot could compromise the benefits from enhanced nutrient supply in summer active grass pasture-crop systems.

Acknowledgements
GRDC Soil biology Initiative II project CSP00138 and Evercrop II
Manage the Risk of Beet Western Yellow Virus (BWYV) and Other Diseases in 2015

Frank Henry¹, Jenny Davidson² and Paul Umina³
¹Department of Economic Development, Jobs Transport and Resources (DEDJTR), ²South Australian Research & Development Institute (SARDI), ³cesar

Summary
Significant summer rainfall over much of the southern cropping zone during January 2015 has stimulated plant growth providing a "green bridge" for last year’s insect pests and diseases to move into this season. Important pests and diseases to watch out for in 2015 include Beet western yellows virus (BWYV), the green peach aphid (GPA) (Myzus persicae) and the cereal rusts. Significant rainfall events over the summer will also alter inoculum levels of soil borne diseases like crown rot, rhizoctonia root rot and take-all.

BWYV is of particular concern as widespread infestations of GPA contributed to an outbreak of BWYV in southern Australia during autumn and winter of 2014. The virus severely affected canola crops across South Australia, Victoria and some parts of NSW, leading to significant yield losses in 2014.

BWYV is not seed borne and is transferred into canola crops by aphids carrying the virus. GPA is the principal vector of BWYV, although other aphid species like the cabbage aphid can transmit the virus at a low level. While further rain and mild temperatures during summer and autumn this season are necessary for an increase in the GPA populations and the associated virus risk, early weed control will minimise the risk.

Growers should continue to pay attention to weather conditions (rainfall and mild temperatures) leading into the growing season as this will provide a good indication of the likely risk of GPA and BWYV, as well as the cereal rusts and soil borne diseases.

Key Messages
- Substantial summer rains have increasing the risk of GPA, BWYV and cereal rusts for 2015.
- Remove the "green bridge" over summer and autumn prior to sowing to reduce the risk of BWYV and its vector the green peach aphid (GPA), as well as cereal rusts.
- Use a current disease guide to check the varietal rust ratings before sowing, and take appropriate action if sowing cereal varieties susceptible to rust.
- To reduce the risk of BWYV, do not sow canola into desiccating weeds/canola volunteers as aphids will move directly from the weeds to the emerging seedlings.
- Monitor GPA populations on weeds, volunteers and seedling crops.
- For early control of GPA use seed treated with a neonicotinoid insecticide, and if farmer applied, ensure proper application and coverage of seed dressing for efficacy against GPA.
- Ensure correct identification of GPA before applying insecticides to protect seedling canola.
- Use a PreDicta B soil test before sowing to identify paddocks at risk of soil borne diseases.
Acknowledgements
Grains Research and Development Corporation (GRDC) and South Australian Grain Industry Trust (SAGIT) for financial support. Bill Kimba, Ken Henry and Greg Baker (PIRSA-SARDI), Joop van Leur and Don McCaffery (NSWDPI), Kym Perry (SARDI), Brenda Coutts (DAFWA), Grant Hollaway, Mohammad Aftab and Piotr Trebicki (DEDJTR), project contributors.
Beet western yellows virus (synonym: Turnip yellows virus) and green peach aphid in canola

Jenny Davidson4, Brenda Coutts1, Roger Jones2, Paul Umina3, Greg Baker4, Mohammad Aftab5
1Department of Agriculture and Food Western Australia, 2The University of Western Australia, 3cesar, 4South Australian Research and Development Institute and 5Victorian Department of Economic Development, Jobs, Transport and Resources

Why was the project undertaken?
Widespread infestations of green peach aphids (GPA) (Myzus persicae) during autumn and winter of 2014 contributed to an outbreak of Beet western yellows virus (BWYV, syn. Turnip yellows virus) in southern Australia. Canola crops across the lower and mid-north regions of South Australia, the Eyre Peninsula, western Victoria and some parts of NSW have been severely affected by the virus. GRDC and SAGIT provided emergency funding to respond to this outbreak.

How was the project done?
Symptomatic plants from 618 canola crops (290 from SA) were submitted by agronomists to the Victorian DEPI in Horsham for virus testing. Interactions with crop management were observed. Approximately 50 GPA samples were collected by researchers, advisors and growers in autumn-spring 2014, and subsequently screened at cesar for insecticide resistance viz. pyrethroids, carbamates and organophosphates. These populations spanned NSW, Victoria and SA. Results of crop surveys for BWYV and yield loss trials conducted in WA from 1998 are also presented.

Key Messages

• Beet western yellows virus (BWYV, syn. Turnip yellows virus) is widespread throughout grain growing areas of Australia.
• Early BWYV infection in canola can cause seed yield losses of up to 46%, decrease seed oil content and increase seed erucic acid and glucosinolate contents.
• Wild radish weeds and volunteer canola are the most important reservoirs but perennials such as lucerne and many weeds species may also be infected.
• Epidemics are likely to occur when aphids are present early in the season (green bridge prior to seeding, warm temperatures). GREEN BRIDGE MUST BE CONTROLLED.
• Integrated management strategies have been devised for BWYV in canola.
• Green peach aphid (GPA), the main vector for BWYV, has a high prevalence of resistance to insecticides. Growers should implement resistance management strategies for insecticides including neonicotinoids.
Acknowledgements

The number of root lesion nematodes (Pratylenchus neglectus) declines after strand medic pasture

Ross Ballard, Jake Howie, David Peck, Nigel Charman, Jeff Hill and Alan Mckay (SARDI)

Why was the trial done?
There have been conflicting reports in the literature and popular press regarding the impact of medics on the population densities of Pratylenchus neglectus (Pn, root lesion nematode). A recent industry report listed cultivars of burr and barrel medic as susceptible or very susceptible, i.e. likely to result in significant multiplication of the nematode. It is at odds with previous field work in SA showing stable or decreasing numbers of Pn following medic.

This study aimed to quantify Pn numbers following the growth of strand medic (Medicago littoralis), the best adapted and most extensively grown medic in Mallee agricultural regions. It adds to work that aims to understand the impact of Pn on medic production, changes in Pn numbers following medic and its implications for the use of medic pastures in crop rotations.

How was the trial done?
Medic plots were sown at Arthurton (Yorke Peninsula) and Pinery (Lower Mid-North) in South Australia, where population densities of Pn had been manipulated in the previous year. This was achieved by sowing 20 cereal varieties that varied in their Pn susceptibility/resistance. Plots were sampled prior, or close to the time of medic establishment, and again in the summer following the medic phase. Number of Pn in the soil samples was determined by the Root Disease Testing Service (SARDI).

Key Messages
- Root lesion nematode number was maintained or reduced following the growth of strand medic.
- The results were consistent at both trial sites.
- The results show that strand medics are unlikely to increase the number of Pn, regardless of initial Pn number. Where moderate numbers of Pn were present (>30/g soil) reductions in nematode number of up to 60% were measured following the growth of the strand medic cultivar Herald.
- The results support previous field studies that have included strand, burr and barrel medics and indicate they are appropriately classified as moderately resistant, under field conditions.
- The reason for the disparity in reported resistance ratings for medic most likely stems from whether the classification is based on greenhouse assays or field tests. Under less favourable field conditions, the opportunity for Pn multiplication is reduced.
- This study shows that strand medics can be grown in rotations to manage levels of Pn.

Acknowledgements
The work was funded by SAGIT and GRDC.
The impact of livestock on paddock health

Jessica Crettenden¹ and Roy Latta²
¹SARDI, Minnipa Agricultural Centre
²Dodgshun Medlin, Swan Hill Victoria
Peer review: Nigel Wilhelm, SARDI, Minnipa Agricultural Centre

Why was the project undertaken?
A long-term study was established at the Minnipa Agricultural Centre from 2008 to 2014 (EPFS Summaries 2008 to 2013) to assess the impact of grazing on crop and pasture production and soil health and also to evaluate this from a systems perspective. The seven year trial with a wheat, wheat, pasture (volunteer and sown annual medic), wheat, pasture (self-regenerating annual medic), wheat and wheat rotation was also established to determine whether productivity could be improved under a higher input system compared to a lower input and more traditional system and what affect this had on soil fertility.

How was the trial done?
In 2008, a 14 ha red sandy loam (pHCaCl 8) portion of a paddock on Minnipa Agricultural Centre was divided into four 3.5 ha sections. Each section represented a system treatment: low input district practice - grazed, low input district practice– un-grazed, high input – grazed and high input – un-grazed. The pasture and grazing treatments were not imposed until 2010. In 2014 the trial was sown to Mace wheat on 10 May at 50 kg/ha with 45 kg/ha DAP and 70 kg/ha with 75 kg/ha DAP for the low and high input treatments respectively. Weed control was imposed on all treatments as required in both summer and during the growing season. Sampling for pre-seeding soil water content and chemical analysis was completed on 14 April and plant establishment counts were recorded on 3 July. Harvest biomass cuts, yield measurements and grain samples were taken on 31 October followed by post-harvest soil water contents on 5 December to estimate comparative water use efficiency.

Key Messages
• After seven years of data, the results have shown no suggestion of any soil health or production loss issues in response to grazing, irrespective of whether crop or pasture inputs were increased or maintained similar to a district practice system.
• The 2014 higher input systems portrayed how increased inputs and costs throughout the season can result in increased productivity and subsequent profitability.
• Soil organic carbon levels remain largely unchanged in 2012 and 2013 from the initial 2008 measurements. Soil organic carbon changes are long term. Whether the 2014 figures are a long term trend which could be attributed to less production, thus more biomass decomposed and subsequent cycling in the soil or a short term anomaly, will be determined in subsequent years.

Acknowledgements
The Grain and Graze 3 project is funded by GRDC. We gratefully acknowledge the help of Mark Klante and Brett McEvoy for trial site management and Ian Richter and Wade Shepperd for data collection.
Benchmarked sheep enterprises using Breeding Value technology

Jessica Crettenden, SARDI, Minnipa Agricultural Centre
Peer Review: Geoff Lindon, AWI and Naomi Scholz, SARDI, Minnipa Agricultural Centre

Why was the project undertaken?
The Eyre Peninsula has the proven capacity to produce productive and profitable sheep as a valuable component of the mixed farming system. Current market forces, a longer term consideration of climate change and the likely adaptations to whole farm systems provide a real opportunity for sheep to reinvigorate farming businesses in the area. Merinos have suffered from limited uptake of new technology in recent decades but there is now good demand for medium wool, meat and restockers. For these reasons, a four year study was undertaken at the Minnipa Agricultural Centre to investigate new sheep breeding technology and management options. The project at Minnipa promoted ways to overcome barriers to new technology adoption and aimed to show how Breeding Values could be used as a benchmarking tool to help set targets and monitor change towards achieving goals in breeding programs.

How was the project undertaken?
The project used the Merino sheep flock at Minnipa to demonstrate the genetic benchmarking system that is known as MERINOSELECT, created by “Sheep Genetics” (a joint MLA AWI project). The three main topics covered in the project were; use of the Minnipa demonstration flock to engage with ram buyers and breeders, technology transfer to ram buyers, and technology transfer to ram breeders. Over the four years of the study the key activities important for the flock to create breeding values were demonstrated to breeders. Measurements were submitted to MERINOSELECT for the 2010, 2011, 2012 and 2013 drops at yearling (Y) age (10-13 months). This process subsequently generated Australian Sheep Breeding Values (ASBVs), which are figures that aim to take the environmental effects (such as feed, birth type, seasonal conditions etc.) out of the actual measured trait and thus better reflect the actual genetic merit and potential of an animal. These Breeding Values are valuable productivity benchmarks but must also be complemented with the longstanding traditional visual assessment in order to stay “on track”.

Key messages
Breeding Values can increase productivity and profitability of a livestock business through long term improvement to genetics of the flock by benchmarking performance, continually setting higher targets and monitoring actual progress. The technology can also be used in conjunction with other sheep husbandry activities to increase labour efficiency. To be effective, the use of technology needs to be closely aligned with visual selection and the setting of stretch productivity targets in each individual flock, in order to see significant improvement.
The project also showed how MERINOSELECT can provide ram buyers with a system to benchmark their flock whilst assisting with ram purchasing decisions. Although the project aimed mainly to demonstrate MERINOSELECT as a genetic benchmarking system and what is involved in its implementation rather than simply validating the use of Breeding Values, the positive genetic changes in the Minnipa flock were an encouraging outcome.

**Acknowledgements**

Support and funding was provided by AWI. I would like to thank Roy Latta, Dodgshun Medlin, Darryl Smith and Forbes Brien, SARDI Roseworthy and Brian Ashton, Sheep Consultancy Service Pty Ltd for project development and delivery. Leonie Mills, Chris Prime, Brenton Smith, Don Baillie and Shannon Mayfield, were members of the project consultative committee and I thank them for their contribution and support. I would also like to thank Mark Klante for his livestock management support and MAC staff Suzie Holbery, Brett McEvoy, John Kelsh and Brian Dzoma for support in the shed and sheep yards.
An improved pasture-crop system increased yields, with and without grazing, on the Eyre Peninsula

Roy Latta, Minnipa Agricultural Centre
Peer Review: Jessica Crettenden, Minnipa Agricultural Centre

Why was the project undertaken?
This long term study commenced at the Minnipa Agricultural Centre in 2008 to assess the ongoing sustainability of the mixed cropping and livestock low rainfall dryland farming system. This followed a sequence of low rainfall seasons with associated concerns relating to soil health from livestock. The hypothesis that sheep will impact negatively on sustainability (soil health and productivity) was tested. The current low input system (district practice) and a higher input system were compared, both with and without animal grazing.

How was the project undertaken?
A long term trial (2008 to 2014) was established at Minnipa Agricultural Centre on the Eyre Peninsula of South Australia with alkaline sandy loam soil and an average annual and growing season rainfall of 325 and 240 respectively. The key treatments were two 7 hectare blocks sown to wheat at two seed (50 and 70 kg/ha) and fertiliser (40 and 60 + Urea kg DAP/ha) rates reflecting low and high input farm practises in 2008, 2009, 2011, 2013 and 2014. In 2010 the high input 7 hectare block was sown to Angel medic with fertiliser, while the low input 7 hectare block had no pasture or fertiliser inputs. In 2012 the annual medics from both 7 hectare blocks regenerated from the residual seed bank with no further inputs. In 2010 and 2012 the 7 ha blocks were split in half by electric fencing to allow sheep to graze a 3.5 hectare block in each of the high and low input 7 ha blocks.

Key messages
The sown medic pasture provided a higher stocking rate capability compared to the regenerated medic pasture (1618 vs 620 DSE grazing days ha) over the two pasture phases of the rotation, 2010 and 2012. The grazing at either level did not result in any decline in soil health parameters or crop production. The sown medic pasture coupled with higher wheat seed and fertiliser rates increased wheat yields with similar or higher quality grain from the 2011, 2013 and 2014 seasons (Table 1).

Table 1 Wheat establishment (plants m²), grain yield (t/ha) and protein content (%) in 2011, 2013 & 2014

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<td>(plts m²)</td>
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<td>100</td>
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<td>Approx. lsd (P=0.05)</td>
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After 6 years (2008-2014) there was no evidence of soil health or productivity decline as a result of the grazing animal. Soil organic carbon contents were comparable with and without grazing. While the study did not clearly demonstrate benefits in soil health from maintaining a pasture ley in a cropping rotation, the indications were that a productive pasture phase halted any decline.

**Acknowledgements**

The project was funded by the Grains Research and Development Corporation as part of the “Grain and Graze” project and the South Australian Research and Development Institute.
Soil type affects forage shrub feed quantity more than feed quality

Andrew P. Smith, Audrey Ropp
CSIRO Agriculture, Waite Campus

Why was the trial/project undertaken?
In mixed farming systems in the low rainfall zone, forage shrubs such as Old Man Saltbush (*Atriplex nummularia*) are usually planted on soils otherwise marginal for year-on-year cropping. The forage shrubs can be a valuable source of feed at a number of points throughout the year and particularly during drought conditions. The potential plant productivity is determined by the soil type as well as climate, which in turn influences the soil and water uptake as well as rooting depth etc. The potential livestock production from grazing forage shrub plantations is influenced by the factors that determine feed quantity, as well as those that affect feed quality. This study looks at the variation in quantity and quality of forage shrub feed when comparing plantings on different soil types.

How was the trial done?
The project involves a trial instigated in 2009 at Waikerie, South Australia to understand how landscape/soil types influence biomass production across a range of rainfall. This research takes the next step to also consider forage quality.

The shrubs were established as seedlings at a density of roughly 634 plants/hectare at Waikerie in South Australia. The site is a catena (soil-landscape interaction) common to many parts of the Mallee - with dunes and swales. The dune soil at the highest elevation is a deep (>1.5 m), light loamy sand, whereas the soils on the mid and swale positions were characterised by a sandy topsoil and a marked shift to heavier clay texture at about 20–30 cm. The depth increases and extent of physical and chemical limitations to plant root growth and functioning in the soil decrease, moving from the swales to the dunes. The shrubs are periodically grazed on an annual basis. In late spring 2014 the shrubs were sampled to assess their nutritional quality.

Key Messages
- Modelling shows that leaf biomass can amount to 1.5–3 t ha–1 for common saltbush and 4–6 t ha–1 for Eyres saltbush at the start of autumn each year
- Edible biomass production on the swale soils was about half of the biomass on the dunes
- Considering the data reported previously, the sampling produced some surprising results – with plant material being more nutritious for livestock,
- Old Man Saltbush (Eyres Green and DeKoch) and Malle Saltbush contained similar metabolisable energy of 9-10 MJ/kg
- No shrub type has dry organic matter digestibility greater than 60%
• There were no significant variations in feed energy value plant nutritional characteristics due to plant size or soil type (landscape location) over the site
• Forage shrubs offer scope for strategic use as a source of protein to complement metabolisable energy provided by other feedstuffs,
• The next step is to test how the interrow can be best managed to ensure optimal livestock production from forage shrub plantations.

Acknowledgements
Work for this project was funded by GRDC under the EverCrop III Project; and by CIRAD (France) under the ARChE_Net Project. Other project contributors included Bill Davoren and Damian Mowat (CSIRO, Adelaide), Elizabeth Hulm and Hayley Norman (CSIRO, Perth).
Management of soilborne Rhizoctonia disease risk in cropping systems

Gupta, V.V.S.R.1, Alan McKay2, Kathy Ophel-Keller2, Nigel Wilhelm2, John Kirkegaard1, Daniel Hüberli3, Bill MacLeod3 and David Roget4
1CSIRO Agriculture Flagship Waite campus and Canberra; 2SARDI Waite campus; 3DAFWA South Perth; 4ex-CSIRO deceased Dec 2013

Why was the project undertaken?
Rhizoctonia continues to be an important (average annual cost $59 million) but complex disease in the southern agricultural region, especially the lower rainfall region. The fungus *Rhizoctonia solani* AG8 is present in Australian soils as part of the microbial community. This pathogenic fungus is a good saprophyte (grows on crop residues and soil organic matter), adapted to dry conditions and lower fertility soils. The aim of this research was to improve our understanding of the interactions between pathogen inoculum levels and natural soil biological activity for long term control of Rhizoctonia and to improve the prediction and management of the disease.

How was the project done?
A series of multi-year field trials were conducted at sites in SA, Victoria and NSW to determine key soil, environment and management factors influencing the pathogen dynamics and disease impact in cereal crops. These trials were complemented with annual field experiments to investigate the effect of specific management practices including fungicide evaluation.

Key Messages
The key to long term rhizoctonia disease control is to keep inoculum in the soil low in the crop and pasture phases and increase the ability of crops to tolerate the infection (create environments where plant infection is reduced and plant tolerance to infection improved). The success of available disease control strategies, e.g. soil disturbance, fertilizer addition or fungicides is greatest at low to medium inoculum levels and their effectiveness declines as inoculum levels increase or where disease suppressive activity is low. Overall, effective control of rhizoctonia disease in cereal crops requires both the reduction of the pathogen inoculum in the soil prior to seeding and control of the infection process in the crop itself. This has to be achieved through management practices spread over more than one cropping season and through an integrated management strategy.

Acknowledgements
GRDC and SAGIT for funding (projects CSE00048, CSP00150 and CSA00025). The Research Team: CSIRO – Bill Davoren, Stasia Kroker, Marcus Hicks, Nady Harris, Stephanie Diallo; SARDI – Dan Smith, Amanda Cook and Paul Bogacki; NSW – Peter Hamblin and University of South Australia – Jack Desbiolles. All the growers (Glen Schmidt, Waikerie; Williams and Goosay families, Streaky Bay; Loller family, Karoonda; Simon Murphy, Galong; Troy Phillips, Wynarka) that kindly allowed CSIRO to conduct the trials on their farm during 2008 to 2014.
Soil-specific Nitrogen Strategies and Upfront N Application on Sands Continue to Pay at Karoonda

Therese McBeath1, Bill Davoren1, Rick Llewellyn1, Vadakattu Gupta1 and Anthony Whitbread1
1CSIRO Agriculture Flagship, Waite Precinct, Adelaide.
3 International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Telengana, India.
Peer review: Pilar Muschietti Piana

Why was the trial/project undertaken?
To identify opportunities to reduce risk and increase profitability by evaluating the soils and conditions where continuous cereal systems perform best and where inputs can be most cost-effectively targeted.

How was the trial done?
Trials were established at Karoonda (Lowaldie) to test soil-specific strategies and tactics for reducing risk and increasing profitability in cereal-based rotations over the 2010-2014 growing seasons. Potential management practices including nil fertiliser, district practice, increased sowing N, increased N applied in-season and pasture breaks in 2009 and 2010 were applied on 150m long plots running across a range of soil types covering a dune-swale system. Simulation modeling was also used together with field results to identify the best long-term strategies for soil zones.

Key Messages
- The trial provides strong support for the use of soil-specific N management to improve profitability and risk management on Mallee dune-swale paddocks.
- Sandy soil types have consistently showed yield responses to increased inputs of N, while the heavy swale soils have not shown a yield benefit of increased N inputs.
- Nil fertiliser (N & P) has been the most profitable fertiliser treatment on the heaviest swale soil and the least profitable elsewhere.
- Upfront N at a higher rate still appears to generate the most consistent yield increase and profit outcome on the sandy soil types.

Acknowledgements
Thanks to the Loller family for their generous support in hosting the trial, to Jeff Braun for monitoring and advising on trial agronomy and to Mick O’Neill for assistance with statistical analysis. Funding for this work was from GRDC Water Use Efficiency Initiative (Project CSA00025) and the Stubble Retention initiative (Project MSF00003). Input from the Karoonda Mallee Sustainable Farming advisory group is gratefully acknowledged.
Wild radish control: understanding the seedbank and resistance management

Cameron Taylor, Birchip Cropping Group (BCG)
Peer Review: Harm van Rees (Cropfacts) and Simon Craig (Agronomise)

Background
From BCG wild radish research trials over the last three years, it is evident that populations are currently in a state of flux, with more incidences of resistance to herbicide Groups B, F and I emerging across North West Victoria. Much of this has been attributed to a heavy reliance on Group B herbicides to control grass weeds such as brome and rye grass. The consistent use of MCPA ester and amine formulations (Group I) is resulting in the effectiveness of these products diminishing. Subsequently the selection pressure being placed on these herbicides is increasing.

In 2014 BCG carried out research trials to help growers understand the life cycle of wild radish in the Mallee and to identify methods that decrease the radish seed bank in problem paddocks. Adopting practices that help to reduce the number of viable weed seeds present in the seed bank (predominantly by preventing new plants from setting seed) improves the productivity of the paddock and decreases the need for costly herbicides, delaying the onset of further herbicide resistance.

This investigation looked at the effectiveness of herbicides used in Clearfield and non-Clearfield cropping rotations to control wild radish and brome grass in the Mallee.

Method
Two trials were established in a paddock at Pira that contained wild radish populations with Group B resistance and tolerance to Groups F and I.

The first trial, which will run for three years, is comparing the impact of a range of crop sequences and herbicide regimes on wild radish numbers and growth habits on subsequent crop performance and profitability. Along with wild radish, the Pira site also had a reasonable population of brome grass so the trial will also investigate how the different systems impact on brome grass numbers throughout the duration of the trial.

The second trial was established to compare the efficacy of a range of herbicides and their effectiveness on Group B resistant wild radish.

Key Messages
- In 2014, an estimated 61 per cent of the seed bank germinated throughout the season, enabling a rapid reduction of the wild radish population and having a positive effect on grain yield. However, due to the long dormancy of the seed (six to eight years), 100 per cent control would be needed to eradicate the entire seed bank.
- Approximately 30 per cent of the seed bank germinated as a result of summer rainfall; best practice is to make the most of seasons that deliver a summer break to get a good knockdown.
- Aim to control 100 per cent of seed set by using multiple cultural, chemical and mechanical practices to eradicate the seed bank and stop resistance development.
Acknowledgements

This project was funded by GRDC through its ‘Improving IWM practices in the Southern Region – Emerging weeds’ project (FR_UA00134).
Sakura® 850 WG herbicide for grass weed control in water repellent soil

Rob Griffith, Bayer

Peer Review: Geoff Robertson and David Gregor, Bayer CropScience

Why the trials were undertaken
Grass weed management in wheat is becoming increasingly difficult. Pre-emergent herbicide performance is further challenged by water repellent (non-wetting) sand.

Background
Grass weeds are becoming incrementally harder to control as post emergent herbicide resistant weed populations evolve in the Mallee. Three seasons of trials on a water repellent soil at Lowaldie, SA evaluated pre-emergent herbicide use in wheat, including Sakura, to take the pressure off post-emergent options. Field trials in the Mallee have indicated pre-emergent herbicides can give variable control. The pre-emergent herbicide Sakura has excellent activity on a range of problem grass weeds including barley grass, annual ryegrass and suppression of brome grass. The level of weed control of Sakura is influenced by moisture before and after sowing. Water repellent soil adds another complicating factor, particularly if the soil is moist at sowing and rainfall following seeding does not move the herbicide to where weed seeds are germinating.

Trial Details

<table>
<thead>
<tr>
<th>Crop / Target</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target weed</strong></td>
<td><strong>Brome grass (Bromus diandrus)</strong></td>
</tr>
<tr>
<td><strong>Sowing equipment</strong></td>
<td>Knife point + press wheel</td>
</tr>
<tr>
<td><strong>Ground cover</strong></td>
<td>50% stubble</td>
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<tr>
<td><strong>Spray timing</strong></td>
<td><strong>Time</strong></td>
</tr>
<tr>
<td>2012 31/05/12</td>
<td>0930-1030</td>
</tr>
<tr>
<td>2013 28/05/13</td>
<td>0845-1000</td>
</tr>
<tr>
<td>2014 15/05/14</td>
<td>1530-1600</td>
</tr>
</tbody>
</table>
Key Messages
Pre-emergent grass weed control alone was highest when the herbicide was applied and incorporated by sowing to dry soil prior to the season-breaking rainfall event in 2013. The sowing operations that occurred after rainfall in 2012 and 2014 were more variable as the weed seeds did not come into contact with the herbicide until after germinating.
Adding a tank mixture partner such as trifluralin may improve weed control where moisture is marginal after application and sowing. The highest levels of brome and annual ryegrass control were achieved where a pre-emergent herbicide supported a post-emergent herbicide.

* Percentage control based on plant numbers. Sakura followed by (fb) Atlantis was not trialled in 2012.
Atlantis® is a Registered Trademark of the Bayer Group
Sakura® is a Registered Trademark of Kumiai Chemical Industry Co. Ltd.

Acknowledgements
Peter & Hannah Loller (cooperating farmers), Bill Davoren CSIRO (site management)

Ruth Sommerville, Rufous and Co

On the 21st of July a group of 19 young and old farmers from the Upper North of South Australia embarked on an informative and valuable bus tour visiting fellow low rainfall zone farming systems groups, Mallee Sustainable Farming (MSF) in South Australia/Victoria and Central West Farming Systems (CWFS) in New South Wales. This trip was funded by the GRDC through its Industry Development Program.

The Group had an early start, departing Booleroo Centre at 7.30am on the Monday morning. There was an all-important iced coffee break at Morgan before heading across the border into the Millewa region of northern Victoria. The first farm visit was at Ron and Nick Hards’ property ‘Yarrara’, where along with Michael Moodie from MSF, we were hosted for lunch. The Hards explained how they were managing the variable soil types of the Mallee environment and the challenges they faced with grain logistics with large distances for export and the use of on-farm storage. We then looked at the MSF paddock scale crop sequencing demonstration on their farm that incorporated different rotations using peas, canola and wheat.

The next stop was at Chris and Colin Hunt’s, where we inspected the MSF paddock scale variety trial where they were comparing the best varieties of the district. Michael discussed the use of how Clearfield (CL) crops were grown in the Mallee to combat Brome Grass issues. Next we were shown some soil pits, located on the sand hill, mid slope and swale areas showing how each soil type changed within a short distance. This site was also part of an ongoing Precision Ag (PA) focus paddock with variable rate trials and implementation of full PA over a number of years being carried out.

As the daylight faded the group then checked out a paddock of Wedgetail wheat (a long season winter variety). Michael Moodie discussed how the farmers in the area had been using Wedgetail to capture late summer rainfall events without the wheat running to head like spring wheats. The idea of having a variety like Wedgetail to benefit from an early rain event generated a lot of discussion and interest within the group. The day drew to a close a short way down the highway into Mildura, with the sampling of a few cold beers at the brewery followed by a generous feed of pizza and pasta.

On day two, the group visited the MSF Murrayville Seeder Trial. It was quite evident that a lot of work had gone in to the trial. Michael Moodie explained how different tyne systems resulted in significant differences in plant establishment and soil treatment in different soil types.

Then the bus headed for Managatang where John Aentz gave us a tour of his Saltbush and Enrich Perennial Forage Shrub Site. John explained why the wider row spacing was better with “Eyre’s Green” (Variety of Saltbush). John explained how he could lamb his ewes down and keep all his sheep off his pasture after they were spray topped until harvest where the sheep could then graze the stubble.

The sun was setting as we drove into the final Mallee stopover at Gav Howley’s near Kyalite to see a field pea trial but instead, with refreshments in hand, Gav showed us around his machinery shed. We looked at his Weed Seeker where Gav explained the use and benefits it was providing to his operation. Gav also talked through his DBS airseeder with liquid fertiliser and explained how by using liquid his workload at seeding time had reduced.

All of the participants thoroughly enjoyed the trip and were very thankful for the hospitality of each of the property owners for giving up their time to show and speak about their farming operations and especially Michael Moodie for organising and guiding us around the Mallee Region.