GRDC's Eyre Peninsula Farming Systems Project

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Eyre Peninsula Farming Systems

2004 Summary

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SAGIT Foreword

Dear Readers,

The SA Grain Industry Trust is pleased to make a significant contribution to both the Minnipa Agricultural Centre through the funding of projects and the highly valued Eyre Peninsula Farming Systems Summary.

SAGIT has been a part of South Australian Research and Development since it was established in 1991. Since then SAGIT has invested in hundreds of projects and this year will be investing more than $1.2 million dollars into South Australian Research and Development.

South Australia is privileged to have SAGIT and it's ability to fund local innovations that are relevant to local issues. SAGIT has funded several projects that directly affect the Eyre Peninsula over the past few years. The funding of Neil Cordon as Extension Agronomist and the selection of pulses and oilseeds for the low rainfall Upper Eyre Peninsula are just a few of the projects that have attracted funding from SAGIT.

SAGIT is a contribution by growers for growers. The selection of projects is made annually by a committee predominantly made up of growers from around the state, they are – Malcolm Sargent, Crystal Brook; Peter Kuhlmann, Mudamuckla; Colin Rowe, Golden Grove; Robert Rees, PIRSA; John McEvoy, Warooka and Simon Ballinger, Wolseley. They are assisted in their decisions by Dr Alan Dube.

The SA Grain Industry Trust has and will continue to be valued in SA. It is an innovative funding body with local knowledge and has the grower interests at heart. We are proud to be involved with this publication and the Eyre Peninsula Agricultural Research Foundation (EPARF) and Minnipa Agricultural Centre.

Malcolm Sargent
Chairman
South Australian Grain Industry Trust

SAGIT

Eyre Peninsula Farming Systems 2004 Summary

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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

Taryn Coad and Michael Kemp

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Front Cover:

From top to bottom: Alison Frischke at Minnipa Sticky Beak Day; Willy Shoobridge and Amanda Cook, MAC canola trials; Seeding with CT at MAC; Locky Friscke at Mudamuckla Sticky Beak Day.

Back Cover:

From top to bottom - left: Minnipa Research Foundation Sowing Systems Field Day 2004 (outside and inside tent), Nicholls' brothers, Sam Doudle and Ben Ward at Goode doing a soil compaction survey. From top to bottom - right: Ed Hunt talking to a group at the Minnipa Research Foundation Sowing Systems Field Day 2004; Neil "Fish" Cordon, Adam and Rex Crosby, co-operators of Fluid Fertiliser demo at Tuckey; Tim Richardson, Carrs' Seeds, at canola variety trial, Mount Cooper.

Inside Back Cover:

Photos from various Eyre Peninsula agricultural events in 2004.

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About this manual

G'day people from EP and beyond!

I was told the other day by a lower EP farmer from the fire zone that he was proud to be a west coaster because of the way the entire Peninsula had mobilised to help in the recent horror of and subsequent clean up from the bushfires. There is no doubt the Peninsula has rallied to support its own, that is a west coast tradition. However, what has heartened people even more has been the other individuals, groups and businesses from all over Australia that have poured their support into LEP over recent weeks.

Well, we've been at it again (just like rabbits!) and here are your 2004 results from all around the upper EP traps. We have SAGIT and GRDC to thank for sponsoring this 2004 edition, so when you have the opportunity, pass your appreciation on to these two funding bodies – you would be surprised what an impact that has when we turn up there for funding again another day!

There have been changes aplenty at the Minnipa Ag Centre over recent months, due to a review of the Centre and subsequent succession plans and project changes. I won't bore you with the details here, but I'm sure a few familiar faces with different hats on will be crossing your path during the year to come.

As you will note somewhere in this book, the Minnipa Research Foundation has changed it's role and it's name to the Eyre Peninsula Agricultural Research Foundation (EPARF). The Chairman of this new body is Rowan Ramsey from Buckleboo. I'll take this opportunity to thank Paul "Charlie" Kaden for his amazing energy and leadership as Chairman of the previous foundation over the past five years. Paul will still be on the EPARF committee and a key support for the new EP Grain & Graze project – succession planning at it's best!

Well I have to admit that I've had very little to do with the EPFS book this year – a result of a change in jobs. Mandy Cook (the new EPFS Project Manager) and Greg Secomb (Field Crop Consultant from Streaky Bay) have shouldered the load. At times they have felt the deadlines creeping up behind them like a pair of Fish's speedos, but on the whole they have appreciated it for the relaxing experience that it is!

I raise my Friday night can of brown bubbly stuff to you all and the excellent season that we all expect and deserve!

Cheers

Sam Doudle

Leader, Minnipa Ag Centre & the EPFS & Minnipa Ag Centre Teams

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Eyre Peninsula Agricultural Research Foundation (EPARF)

Geoff Thomas, Executive Officer, EPARF

EPARF
EYRE PENINSULA
Agricultural Research Foundation

Background

The management of the Minnipa Agricultural Centre has revolved around the input from two overseeing bodies. The Minnipa Agricultural Foundation, which has essentially been the fund raising arm of the Centre and the MAC Committee that had an advisory role in the running of the Centre.

In 2004 the Minnipa Agricultural Centre Committee and Minnipa Agricultural Foundation were subject to a review to enable the Centre to better position itself for the future of agricultural research on the Eyre Peninsula.

As a result the Eyre Peninsula Agricultural Research Foundation (EPARF) was formed to unite the activities of the Committee and Foundation into the one body.

What is the role of EPARF?

The main role of EPARF is to actively promote the needs and benefits of a concentrated research program on Eyre Peninsula, to attract adequate resources to undertake the programs and in doing so broaden the funding base for those, so as to ensure their security.

Why the change and what are the benefits?

- As an incorporated body the Foundation now offers a more robust legal and commercial entity with which our partners can do business. This has been an important step forward to adapt to an environment where research and extension are taking a more commercial focus.
- The new Foundation now represents the entire Eyre Peninsula, rather than just concentrating on the northern areas. It will ensure that the views of farmers and the broader agricultural community continue to be an essential part of the research and extension activities in the future.
- As a member of the Low Rainfall Collaboration Group, the Foundation will contribute to National Low Rainfall Farming Systems research and extension programs. In turn, the Foundation will have access to the good work being done by other Farming Systems groups and provide the results to local farmers.
- A Strategic Alliance has been put in place to consolidate the working relationships between the new Foundation, the South Australian Research and Development Institute and the University of Adelaide. This will provide greater security in the future availability of infrastructure, ensures that there is scientific rigor in all that we do and diversifies our funding opportunities.
- The alliance also ensures a close link with the Farm Systems Program at Roseworthy Campus and with the Sustainable Agriculture initiatives at SARDI.

2004 In Review – Achievements and Highlights:

2004 Field Day

The Eyre Peninsula Sowing Systems Field day held in August was again well supported by farmers, members and sponsors. With both days booked out (120 people each day) it goes to show there is strong support for these specialized Focus Field days. We again thank our sponsors for their support.

Major Sponsors

- Pringles Ag Plus
- Ramsey Brothers
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- GRDC
- Rabobank

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- Bank SA

Other Highlights

- We were successful in gaining funding from SAGIT to support 50 % of the publication of this book.
- EPARF supported MAC in the successful development of the EP Grain & Graze project and the ongoing development of the new EPFS project.
- EPARF supported the alterations to improve the low rainfall farming systems collaboration group (See section 11).

Outgoing Sponsors

EPARF would like to recognize the outstanding sponsorship contribution from;

- SACBH/AusBulk/UGH over the past five years. These companies sponsored the EPFS book and newsletters.
- Beeline over the past three years. The Beeline satellite navigation system allowed the MAC farm to develop CT systems to within 2 cm accuracy.

Membership

Membership of the Foundation is by annual subscription, currently $100 for the first person and $50.00 for each extra person with in that farm business. There is also provision for corporate members and life membership for those deemed to have made an outstanding contribution to agriculture on Eyre Peninsula. A comprehensive package of benefits is provided for members.

The Foundation Board members are:

- Rowan Ramsey
  Chair
  Farmer Buckleboo
- Paul Kaden
  Farmer; Cowell
- Bruce Heddle
  Farmer; Minnipa
- Peter Kuhlmann
  Farmer, Mudamuckla
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  University of Adelaide
- Dr Peter Gibson
  Chief Plant Scientist; SARDI
- John Masters
  Farmer; Arno Bay
- Ed Hunt
  Farmer & Consultant; Port Neill

The Board is keen to broaden its membership base and to increase the value to members with an improved package of benefits. Members not only benefit directly but they also have the satisfaction of knowing that they are supporting an organization established specifically to look after the interests of Eyre Peninsula.

The year ahead

- With the current funding for the EPFS project due to conclude in June 2005, MAC staff and EPARF representatives have been working to secure the continuation of this project for a second term.
- The EPARF Field Day will be on again in August with a focus on crop breeding (more details to come soon).
- A new proposal is being developed to further the CT on the MAC farm and other farms on the EP.

Members of the Minnipa Research Foundation

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Longmire	Jeffery & Caroline	Lock
Lymn	Alan	Wudinna

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O'Brien	Sean	Kyancutta
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Oswald	Clint	Yaninee
Oswald	Dean	Wudinna
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Pearce	Kym	Cleve
Penfold	Liz	Port Lincoln
Petterson	Simon	Streaky Bay
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Phillis	Rob	Whyalla Playford
Phillis	Lucien	Whyalla Playford
Polkinghorne	Peter	Penong
Polkinghorne	Andrew & Jenny	Lock
Pope	Mark	Warramboo
Pope	Lindsay	Warramboo
Priess	Kevin L	Arno Bay
Prime	Peter	Wharminda
Prime	Andrew	Wharminda
Prime	Christopher	Wharminda
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Ranford	Ben	Cleve
Rayson	Peter	Kimba

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Weiss	Darren	Cleve
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2004 Eyre Peninsula season summary

Greg Secomb, Jeff Braun, Kieran Wauchope

Rural Solutions SA, Streaky Bay, Port Lincoln, Cleve.

Western Eyre Peninsula

2004 was again such a variable year for grain growers on the Western Eyre Peninsula.

- Opening rains were patchy across the district. Areas around Nundroo received good opening rains at the end of April and commenced sowing at that time. Many other districts still had to wait until early to mid June to get sufficient moisture to get the crop in the ground.
- Marginal moisture was experienced during June, July and most of August. *Rhizoctonia* was present in many crops across the whole district.
- Good widespread rains during late August and early September set crops up very well and the district was looking excellent.
- The rains and subsequent weather were also ideal and conducive to a Stripe Rust epidemic that gripped a large area - predominantly in an area from Penong to Poochera. More than 100,000 hectares of wheat was treated with fungicide during the month of September. This was the first time that the use of fungicide had been used in such a wide scale to treat a disease epidemic in this district.
- While this was all happening there was no significant rainfall event from mid September until early November. Combined with some severe hot and windy conditions during October yield potential quickly declined.
- Overall, districts in the Far West fared well with average to above average yields while in the Central and Upper inland areas yields were below average for many growers.

Lower Eyre Peninsula

- A relatively early break in the higher rainfall zones allowed for the early sowing of canola.
- The season broke much later for areas around Tumby Bay and Port Neill. This put crops on the back foot right from start.
- Winter rainfall was adequate in most areas allowing later sown crops to catch up. The prospect of achieving average yields for the season was likely by the end of August.
- However, lack of rain and low subsoil moisture levels combined with hot weather in spring led to reduced yield potentials in all crops. Crops grown on heavier soil types in the wetter areas tended to hold on better during the hot October conditions and didn't suffer the same degree of damage.
- High numbers of Heliothis caused problems in canola and pulse crops in late spring.
- Rain and cool conditions during December delayed the completion of harvest by a week or two.

Eastern Eyre Peninsula

2004 provided a season that seemed to go from bad to worse for most farmers on the Eastern Eyre Peninsula. A late start to the season followed by damaging heat and winds left farmers with potential of achieving, at best, below average yields. Many farmers considered 2004 to be the worst season in 30 years.

- There was no significant summer rainfall leading up to the 2004 season, and Your Soils Potential soil tests confirmed little to no subsoil moisture.
- First month of significant rainfall was June, allowing farmers to begin sowing into wet top soil, others had already began sowing dry in late May early June. Later crops were sown at the end of July, mainly to get cover on worked soil. The area sown in the district was reduced as a result of the late break, with some farmers not sowing any crop.
- With a late start forcing seedlings to emerge in cold soils, plants were weak and many suffered the effects of *Rhizoctonia* and *Pratylenchus*.
- Variable rainfall across the region in September, with warm to hot windy days drying soil when moisture was already limited. The 12th of October dealt the final blow with a hot (40°C) northerly winds (83 km/hr) causing further yield losses.
- Cutworm, Southern Armyworm and Brown Pasture Looper all caused some trouble, many farmers enduring the extra cost and spraying, some just doing border sprays in paddocks with neighboring pastures.
- There was significant variation between different regions in regards to grain yields and quality. Barley averaged between 2-3 bags with some reports of 7 bags/acre on lighter soils. Protein was generally high and retention too low, resulting in most crops going Feed 2,3 and 4.
- Wheat was of good quality with high protein but yields considerably lower than average, generally 2-3 bags/acre. Small grain was prevalent and a many paddocks not harvested due to crop failure.
- Peas yields were reported to be in the 2-3 bags/acre range. Canola that was harvested averaged between 250-450 kg/ha and had a lower than normal oil content.
- Stock prices again high for breeding stock and prime lambs. Feed growth was restricted due to low rainfall, no hay cut and some hand feeding occurred. Stock numbers were below district average due to more intensive cropping and the high price of breeding stock. Several properties off-loaded any surplus stock early in the season.

There was no subsoil moisture and recordings of only a decile 2-3 rainfall. However, rainfall did vary across this wide region, with small pockets recording a decile 5-6 season. The damage caused by the heat and wind on the 12th of October was the single worst event seen for many years. This reduced yields, lowered grain weight and increased screenings, which when combined with low grain prices, impacted severely on the farmer's bottom line.

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, the differences between means are compared to see whether they 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 different results 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*.

TREATMENT	GRAIN YIELD (t/ha)
Control	1.32 a
Fertiliser 1	1.51 a,b
Fertiliser 2	1.47 a,b
Fertiliser 3	1.70 b
Significant treatment difference	P … 0.05
LSD (P=0.05)	0.33

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

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. And the three fertiliser treatments 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 unreplicated 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 trial programs to validate.

The bottom line with unreplicated 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, keep the following points in mind:

- Choose your test site carefully so it is as uniform as possible and representative - yield maps will help, if available.
- Plan and identify what sort of treatments you wish to investigate and their possible effects. Don't go overboard with 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 area which is completely even for everything, then run your strips in a direction 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 strips will have part of their length on the flat, part on the mid slope and part at the top of the rise. This is much better than running the strips across the slope, which may mean that your control ends up on the sandy soil at the top of the rise and your treatment on the heavy flat. This would make a direct comparison very tricky.
- Record treatment details 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 interpretting the results.

More comprehensive guidelines for setting up on-farm trials are provided in the publication "A manual for broad scale on-farm testing", available from MAC and PIRSA district offices.

Types of Work in this Publication

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

Type of Work	Replication	Size	Work conducted by	How analysed
Demo	No	Normally large plots or paddock strips	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 & Researchers	Usually summary of research results
Information	n/a	n/a	n/a	n/a

Some Useful Conversions

Area
1 ha (hectare) = 10,000 m2 (square 100 m by 100 m)
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
1 bar = 100 kPa (kiloPascals) = 14.5 psi (pounds per sq inch)

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

Working with Product Concentrations

Brendan Frischke

SARDI, Minnipa Agricultural Centre

Concentration

Active ingredients or quantity of a particular element can be specified as:

w/w – weight per total weight

w/v – weight per total volume

v/v – volume per total volume

Weight and volume units are specified and can be imperial or metric. Concentrations can also be expressed in the same way as a percentage but has no units, i.e. % w/w.

Here are some examples:

Glyphosate 450 g/L	(w/v or weight/volume)
Diuron 900 g/kg	(w/w)
UAN 32%	(%w/v) – As it is in Australia
UAN 32%	(%w/w) – As it is in North America

Note that the above two UAN products have different concentration; the North American product has more nitrogen per litre.

Some medicines and household chemicals use (v/v) or (%v/v).

Concentrations in w/w can be converted to %w/w simply dividing the active weight by the total weight and multiplying by 100, both weights need to be in the same units.

Example:

Diuron 900 g/kg = (900/1000)*100 = 90% w/w

Concentrations in w/v are converted to %w/v by dividing the concentration in g/L by 10 (1% w/v = 10g/L).

Example:

Glyphosate 450 g/L = 45% w/v

In Practice

The units required are best decided by the application rate and how the product is to be measured. For instance, you may want to apply 15 kg N/ha from UAN and will measure it using a flow meter and apply a metered volume (i.e. Litres) per hectare. In this case the best units are w/v. Alternatively, for some reason a batch-mixing tank may be used mounted on load cells (cattle scales), here w/w would be needed to know the exact quantity of elemental product in the tank. Sometimes product concentrations are specified in %w/w but you require it in %w/v or vice versa and conversion is required. Phosphoric acid is a good example, which is specified in %w/w, but in the field is measured in litres and applied using litres/ha, %w/v is required.

Converting Units: The first thing you need to know is the specific gravity, which units the product concentration are specified in and the units required.

Specific gravity describes the density of a substance relative to water. Water has a density of 1kg per 1 litre and a specific gravity of 1 (SG = 1). For a substance with a specific gravity of 1.32, 1 litre weights 1.32 kg (or 1 kg of substance has a volume of 1/1.32 = 0.758 L).

Using UAN as an example:

w/v to w/w

Convert UAN 32% w/v (as it is in Australia) to w/w

32% w/v = 320 g/L = 0.32 kg/L = 32 kg/100L

A% w/v = (A/SG)% w/w

Specific gravity = 1.28

32% w/v = (32/1.28) % w/w = 25% w/w = 0.25 kg/kg

w/w to w/v

Convert UAN 32% w/w (as it is in North America) to w/v

32% w/w = 320 g/kg = 0.32 kg/kg

B% w/w = (B*SG)% w/v

Specific gravity = 1.3

32% w/w = (32*1.3) % w/v = 41.6% w/v = 416 g/L = 41.6 kg/100L

Grains Research & Development Corporation

The GRDC is proud to have been a major investor in Eyre Peninsula Farming Systems since 1998. During that time the positive collaboration between SA Government, industry, grain growers, The University of Adelaide and the GRDC have delivered significant outcomes for the industry on Eyre Peninsula.

Many of the technical outcomes of validating and integrating new technology into Eyre Peninsula farming systems have been highlighted in the Summary publications.

Better integration of pastures into cropping systems, improved nitrogen management and the use of fluid fertilisers to name of few, all assist to make growers more profitable. But in my view, by far and away the most important outcome for the GRDC has been the increased ability of Eyre Peninsula growers to pull together information from a range of sources to address the big issues of on-farm profitability, especially during drought. In short, Eyre Peninsula growers are better risk managers in 2005 then they were in 1998.

The Hassall's Review of our GRDC investments through grower groups really highlighted that Eyre Peninsula Farming Systems increased the rate of information flow across the Eyre Peninsula. The benefits of better rotations, better nutrient management and better risk management have been shared more fully. What makes these outcomes so special is the large number of properties and the large area of cropping that the work is relevant to right across the Peninsula.

In this issue the summaries of the 2004 season again make essential reading for all involved with agriculture on the EP. The nutrition section is packed with the latest information on fluid fertilisers that reflects the leading edge work being done at the MAC. Also, with root diseases being a major problem across the region, there is also a wealth of information in terms of break crops, rotations and disease management. I am sure that every farmer can draw on the information presented in this year's summary to add value to their farming business.

My congratulations go to Sam Doudle in her new role as leader of the Minnipa Agricultural Centre. The success of Eyre Peninsula Farming Systems has in large part been due to her enthusiasm and drive.

In recent discussions with the GRDC it is clear that Eyre Peninsula Farming Systems is developing a robust strategic plan to deliver benefits to the majority of growers managing the majority of land on Eyre Peninsula. The Genius Day was a resounding success where experts from around the country gathered together to think through some of the key issues on the Eyre Peninsula. A major focus for the future coming out of the genius day is on increasing the water limited yield of the crops grown; managing and removing the constraints that prevent crops utilising all the water available in the rooting zone.

The GRDC looks forward to a continued partnership on the Eyre Peninsula to develop more profitable and sustainable systems that produce grain that meets and exceeds market expectations.

Martin Blumenthal

Program Manager – Sustainable Farming Systems

GRDC

Section 1

Section editor: Neil Cordon

SARDI, Minnipa Agricultural Centre

Cereals

2004 showed considerable climatic variation across the Eyre Peninsula. Districts on Eastern EP struggled for moisture all year, whilst other areas had the potential at the beginning of September for a record harvest. With almost no rainfall from the first week of September to the first week of November, together with hot and windy weather, yields were dramatically reduced. The total production figures for EP were approximately 905,000 tonnes of wheat, 400,000 tonnes of barley, 20,000 tonnes of oats and 10,000 tonnes of triticale.

Cereal Variety Performance, 2004

SAFCEP Triticale Variety Yield Performance at Eyre Peninsula Sites

2004 and long term (1998-2004) yields expressed as a % of Tahara's yield.

Variety	2004				7 year average (1998 - 2004)		
	Greenpatch	Minnipa	Streaky Bay	Wharminda	Greenpatch	Minnipa	Wharminda
Abacus					89	80	77
Everest	94	110	101	93	99	103	100
Kosciuszko	96	111	96	102	104	113	113
Speedee	94	105	99	113	104	109	109
Tahara	100	100	100	100	100	100	100
Tickit	99	98	96	103	100	104	107
Treat	101	107	103	101	99	102	103
Tahara's yield (t/ha)	**3.11**	**0.54**	**1.05**	**0.59**	**3.19**	**1.41**	**1.36**
Date sown	26-May	15-Jun	5-Jun	17-Jun			
Soil type	LS/CS	LiSCL/SCL	SL/LS	S/SC			
pH (water)	5.8	8.3	8.5	7.0			
Apr-Oct rain (mm)	390	223	268	129			
Site stress factors		de, dl	de, w, rh	de, dl, pe			

Soil type S = sand, C = clay, L = loam, H = heavy, M = medium, Li = light, / = over • Site stress factors - b=boron, c=cereal eelworm, de=pre-flowering moisture stress, dl=post flowering moisture stress, lb=late break (late sown), lr=leaf rust, ns=spot form net blotch, pe=poor emergence, s=stripe rust, sc=scald, rh=rhizoctonia, ys=yellow spot, w=weeds. • Data source: SAFCEP, REML analysis. Long term data based on weighted analysis of sites, Biometrics SA. • More information: Rob Wheeler 08 8303 9480 or e-mail wheeler.rob@saugov.sa.gov.au, Sue Hoppo 08 8303 9386 or e-mail hoppo.sue@saugov.sa.gov.au, Richard Saunders 08 8595 9152 or e-mail saunders.richardj@saugov.sa.gov.au

SAFCEP Wheat Variety Yield Performance at Eyre Peninsula Sites

2004 and long term (1998-2004) yields expressed as a % of Frame's yield.

Variety	Upper, Eastern and Western Eyre Peninsula																Mid and Lower Eyre Peninsula					
	2004								7 year average (1998-2004)								2004			7 year average (1998-2004)		
	Kalanbi	Kimba	Minn-ipa	Mitche-llville	Nunji-kompita	Pen-ong	Streaky Bay	Warr-amboo	Kalanbi	Kimba	Minn-ipa	Mitche-llville	Nunji-kompita	Pen-ong	Streaky Bay	Warr-amboo	Cum-mins	Lock	Ung-arra	Cum-mins	Lock	Ung-arra
Annuello	128	94	182	81	102	101	79	101	108	102	104	105	100	105	97	100	105	182	100	102	99	103
Camm									113	109	114	109	105	106	104	107				103	106	105
Castle Rock	115	115	192	114	103	93	83	99									98	203	92			
Chara	101	48	131	80	100	92	96	91	98	90	92	96	96	98	94	93	103	150	93	100	94	98
Clearfield JNZ	124	77	175	92	95	95	77	93									98	143	96			
Combat	121	95	198	124	98	97	81	93									103	211	94			
Drysdale	117	113	163	167	95	82	95	100	99	100	104	101	95	100	97	101	101	209	81	102	99	99
Excalibur	128	145	200	209	111	104	114	124	106	108	110	110	106	110	106	109	100	237	99	103	107	104
Frame	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
H45	123	161	253	142	111	99	85	120	109	108	110	111	101	106	98	108	122	277	103	105	105	103
Janz	120	84	180	113	98	93	84	95	100	95	99	100	92	98	90	95	95	192	98	98	96	100
Krichauff	133	152	209	142	109	109	108	117	117	110	114	113	106	110	106	109	112	243	97	104	108	104
Kukri	114	126	152	181	94	91	96	94	91	96	97	98	90	95	91	94	100	174	90	97	97	97
Pugsley	113	112	144	127	101	99	90	113	116	109	116	110	110	111	108	111	105	173	105	104	108	106
RAC1055	128	137	197	169	111	100	90	106	116	110	116	112	109	112	106	111	105	232	95	106	108	105
Ruby	128	143	226	143	106	99	107	115									110	245	91			
Sapphire	127	95	185	101	101	102	83	93	106	102	105	106	100	105	96	102	105	201	94	102	101	103
Shenton	129	89	158	60	102	100	107	113									105	148	92			
Ventura	122	135	139	108	101	83	96	101									94	130	92			
Eagle Rock	103	78	152	123	95	89	83	90									107	207	85			
Wyalkatchem	140	116	224	196	112	107	110	119	121	116	118	116	111	114	110	115	118	251	102	110	112	107
Yitpi	113	103	124	115	107	109	97	109	108	107	111	106	105	106	105	107	106	135	104	103	104	103
Frame's yield (t/ha)	**1.07**	**0.25**	**0.42**	**0.23**	**1.31**	**1.54**	**1.03**	**0.91**	**0.80**	**1.46**	**1.06**	**1.51**	**1.13**	**1.40**	**1.31**	**1.62**	**3.09**	**0.29**	**3.56**	**3.64**	**1.97**	**3.21**
Date sown	9-Jun	21-Jun	15-Jun	29-May	9-Jun	8-Jun	5-Jun	15-Jun									10-Jun	16-Jun	15-Jun			
Soil type	LiSCL/SCL	LiSCL/SCL	LiSCL/SCL	SL/SCL	SL/SCL	LiSCL	SL/LS	SL/SCL									S/SC	LS/LC	CL/LiC			
pH (water)	8.9	8.5	8.3	8.6	8.6	8.8	8.5	8.2									6.8	6.8	8.2			
Apr-Oct rain (mm)	222	170	223	155	212	251	268	208									294	177	279			
Site stress factors	b,dl,s	de,dl,lb,w	b,de,dl,lb	b,de,dl	dl,ys	dl	dl,rh,w,ys	de,dl,lb									rh	de,dl,lb	dl			

Soil type S = sand, C = clay, L = loam, H = heavy, M = medium, Li = light, / = over • Site stress factors - b=boron, c=cereal eelworm, de=pre-flowering moisture stress, dl=post flowering moisture stress, lb=late break (late sown), lr=leaf rust, ns=spot form net blotch, pe=poor emergence, s=stripe rust, sc=scald, rh=rhizoctonia, ys=yellow spot, w=weeds. • Data source: SAFCEP, REML analysis. Long term data based on weighted analysis of sites, Biometrics SA. • More information: Rob Wheeler 08 8303 9480 or e-mail wheeler.rob@saugov.sa.gov.au, Sue Hoppo 08 8303 9386 or e-mail hoppo.sue@saugov.sa.gov.au, Richard Saunders 08 8595 9152 or e-mail saunders.richardj@saugov.sa.gov.au

SAFCEP Barley Variety Yield Performance at Eyre Peninsula Sites

2004 and long term (1998-2004) yields expressed as a % of Schooner's yield.

Variety	Upper Eyre Peninsula										Lower Eyre Peninsula			
	2004					7 year average (1998 – 2004)					2004		1998-2004	
	Elliston	Mangalo	Minnipa	Streaky Bay	Wharminda	Elliston	Mangalo	Minnipa	Streaky Bay	Wharminda	Cummins	Wanilla	Cummins	Wanilla
Barque	131	106	101	117	83	113	113	108	114	106	114	107	106	105
Baudin	98	57	86	119	103	104	105	106	110	101	105	94	103	102
Capstan	130	58	120	120	86	117	114	115	121	108	107	97	109	107
Dhow	115	69	93	106	85	102	102	102	103	91	102	104	99	97
Franklin						97	92	79	95	82			95	94
Gairdner	108	26	55	118	73	112	111	103	114	97	102	89	103	102
Keel	135	231	124	116	131	115	116	120	112	112	110	116	109	106
Maritime	108	139	76	111	91	111	120	109	114	110	117	117	108	108
Mundah						108	116	102	107	97			103	104
Schooner	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Sloop	111	91	57	105	91	103	105	99	103	98	102	95	100	100
SloopSA	111	89	80	108	100	103	106	103	105	99	100	89	101	100
SloopVic	111	65	58	110	93	102	103	95	104	98	104	85	100	98
Torrens	107	85	83	100	65	92	87	87	89	82	98	81	94	90
VB0021	119	114	95	119	103	118	117	116	118	108	115	94	109	108
WI3586/R	123	66	90	118	109	109	108	104	108	100	100	93	102	102
WI3804	129	97	79	120	76	121	118	115	122	114	121	100	112	109
Schooner's yield (t/ha)	**1.80**	**0.27**	**1.09**	**1.37**	**0.87**	**1.90**	**1.64**	**1.80**	**1.61**	**1.71**	**3.71**	**2.96**	**3.55**	**3.24**
Date sown	3-Jun	24-Jun	15-Jun	4-Jun	17-Jun						10-Jun	28-May		
Soil type	SL/LS	LS/CLS	LiSCL/SCL	LS	S/SC						S/LiSC	S/CS		
pH (water)	8.4	7.3	8.3	8.6	7.0						7.3	7.6		
Apr-Oct rain (mm)	306	174	223	251	129						294	357		
Site stress factors	c,ns,r	de,dl,lb	b,de,dl,sc	de,dl,lr,rh	de,dl,lb,ns,rh						ns,sc	hl,rh,w		

Soil type S = sand, C = clay, L = loam, H = heavy, M = medium, Li = light, / = over • Site stress factors - b=boron, c=cereal eelworm, de=pre-flowering moisture stress, dl=post flowering moisture stress, lb=late break (late sown), lr=leaf rust, ns=spot form net blotch, pe=poor emergence, s=stripe rust, sc=scald, rh=rhizoctonia, ys=yellow spot, w=weeds. • Data source: SAFCEP, REML analysis. Long term data based on weighted analysis of sites, Biometrics SA. • More information: Rob Wheeler 08 8303 9480 or e-mail wheeler.rob@saugov.sa.gov.au, Sue Hoppo 08 8303 9386 or e-mail hoppo.sue@saugov.sa.gov.au, Richard Saunders 08 8595 9152 or e-mail saunders.richardj@saugov.sa.gov.au

SAFCEP Oat Variety Grain Yield Performance at Eyre Peninsula Sites

2004 and long term (1998-2004) yields expressed as a % of Echidna's yield.

Variety	2004			7 year average (1998 - 2004)			
	Minnipa	Nunjikompita	Greenpatch	Minnipa	Nunjikompita	Greenpatch	Wanilla
Dalyup	104	94	104	94	90	97	
Echidna	100	100	100	100	100	100	100
Euro	140	94	102	89	80	92	91
Mitika	180	109	127	108	104	105	102
Mortlock	106	70	99	79	65	90	87
Numbat	24			54	35	76	69
Possum	169	104	116	104	99	104	99
Potoroo	129	106	103	100	100	103	101
Quoll	123	99	93	103	103	100	101
Echidna's yield t/ha	**0.48**	**1.30**	**2.88**	**1.62**	**1.19**	**3.20**	**3.04**
Date sown	15-Jun	9-Jun	26-May				
Soil type	LiSCL/SCL	SL/SCL	LS/CS				
pH (water)	8.3	8.6	5.8				
Apr-Oct rain (mm)	223	212	390				
Site stress factors	b,de,dl	dl	dl				

Soil type S = sand, C = clay, L = loam, H = heavy, M = medium, Li = light, / = over • Site stress factors - b=boron, c=cereal eelworm, de=pre-flowering moisture stress, dl=post flowering moisture stress, lb=late break (late sown), lr=leaf rust, ns=spot form net blotch, pe=poor emergence, s=stripe rust, sc=scald, rh=rhizoctonia, ys=yellow spot, w=weeds. • Data source: SAFCEP, REML analysis. Long term data based on weighted analysis of sites, Biometrics SA. • More information: Rob Wheeler 08 8303 9480 or e-mail wheeler.rob@saugov.sa.gov.au, Sue Hoppo 08 8303 9386 or e-mail hoppo.sue@saugov.sa.gov.au, Richard Saunders 08 8595 9152 or e-mail saunders.richardj@saugov.sa.gov.au

SAFCEP Oat Variety Hay Yield Performance at Eyre Peninsula Sites

2004 and long term (1998-2004) yields expressed as a % of Marloo's yield.

Variety	2004		7 year ave. (1998 - 2004)	
	Greenpatch	Minnipa	Greenpatch	Minnipa
Bettong		98	101	101
Brusher	107	116	107	110
Eurabbie	123	93	104	98
Glider	112	83	105	98
Kangaroo	121	104	110	109
Marloo	100	100	100	100
Swan	107	97	97	103
Wallaroo	128	115	109	106
Wintaroo	131	128	111	113
Marloo's yield t/ha	10.30	3.50	11.00	3.30
Date sown	26-May	15-June		
Soil type	LS/CS	LiSCL/SCL		
pH (water)	5.8	8.3		
Apr-Oct rain (mm)	390	223		
Site stress factors	dl	b,dl,lb		

Soil type S = sand, C = clay, L = loam, H = heavy, M = medium, Li = light, / = over • Site stress factors - b=boron, c=cereal eelworm, de=pre-flowering moisture stress, dl=post flowering moisture stress, lb=late break (late sown), lr=leaf rust, ns=spot form net blotch, pe=poor emergence, s=stripe rust, sc=scald, rh=rhizoctonia, ys=yellow spot, w=weeds. • Data source: SAFCEP, REML analysis. Long term data based on weighted analysis of sites, Biometrics SA. • More information: Rob Wheeler 08 8303 9480 or e-mail wheeler.rob@saugov.sa.gov.au, Sue Hoppo 08 8303 9386 or e-mail hoppo.sue@saugov.sa.gov.au, Richard Saunders 08 8595 9152 or e-mail saunders.richardj@saugov.sa.gov.au

Franklin Harbour wheat trial

Demo

Neil Cordon

SARDI, Minnipa Agricultural Centre

Key Messages

- **Little yield difference between the varieties identifies the need to evaluate other characteristics before changing varieties.**
- **There is no strong evidence to change from the established varieties (e.g. Frame, Yitpi, Krichauff and Wyalkatchem) to the newer interstate wheats (e.g. Drysdale and Rees).**

Why do the trial?

The aim of the trial is to evaluate the performance of selected wheat varieties in a different environment (rainfall and soil type) to the Cowell Stage 4 wheat site.

How was it done?

Treatments: Eleven commercially available wheat lines were sown in single demonstration strips.

Measurements: grain yield, grain quality and gross income.

Sowing date: 25th June 2004

Sowing rate: 65kg/ha

Fertiliser: 18:20:0 Zn 2.5 % @ 70kg/ha

What happened?

Well below average rainfall coupled with dry, hot, windy weather during October produced tough conditions for crop growth and grain production. Varieties yielded up to 72% of the potential with delayed sowing and weather events severely limiting yields (*Table 1*).

It is difficult to draw conclusions from this demonstration as the top eight varieties all yielded similarly.

What does this mean?

The performance of the varieties in this demonstration should be evaluated in conjunction with the replicated cereal program at Cowell and Upper Eyre Peninsula.

Characteristics such as disease resistance, nutrient efficiency, maturity and resistance to weather damage, along with yield should also be considered when selecting varieties.

Acknowledgements

Donna Longmire, Elders, Cleve

Roger Story and Mark Turnbull for their time, machinery, land and dedication to the trial.

Try yourself

Location
Miltalie: Mark Turnbull
Franklin Harbour Ag Bureau

Rainfall
Av Annual: 390mm
Av GSR: 277mm
2004 Total: 285mm
2004 GSR: 181mm

Yield
Potential: (W) 1.54 t/ha

Paddock History
2003: Pasture
2002: Wheat
2001: Pasture

Soil Type
Reddish light clay sandy loam

Other Factors
Delayed sowing, severe moisture stress during grain development.

Table 1: Yield, grain quality and gross income of wheat at Franklin Harbour Ag Bureau site 2004.

Variety	Grade	Protein	Screenings	Test Weight	Yield	*Gross Income
		(%)	(%)	(kg/hL)	(t/ha)	($/ha)
Bonnie Rock	APW	10.2	2.6	85.4	1.08	164
Drysdale	APW	10.3	3.5	85.2	1.08	162
Rees	APW	10.2	2.3	83.6	1.06	162
Krichauff	ASW	10.6	2.7	82.2	1.08	159
Carnamah	APW	12.0	4.4	82.0	1.00	155
Sapphire	APW	10.6	1.7	84.6	0.99	153
Yitpi	AH	11.0	4.2	83.2	0.97	147
Frame	APW	12.0	2.1	85.0	0.86	138
Wyalkatchem	APW	10.9	3.2	83.6	0.89	137
Clearfield JNZ	AH	12.2	5.5	83.0	0.83	130

**Gross Income is yield x price (with quality adjustments) delivered to Port Lincoln as at 1st December 2004.*

Wheat variety evaluation on sand

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

Research

Best practice

Location
Elliston – Nigel & Debbie May

Rainfall
Av. Annual: 410 mm
Av GSR: 340 mm
2004 Total: 378 mm
2004 GSR: 306 mm

Yield
Potential: 3.9 t/ha

Paddock History
2003: Pasture
2002: Pasture
2001: Barley

Soil Type
Highly calcareous loamy sand

Plot size
1.5m x 10m x 3 replicates

Location
Wharminda - Peter Forrest & Dave Herron

Rainfall
Av. Annual: 320 mm
Av GSR: 258 mm
2004 Total: 185 mm
2004 GSR: 133 mm

Yield
Potential: 0.9 t/ha

Paddock History
2003: Barley
2002: Pasture
2001: Wheat

Soil Type
Non wetting sand over a sandy clay

Plot size
1.5m x 10m x 3 replicates

Key Messages

- **Wyalkatchem, Yitpi and Pugsley were consistently the highest yielding wheat varieties in trials on sandy soils in 2004 and in previous years.**
- **Most new varieties from interstate breeding programs (except Wyalkatchem) generally failed to demonstrate consistently good yields or grain quality characteristics in the 2004 trials on sandy soils.**
- **Disease risk should be balanced against proven yielding ability and quality grades when choosing the wheat variety mix for your farm.**

Why do the trials?

In response to interest from local Ag Bureau groups, wheat trials were established adjacent to existing Field Crop Evaluation secondary barley trial sites in the districts of Elliston, Wharminda and Wanilla. A fourth trial was established in 2004 at Mangalo to meet grower demand. The aim of these trials was to allow farmers to compare the performance of new wheats with current popular varieties on sandy soils within their districts. Previous years results have been presented in Eyre Peninsula Farming Systems annual summary books.

How was it done?

Elliston District Wheat on Sand Trial

Treatments:	9 commercial wheat varieties.
Sowing date:	June 3, 2004
Fertiliser:	All varieties received 100 kg/ha of 23:16:00, drilled with the seed, and a foliar spray of manganese.
Herbicides:	Triflur480® @ 0.8 L/ha, Sprayseed250® @ 0.8L/ha, and Ovation500® @ 0.5 L/ha. Meta® snail bait topdressed.
Measurements:	Grain yield and quality.

Wharminda District Wheat on Sand Trial

Treatments:	15 commercial wheat varieties.
Sowing date:	June 17, 2004
Fertiliser:	All varieties received 80 kg/ha of 21:16:00.
Herbicides:	RoundupMax® @ 1.0 L/ha, Triflur480® @ 1.0 L/ha, Sprayseed250® @ 1.0 L/ha, LVE MCPA @ 1.2 L/ha.
Measurements:	Grain yield and quality.

Wanilla District Wheat on Sand Trial

Treatments:	12 commercial wheat varieties.
Sowing date:	May 28, 2004
Fertiliser:	All varieties received 100 kg/ha of 18:20:00, plus 100kg/ha Urea
Herbicides:	Triflur480® @ 1.0 L/ha, Sprayseed250® @ 1.0 L/ha, RoundupMax® @ 1 L/ha, LVE MCPA @ 0.9L/ha, Dual Gold® @ 0.3 L/ha.
Measurements:	Grain yield and quality.

Mangalo District Wheat on Sand Trial

Treatments:	7 commercial wheat varieties.
Sowing date:	June 24, 2004
Fertiliser:	All varieties received 100 kg/ha of 23:16:00, plus 2.5 % Zn.
Herbicides:	RoundupMax® @ 1.0 L/ha, Triflur480® @ 1.0 L/ha, Diuron500® @ 1 L/ha, Ally® @ 5g/ha.
Measurements:	Grain yield and quality.

What happened?

All four sites experienced late opening rains and a relatively dry finish to the season. The Eastern Eyre Peninsula sites, Wharminda and Mangalo, suffered restricted moisture through most of the growing season, where as Wanilla and Elliston had minimal moisture stress, except during grain fill. *Rhizoctonia* had a moderate effect on yields at both Elliston and Wanilla. No other major problems with diseases or pests that would have affected yields were identified.

Yields were well below the French and Schultz potential at all sites in 2004, largely due to the later than optimum sowing and the hot dry spring conditions for grain fill. Across the sites in 2004, Wyalkatchem, Yitpi and Pugsley were the highest yielding varieties, which is consistent with their performance in SAFCEP trials across Eyre Peninsula. Excalibur also performed well.

Except for Wyalkatchem, none of the new varieties from interstate breeding programs have in the past shown useful

Table 1: Grain yield and quality characteristics of wheat varieties at Elliston in 2004, and grain yields relative to Yitpi, 2001 to 2004.

VARIETY	2004 YIELD t/ha		2004 QUALITY		YIELD AS % YITPI				
			Protein (%)	Screenings (%)	2001	2002	2003	2004	Average
Annuello	1.52	BC	11.8	3.8				84	84
Clearfield JNZ	1.42	CD	12.2	3.9				78	78
Drysdale	1.23	D	12.4	8.1				68	68
EGA Bonnie Rock	1.31	D	12.6	5.5				73	73
Excalibur	1.64	AB	13.2	2.8				91	91
GBA Sapphire	1.36	CD	12.2	3.8				75	75
Krichauff					87	113	92		97
Pugsley	1.73	A	12.9	3.7		90	98	96	95
Westonia					81	122			102
Wyalkatchem	1.76	A	12.3	1.3		126	112	97	112
Yitpi	1.80	A	12.0	1.8	100	100	100	100	100
Site mean	1.53		12.4	3.9					
LSD (P≤0.05)	0.27								

Table 2: Grain yield and quality characteristics of wheat varieties at Wharminda in 2004, and grain yields relative to Yitpi, 2001 to 2004.

VARIETY	2004 YIELD t/ha		2004 QUALITY		YIELD AS % YITPI				
			Protein (%)	Screenings (%)	2001	2002	2003	2004	Average
Annuello	0.49	CDE	12.7	9.0				69	69
Blade	0.58	BC	14.3	7.5	111		88	81	93
Clearfield JNZ	0.38	DE	12.4	13.4				53	53
Clearfield STL	0.61	ABC	12.7	4.7				89	89
Drysdale	0.37	E	13.6	14.6				51	51
EGA Bonnie Rock	0.61	ABC	12.4	14.4				85	85
EGA Eagle Rock	0.54	CD	14.1	6.3				75	75
Excalibur	0.63	ABC	13.1	12.3	115	99	106	88	102
GBA Sapphire	0.37	E	12.3	14.8				51	51
Krichauff	0.51	CDE	13.1	9.0	114	102	89	72	94
Pugsley	0.61	ABC	12.5	8.2	123	101	99	86	102
Trident	0.64	ABC	12.1	12.6	117	113	99	90	105
Westonia	0.61	ABC	12.5	12.4	130	106	116	86	109
Wyalkatchem	0.74	A	13.0	5.8		100	115	104	106
Yitpi	0.71	AB	12.7	5.8	100	100	100	100	100
Site mean	0.56		12.9	10.1					
LSD (P≤0.05)	0.16								

Best practice

Location
Wanilla – Graham & David Giddings

Rainfall
Av. Annual: 450 mm
Av GSR: 370 mm
2004 Total: 446 mm
2004 GSR: 358 mm

Yield
Potential: 5.0 t/ha

Paddock History
2003: Wheat
2002: Canola
2001: Pasture

Soil Type
Sand over medium clay

Plot size
1.5m x 10m x 3 replicates

Location
Mangalo - Donald Henderson

Rainfall
Av. Annual: 350 mm
Av GSR: 280 mm
2004 Total: 245 mm
2004 GSR: 174 mm

Yield
Potential: 1.5 t/ha

Paddock History
2003: Pasture
2002: Pasture
2001: Wheat

Soil Type
Loamy sand over a sandy clay loam

Plot size
1.5m x 10m x 3 replicates

adaptation to these soil types and environments, especially in 2004. Annuello, EGA Bonnie Rock, EGA Eagle Rock, GBA Sapphire, Clearfield JNZ, Clearfield STL and Drysdale all yielded well below Wyalkatchem, Yitpi and Pugsley, and appeared particularly poor at handling the hard finishing conditions of 2004. The claim for Drysdale as a “drought tolerant” variety is not apparent, for these environments at least.

Grain protein and screenings levels were generally acceptable at all four sites in 2004. Proteins were on the low side at Wanilla (average of 10.9 %) as could be expected following wheat in 2003, and high at Mangalo (average of 17.5 %) due to the extreme dry spring conditions and low yields. Yitpi achieved slightly below the average protein at all three sites. Average screenings levels were low (3 - 4 %) at all sites except Wharminda (10 %). Large differences in screenings levels were observed between varieties especially at Wharminda where Clearfield STL had 4.7 % screenings while GBA Sapphire reached 14.8 %. Yitpi, Wyalkatchem and Pugsley all produced grain screenings lower than the average at each site. Again many of the new varieties from interstate failed poorly on screenings levels.

Table 3: Grain yield and quality characteristics of wheat varieties at Wanilla in 2004, and grain yields relative to Yitpi, 2003 to 2004.

VARIETY	2004 YIELD t/ha		2004 QUALITY Protein (%)	Screenings (%)	YIELD AS % YITPI 2003	2004	Average
Annuello	1.97	DE	10.8	4.6	108	68	88
Clearfield JNZ	2.03	CDE	10.8	3.2		71	71
Clearfield STL	2.67	AB	10.6	1.9		93	93
Drysdale	1.59	E	11.7	5.7		55	55
EGA Bonnie Rock	2.47	BCD	11.3	2.1	112	86	99
Excalibur	2.61	AB	11.0	2.9	108	91	100
GBA Sapphire	1.81	E	11.1	3.4		63	63
Krichauff	2.46	BCD	11.1	2.6	98	86	92
Pugsley	3.04	A	10.3	1.1	96	106	101
Westonia	2.50	BC	10.8	2.6	122	87	105
Wyalkatchem	2.91	AB	11.0	1.3	134	101	118
Yitpi	2.88	AB	10.7	2.0	100	100	100
Site mean	2.41		10.9	2.8			
LSD (P≤0.05)	0.53						

Table 4: Grain yield and quality characteristics of wheat varieties at Mangalo in 2004

Variety	2004 YIELD t/ha		% Yitpi	2004 QUALITY Protein (%)	Screenings (%)
Drysdale	0.22	BC	77	17.5	3.8
EGA Bonnie Rock	0.36	A	125	16.8	4.8
Frame	0.29	AB	100	17.3	2.9
Janz	0.16	CD	54	17.1	3.3
Pugsley	0.31	AB	108	17.9	2.9
Rees	0.15	D	51	17.7	3.9
Wyalkatchem	0.29	AB	99	18.2	2.5
Site mean	0.25			17.5	3.4
LSD (P≤0.05)	0.09				

What does this mean?

Stripe and stem rusts, posed a major threat to crops on Eyre Peninsula during 2004. With the emergence of new strains breaking down the resistance of many current varieties, rusts can be expected to pose an on-going heightened risk. Growers therefore need to balance the yield advantages of varieties such as Wyalkatchem, Yitpi and Pugsley against their respective disease risks. Wyalkatchem in particular is susceptible to a new strain of stem rust identified in WA in 2003 which is likely to arrive in our region at some stage. It is also susceptible to the stripe rust strains. Yitpi's major weakness is susceptibility to stem rust, while Pugsley has moderate resistance to all rusts except the WA stem rust and the 'older' stripe rust strain (VPM). Spreading the risks through a considered mix of wheat varieties is a sound strategy.

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Barley breeding for the low rainfall environments

Research

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SARDI, Minnipa Agricultural Centre[2]

Key Messages

- **Yield and physical grain quality is reduced by constraints limiting the use of current rainfall.**
- **Breeding for avoidance or tolerance to constraints improves moisture availability.**
- **Newly developed South Australian feed varieties have superior adaptation to a range of moisture environments.**
- **Specific adaptation to low rainfall environments has been identified using ICARDA lines.**
- **Australian x ICARDA crosses will combine adaptive features and traits from both gene pools.**
- **Alternative genetic sources of adaptation remain to be exploited to tackle our hostile environments.**

Why do the trial?

Moisture supply and demand imbalance during crop growth reduces the formation of yield and physical grain quality, and defines drought stress in the context of productivity. Varying intensity of drought stress can occur at different stages of growth, but becomes more frequent and intense towards maturity and in lower rainfall zones. In the environments of southern Australia, yield potential is dependant on growing season rainfall (GSR) with minimal stored moisture contribution from out-of-season rainfall events. In the low rainfall environments (<250mm GSR) the yield potential of barley is less than 3.2t/ha, however this is not achieved even if appropriate management is implemented since additional environmental constraints limit moisture availability. The soils of the EP are quite hostile, and in the background of low moisture availability makes barley production challenging. Equally challenging is breeding for improved adaptation to these low rainfall environments with hostile soils.

The University of Adelaide is collaborating with ICARDA (International Centre for Agricultural Research in the Dry Areas) in Syria under a GRDC supported research grant to produce barley that is better adapted to the low rainfall environments of Australia. This partnership with ICARDA has allowed the exchange and evaluation of barley lines in the low rainfall environments of Australia and the Middle East. ICARDA have utilised wild barley and primitive land races to improve drought tolerance and adaptation to soils of low fertility, and have selected types that are high yielding under severe drought stress. Barley from ICARDA offers a unique and genetically different source of adaptation to the low rainfall environments and the potential to increase the yield per millimitre of rainfall of Australian barley.

How was it done?

The collaborative project with ICARDA was initiated in 1999 with ICARDA barley breeders and introductions were evaluated in low rainfall environments in South Australia between 1999-2001 (*see FS1999 pg 15, FS2000 pg 15-16, FS2001 pg 29-30, FS2002 pg 28-29*). During 2002-2004 (*see FS2003 pg 24-26*) a national low rainfall trial network was established to include South Australia (MAC and Pt. Wakefield), Western Australia, Victoria, New South Wales, and Queensland. This has enabled a national focus on the usefulness of ICARDA germplasm for the benefit of Australian breeding programs and grain growers. These are pre-breeding trials in which introductions are eliminated from trials and replaced with new introductions if they have poor performance based on yield, physical grain quality, and adaptation defects. The purpose of these trials is to:

1. Identify ICARDA barley with superior performance across a range of low rainfall environments.
2. Evaluate elite Australian breeding lines in low rainfall environments.
3. Conduct a genetics analysis of drought tolerance.

What happened?

A number of ICARDA lines with yield and physical grain characteristics equivalent to Australian elite breeding lines and cultivars have been identified. From a large number of ICARDA and Australian barleys evaluated in multiple low rainfall environments in Australia, a subset of the best types is presented in *Figure 1*. Australian and ICARDA barleys with stable yield (environment effect equals zero) plus high yield (positive yield effect) are desirable types. General conclusions from the analysis are that the majority of Australian barley (particularly malting types) shows adaptation to higher yielding environments and that most ICARDA barleys have specific adaptation to low yielding environments. This indicates ICARDA barleys are an excellent source of adaptation to drought stressed environments in Australia, which is a significant result considering most straight introductions from other origins perform relatively poorly, especially in low rainfall environments. The ICARDA barleys on *Figure 1* have excellent yield and physical grain characteristics equivalent to elite Australian breeding lines and cultivars. These ICARDA barleys have been crossed with current Australian cultivars and breeder's lines with the aim of developing the next generation of Australian barley varieties adapted to the low rainfall environments. Approximately 100 crosses have been made to date, and the initial lines developed from these crosses will be promoted to advanced testing across southern Australia by the SA Barley Improvement Program, in addition to testing in dedicated low rainfall trials in 2005.

Benchmarking current varieties and advanced lines from each of Australia's breeding programs against ICARDA germplasm in dedicated low rainfall yield trials has highlighted the superior adaptation and yield of some Australian lines. The

CCN/Net Blotch resistant feed barley Keel (indicated by ■ in the graph), released by the SA Barley Improvement Program in 1999, possesses the highest yield and best adaptation to low rainfall environments. The analysis has also highlighted the superior adaptation and yield of the breeders' lines WI3804 (▲) and WI3806 (◆) derived from a Mundah/Keel//Barque cross. This cross has combined adaptive traits from Keel (■), physical grain quality and sandy soil tolerance from Mundah (●), and the yield potential of Barque (✖). WI3804 and WI3806 show adaptation to a range of drought stress conditions across a range of soil types including deep sands. WI3804 is on track to be commercially available as feed barley for the 2006 season. These Australian barleys have derived their adaptation to a range of environments from barley lines of the Central West Asia North Africa (CWANA) region, so the results of this analysis are not surprising.

Tolerance to subsoil constraints is also assessed in an effort to improve adaptation through maintaining the plants ability to utilise available moisture. Boron is one constraint prevalent in the soils of the EP, and trials are conducted at the MAC to identify genotypes with low leaf death under boron toxicity. The boron trial in 2004 at the MAC discriminated well between the different barley lines, and it can be seen in *Table 1* that WI3804 and WI3806 have low leaf symptom score. A number of breeder lines have excellent boron tolerance, however the results highlighted the sensitivity of WI3408 to boron toxicity. ICARDA lines have show good levels of boron tolerance and a high frequency of CCN resistance, indicating that these lines are alternative sources of tolerance to constraints interacting to influence moisture availability.

Table 1: Leaf symptom scores of barley lines grown in boron toxic soil at MAC in 2004.

Barley Line	Score
WI4052	0
SloopVic	1
WI3806	1.5
WI3804	2.8
Keel	4
Barque	5
Schooner	6.5
Mundah	7
WI3408	9
LSD (P=0.05)	2

The genetic analysis of ICARDA germplasm has identified genomic regions associated with improved yield and physical grain quality in low rainfall environments. This analysis has identified the importance of genes associated with developmental patterns (particularly height, earliness, and photoperiod sensitivity) in yield under drought stress. Wild barley is being used to identify sources of novel genes for breeders to make further improvements in adaptation to drought stress.

What does this mean?

The collaboration with ICARDA has allowed the availability of genetic resources for use by Australian breeding programs and shows great potential to improve adaptation to the mid-low rainfall environments. Improved adaptation derived from crosses between Australian and ICARDA germplasm will have immediate impact on improving feed barley production in the low rainfall areas and long-term impact on improving the adaptation base of Australian malting barley. However, to continue genetic improvement of current cultivars we need an understanding of how low rainfall environments with multiple productivity constraints impact-productivity, what traits are available within current breeders lines to make improvements and where the genetic resources are worldwide to make improvement beyond the limitations of the current Australian breeding pool.

The application of new genetic resources, trait based selection and dedicated testing sites are allowing better breeding progress for the low rainfall environments. The next step is to evaluate novel international barley resources from low rainfall environments including Spain, the former Soviet Republics of the Central Asia and Caucasus (CAC) region (particularly Kazakhstan and Uzbekistan), resources held by the Vavilov

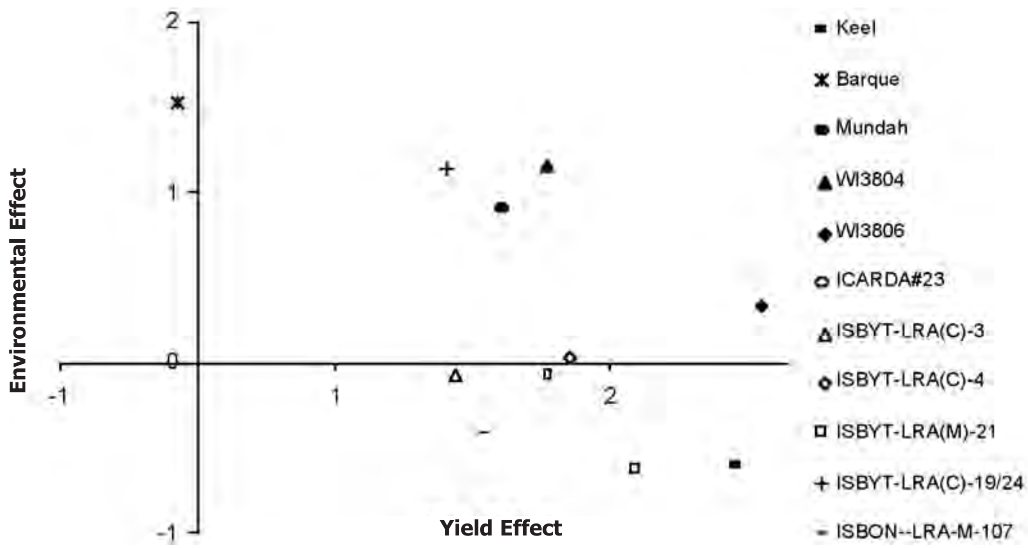

Figure 1: The yield and environmental stability of the best 8 ICARDA and 5 Australian genotypes expressed as a common effect from the average of 210 barleys and 10 low rainfall environments (including trials at MAC in 2002-2003).

All-Russian Scientific Research Institute of Plant Genetic Resources, wild barley and landraces from the Middle East including Iraq, and material from the CWANA region. Evaluation of a wider range of germplasm from similar international low rainfall environments with multiple productivity constraints will ensure the resources are available to maintain breeding progress for adaptation to our low rainfall environments. The key message is that utilising germplasm adapted to similar target environments from other parts of the world and incorporating beneficial traits and genes into an Australian barley background has and will continue to drive improvements in productivity per mm of rainfall with less environmental impact and improved yield stability to benefit Australian grain growers, and provide international market competiveness through the development of better varieties.

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GRDC Grains Research & Development Corporation

THE UNIVERSITY OF ADELAIDE AUSTRALIA

Research

Canopy management in low rainfall regions

Jon Hancock

SARDI, Minnipa Agricultural Centre

Searching for answers

Location
Minnipa Agricultural Centre

Rainfall
Av. Annual: 325mm
Av. GSR: 242mm
2004 total: 288mm
2004 GSR: 223mm

Yield
Potential: 2.25 t/ha

Paddock History
2003: Medic pasture
2002: Wheat (Yitpi)
2001: Medic pasture

Soil Type
Alkaline reddish brown sandy loam

Plot size
10m x 1.7m

Key Messages

- **Grain yield was not improved through canopy management techniques.**
- **Dry matter at anthesis was positively correlated with grain yield.**
- **Soil moisture conservation through reduced canopy size was small and insignificant.**

Why do the trial?

In low rainfall environments there is concern that excessive early crop growth increases crop water use to the extent that soil moisture reserves become depleted later in the season. Plants become drought stressed during the crucial grain fill stage between anthesis and harvest reducing grain size and yield. The issue, known as haying off, has long been limiting grain yields in low rainfall environments, particularly when levels of available soil nitrogen (N) have been excessively high, promoting unnecessarily high early plant growth.

In higher rainfall regions, management of a crop canopy is achieved through the strategic application of N fertiliser. In low rainfall regions however, there is little opportunity to manage canopies with delayed N applications as soil reserves of N are often more than adequate for crop requirements. Consequently, more novel approaches are required to manage crop canopies.

This trial aimed to compare different techniques of manipulating crop canopies and assess whether this can conserve soil moisture and improve grain yield in low rainfall environments.

How was it done?

Wheat (cv. Wyalkatchem) and mixes of wheat and oats were sown into replicated plots at a target density of 150 plants per square metre with 70 kg/ha of triple superphosphate. Additional N (15 or 30kg N/ha) was applied as urea beneath the seed in two of the treatments.

At the end of tillering, when tiller number had been set, various approaches were implemented to reduce canopy size and crop water use. Topik® was sprayed over the trial to take the oats out and various mechanical treatments were applied to reduce canopy size. These involved removing tillers from plants by hand to mimic uniculm (restricted tillering) wheats, removing every third crop row and cutting the crop off approximately 4cm above ground level.

Soil samples were taken at sowing to determine the amount of available nitrogen in the soil. Plant samples were taken at tillering and anthesis and soil samples were taken at anthesis to compare moisture levels between treatments. Harvest cuts were taken at maturity to assess the final canopy size, determine harvest index and measure yield components. Plots were harvested at maturity to determine grain yields and grain samples were retained to measure grain protein and screenings. Soil samples were taken at maturity prior to any summer rainfall to determine the dry upper limit of soil moisture so that plant available water levels could be calculated.

What happened?

Soils tests taken at sowing revealed that 202 kg/ha of N was available in the top 60 cm. The growing season was very short, with a late break and a dry finish. Only 6.4 mm of rain fell after the 14th of September and consequently, plants had to fill grain on low reserves of soil moisture, resulting in poor yields and high protein concentrations.

Crop growth was similar between all treatments until the end of tillering when the various canopy management techniques were applied. Quite large differences in dry matter were measured at anthesis (*Table 1*), however reduced crop canopies only led to small, insignificant soil moisture savings.

Grain yield was not improved by any of the techniques applied to reduce canopy size. The control and addition of 30 kg N/ha treatments were the highest yielding treatments (*Table 1*). However there was no yield penalty from the removal of every third crop row or from spraying out oats within the crop to reduce the canopy level. There was a positive correlation between anthesis biomass and grain yield as treatments with higher crop biomass at anthesis also had higher grain yields.

In the most extreme treatment, involving tiller removal, the yield reduction was purely a result of decreased grain size that also resulted in more screenings. The number of grains per square metre was actually greater than all other treatments as although there were less heads, plants overcompensated by increasing the number of grains in each head. So while the potential yield was higher for this treatment, there were not enough resources available to adequately fill this potential, resulting in the smallest grain weight of all treatments.

The removal of plant tops in the mown treatment caused both grain number and grain size to be reduced. This culminated in severely reduced yield, the lowest of all treatments.

What does this mean?

This trial doesn't provide any evidence that reduced canopy size leading up to anthesis improves grain yield. In fact, for some treatments there were substantial yield penalties associated with a reduced crop biomass. Canopy management options had the opposite effect to what was anticipated.

Although it was thought that reduced crop canopy would conserve moisture leading to improved grain fill, in practice, no significant saving of soil moisture was measured. Grain weight was often worse, resulting in reduced yield and more screenings. So two questions arise. Why didn't reducing canopy growth lead to greater soil moisture savings and why didn't any extra moisture and head reduction lead to larger grains?

The extent of water loss through evaporation was not measured, however this could have accounted for a substantial amount of water loss particularly as there was little stubble cover over the soil (a typical situation in this environment). This could have even been increased under thinner crops where light interception on the ground was increased and may have counteracted any soil water benefits from less transpiration in thinner crops.

Since the canopy management techniques were not implemented until tiller number had been set by the plants, the bulk that was removed was a waste of resources as this was not able to give any contribution to grain yield. The water required to grow this had to be sacrificed and the time between tillering and anthesis may not have been great enough to accumulate any significant water savings.

In crops with less biomass, plant photosynthesis and the synthesis of stem sugars would have been reduced. Furthermore, the removal of crop canopy would have reduced the reserve of assimilates within plants available for grain fill. Consequently, the remobilisation of assimilates to the grain during grain fill may have been reduced in treatments of reduced crop canopies and may explain the lower yields of these treatments.

Further investigation may be warranted as assessment of variety and sowing date may impact the results. The variety used, Wyalkatchem, has reasonable drought tolerance and relatively high harvest indices. Bulkier type wheats may have shown a different result. The late sowing may have limited the opportunity for excess bulk to be produced and this could be quite different in an earlier season.

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Table 1: Anthesis Dry Matter, Anthesis Water, Grain Yield, Grain Quality and Yield Components.

Treatment	DM at Anthesis (t/ha)	PAW* at Anthesis (mm)	DM at Maturity (t/ha)	Grain Yield (t/ha)	Protein (%)	Screenings (%)	Grains per m²	Fertile Heads per m²	1000 Grain wt (g)
Control	1.76 ab	4.2	3.04 a	0.77 a	18.8 cd	9.20 c	2005 bcd	160 a	31.26 ab
30N	1.85 a	4.5	2.92 ab	0.77 a	19 ab	9.44 c	1982 bcd	156 ab	30.78 abc
3rd Rows Removed	1.60 bc	5.6	2.80 ab	0.75 a	18.8 bcd	11.05 bc	2290 ab	154 ab	30.24 bc
20% Oats	1.60 bc	6.1	2.80 ab	0.74 a	18.8 bcd	9.73 bc	2157 ab	139 b	30.87 ab
33% Oats	1.41 cd	5.2	2.61 bc	0.71 ab	18.7 d	10.81 bc	2098 abc	139 b	31.5 ab
15N	1.76 ab	4.7	2.73 ab	0.65 bc	18.9 bc	8.67 c	1477 d	138 b	33.16 a
Tillers Removed	1.22 d	8.6	2.24 cd	0.64 bc	19 ab	14.92 a	2636 a	114 c	25.33 d
Mown	1.28 d	7.1	1.87 d	0.57 c	19.2 a	12.06 b	1501 cd	111 c	28.21 c
LSD(≤0.05)	0.21	ns	0.41	0.09	0.2	2.57	602	20	2.60

**PAW is plant available water – the amount of water within the soil which plants are able to extract.*

Research

Fast tracking the development of wheat varieties with improved drought tolerance

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Key Messages

- **Commercial release of drought tolerant lines is on track for 2007.**
- **Grain from 2004 is to be submitted to first stage quality testing and grade classification.**

Why do the research?

To fast track the final stages of evaluation and seed multiplication of elite drought tolerant breeders lines.

To rapidly eliminate agronomic defects, including leaf rust susceptibility, in elite drought tolerant breeders lines.

To evaluate synthetic hexaploid wheat derivatives introduced from CIMMYT for their application in the South Australian focused wheat breeding activities of Australian Grain Technology (AGT).

This is the fourth year of evaluation with results in EPFS Summaries 2001, 2002 and 2003.

How the work is done?

Germplasm derived from crosses made in this project is currently at various stages of the AGT breeding program from pre-commercial seed production to first field nurseries. The germplasm is at various stages because of the biological constraints of implementing fast tracking breeding strategies, namely appropriate timing of plant life cycle with key operational stages such as winter and summer sowing windows.

From the 101 advanced lines tested in drought tolerance trials and quality evaluation in 2003, nine elite leaf rust resistant lines were selected for wide scale testing in 2004. These lines were tested at six sites on Upper Eyre Peninsula (Penong, Kalanbi, Streaky Bay, Nunjikompita, Kimba, and Cowell) and a further two seeding times at Minnipa. In addition six of these lines were included in the AGT A3 trials conducted at 15 locations across southern Australia, four major rust resistance screening nurseries and within various other disease resistance screening nurseries (septoria, yellow leaf spot, etc). All of these elite lines selected for advanced trials showed high relative grain yields under drought stress in both 2002 and 2003.

What Happened?

The conditions in 2004 on Upper EP were not ideal for differentiating between the drought tolerant lines and control varieties. Time of seeding was at least two weeks later than optimum, winter rainfall was generally higher than average, (at least on the far west of EP), and winter and early spring temperatures were very mild up until the first week of October. While September was very dry, temperatures were mild and early flowering varieties quickly established yield potential before the very hot days in early October. In contrast, mid and later maturing types flowered during the full brunt of the hot period in early October. In previous years early flowering has not been a critical factor associated with high yield in these drought stressed environments. High yield has been associated with the ability for plants to survive through cyclic periods of drought associated with the typical small frontal rainfall systems combined with intermittent periods of warm to hot temperatures. While the drought conditions experienced were not typical of the area, the lines that have performed well in the past still performed relatively well in 2004. Some of the early flowering control varieties that have not performed well in the past however, such as Krichauff and Wyalkatchem, did perform well in 2004.

Six lines A012, E002, E010, E023, E026, and F018 were found to have excellent levels of resistance to leaf, stripe and stem rust (*Table 1*) and have yielded well in drought affected trials over three years (*Table 2*). Five of these lines also produced competitive yields in higher yield potential environments (*Table 3*).

The first results from quality testing were also very encouraging with five of the six lines listed above performing at a level that indicates they could be eligible for AH classification or even Prime Hard in some cases (subject to repeat performance and end product testing).

Based on yield, leaf rust scores and quality, three of these lines E002, E010 and E023 were selected for a preliminary (best guess) pure seed bulk up. Approximately 500 kg of pure seed of E002, 650 kg of E010, and 200 kg of E023 were harvested in late December of 2004.

One of the parents used in the CO5693 cross was RAC875. RAC875 carries LMA (late maturity alpha amylase) that is a quality defect where certain environmental conditions (cold temperatures followed by humidity) trigger damage to the grain equivalent in effect to pre-harvest sprouting. These lines are currently being assessed for this potential fault and results are expected in late February 2005. If they carry this fault then they will be eligible for feed grades only. If the lines are clear for LMA two or more will enter full scale commercial seed production in 2005 with the potential for a limited release in 2006 or a very large scale release for 2007 sowing.

The elite rust susceptible lines were crossed to Annuello (caries durable leaf and stripe rust resistance genes, CCN resistance and excellent quality) and the resultant F1 crossed back to the drought tolerant breeders lines. In addition high yielding selections with rust resistance were intercrossed with high yielding rust susceptible drought tolerant lines. The first batch of 67 doubled haploids from these crosses were grown in a summer irrigated seed increase nursery at Roseworthy and then included in AGT S1 yield trials and disease nurseries in 2004. The remaining doubled haploids were grown in seed increase rows over winter of 2004. Conditions ideal for stripe rust resistance selection were experienced. As a result 684 stripe rust resistant doubled haploids were selected for NIR flour colour screening and first yield and disease resistance trials in 2005.

The elite lines have also been crossed to high yielding disease resistant elite lines from the general AGT breeding program and to different sources/types of drought tolerance carried by Drysdale and Rees (transpiration efficiency gene). The aim of these later crosses is to combine different known mechanisms of drought tolerance to provide stable yields in a wide range of low rainfall circumstances, ie a range of different types of drought (timing).

Approximately 180 synthetic hexaploid derivatives obtained from the CIMMYT wheat breeding program in Mexico were grown at Roseworthy in 2004. While many of these synthetic derivatives have shown outstanding yield in Mexico not one of these was found to be significantly higher yielding than the control varieties Krichauff, Stylet, Wyalkatchem, Yitpi and Janz. The selections made from several F3 bulk populations in 2002 and 2003 found that it is highly unlikely that this germplasm will be suitable for AWB quality grades and will require further crossing to good quality parents to access any desirable stress tolerance genes carried by the synthetic derivatives.

What does this mean?

If one or more of the six elite lines are shown to be clear of LMA, at least two of these will enter full scale commercial seed production in 2005 with the potential for a limited release in 2006 or a very large scale release for 2007 sowing. Grain harvested from 2004 advanced trials will be submitted to AWB for end product testing and the first stage of AWB quality grade classification.

Table 1: Agronomic characteristics of advanced drought tolerant breeders lines and control varieties in AGT S3 experiment 2004

NAME	Leaf Rust	Stem Rust	Stripe Rust	Yellow Leaf Spot	Maturity
Drysdale	MS	MR	MR/MS		EM
Frame	MS	MR/MS	MR/MS	S	ML
H45	MS	MR/MS	VS	R/MR	VE
Janz	MS	R	MR/MS	S	M
Krichauff	S	R	S	MS	E
Wyalkatchem	MR	MS	MS	MR	ME
Yitpi	MS	S*	MR/MS	VS/S	ML
A012	R	R	R	MS	M/ML
E002	R	R	R	MS	M/ML
E010	R	R	R	MS	M/ML
E023	R	R	R	MS	M/ML
E026	R	MR	R	MS	M/ML
F018	R	MR	R	MS	M/ML

Table 2: Summary of grain yield of drought tolerant breeding lines and check varieties in 2002 at Minnipa and the 2003 and 2004 field experiments.

Name	Minnipa 2002 (% Site Yitpi)	2003 Drought Tolerance Trials (% Yitpi)	2004 Drought Tolerance Trials (% Yitpi)
Excalibur	103	133	119
Frame	97	95	87
Janz	92	97	98
Krichauff	105	99	113
Kukri	102	97	98
Pugsley	--	91	99
Wyalkatchem	--	109	115
Yitpi	100	100	100
RAC 875	118	127	117
CO5235*B55	104	131	121
CO5693*A012	101	127	114
CO5693*B036	112	130	119
CO5693*E002	120	147	117
CO5693*E010	115	131	118
CO5693*E023	100	128	110
CO5693*E026	108	133	112
CO5693*F018	103	132	117
Mean Site Yield (t/ha)	1.17	0.85	0.76
Number of Trials	1	3	8

Table 3: Yield (% Site Mean) of advanced drought tolerant breeders lines and control varieties in AGT S3 experiments 2004

NAME	SA	WA	Vic	NSW
Drysdale	92	96	103	99
Frame	100	94	95	87
H45	97	98	94	94
Janz	98	98	93	98
Krichauff	100	96	96	86
Wyalkatchem	101	113	98	102
Yitpi	104	107	110	95
A012	101	106	111	110
E002	101	100	107	113
E010	106	107	107	108
E023	101	95	98	106
E026	99	92	90	99
F018	99	98	103	106
Mean Site Yield (t/ha)	2.18	2.34	0.70	3.09
Number of sites	**5**	**5**	**1**	**3**

Sixteen further lines from the CO5693 and other related crosses were assessed in AGT S2 trials in 2004. Those surviving yield, quality and disease resistance culling will be included in advanced drought tolerant trials in 2005 across U.E.P. and in AGT S3 trials. The surviving defect elimination and intercross lines (from 684) will be grown in AGT S1 trials and disease resistance screening nurseries in 2005.

Detailed study of specific traits conferring tolerance to these environments will be continued to allow improved rates of genetic gain for drought tolerance in the future (including the development of molecular markers linked to genes of importance).

Elite synthetic hexaploid derived lines will be promoted to stage 2 testing in the AGT selection program. Superior individuals will also be included in crossing programs.

SAGIT

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Section 2

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Break Crops

The production of canola and legume crops on Eyre Peninsula in 2004 was; 65,000 tonnes of canola, 12,000 tonnes of peas, 20,000 tonnes of lupins, 11,000 tonnes of beans and 5,000 tonnes other pulse crops.

Break crop variety evaluation 2004

SAFCEP Field Pea Variety Yield Performance at Eyre Peninsula Sites

2004 and long term (1997-2004) yields expressed as a % of Parafield's yield.

Variety	2004			1997-2004		
	Lock	Minnipa	Yeelanna	Lock	Minnipa	Yeelanna
Dunwa	105	100	100	90	91	94
Excell	-	-	-	91	90	92
Kaspa	93	93	106	105	104	103
Moonlight	93	96	101	94*	92	97*
Mukta	74	73	95	90	94	99
Parafield	100	100	100	100	100	100
Soupa	81	92	103	91	95	99
Sturt	120	95	99	103	103	101
Yarrum	109	88	104	97*	97*	99*
Parafield's yield (t/ha)	**1.04**	**0.92**	**2.10**	**1.88**	**1.52**	**2.96**
Date sown	4-Jun	1-Jun	18-Jun			
Soil type	S/LS	LiSCL/SCL	SCL/LC			
pH (water)	8.5	8.4	8.3			
Apr-Oct rain (mm)	191	223	334			
Site stress factors	de,dl,ht,id	dl,ht,w,lb	dl,ht,id			

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

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

Site Stress Factors — *a=ascochyta, de=pre-flowering moisture stress, dl=post flowering moisture stress, hd=herbicide damage, he=heliothis damage, ht=high temperatures during flowering/pod fill, lb=late break (late sown), ne=necking, pe=poor emergence, rh=rhizoctonia, w=weed competition, wl=waterlogging, id=insect damage.*

Data Source: SAFCEP, REML analysis. Long term data based on weighted analysis of sites, Biometrics SA.

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SAFCEP Canola Variety Yield Performance at Eyre Peninsula Sites

2004 and long term (1998-2004) yields expressed as a % of Ag-Spectrum and ATR-Beacon yield.

Variety	2004					7 year average (1998-2004)				
	Minnipa	Yeelanna	Mt Hope	Tooligie	Ungarra	Minnipa	Yeelanna	Mt Hope	Tooligie	Ungarra
Conventional canola varieties										
44C11	114	103				112	104	106		
44C73	96	82				96	90	95		
45C05	99	86	101			93	96	98		
45C75	79	64				82	83	91		
46C04	92	91	108			99	98	101		
46C76	88	85				87	90	95		
Ag-Comet	98	76				103	92	95		
Ag-Emblem						95	96	97		
Ag-Outback	94	91				106	98	100		
Ag-Spectrum	100	100	100			100	100	100		
AV-Sapphire	65	98	99			87	96	99		
Hyola 61	99	88	114			96	95	99		
Kimberley	103	88	116			102	95	100		
Lantern	109	85	88			93	95	98		
MC201	48	76				62	80			
MC202	56	76				70	82			
Rainbow	100	93				87	94	96		
Rivette	110	102				110	100	101		
Rocket	59	57								
Skipton	122	94				100	99	101		
Surpass 603CL	76	8	51			82	82	89		
Ag-Spectrum's yield (t/ha)	**0.31**	**1.76**	**1.76**			**0.78**	**1.98**	**2.04**		
Triazine tolerant (TT) canola varieties										
ATR-Beacon	100		100	100	100	100			100	100
ATR-Grace	77		90	84	91	91			93	94
ATR-Hyden	82		89	94	103	90			97	97
ATR-Stubby	103		88	108	91	103			98	96
Bravo TT	106		96	111	123					
Tornado TT	108		95	106	108	98			99	100
Tranby	103		90	96	96	92			93	95
Trigold	111		91	116	93					
Trilogy	110		64	108	65					
ATR-Beacon's yield(t/ha)	**0.64**		**2.01**	**0.59**	**0.76**	**0.68**			**1.26**	**1.38**
Date sown	18-May	25-May	25-May	4-Jun	13-Jun					
Soil type	LiSCL/ SCL	S/SC	SL/C	SL/SCL	S/CS					
pH (water)	8.4	5.7	6.2	8.5	7.6					
Apr-Oct rain (mm)	228	257	389	219	249					

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

Site Stress Factors ap=aphids, bl=blackleg, de=moisture stress preflowering, dl-moisture stress post-flowering, pe=poor establishment, sh=shattering, sn=snails, w=weeds.

Data Source: SAFCEP, REML analysis. Long term data based on weighted analysis of sites, Biometrics SA.

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SAFCEP Faba Bean Variety Yield Performance at Eyre Peninsula Sites

2004 and long term (1998-2004) yields expressed as a % of Fiesta's yield.

Variety	Density	2004			1998-2004		
	Seeds / sq.m	Cockaleechie	Lock	Minnipa	Cockaleechie	Lock	Minnipa
Ascot	24	95	62		90	83	62
Cairo	24	94	161	123	94	96	91
Farah	24	88	121	99	101	99	98
Fiesta.hi	24	100	100	100	100	100	100
Fiesta.med	18	86	85	94	94	91	84
Fiord	24	111	102	108	97	93	85
Icarus	18	62	59		80	77	56
Manafest	18	80	140	97	91	96	84
Ic*As/7/3	24	107	134	79	104	101	104
Fiesta.hi yield (t/ha)		**1.81**	**0.26**	**0.59**	**3.17**	**1.63**	**0.94**
Date sown		June 11	June 4	June 2			
Soil type		CL/LiC	S/LS	LiSCL/SCL			
pH (water)		8.2	8.5	8.3			
Apr-Oct rain (mm)		274	191	223			
Site stress factors		dl,ht,he,ne	de,dl,hd,ht,he	de, dl, ht			

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SAFCEP Vetch Variety Yield Performance at Eyre Peninsula Sites

2004 and long term (1998-2004) yields expressed as a % of Blanchefleur's yield.

Variety/Line	2004		1998-2004	
	Minn-ipa	Yeel-anna	Minn-ipa	Yeel-anna
Blanchefleur	100	100	100	100
Languedoc	62	88	97	100
Morava	64	85	99	97
Blanchefleur's yield (t/ha)	**0.60**	**1.96**	**1.09**	**2.32**
Date sown	3-Jun	18-Jun		
Soil type	LiSCL /SCL	SCL/LC		
pH (water)	8.4	8.3		
Apr-Oct rain (mm)	223	334		
Site stress factors	de, dl			

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SAFCEP Narrow-leafed Lupin Variety Yield Performance at Eyre Peninsula Sites

2004 and long term (1998-2004) yields expressed as a % of Merrit's yield.

Variety	2004			1998-2004		
	Tool-igie	Ung-arra	Wan-illa	Tool-igie	Ung-arra	Wanilla / Kapinnie
Danja	112	106	85	95	95	96
Jindalee	106	122	98	102	105	103
Mandelup	124	121	119	108	104	106
Merrit	100	100	100	100	100	100
Moonah	119	115	103	101	101	100
Quilinock	123	110	99	108	103	103
Wonga	86	99	104	99	99	98
WALAN2118	106	112	118	103	102	102
Merrit's yield (t/ha)	**0.68**	**0.97**	**2.04**	**1.44**	**2.33**	**2.72**
Date sown	June 5	June 13	May 21			
Soil type	S/SC	S/CS	S/CS			
pH (water)	6.8	7.6	7.0			
Apr-Oct rain (mm)	219	249	358			
Site stress factors	lb,pe, w,dl	lb,de, w,dl	Rh			

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SAFCEP Lentil Variety Yield Performance at Eyre Peninsula Sites

2004 and long term (1998-2004) yields expressed as a % of Nugget's yield.

Variety/Line	2004		1998-2004	
	Cockaleechie	Yeelanna	Cockaleechie	Yeelanna
Aldinga	99	129	99	99
Digger	89	119	98	100
Matilda	105	-	96	96
Northfield	92	115	93	94
Nugget	100	100	100	100
CIPAL203	86	109	98	100
Nugget's yield (t/ha)	**1.24**	**1.15**	**2.15**	**2.32**
Date sown	17-Jun	18-Jun		
Soil type	CL/LiC	SCL/LC		
pH (water)	8.2	8.3		
Apr-Oct rain (mm)	274	334		
Site stress factors	dl,ht,wl	dl,ht,w		

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SAFCEP Chickpeas Variety Yield Performance at Eyre Peninsula Sites

2004 and long term (1998-2004) yields expressed as a % of Howzat's (desi chickpeas) or Genesis 090's (kabuli chickpeas) yield.

Variety/Line	2004			1998-2004		
	Cockaleechie	Lock	Minnipa	Cockaleechie	Lock	Minnipa
DESI TRIALS						
Genesis 508	69	94	65	91	87	82
Genesis 090#	89	103	98	100	99*	101*
Howzat	100	100	100	100	100	100
Rupali	65	86	90	91*	87*	84*
Sonali	84	121	93*	100	101	97*
Howzat's yield (t/ha)	**1.27**	**0.30**	**0.44**	**1.71**	**1.00**	**0.71**
KABULI TRIALS						
Genesis 090#	100			100		
Howzat	102			102		
Kaniva#	64			85		
Genesis 090's yield (t/ha)	**0.99**			**1.63**		
Date sown	11-Jun	4-Jun	3-Jun			
Soil type	CL/LiC	S/LS	LiSCL/SCL			
pH (water)	8.2	8.5	8.4			
Apr-Oct rain (mm)	274	191	223			
Site stress factors	dl,al,ht	pe,dl,ht	dl,ht,lb			

*# Kabuli lines   * Varieties have only had limited evaluation at these sites, treat with caution.*
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Canola and mustard in a dry environment

Research

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Try yourself

Location
Minnipa Agricultural Centre
Paddock – N4

Rainfall
Av. annual : 326 mm
Av. GSR: 241 mm
2004 total : 288 mm
2004 GSR: 223 mm

Paddock History
2004: Pulse/Canola trials
2003: Barque barley
2002: Yitpi wheat

Soil Type
Sandy loam, pH 8.9

Key Messages

- **New higher yielding lines for low rainfall areas are being identified through the current breeding programs**
- **Limited amounts of Juncea canola (mustards with canola quality oil) will be available in 2006**

Low rainfall canola cultivars

There are several types of canola currently available for low rainfall areas. These include conventional cultivars, triazine tolerant cultivars and Clearfield canola. Each type has advantages and disadvantages that we will discuss here.

Trials conducted at Minnipa and other low rainfall sites between 2001 and 2004 tested a range of early maturing canola cultivars. When looking at these results (*Table 1 and Table* 2), be aware that oil contents in 2001 were high compared to poorer years and oil contents for 2002 are low due to late sowing and a dry finish. The season of 2003 was even worse than 2002 with an even later break and then little rain at the end. During 2004 we had still a later break but good rain in August followed by a dry finish. In future it may be that we need to achieve over 42 % oil to avoid a dockage in price.

Early maturing conventional cultivars have been improved over the last few years, with Ag-Outback having a higher grain yield than Monty, but with a lower oil content. Rivette, released in 2001 from NSW Agriculture showed improved yield and oil content. Both Ag-Outback and Rivette are later flowering than Monty. The new conventional cultivars 44C11 from Pioneer and Kimberley, marketed by Pacific Seeds, are early-mid season cultivars that may fit into the low rainfall area.

The highest yielding early maturing Clearfield cultivar in trials in 2001 and 2002 was 44C73 that produced similar yields to the best conventional cultivars. Oil content of 44C73 was relatively low compared to the highest cultivars.

When triazine tolerance (TT) has been crossed into canola it has been shown that there is less radiation use efficiency than in the conventional parent and this results in less biomass at maturity. Grain yields have been shown to be up to 25 % lower than conventional cultivars and oil content is reduced by 2 - 5 % (a greater reduction in low oil environments). The other result of incorporating the TT trait into a cultivar is that flowering date is delayed by several days. This is probably the major reason why it has been so difficult to select early maturing TT cultivars.

New TT cultivars that have been released since 2004 include ATR-Stubby, Tranby, Trigold and Trilogy, all early season cultivars that may be adapted to low rainfall areas. A mid season cultivar is Tornado TT from Pacific Seeds and this cultivar has yielded similarly to ATR-Stubby. Another mid season cultivar, Bravo TT will also be released by NSW DPI for 2005 and marketed by PlanTech.

Table 1: Grain yield (t/ha) in 2004 and long term (1998-2004) and oil content (%) of conventional and Clearfield canola cultivars at Minnipa, 2001, 2002 and 2003.

Cultivar	Oil Content 2001(%)	Oil Content 2002 (%)	Oil Content 2003 (%)	Grain Yield 2004 (t/ha)	Grain Yield 1998-2004 (t/ha)
Conventional					
Monty	39.1				0.65
AG-Outback	38.8	34.9	35.6	0.58	0.82
Rivette	42.1	35.9	36.5	0.63	0.86
44C11		36.6	35.5	0.66	0.79
Kimberley		35.1	36.4	0.65	0.79
Clearfield					
44C73	39.7	34.4	34.2	0.57	0.75
Surpass402CL	43.1	36.8	37.3		0.59

Table 2: Grain yield (t/ha) in 2004 and long term (1998-2004) and oil content (%) of triazine tolerant canola cultivars at Minnipa, 2001, 2002 and 2003

Cultivar	Oil Content 2001 (%)	Oil Content 2002 (%)	Oil Content 2003 (%)	Grain Yield 2004 (t/ha)	Grain Yield 1998-2004 (t/ha)
Karoo	38.3	35.2			0.67
ATR Eyre	40.5	33.2	35.7		0.54
Surpass 501TT	41.8	36.1	37.3	0.74	0.64
ATR Beacon	39.3	35.0	33.9	0.64	0.68
ATR Stubby		36.5	35.1	0.66	0.70
Tranby			34.9	0.66	
Trigold				0.72	
Trilogy				0.71	
Tornado TT			36.1	0.69	

Where do these cultivars fit?

If you are certain that your paddock is virtually free of broad leaf weeds then the best option is to use conventional cultivars. These have higher yield and oil content.

However, the Clearfield system may be more applicable if you have a Brassica weed problem, but the herbicide (On-Duty®) is a group B herbicide that may cause problems if you have resistant ryegrass.

Triazine tolerant canola has been shown in trials to have lower yield than the other canola cultivars and many cultivars have lower oil contents as well. However the cost of the TT package is relatively inexpensive. On low rainfall alkaline soils only a low rate of simazine (perhaps 1.5 L/ha) will be able to be used due to carry over problems but this rate has been shown to be very effective at controlling brassica weeds.

The last three years have shown that sowing date and conditions during the growing season have a major effect on canola and mustard yields. Crops in both 2001 and 2002 were sown in late May or early June. With the exceptional season in 2001, high grain yields were achieved. However 2002 was tougher and much lower grain yields were produced. Sowing in 2003 could only occur in early June and the dry finish resulted in very low yields. In order to produce high yields it is necessary that canola be sown as early as possible, given good weed control, and sowing as late as was the case in the last two years is not recommended. The end of the third week of May could be used as a cut-off point for including canola in the rotation because for later sowings, we are relying on a very favourable spring to ensure good yields. An early break that allowed canola to be sown in April is the best option for farmers to grow canola in the rotation in low rainfall areas. Use it as an opportunity crop rather than trying to grow it each year. Mustard is an earlier flowering option and when canola quality mustard is available it may be able to be included more frequently than canola is now.

The future

Mustard (*Brassica juncea*)

Breeding programs for canola quality *B. juncea* (Indian mustard) commenced in Australia in the late 1970's and early 1980's. The programs aimed at producing canola quality *B. juncea* for lower rainfall environments. *B. juncea* has a number of potential advantages over *B. napus*, including enhanced seedling vigour, blackleg resistance and shatter resistance, plus higher tolerance to drought and high temperature stresses. In order for canola quality *B. juncea* to be used interchangeably with *B. napus* in the market place, it has been important to increase oleic acid levels to match the *B. napus* level of 60%. Early maturing, high yielding Australian canola quality *B. juncea* lines have been crossed with higher oleic acid sources from Canada. While the initial juncea canola cultivars are likely to have similar yields to early *B. napus* cultivars, production costs are expected to be significantly less. Further yield improvements are anticipated with additional breeding. The initial *juncea* canola cultivars will be conventional, with TT and Clearfield cultivars expected in 3-4 years.

Table 3: Grain yield (t/ha) and oil content (%) of mustard lines and canola cultivars at Minnipa, 2001, 2002, 2003 and 2004

Cultivar/Line	Grain Yield 2001 (t/ha)	Grain Yield 2002 (t/ha)	Grain Yield 2003 (t/ha)	Grain Yield 2004 (t/ha)
Canola				
AG-Outback	1.47	0.47	0.62	0.74
Rainbow	1.49	0.29	0.45	0.67
Mustard				
Non canola quality	1.34	0.50	0.62	0.73
Canola quality	1.15	0.46	0.63	0.65

Table 4: Grain yield (t/ha) of canola selections at Minnipa in 2004 (different trials so yields can not be compared between trials)

Cultivar/Line	Conventional	Triazine Tolerant
Best Control	0.77 (Kimberley)	0.78 (Trigold)
Highest Yielding Line	0.99 LN2844*LA301)	1.16 (T0073*SP020-LA311)

Plans for 2005 include a series of demonstration trials using advanced breeding lines to highlight the benefits of *juncea* canola, concurrent seed increase of the most promising advanced lines (for potential production in 2006) and further agronomic research. The support of all players in the canola supply chain for release in 2006 is currently being sought through the Australian Oilseeds Federation.

As can be seen from *Table 3*, in years where canola yields above about 1t/ha, the mustard lines under test produce lower yields than commercial canola cultivars. However, in years where lower yields are attained such as in 2002, the mustard lines often perform better than canola, although yields were similar in 2003. At present, it seems that mustards that are more likely to produce canola quality grain produce lower yields than mustards that have lower levels of Oleic acid (the fatty acid that makes canola oil monounsaturated and therefore more healthy to eat). However much of this yield difference is caused by the later flowering due to crossing Australian adapted mustards to later flowering but better quality Canadian lines.

Canola

We are attempting to select canola lines that are better adapted to low rainfall conditions in SA. Single plants have been selected from our trials at Lameroo in the southern Mallee since 1998, and also at Minnipa since 2002, and those lines with the highest oil content are yield tested at Lameroo and Minnipa. The aim is to test elite lines from these sites in trials throughout Australia and to release cultivars of conventional and TT canola with high yield and increased oil content. As can be seen from *Table 4*, increased yields have been achieved in both triazine tolerant and conventional canola lines and oil content has also been increased (data not shown). We hope to release early flowering conventional and triazine tolerant cultivars in the next two years that will give more consistent yields and higher oil content than the currently available commercial cultivars.

Acknowledgements

This work was funded by SAGIT, GRDC and SARDI. Thank you to Leigh Davis, Michael Bennet and Willy Shoobridge for their help with the management of the canola trial work at MAC.

Mustards for biodiesel: how did they perform in 2004 ?

Nigel Wilhelm and Amanda Cook

SARDI, Minnipa Ag Centre

Searching for answers

Location
Closest town: Poochera
Cooperator: Ray, Matthew and Damien Carey

Rainfall
Av. Annual total: 326 mm
Av. GSR: 241 mm
Actual annual total: 288 mm
Actual GSR: 223 mm

Yield
Potential: 2.0 t/ha
Actual best: 0.8 t/ha

Paddock History
2003: Yitpi wheat
2002: Pasture

Soil
Grey sandy loam over limestone

Plot size
22 m x 1.5 m

Other factors
Shallow soil resulted in severe water stress in spring

Key Message

Mustards produced yields at Chandada which offer the prospect of acceptable returns as a break crop, providing the agronomy is top notch (and a biodiesel market does develop!).

Why do the trial?

Biodiesel is a generic name for fuels obtained by esterification of any vegetable oil or animal fat. It can be blended with conventional diesel or used in 100 % concentrations. The end product is a fuel with very similar properties to pure diesel, but with much better emissions performance and is renewable. Biodiesel can be made from crop-sourced oils and with a biodiesel plant about to be built at Port Adelaide, there will be a local demand for vegetable oil for biodiesel production in the very near future.

We believe mustard represents the best potential match of farmers' requirements for a reliable and profitable crop and the biodiesel industry for a cheap source of vegetable oil (canola is too expensive in the current fuel pricing environment). Mustard for biodiesel production is a particular opportunity for low rainfall farming districts because –

- (Relatively) high yielding lines exist which produce oil of a quality which has little other use than as a source for biodiesel (and hence is cheap for the industry to purchase).
- Mustard performs well in low rainfall environments where farmers have few options for other break crops.
- Large areas of low rainfall cropping land may be suitable for mustard production, especially with further development of the crop.

Two trials were conducted in 2003 to test the performance of a range of mustard lines under low rainfall conditions; one at Chandada on a shallow grey calcareous loam and the other at Cambrai in the Murray Plains. These trials showed some promise that mustards may be a viable biodiesel crop for low rainfall areas but also indicated that the performance of canola (relative to mustard) had improved substantially.

How was it done?

Three conventional mustard lines were compared to three canola-quality mustard lines and three currently recommended canola varieties for Upper Eyre Peninsula. Several different agronomic treatments were also imposed on one mustard line to assess their impacts on yield (these are described in the table of results). A late seeding treatment for mustard and canola was also included to assess its impact on yield. Two sites were chosen, one at Chandada and the other at Franklin Harbour. The Chandada trial was seeded on 2nd June with the late seeding plots sown 26 days later on 28th June. The basal fertiliser treatment was 60 kg/ha of 17:19 Zn 2.5 % applied with the seed (@ 3 kg/ha).

Trent Potter (SARDI) made selections of the best performing plants in each mustard line from this trial for future development.

Measurements – establishment, height at flowering, grain and oil yield (oil analyses not yet completed).

The Franklin Harbour trial failed due to the poor season (only 107 mm of rain from April to October) and was not harvested.

What happened at Chandada ?

All plots established well except for the wild turnips. It was later found that germination of the turnip seed was extremely low (less than 20%) which may have been due to hard seededness. All canola and mustard treatments, even the low seeding rate, averaged more than 25 plants/m^2 which is the minimum plant population necessary for maximum yield of canola in low rainfall environments. Agronomic treatments had little impact on establishment.

Although the mustard breeding programme has reduced plant height as a priority, the three lines used in this trial were still 20-30 cm taller than the three canola varieties. However, the mustard line used in the agronomy treatments was of a similar height to the canola's. Reduced height is especially important for low rainfall crops because it means that the plant invests less energy in producing bulk and should be able to produce more grain.

Comparing the different mustard lines to the three canola varieties, all at standard agronomy, the best mustard produced 640 kg grain/ha, out yielded the best canola by only 8 %. Given that mustards still tend to have lower oil extractions than canola, we are expecting that this small yield advantage would only just offset the lower oil extraction to provide the same oil yield as canola (our grain quality assessments will check this).

Seeding Date

Not surprisingly, both mustard and canola yields suffered severely with a delay in seeding of nearly four weeks. Mustard exhibited better drought tolerance in this respect in that it out yielded the canola by more than 50 %.

Seeding Rate

Halving the seeding rate of mustard had no impact on yield compared to the standard of 3 kg/ha.

Nutrition and Seed Treatment

Using extra N or a switch to fluid fertiliser at seeding improved productivity of mustard considerably, resulting in yields of more than 800 kg/ha compared to Gaucho® seed dressing (which appeared to have no impact on yield) of less than 600 kg/ha. Gaucho® is effective against red legged earth mites so its lack of impact suggests the RLEM may not have been in damaging numbers at this site. Similarly, Jockey® had no consistent impact suggesting that blackleg may not have been a problem. Leaving zinc out of the fertiliser also appeared to have little impact on yield, unlike 2003.

Wild turnip was included in the trial because it is such a vigorous weed and is an oilseed. However, this trial is not a true test of its potential as an oilseed crop because its establishment was so poor.

What does this mean?

Similar to the results from this trial in 2003, canola performance was not far behind the mustards, which leaves little margin for mustard to outperform canola in returns to the farmer (given that the biodiesel industry is unlikely to pay canola prices for its feedstocks). However, we can take some comfort from the fact that mustards still had their nose in front of the canola's despite mustard having had very little breeding attention paid to it compared to canola. If the same gains realised with canola over the last 10 years could also be realised with mustard, then it may prove to be a very attractive cropping option in the future.

This trial showed that changing agronomy (extra N or fluid fertiliser) from a pretty conservative standard substantially improved the performance of mustard, suggesting that a combination of agronomy and breeding may make large gains with mustard performance in the future.

The best yields in this trial of just over 0.8 t/ha offer the prospect of reasonable returns from this break crop even now (given that a break even result may still be enough for a break crop to justify a spot in a cropping rotation) after a season of average in-crop rainfall but a pretty tough spring.

Acknowledgements

Australian Renewable Fuels Pty Ltd for funding this trial programme. Leigh Davis and the rest of the team at Minnipa Ag Centre for running the trials. Wayne Burton from NRE, Horsham for providing seed for the mustard lines. Franklin Harbour Ag Bureau for providing a trial site.

Table 1: Performance of mustard and canola lines with different agronomic treatments at Chandada in 2004.

Crop Type		Treatment	Plants [i] per m^2	Grain Yield (t/ha)
Mustard	JP056	Standard	48	0.48
	JN028	Standard	48	0.57
	JQ010	Standard	66	0.64
Canola quality (juncea)	JR042	Standard	51	0.56
Canola quality (juncea)	JR048	Standard	36	0.56
Canola quality (juncea)	JR050	Standard	52	0.64
Wild turnip		Standard	1	0.30
Canola	44C73	Standard	57	0.54
	Rivette	Standard	56	0.59
	Stubby	Standard	47	0.45
	Stubby	Late seeding [a]	53	0.21
	Stubby	Jockey® seed [b]	44	0.39
Mustard	JR049	Extra N[c]	47	0.81
	JR049	Fluid fertiliser[d]	62	0.84
	JR049	Gaucho® seed dressing[e]	47	0.56
	JR049	Jockey® seed dressing[b]	52	0.77
	JR049	Half seeding rate[f]	26	0.57
	JR049	No Zn[g]	58	0.72
	JR049	Late seeding [a]	45	0.33
	45C75	Gaucho® +Jockey® seed [h]	44	0.59
		LSD (P=0.05)	*18*	*133*

[a] *Treated in the same way as STANDARD except seeded 26 days later.*
[b] *Treated in the same way as STANDARD except a Jockey®seed dressing was used.*
[c] *Treated in the same way as STANDARD except with an extra 15 kg N/ha at seeding.*
[d] *Treated in the same way as STANDARD except fluid fertiliser was used at seeding instead of granular at the same nutrient rates.*
[e] *Treated in the same way as STANDARD except Gaucho® seed dressing was used.*
[f] *Treated in the same way as STANDARD except seeded at 1.5 kg/ha.*
[g] *Treated in the same way as STANDARD except no Zn applied at seeding.*
[h] *Treated in the same way as STANDARD except Gaucho®+Jockey® seed dressings were used.*
[i] *Establishment counts were taken 9 weeks after seeding standard plots.*

Calca canola variety evaluation

Research

Tim Richardson,

Carrs Seeds, Cummins

Searching for answers

Location
Closest Town: Port Kenny
Cooperator: Tim & Jo Schulz

Rainfall
Av. annual: 375 mm
Av. GSR: 315 mm
2004 GSR: 273 mm

Paddock History
2003: Wheat
2002: Pasture

Plot size
1.5m x 10m x 4 replicates

Break Crops

Key Messages

- **Some of the new varieties showed improvement over existing commercial varieties.**
- **Jockey applications had no impact on yield, which means conventional blackleg levels were low.**
- **All varieties with sylvestris resistance yielded poorly.**

Why do the trials?

This trial originated from local farmer interest and a lack of local data available on the performance of various conventional, triazine and Clearfield canola varieties. With interest in canola increasing in the area it is important to generate local yield and quality information to allow for suitable variety choices.

Table 1: Calca Conventional Canola Variety Trial, 2004

Variety	Yield (t/ha)
Ag Outback	1.98
44C11	1.97
Kimberley	1.88
Rivette	1.83
AGC103	1.82
Mystic	1.76
Ag Emblem	1.65
BLN2026 X SL902	1.61
Hyloa43	1.42
Surpass 400	1.09
Site mean	1.70
CV (%)	3.4
LSD (P<0.05)	0.10

Table 2: Calca Triazine Tolerant Canola Variety Trial, 2004

Variety	Yield (t/ha)
Stubby	1.94
Beacon	1.83
Beacon + Jockey	1.83
Tornado	1.77
Trigold	1.70
Trigold + Jockey	1.70
Tranby	1.67
Trilogy	1.46
Surpass 501tt	1.46
Eyre	1.38
Site mean	1.67
CV (%)	6.9
LSD (P<0.05)	0.20

How was it done?

Treatments: varieties included ten Conventional lines, ten Triazine lines, and two Clearfield lines

Sown: May 20, 2004

Fertiliser: All varieties received 90 kg/ha of 15:15:15, drilled with the seed, and 100 kg/ha Urea.

Herbicides: Credit and Bonus®, Lorsban® @ 1.0L/ha, Simazine @ 2.5 L/ha (TT plots only), Select® @ 300ml/ha, Fastac Duo® @ 120 ml/ha, Lontrel® @ 300 ml/ha.

Measurements: grain yield and quality attributes

What happened?

This site experienced reasonable opening rains and moisture levels were satisfactory throughout most of the growing season, but the lack of late rains reduced yield potential. There were no major problems with diseases or pests that would have limited yields.

What does this mean?

There were no great surprises in the variety ranking from the Calca canola trial. Stubby, Beacon and Tornado topped the Triazine tolerant trial and Outback, 44C11 and Kimberley performed well in the Conventional trials. There are limited variety options in the Clearfield market, but 44C73 showed a clear yield advantage.

The performance of all the canola varieties with sylvestris resistance was very interesting. Prior to the discovery of the new strain of blackleg on Lower Eyre Peninsula, Surpass 400, Surpass 404CL and Surpass 501TT were widely grown due to their high yield potential. However in 2004 all these varieties performed well below expectations, which indicates that it is quite probable that the new blackleg strain has arrived on Upper Eyre Peninsula. These varieties are no longer available from Pacific Seeds and their use is not recommended.

Acknowledgements

We would like to acknowledge Tim and Jo Schulz for making their land available for research purposes and Leigh Davis, MAC for his assistance in trial management.

Table 3: Calca Clearfield Canola Variety Trial, 2004

Variety	Yield (t/ha)
44C73	1.71
Surpass 404CL	1.31
Site mean	1.51
CV (%)	2.87
LSD (P<0.05)	0.32

Searching for answers

Status of GM canola in Australia

Phil Salisbury[1, 2], Trent Potter [3], Wayne Burton[1] and Rob Norton[2]

Department of Primary Industries, Horsham[1], Vic, Faculty of Land and Food Resources, The University of Melbourne, Vic[2], SARDI, Naracoorte, SA[3].

Research

Genetically Modified (GM) canola is effectively on-hold in the short term in Australia due to the moratoriums imposed by state governments. Planned co-existence trials with GM canola in 2004 were not able to proceed. Two GM canola products, Roundup Ready, cultivars and InVigor, hybrids, were effectively ready for large scale demonstrations and commercial release when the moratoriums were imposed. Trials of these products had already shown them to be highly competitive. In trials to date, potential Roundup Ready, cultivars have demonstrated yields equivalent to conventional cultivars. The yields following application of appropriate management systems were consistently higher than both conventional and TT systems (*Hudson, 2002*).

Results from these trials have also supported the commercial experience of growers in Canada where substantial savings on herbicides, fuel and time have significantly improved growers' gross margins and competitiveness (*Hudson, 2002*).

Likewise, InVigor, hybrids have demonstrated significant yield advantages over open-pollinated cultivars (*Tables 1 and 2*) in trials throughout Australia (*Pike and Clarke, 2004; Bayer, 2004*).

As with the Roundup Ready, management system, when management systems were compared, the InVigor, system outperformed conventional and TT systems (*Table 3*).

The results highlight the potential benefits these and other new technologies offer to Australian growers. As with any new product type, additional breeding with these products in Australia would further enhance the benefits to the Australian industry. Once GM canola becomes available in Australia, it is expected that within 5-7 years, the majority of canola production would come from GM cultivars.

Many of the genetic improvements in canola in the foreseeable future will result from the use of molecular genetic techniques to introduce new genes, modify existing ones and to provide more efficient means to identify specific combinations of genes. For production and marketing purposes, these developments can be divided into two categories, those with modified crop production traits and those with modified product quality traits. Examples of modified production traits include new sources of resistance to herbicides, insects, diseases, viruses and stress, plus modification of crop architecture. Product quality modifications include oil content, oil quality, protein content and quality, reduced anti-nutritional components and novel constituents (including plant-based vaccines, peptides and industrial enzymes). If Australian canola growers are to remain competitive in export markets, they will need to have access to these new characteristics.

Table 1: Yield of InVigor, 40 in Mid-Season Areas of SE Australia in 2001 and 2002

Cultivar	Yield[1]		Oil (%)	Blackleg rating	Days to flower
	2001	2002			
InVigor 40	109	122	46	6.5P	100
Rainbow	100	100	42	6.0	97
Hyola 60	120	112	45	9.0	95
Pinnacle	61	74	40	5.5	100

[1]*Yield is expressed as a percentage of the yield of Rainbow (5 sites)*

Table 2: Yield of InVigor, 60 in Mid-Season Areas of SE Australia in 2001, 2002 and 2003

Cultivar	Yield			Oil (%)	Blackleg Rating	Days to flower
	2001	2002	2003			
InVigor 60	109	122	109	45	6.0P	116
InVigor Exp ARHY0323	-	-	120	44	6.0 P	111
Rainbow	100	100	100	42	5.5	110
Hyola 60	120	112	109	45	9	110
Pinnacle	61	74	-	-	5.0	-

[1]*Yield is expressed as a percentage of the yield of Rainbow (8 sites)*

Table 3: InVigor, Management System Demonstration Strips1 – Dooen 2003 results

Cultivar	Yield[2] %	Days to flower	Height (cm)	Oil (%)
InVigor 60	133	115	140	45
InVigor Exp ARHY0306	132	111	128	43
Hyola 60	125	108	143	44
InVigor 70	122	117	138	44
Beacon	114	111	110	39
Rainbow	100	108	120	43
Check mean kg/ha	1889			

[1]*All entries were treated with their appropriate herbicides.*
[2] *Yield is expressed as a percentage of the yield of Rainbow.*

References

Bayer (2004). 'InVigor Hybrid Canola' results leaflet, 2pp.

Hudson D (2002). GM Herbicide Tolerant Canola: Benefits in an Australian Cropping System. A Summary of Australian Roundup Ready Trials (1999-2001), 13pp.

Pike D and Clarke M (2004). 'InVigor Hybrid Canola' information leaflet, 4pp.

Upper EP break crop survey

Amanda Cook[1] and Jim Egan[2]

SARDI, Minnipa[1], SARDI, Pt Lincoln[2]

Key Messages

- **Farmers are sowing break crops in the last week of May and still achieving reasonable yields**
- **Sowing rates of canola vary between 2 and 5 kg/ha**
- **Sowing rates of peas vary between 80 and 150 kg/ha**

Why was it done?

The Break Crops program on Upper Eyre Peninsula is funded by the South Australian Grain Industry Trust (SAGIT) and aims to develop new varieties of peas, beans, canola and mustards which are better adapted to our environment and soil types. Current funding for this program finishes in June 2005. The break crops survey was conducted to gain information on a number of management issues such as sowing rates and dates, and identify any other issues with break crops which need to be addressed, as support for renewal of funding.

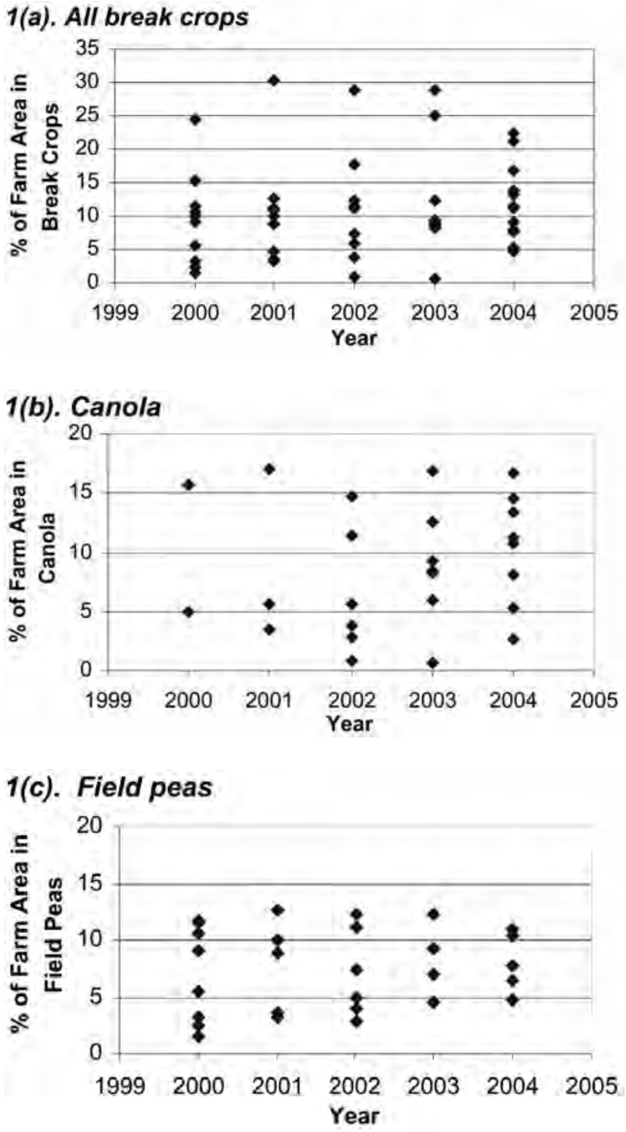

Figure 1: Percent farm area cropped to break crops each year on survey farms.

How was it done?

The survey form was handed out to farmers at the Sowing Systems Field Day and the Minnipa Agricultural Centre Field Day, and forms were also sent to farmers known to grow break crops on Upper EP. All information was confidential and original forms were destroyed after the data was collated.

What did we find?

As only 14 survey forms were returned, the results represent only a small sub sample of the Upper EP farmers growing break crops. Canola and peas are the most popular break crops grown on Upper EP, with some vetch, beans, lentils and lupins being grown in areas suited to these crops. Farmers growing break crops are cropping between 2 and 17 % of their farm area to canola (*Figure 1(b)*), and 2 to 12 % with peas (*Figure 1(c)*). Some farmers growing both canola and pulses are cropping almost 30 % of their farm to break crops (*Figure 1(a)*). Of the farmers growing break crops, 30 % are growing only canola, 30 % are growing only peas and 40 % are growing both canola and other pulse crops.

Sowing Rates of Canola

All canola trials at Minnipa are currently sown at 5 kg/ha to ensure good establishment. Farmers are often sowing at lower seeding rates, such as 2.5 to 3 kg/ha, due to the cost of seed. The survey and trial data indicate that, provided there is adequate plant establishment, there is no decline in yield with lower seeding rates (*Figure 2*).

Sowing Date of Break Crops

The current recommended sowing date for break crops in this region is before the third week in May. However sowing after this date has still resulted in reasonable yields if followed by good spring rains, as shown by farmer experience in *Figure 3*. Sowing before the end of May or early June has still achieved high yields, with no obvious sharp decline after May 20.

Break Crop Varieties, Seeding Rates and Soil Types

Canola varieties grown include Beacon, Eyre, Surpass 501TT, 44C73 and ATR-Stubby. Canola has mainly been grown on the sandy loam type soils, and seeding rates as shown in *Figure 2* varied between 2 and 5 kg/ha, with 3-4 kg/ha being most common.

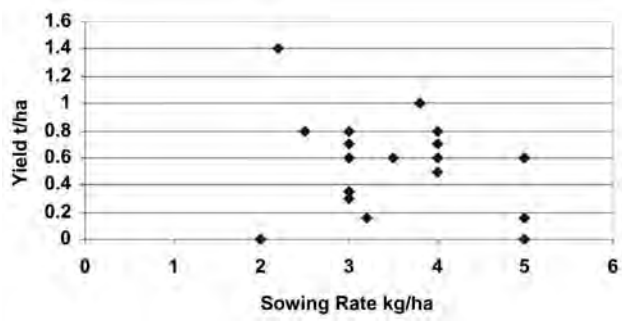

Figure 2: Sowing rates and yields for canola on Upper EP survey farms and field trials.

The most common field pea variety grown between 2000 and 2004 was Parafield, with some growers moving to Kaspa in 2004. Sowing rates of peas ranged from 80 to 150 kg/ha, with 90.to 110 kg/ha being most common. Peas are grown over a wide range of soil types from light sands to red loams.

Faba beans and lupins were mainly being grown on the sandy loam soils. Sowing rates for beans ranged from 100 to 140 kg/ha and for lupins from 90 to 110 kg/ha. Of the 14 vetch crops sown in the survey responses, 4 were sown with oats and harvested for hay, 4 were harvested for grain, and the rest were sprayed out as a brown manure crop.

Issues which survey farmers identified for further attention for canola included machinery modification, emergence problems, sowing depth, Polyphrades weevil, mustards and Roundup Ready canola. Pea issues to be addressed are harvestability (semi-leafless types will hopefully improve this), low profitability and high erosion risk. Other break crop issues are lupins suitable for low rainfall environments and alkaline soils, and the suitability of higher rainfall crops such as lentils.

Reasons that EP farmers gave for not growing break crops were: unsuitable soil types (rock) causing harvest difficulties; erosion risk; the need to retain livestock to control grasses; and the reliability of break crops.

SAGIT

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

GRDC Grains Research & Development Corporation

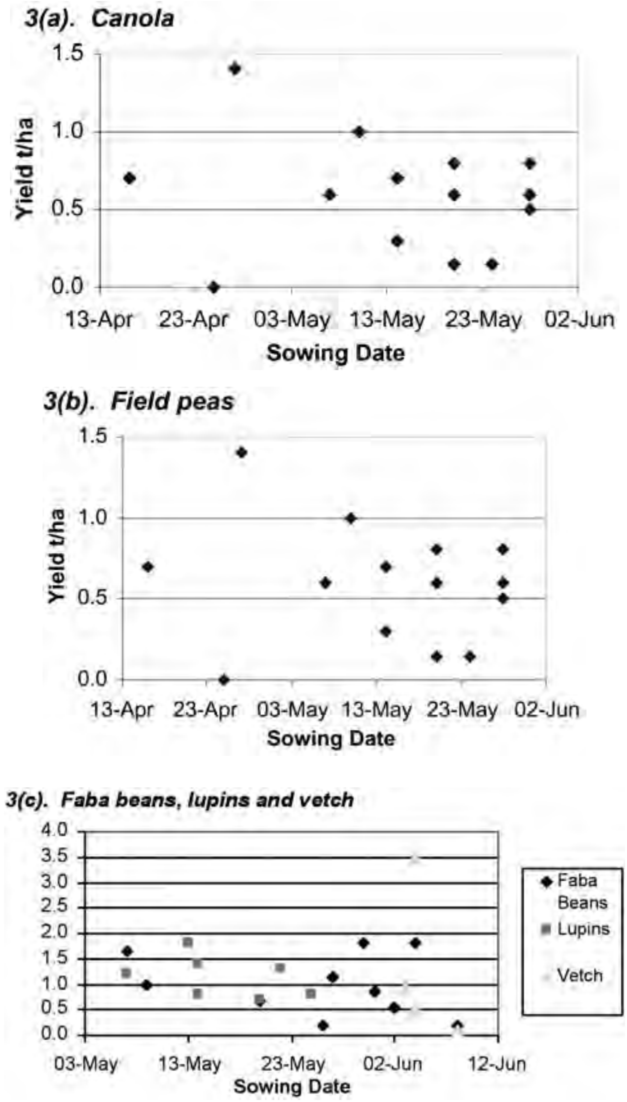

Figure 3: Sowing dates and yields for break crops on Upper EP survey farms and field trials.

Minnipa farmers comments on growing break crops on upper Eyre Peninsula

Growing canola

Bruce Heddle

We have been growing canola with varying success on a small scale since 1993. In 2004 it constituted just under 10 % of our farmed area and with current commodity prices, it is unlikely to rise above that level. With the unfavorable season in 2004 its yield performance dropped from 50 % of wheat to 40 % and the price moved well below double that of wheat, making the economic outcome far from satisfactory. That being said, the same is probably true for barley and most of the break crops this season, and while the oil content was poor, the sample was saleable without any complicated or expensive cleaning process or other price penalty for quality.

The appeal of canola for us is:

- That it has the potential to be profitable in its own right, with the rotational benefits a bonus. On our farm, this is more than can be said for the other alternative crops.
- It is not difficult to establish or harvest with our existing equipment.
- It poses a very low post harvest erosion risk, even after a crop failure.
- The stubble seems much more attractive to sheep than we ever expected. They preferentially graze it and do well on it long after it seems grazed out, with no erosion risk.
- The following cereal crops have tended to grow less bulk but still yield well – we get a better balanced crop that finishes strongly.
- Canola STRONGLY suppresses summer weeds for us.

Things we see as important for canola to work in our environment are:

- Some stored moisture considerably reduces risk. While we have had satisfactory results with no stored moisture, the chances of keeping yield above 50 % of wheat seem much better when that reserve exists.

- Inputs need not be high. Applied N is expensive when it is not needed, and in many systems where high quality pastures have been used in the recent past, the N supply can be met from soil reserves in this low yielding environment. If in doubt – test. We have no experience with canola into pasture - it always goes into wheat stubble. The cost of the inputs were about 25 % higher than wheat last year, including the use of Jockey, on seed and Heliothis control in spring, an uncommon situation for us.
- Establishment is not difficult on these soils which don't tend to crust. However sowing too shallow seems fatal. Sowing less than 20 mm deep requires good soil moisture for too long; about 30 mm in good conditions and down to 40 mm if chasing moisture on sandy loam's still seems okay. Generally, we No-till into slashed stubble without presswheels. We believe sowing rates of 2-3 kg/ha are adequate for the yields we are aiming for, i.e. probably very rarely above 1.5 t/ha. What we hope to get is fewer but stronger, more robust plants to deal with drought or insect attack. Last year we failed to achieve this aim because we sowed dry, which we will not do again without some good reason.
- Insects need to be watched closely. When establishment conditions are less than ideal, an attack that would be no problem in good conditions seems to be lethal. Any gaps in establishment are space for weeds, so you seem to need to get help and get moving.
- At yields up to 1-1.2 t/ha, direct heading with some conventional platforms seems successful. Cutterbar losses can be kept far below the cost of swathing, which is not without risk from wind anyway. Above these yields, swathing or a draper platform may well be necessary.

Growing pulse crops

Graeme Gerschwitz

Field peas

Our first attempt to introduce a legume into our rotation was back in 1999 and Alma (field peas) was the variety chosen. We have gradually changed to Parafield and this season (2004) Kaspa has been grown. We had not previously given peas consideration due to the many reasons people have offered as to why it is not practical to grow them in lower rainfall areas, e.g. lighter soils, all the spraying that was required, and the harvesting problems. Despite this we tried to grow them and have been pleased with the results. Wheat yields following peas have always been our best and the improvement of paddock health has been very noticeable.

We have settled on a sowing rate of 150 kg/ha due to having many paddocks with lighter soils and wanting to ensure adequate cover. We inoculate before seeding at the recommended rate. Most pea paddocks are sprayed prior to seeding with zinc sulphate at 10 kg/ha and receive 1.5 kg/ha as a foliar spray during the growing season. Spraying usually consists of Trifluralin at 1.2 L/ha at seeding followed by Lexone, at 180 g/ha pre–emergent where possible. Grass control using Targa, at 300 – 330 ml/ha is our normal option. Only one spray of an insecticide per season has been required for insects.

Fertiliser used is 10:22:00 or 18:20:00 at 60-65 kg/ha. We usually sow in the first to third week of May. Quite often peas are sown dry as black spot has not been a noticeable problem in the area. Seed dressings of P-Pickel T, at half rate are used.

Preferably the paddock is culti- packed or rolled after seeding to ensure good harvesting conditions. Generally the peas are sprayed with Gramoxone, at 1.2 L/ha to catch any escapee weeds and complete ripening evenly. Harvesting is with a pea plucker and commences in most years at the end of October. During the last five years our growing season rainfall has ranged from 152 to 259 mm and pea yields have ranged from 0.64 to 1.24 t/ha. It is important not to put stock into the stubbles too early due to the risk of erosion, as there is very little cover left after harvesting.

Beans

This year (2004) was our first attempt to grow beans, with Fiesta the chosen variety. Rainfall for the growing season was 211 mm and the yield achieved was 0.68 t/ha. Sowing was on May 20 at 120 kg/ha, with 65 kg/ha of 18:20:00 fertilizer. The seed was inoculated before seeding at the recommended rate. Spraying at seeding was Trifluralin @ 1.2 L/ha followed by Lexone, @ 180 g/ha pre-emergent. Targa, was used for grass control at 300-330 ml/ha. Fungicide was applied twice, although the second application was probably being overcautious. Insecticide was used for grubs.

Harvesting was easy although we needed to be as close to the ground as possible. Not needing a plucker is certainly an advantage, as the stubble is left standing providing some ground cover.

Generally extra spraying is needed for legume crops, but when you consider the spraying required to grass-free a paddock with little chance to gain an income, growing a legume crop and the improvement in crop yields the following year, it is worth the effort.

Growing lupins on deep sandhills

Kenny Gosling

Reasons for growing lupins are to build the fertility for the following crop in poor yielding sands, to control brome grass and capeweed with Targa, Simazine or Brodal,, and to supply grain for feedlotting stock.

Benefits of growing lupins are an increase in available nitrogen (seed must be inoculated), the disease cleaning effect (especially *Rhizoctonia* and take-all), and better weed control.

Downfalls are exposure to wind erosion, so some stubble cover is essential, only light grazing, if any, is possible, and higher inputs (chemical costs).

Peas are sown on the flats with lupins on the sandhills. We need to test the soil for free lime to determine suitable crop types. The new pea variety Kaspa performed well in 2004 (1.0 t/ha) compared to Parafield (0.6 t/ha).

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Location
Minnipa Agricultural Centre
Paddock – N4

Rainfall
Av. annual: 326 mm
Av. GSR: 241 mm
2004 total: 288 mm
2004 GSR: 223 mm

Paddock History
2004: Pulse/Canola trials
2003: Barque barley
2002: Yitpi wheat

Soil Type
Sandy loam, pH 8.9

Pea, bean, chickpea and vetch evaluation on upper Eyre Peninsula in 2004

Research

Larn McMurray[1], Amanda Cook[2], and Jim Egan[3]

SARDI, Waite Precinct[1], SARDI, Minnipa Agricultural Centre[2], SARDI, Port Lincoln[3]

Key Messages

- **Peas continue to be the most robust pulse option in low rainfall environments, but must be well managed.**
- **Early sowing is essential for maximising pulse yields, particularly in years with dry finishes.**
- **Parafield consistently yields higher than Kaspa in years of below average rainfall at Minnipa.**
- **Kaspa is resistant to downy mildew (widespread in 2004) and has less sensitivity to some post emergent herbicides than Parafield but is better suited to more favourable environments.**
- **Faba beans need to be sown early (before end of May) to minimise the risk of poor yields from harsh spring conditions. Farah and Fiesta are the best variety options currently available.**
- **Chickpeas and grain vetch are opportunity crops only in low rainfall environments and suited only to early sowing dates and the more favourable seasons.**

Why do the trial?

Pulses are a valuable break crop option in rotations in many low rainfall areas, although they do not currently fit all areas, situations and seasonal conditions. Pulse variety evaluation trials conducted at Minnipa contain breeding lines which are evaluated alongside commercial varieties, with the aim of producing varieties better adapted to low rainfall environments and also to evaluate commercial varieties for adaptation in these environments.

What happened?

Seasonal conditions were again challenging for pulse production on the Upper Eyre Peninsula in 2004. A later than ideal sowing date occurred for all pulses due to the patchy late break to the season. Light rainfall events at the end of May enabled sowing to commence in early June, although only a partial germination of weeds had occurred. In particular medic emerged poorly early and later germinations occurred. Rainfall events during July and August were above average allowing for relatively high amounts of early vegetative growth. Moderate levels of blackspot were present during winter, but due to seasonal conditions were not likely to have had a significant effect on yield. After a significant rainfall event on September 8 the growing season finished abruptly and for the third consecutive year growing season rainfall was below the average of 240 mm. Strong winds and high temperatures on September 20-21, combined with a lack of subsoil moisture, meant that flowering in late varieties and pod filling in all varieties occurred under high levels of moisture and temperature stresses. A severe hot wind event on October 12 rapidly matured all pulse crops making stems and pods very brittle. Pea varieties which were more erect at maturity were particularly susceptible to pod drop after this event while vetch was very susceptible to shattering. Harvest of pulses at Minnipa started on October 25, around two weeks earlier than usual.

The mean pea yield at the site was 0.82 t/ha, which compares favourably with yields from previous years with similar levels of growing season rainfall, and also with many cereal yields in 2004. The mean faba bean yield in the Minnipa trial was 0.55 t/ha. Desi chickpea site yield averaged 0.4 t/ha, which is respectable given the relative later maturity time of this crop and the savage abrupt finish to the season. The average site yield for vetch was 0.6 t/ha. Thus peas continue to be the most reliable pulse option in low rainfall areas, providing erosion risks are managed.

Peas

A replicated Stage 4/Interstate pea variety trial was sown on June 1 at seeding rates of 40 plants/m^2 (for tall types), 50 plants/m2 (medium height) and 60 plants/m^2 (short height), with 70 kg/ha of 18:20:0 fertiliser. The trial was harvested on October 25.

Grain yields of field peas at Minnipa correlated very closely with flowering date in 2004, with the earlier flowering lines being higher yielding (*Table 1*). This was similar at many locations in SA last year, although generally not as pronounced as at Minnipa. The lack of rain events after September 8 and the very quick finish under high levels of moisture stress meant that late flowering varieties suffered high levels of flower and pod abortion and failed to fill well. The highest yielding commercial varieties were Parafield and Dunwa at 0.92 t/ha. This was the first year that Dunwa, a sister line to Parafield, has yielded similarly to this variety. Dunwa was selected for the short growing season environments of WA and seasonal conditions favoured this variety last year. Kaspa was 7 % lower yielding than Parafield, which is similar to results in other years with below average growing season rainfall (*Table 2*).

A number of recently released pea varieties were also evaluated at Minnipa last year. The white pea variety Sturt which has looked promising in previous years at Minnipa was 5 % lower yielding than Parafield in 2004. Sturt generally flowers for a longer period than Parafield and like later flowering varieties in 2004 suffered yield loss. Sturt has Laura as one of its parents and has been released for the mallee areas of Victoria where it is the highest yielding variety long term. Sturt, like Parafield, is susceptible to downy and powdery mildew and blackspot. It is also susceptible to both post-sowing/pre-emergent and post-emergent applications of metribuzin on alkaline soils. Despite higher yields than Kaspa in dry years and at low rainfall sites and slightly higher yields than Parafield, Sturt's use in SA is likely to be limited due to its disease and herbicide susceptibilities.

Yarrum is a late flowering dun type with powdery mildew resistance released for Northern NSW. It was 12 % lower yielding than Parafield and like other late flowering varieties Mukta and Soupa was not suited to the dry finish to the season. Moonlight, a white pea released for Southern NSW, was also lower yielding than Parafield in 2004 and has been over 3 years evaluation at Minnipa.

Parafield is very broadly adapted and continues to be the best option for low rainfall areas, especially in years of below average rainfall and dry finishes to the season. Kaspa is less sensitive than Parafield to post-emergent applications of Broadstrike®, Raptor® and Spinnaker® on alkaline soils and is resistant to downy mildew. However it is better suited to the more favourable growing districts due to its later flowering characteristic. Several earlier flowering sister lines to Kaspa performed well at Minnipa last year, including 89-036-*9-8 (20 % higher than Parafield) and 89-036-*3-6 (1 % higher). These lines are being considered for release over the next few years.

General pea performance in 2004

Kaspa continues to offer higher yields to SA growers based on results from 2004 SARDI South Australian (SA) Field Crop Evaluation trials. Across all trials Kaspa was 4 % higher yielding than Parafield, which was less than in previous years due to the dry and early finish to the season in most districts, but still indicating that Kaspa is well suited to many areas of SA. The greatest yield advantage of Kaspa over Parafield, as in previous years, was at sites affected by downy mildew and in areas where finishing conditions were favourable, with low risks of high temperatures during flowering. Kaspa's poorest relative performance was generally in areas which had dry finishes with periods of heat stress in spring.

Heliothis (native bud worm) numbers were at extremely high levels in most areas of SA in 2004. In some instances where Kaspa and Parafield were sown adjacent, it appeared that a greater level of seed damage occurred in Kaspa under these high population levels. It is unclear whether these findings will be an ongoing issue in Kaspa. However frequent close monitoring and careful timing of chemical application during Kaspa's short and condensed flowering pattern is recommended in seasons of high Heliothis numbers.

Dark seed markings on the seed coat of Kaspa occurred in areas where very high temperatures in October and a lack of subsoil moisture brought on extremely rapid maturity. Preliminary germination tests have suggested that the germination ability of this affected seed has not been reduced.

Downy mildew was widespread in SA in 2004 and the prolonged cold temperatures exacerbated damage during winter. Many crops of Parafield suffered damage resulting in significantly reduced plant establishment and yield loss. Peas grown on paddocks where downy mildew has been previously identified should either be resistant types like Kaspa or treated with a seed dressing for the disease. Kaspa's susceptibility to blackspot is similar to that of Parafield and growers must implement blackspot management strategies to minimise yield loss due to this disease.

Table 1: 2004 Minnipa selected pea trial yields (as a % of Parafield) and flowering dates, and long term predicted yield (1997-2004) as a % of Parafield

Variety/Line	2004 Yield	2004 Flowering Date	Long term yield
Dunwa	100	Sept 1	91 (4)
Kaspa	93	Sept 9	104 (5)
Moonlight	96	Sept 1	92 (3)
Mukta	73	Sept 13	94 (6)
Parafield	100	Sept 1	100 (7)
Soupa	92	Sept 9	95 (6)
Sturt	95	Sept 1	103 (4)
Yarrum	88	Sept 9	97 (2)
89-036*3-6	101	Sept 3	N/A
89-036-*9-8	120	Sept 1	103 (2)
Parafield's Yield (t/ha)	0.92		1.52

Number of comparisons in brackets

Faba beans

A combined Stage 3 and 4 faba bean trial with 50 entries, and an early generation S2 trial with 34 breeder's lines and Fiesta and Fiord check plots, were sown on MAC on June 2. Seeding rates were 24 seeds/m^2 for most entries, except for several larger-seeded lines at 18 seeds/m^2. Fertiliser application at sowing was 70 kg/ha of 18:20:0. Trials were harvested on November 15.

Experience with faba beans on Upper Eyre Peninsula has shown the importance of early sowing, preferably before mid-May, to achieve good yields. The early June sowing therefore, combined with the hot, dry spring conditions, resulted in below average yields in these trials. Several very hot days towards the end of September brought flowering to an abrupt end in later lines, so that yields were largely determined by maturity time. Average yield in the S3/4 trial was 0.55 t/ha, and Fiesta's yield of 0.59 t/ha was well behind its long-term average at Minnipa of 0.94 t/ha.

Table 2: Parafield and Kaspa pea trial yields compared with rainfall and sowing date at Minnipa, 1999-2004

	1999		2000		2001		2002		2003		2004	
	Parafield	Kaspa	Parafield	Kaspa	Parafield	Kaspa	Parafield	Kaspa	Parafield	Kaspa	Parafield	Kaspa
Yield (t/ha)	0.90	0.81	2.20	2.24	2.46	2.56	1.40	1.40	0.87	0.79	0.92	0.86
GSR (mm)	210		299		267		219		204		223	
Annual Rainfall	268		389		354		277		263		288	
Seeding Date	May 31		June 2		May 29		May 27		June 8		June 1	

Farah, the most recent faba bean variety release for southern Australia with improved ascochyta resistance and more uniform seed size and colour than Fiesta, yielded much the same as Fiesta at Minnipa in 2004, while its long-term yield there has been 98 % of Fiesta. The crossbred line, Icarus*Ascot/7/3, which is planned for release in 2006, yielded poorly (0.47 t/ha) relative to Fiesta, well short of its long-term (5 year) average of 4 % better than Fiesta. Its slightly later maturity is a likely factor in its poorer result in 2004. The major advantages of this variety will be improved ascochyta and chocolate spot resistance, hopefully making disease control in beans easier, cheaper and less of a risk.

One of the best yielders in the Minnipa 2004 trial was Cairo (0.72 t/ha), a new release for the northern NSW / southern Queensland bean production areas. The hot flowering and ripening conditions appear to have suited Cairo, but its poor ascochyta and chocolate spot resistance make it a non-favoured variety choice for SA. The top yielding line, 668*683/34, achieved 0.77 t/ha, 30 % better than Fiesta. This line was 5 % higher in 2003, and indicates the potential for improving bean yields in low rainfall environments. The fact that 12 of the 50 entries in the S3/4 trial at Minnipa in 2004 were selected specifically for low rainfall conditions and not included at other SARDI S3 trials around the State, highlights the current emphasis on breeding faba beans for this environment.

Chickpeas

A replicated Stage 4 desi chickpea variety trial was sown on June 3 at seeding rates of 50 plants/m^2 for desi types and 35 plants/m^2 for the kabuli check plot (Genesis 090), with 70 kg/ha of 18:20:0 fertiliser. The trial was harvested on November 26.

Yields of all chickpea varieties were greatly reduced by the late sowing date and the dry finish to the season at Minnipa in 2004. Most varieties were reasonably well grown due to good late winter rainfall, however the trial averaged just 0.4 t/ha, with the highest yielding commercial variety being Howzat at 0.44 t/ha. As there was no ascochyta disease in the trial due to the dry conditions, varieties like Howzat with only partial resistance, were not penalised last year.

The newly released ascochyta resistant varieties Genesis 508 and Genesis 090 were 35 % and 2 % lower yielding than Howzat respectively. Due to its lower yields than Howzat, poor adaptation to dry conditions and inherently small dark seed (making it less preferred by marketers than Howzat), Genesis 508 will not be suited to low or medium to low rainfall areas. Genesis 090, a small seeded kabuli type, demonstrated in 2004 that it is better suited to low rainfall areas than 508. When available Genesis 090 will provide chickpea growers in medium to low rainfall areas with a low disease risk option of growing the crop. Disease management trials have shown that only one fungicide spray (at podding) is required to successfully grow these varieties under severe ascochyta disease pressure.

Sonali and Rupali are two desi varieties released by the Department of Agriculture Western Australia for their environments. They were selected in WA for their ability to set seed at lower temperatures than commercial varieties. They both have only intermediate resistance to ascochyta (slightly better than Howzat but less than Genesis 508 and 090) and suffered significant yield loss in trials where the disease was present and not controlled by regular fungicide application. This small increase in the resistance level to ascochyta is not considered enough for SA growers due to the high disease pressure which occurs in this State. If grown in SA a proactive complete disease prevention strategy, similar to that used in Howzat, is required which will greatly reduce the economics of growing these varieties. Yields of both varieties at Minnipa were below Howzat in 2004, although Sonali has yielded higher than Howzat in the past.

Despite the release of ascochyta resistant and other better adapted varieties chickpeas are still poorly adapted to the Upper EP, particularly in years with late seasonal breaks. Currently chickpeas on the Upper EP are limited to an opportunity crop in the more favourable areas when the season break is early. If grown in these areas, the resistant types are recommended due to their low risk to the disease and the reduced fungicide inputs required. Recognising this limitation in the current chickpea germplasm, we will no longer conduct a chickpea Stage 4 evaluation trial at Minnipa from 2005. However medium to low rainfall site evaluation will continue with trials at Lock, Lameroo and Balaklava.

Vetch

A replicated Stage 4 vetch variety trial was sown on June 3 at seeding rates of 60 plants/m^2, with 70 kg/ha of 18:20:0 fertiliser. The trial was harvested on October 28.

Vetch grain yield averaged 0.58 t/ha in this trial. The late break and dry finish to the season severely reduced dry matter production early in the season and consequently grain yield. Vetch was very susceptible to shattering in 2004, particularly in susceptible lines like Languedoc, due to the rapid dry end to the season. Blanchefleur was the highest yielding variety at 0.6 t/ha, approximately 35 % higher yielding than the early maturing variety Languedoc and the late maturing variety Morava.

The SARDI vetch breeding program is currently building up seed of an advanced line for potential release in 2006. This line SA34719 is from a complex cross between Morava, Languedoc and a Russian variety and is seen as a potential replacement for Blanchefleur and Languedoc in medium and low rainfall areas. SA34719 is primarily a grain type, as dry matter production is less than Morava although greater than Languedoc. This line was 5 % higher yielding than Blanchefleur at Minnipa in 2004 and long term is 3 % lower yielding than Blanchefleur. Flowering and maturity timing of this line is similar to that of Blanchefleur, however it is resistant to rust and ascochyta. Toxin levels are similar to Morava and it has a beige coloured cotyledon.

Acknowledgements

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Research

Miltaburra and Buckleboo break crop trials

Amanda Cook[1], Trent Potter[2] and Jim Egan[3]

SARDI, Minnipa[1], SARDI, Struan[2], SARDI, Port Lincoln[3]

Try yourself

Location
Miltaburra – L,C and D Mudge

Rainfall
Av. annual: 306 mm
Av. GSR: 212 mm
2004 total: 255 mm
2004 GSR: 218 mm

Paddock History
2004: Canola
2003: Carnamah wheat
2002: Frame wheat

Soil Type
Light sandy loam

Location
Minnipa Agricultural Centre - N4

Rainfall
Av. annual: 326 mm
Av. GSR: 241 mm
2004 total: 288 mm
2004 GSR: 223 mm

Paddock History
2004: Pulse/Canola trials
2003: Barque barley
2002: Yitpi wheat

Soil Type
Heavy sandy loam

Key Messages

- **Parafield peas out yielded Kaspa at Miltaburra, Buckleboo and Minnipa in 2004, but Kaspa is still a realistic option for the district.**
- **No yield response to either granular inoculants or standard slurry inoculation of seed was measured in Kaspa peas.**
- **Farah is the variety of choice in faba beans for yield, disease risk and marketability.**
- **Triazine tolerant canola varieties have shown good yields with weed control flexibility.**
- **Progress is being made in developing new break crop varieties better suited to Upper EP.**

Why was it done?

The break crops program on Upper EP is funded by the South Australian Grain Industry Trust (SAGIT) with the aim of developing new varieties of field peas, faba beans, canola and mustards which are better adapted to our environment and soil types.

While Minnipa Agricultural Centre is the major focus for this work, where all breeding material is sown and monitored throughout the growing season, smaller trials were also sown at Miltaburra and Buckleboo in 2004 with selected pea, bean, canola and mustard varieties. These trials aimed to compare current varieties and breeding lines on different soil types, and in response to EPFS group priorities, determine if current break crop varieties are performing better than past varieties.

How was it done?

The trials were sown on May 22 at Miltaburra and June 7 at Buckleboo, to complement the main trials sown on Minnipa on May 21 to 23 (canola) and June 4 (pulses). Pulses were sown with 70 kg/ha of 18:20 or 10:22 fertiliser and the oilseeds with 70 kg/ha of 19:13:0 and 50 kg/ha of urea below the seed.

Trials were sprayed with 1.0 L/ha Roundup Powermax®, and 1.2 L/ha TriflurX®, pre-seeding, and 1 L/ha Lorsban®, post-seeding for insect control. The triazine tolerant canola and beans received 800 ml/ha of Simazine at Miltaburra and 1.0 L/ha Simazine® at Buckleboo post seeding. Weeds were controlled later in the season with 220 ml/ha of Select, and 120 ml/ha Fastac Duo, for insects.

Rainfall received for the growing season was 218 mm at Miltaburra, 170 mm at Buckleboo and 223 mm at Minnipa. The soils at Miltaburra and Buckleboo were both light sandy loams and Minnipa a heavy sandy loam.

What did we find?

The yields are a reflection of the rainfall and growing conditions, which were very variable across Eyre Peninsula. The trial at Miltaburra was sown early and yielded well due to good rainfall during the growing season. *Figure 1* shows the decline in yield of each of the field pea entries from west to east across the three sites, in response to sowing date and rainfall changes.

Field peas

The average yields of peas were 1.4 t/ha at Miltaburra, 0.82 t/ha at Minnipa and 0.49 t/ha at Buckleboo. Parafield out yielded Kaspa at all three sites in 2004, and a strong reduction in yield with later sowings was evident (*Figure 1*). The suitability of Kaspa peas to our environment, due to its later and shorter flowering window, has always been an issue and the slight yield decline against Parafield this year may be due to higher temperatures during flowering/pod filling. However Kaspa should still be considered as an option, due to its improved harvestability. Several pea breeding lines also performed well in 2004, although they must yield well for several years to be considered for release as new varieties.

Trials with Kaspa peas were included at Buckleboo and Minnipa to compare new granular inoculants with the standard procedure of slurry inoculation of seed. The granular inoculants tested were ALOSCA® and Bio-Care®, mixed dry with the Kaspa seed at a rate to deliver granules @ 10 kg/ha. Uninoculated plots were included as controls, to measure if background soil rhizobium levels were adequate for satisfactory nodulation and crop growth. Root nodule scores, early plant top weights, grain yield and seed weights were measured to assess inoculation effects. None of the inoculation treatments gave significant responses over the control plots in any of these measures at either site, with the exception of a small increase in root nodules with the standard slurry treatment (17 % higher than control) and the Bio-Care granules (13 % higher than control) at Buckleboo. It appears that soil rhizobium levels at these sites were generally adequate for effective nodulation in peas without the need to inoculate seed.

Faba beans

The average yields of faba beans were 0.55 t/ha at Minnipa (70 lines tested) and 0.41 t/ha (4 varieties tested) at Buckleboo (*Table 1*). Farah is the current recommended variety due to better disease resistance (particularly ascochyta) than Fiesta

Location
Buckleboo – M Schaefer

Rainfall
Av. annual: 325 mm
Av. GSR: 305 mm
2004 total: 190 mm
2004 GSR: 170 mm

Paddock History
2004: Surpass 501TT Canola
2003: Barque Barley
2002: Westonia wheat

Soil Type
Light sandy loam

and Fiord, and more uniform seed size and colour, improving marketability. Farah's yields were similar to Fiord and Fiesta at Buckleboo, and slightly down on Fiord's at Minnipa. The yields of the crossbred line Icarus*Ascot/7/3 were behind at both sites, but this line has much improved dual resistance to ascochyta and chocolate spot, which should make it a preferred variety in districts where these diseases are a constant risk. Release of Icarus*Ascot/7/3 is anticipated in 2006.

Canola, Juncea canola and mustard

Mustard averaged slightly higher yields (0.5 t/ha) than canola (0.48 t/ha) at Miltaburra. Overall, triazine tolerant canola varieties performed better at Miltaburra than conventional lines, averaging 0.62 t/ha due to better weed control options (*Figure* 2). Seed source and seeding rates were also included in the Miltaburra trial (*Table* 2). Farmer's seed of ATR-Eyre outyielded ATR-Eyre seed from within the breeding program at both the Miltaburra and Buckleboo sites. Grading farmer ATR-Eyre seed for larger seed size (1.8 mm sieve) gave no yield increase over ungraded seed at Miltaburra, despite looking better early in the season.

Table 1: Yield of Faba Beans at Minnipa and Buckleboo in 2004.

Variety	Yield t/ha	
	Buckleboo	Minnipa
Fiord	0.432	0.64
Fiesta	0.428	0.56
Farah	0.418	0.58
Ic*AS/7/3	0.362	0.47

There were no yield differences between seeding rates of 10, 5 and 2.5 kg/ha at Miltaburra, indicating lower seeding rates are acceptable if plant establishment is successful (*Table* 2). Turnip was included in the trial at Miltaburra as a possible biodiesel source (oil quality not available yet) and establishment was good due to high background population, but germination may be an issue due to small seed and hardseedness.

The later seeding and lower rainfall at Buckleboo resulted in lower yields, at 0.33 t/ha for mustards, 0.29 t/ha for conventional canola, and 0.24 t/ha for triazine tolerant lines.

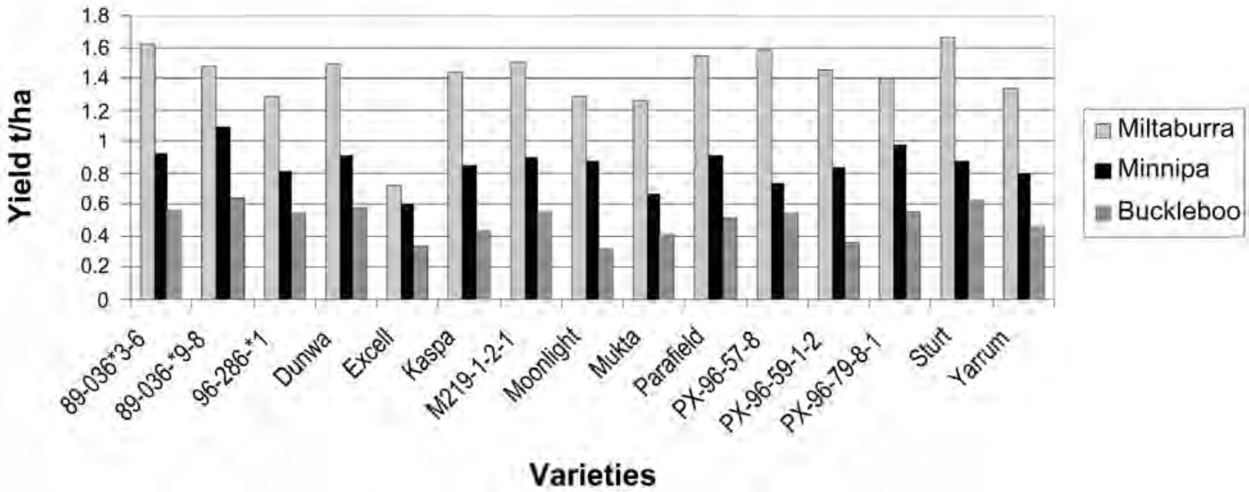

Figure 1: Yield of field pea varieties at Miltaburra, Minnipa and Buckleboo in 2004.

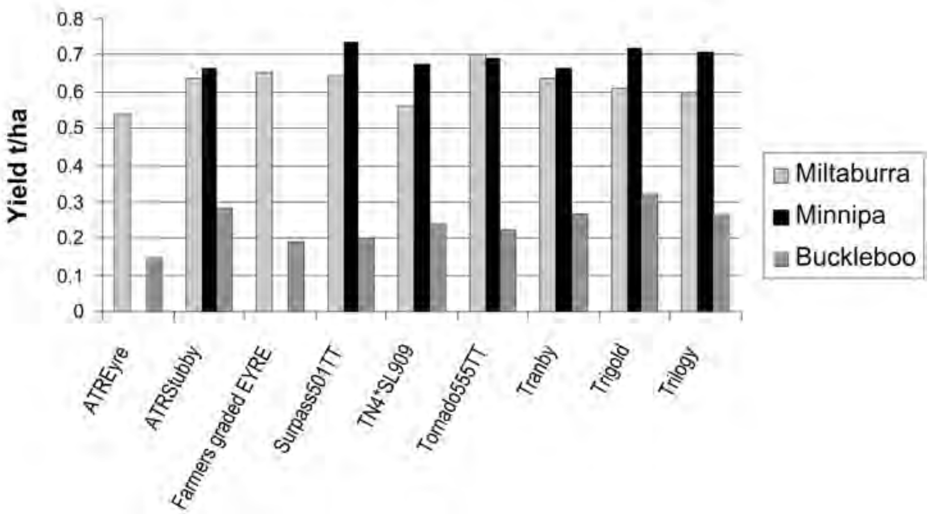

Figure 2: Yield of triazine tolerant canola at Miltaburra, Minnipa and Buckleboo in 2004.

Table 2: The effect of seed grading and seeding rate on canola yield at Miltaburra in 2004.

Variety	Yield t/ha
ATR Eyre	0.53
Farmers Ungraded Eyre	0.64
Farmers Graded Eyre	0.65
Surpass 501 TT	0.64
Double Rate Surpass 501 TT	0.66
Half Rate Surpass 501 TT	0.57

Here also the lower seeding rate of Kimberley (2.5 kg/ha) out yielded the 10 and 5 kg/ha seeding rates, probably due to less moisture stress (*Figure 3*).

At Minnipa the mustards did not perform as well as expected, partly due to damage from Lontrel® applied to control medic. The Lontrel® was applied six weeks post-sowing but earlier developing mustard lines indicated Lontrel® damage with some twisting of the branches and pods missing. This suggests that mustards may be more susceptible to Lontrel® damage than canola and some trial work on timing and rates of chemical applications will be undertaken on mustards in 2005.

What does this mean?

All the graphs show the same trend in varietal yields across the three sites, so we can be confident that superior lines selected at Minnipa will also perform well on other soil types in low rainfall districts of Eyre Peninsula. Since a number of the new breeding lines are performing better then current varieties, we are gradually moving towards new varieties of peas, beans, canola and mustards which are better adapted to our environment and soil types.

Acknowledgements

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SAGIT

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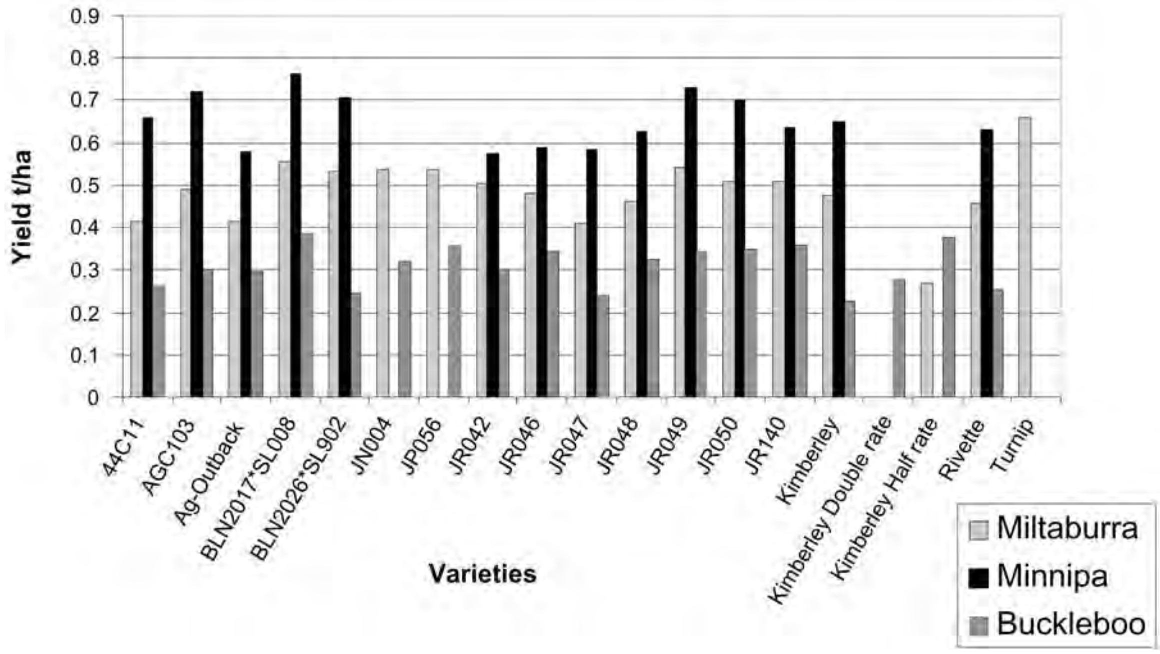

Figure 3: Conventional canola, Juncea canola and mustard (J lines) at Miltaburra, Minnipa and Buckleboo in 2004.

Disease risk index (DIRI) for blackspot of field peas

Jenny Davidson

SARDI, Waite Campus.

Research

Key Messages

- **A computer model (DIRI) can predict blackspot risk in different locations and under varying management strategies.**
- **Blackspot in field peas is determined by:**
  - environment (rainfall intensity)
  - management (sowing time, paddock rotation, proximity to pea stubbles)
- **DIRI allows growers to determine the disease risk prior to sowing and make informed management choices.**

Validation of DIRI

The blackspot complex, also known as ascochyta blight, is a common disease of field peas in Australia, and is found in most pea crops to varying degrees. Because there is no resistance to blackspot, disease control is reliant upon management practices such as delayed sowing to reduce seedling infection, wider rotations to reduce spore carryover in the soils and placement of pea crops away from the previous years pea stubbles. These strategies may have an impact on final yields, especially delayed sowing, so crop management and final yield is often a compromise between longer growing seasons and disease minimisation.

DIRI predicts blackspot disease development and percentage yield loss from disease by using variables such as sowing date, rainfall before and after sowing, and degree-days in the growing season. Used in combination with long range weather forecasting and historical climatic conditions, this index will assist growers to make management decisions that will maximise pea yields and minimise disease. The index was validated in pea crops on Eyre Peninsula in the Wudinna region, Yorke Peninsula and Riverton in the 2003 growing season and again on the Eyre Peninsula in 2004.

Observed blackspot levels were correlated against blackspot levels predicted by DIRI. In the high rainfall and medium rainfall crops, the observed disease levels and expected levels generated from DIRI were comparable (*Figure 1*). DIRI did not accurately predict blackspot in the low rainfall zone and additional data was collected in 2004 (*Figure 2*) to correct this. Analysis of 2004 data is currently underway.

Blackspot is higher in early sown crops (*Figure 3*) because the fungal spores are released from pea stubbles with rain and are particularly numerous in May and early June. Farmers are often encouraged to delay sowing until at least the second week of June to avoid high disease level, however in short season areas such as the upper Eyre Peninsula the yield loss associated with delayed sowing could be greater than the yield loss from blackspot.

Table 1: Yield loss estimated by DIRI, from blackspot infection, in commercial field pea crops monitored in 2003

Zone	Blackspot score (0-5)	Blackspot risk	% Yield Loss
High Rainfall	0.81-1.6	Low	0.0 -1.9
	1.97-1.99	Low-Medium	4.7-4.8
	2.04-2.77	Medium	5.2-10.8
Medium Rainfall	1.25-1.73	Low	0.0-2.9
Low Rainfall	0.9-1.7	Low	0.0-2.6
	2.4-2.6	Medium	7.9-9.5
	3.6-3.8	Medium-High	17.1-18.7

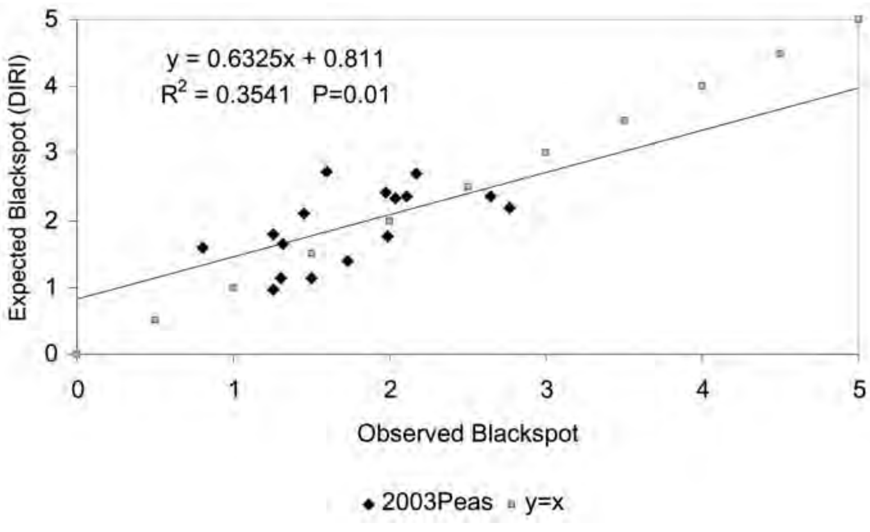

Figure 1: Comparison of blackspot scores assessed in field pea crops and blackspot scores generated by DIRI in high and medium rainfall zones (>400mm) in 2003.

Avoiding infected stubbles can reduce Blackspot. Pea crops should not be planted immediately adjacent to pea stubbles, nor should they be planted within one kilometre downwind of stubbles, since the fungal spores will be blown in the direction of the seedling crop. A number of the crops assessed in the Wudinna region on Eyre Peninsula in 2003 and 2004 fitted into this category and this was reflected by the amount of blackspot seen in the crops.

Yield loss associated with blackspot has been determined in previous fungicide trials run by SARDI and this relationship has been incorporated into DIRI. This relationship was used

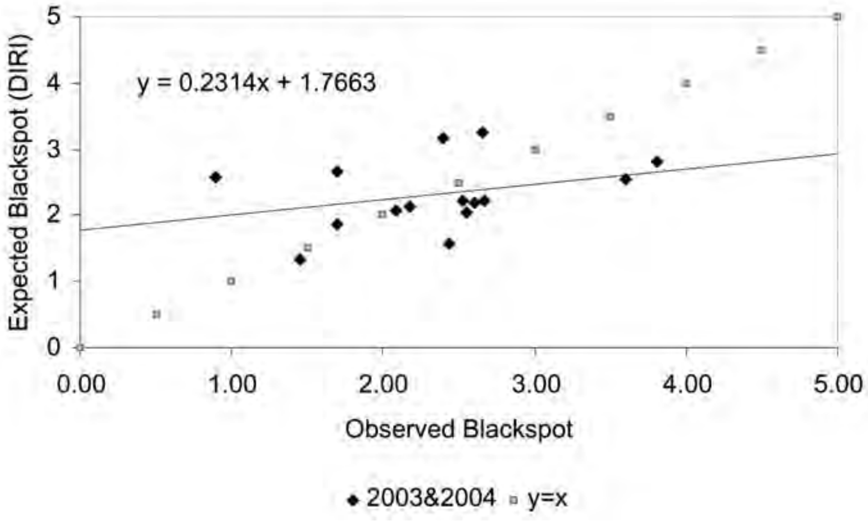

Figure 2: Comparison of blackspot scores assessed in field pea crops and blackspot scores generated by DIRI in the low rainfall zone (325 mm) in 2003 and 2004.

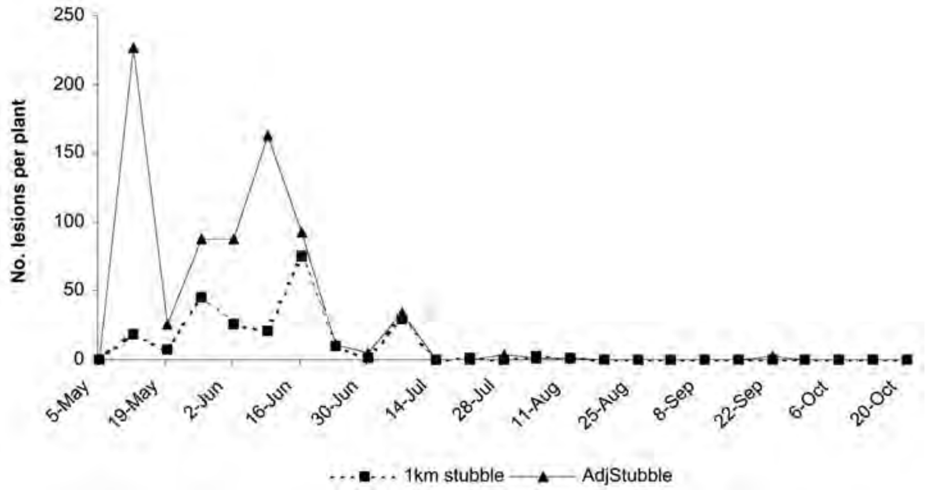

Figure 3: Blackspot infection from adjacent pea stubble compared to pea stubble 1 kilometre distant, from May to October.

to estimate the yield loss associated with blackspot in each of the crops that were assessed in 2003 (*Table 1*). Crops in the medium rainfall zone (Minlaton) had negligible yield loss from blackspot infection, while those in the other two zones varied extensively. Early sowing in the high rainfall zone (Riverton) resulted in yield losses of about 10 %. All crops in the low rainfall zone (Wudinna and Minnipa) were relatively early sown; a necessary part of pea management in this area due to the shorter growing season that is available. A slightly higher than normal rainfall in this area lead to greater levels of blackspot and the highest amount of yield loss in this data set (17 - 18 %).

Further research is proposed to link the DIRI blackspot model with an APSIM pea yield model. This will enable growers to use the predictions to optimise yields through selecting a sowing date that will maximise yields, but minimise disease and also enable them to incorporate additional management decisions.

DIRI is available on SARDI website at -
http://www.sardi.sa.gov.au/pages/field_crops/pathology_quarantine/pulse/diri_blackspot.htm:sectID=737&tempID=47Project background

Acknowledgements

DIRI blackspot was initially produced by Dr. Alexandra Schoeny, INRA France, who visited SARDI Crop Pathology Oct 2001 - July 2002.

Neil (Fish) Cordon Senior Extension Agronomist - Minnipa Agriculture Centre, Michael Richards SYP Alkaline Group-Minlaton and Andrew Parkinson - Landmark Riverton, assisted with the validation of the DIRI.

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Searching for answers

Location
Minnipa Agricultural Centre – N4

Rainfall
Av. annual: 326 mm
Av. GSR: 241 mm
2004 total: 288 mm
2004 GSR: 223 mm

Paddock History
2004: Pulse trials
2003: Barque barley
2002: Yitpi wheat

Soil Type
Alkaline red sandy loam, pH 8.9

Plot size
10m x 1.44m x 4 Reps

Herbicides effect yield and nitrogen fixation in peas

Research

Elizabeth Drew, Gupta Vadakattu, David Roget

CSIRO, Waite Campus

Key Messages

- **In-crop applications of some broadleaf and grass herbicides can reduce nodulation and nitrogen fixation of peas.**
- **Timing of herbicide application and seasonal conditions play an important role in herbicide-legume interactions.**
- **Late applications of some broadleaf and grass herbicides can reduce crop yields.**

Why do the trial?

In the low rainfall region of the Murray Mallee, a number of herbicides recommended for use in legumes (vetch and peas) have been found to reduce the number of nodules per plant and nitrogen fixation. Herbicides are a vital component within current farming systems and are commonly used in legume crops and pastures to control weeds.

Trials were conducted at the Minnipa Agricultural Centre in medic and peas in 2002 and 2003 and in peas in 2004. Trials in 2003 indicated post-emergent applications of some herbicides caused crop yellowing and reduced nodulation of peas. Single applications of flumetsulam, imazethapyr, metribuzin, and clethodim caused yield reductions in peas (*Refer to 'EPFS 2003 pg 40' for more information*). The aim of the trial in 2004 was to investigate the effects of six commonly used herbicides for the control of grass and/or broadleaved weeds in peas on the growth, nitrogen fixation and yield of the crop. The impact of spray time was also investigated.

How was it done?

Replicated plots of Parafield peas (fertilised with 0:20:0 @ 70 kg/ha) were sown on 3rd June 2004.

Half the post-emergent herbicide treatments were applied on the 30th June when the crop was at the 3-node growth stage. The remainder of the trial was sprayed on September 1st just as flowering commenced (10 - 20 % crop had commenced flowering). It should be noted that spraying during flowering is not recommended practice for herbicide treatments flumetsulam and diflufenican. Herbicides were applied using a 2.0m shrouded boom with TeeJet® 11002 nozzles at a pressure of 32 psi. Water volume was 100 L/ha.

Table 1: Herbicide treatments applied to Peas.

Active Chemical	Herbicide Rate	Additive	Recommended label application time
Control (no herbicide)	-	-	-
Flumetsulam 800 g/kg	25 g/ha	Uptake 0.5%	2-6 node
Diflufenican 500 g/L	200 ml/ha	-	3 node – pre flowering
Butroxydim 250 + Fluazifop P butyl	280 g/ha	DC Trate 2%	Any
Clethodim 240 g/L	250 ml/ha	Hasten 1%	Not stated
Sethoxydim 186 g/L	1.0 L/ha	DC Trate 1%	Not stated
Haloxyfop 520 g/L	40 ml/ha	Uptake 0.5%	2 node – full flowering

Assessment: plants were sampled three weeks after the initial herbicide application. Plant dry matter and nodulation was assessed. Anthesis (end flowering) dry matter cuts were taken on 21st of October. Peas were harvested on 28th October.

What happened?

Results for 2004 show the initial application of herbicides had no significant effects on crop growth or nodulation measured at three weeks after spray time, however some trends were apparent, compared to the clear effects observed at the site in 2003 (*Table 2*). Several factors contribute to the magnitude of the herbicide effect including crop health and herbicide application time. Plants were sprayed much earlier in the growing season in 2004, 4 weeks after sowing vs. 6-8 weeks after sowing in 2003, which is reflected in the SDW in *Table 2*. Larger plants in 2003 would not only have a greater capacity to absorb the herbicide, but would also have a greater demand for nutrients and moisture and therefore be more susceptible to environmental stress at the time of spraying.

Late herbicide application of herbicides in 2004 (start flowering) significantly reduced anthesis crop dry matter (data not shown) and yields (*Figure 1*) compared to unsprayed and 3 node sprayed treatments. The grass herbicides tested reduced yields up to 43 %, it should be noted that while broadleaf herbicides flumetsulam and diflufenican reduced yields they are not recommended for late spraying (*Table 1*).

What does it mean?

Reductions in nodule number due to herbicide applications can translate to a reduction in nitrogen fixation by the legume thus affecting the legume crop yield and also less nitrogen carry over benefit to the following wheat crop, as was observed in pea trials at Waikerie in 2003. Further analysis will determine if herbicides affected nitrogen fixation at Minnipa in 2004.

As the growing season progresses the crop has an increasing demand for moisture and nutrients. Late applications of herbicides is an additional stress to the crop which can either directly impact on pod formation or reduce photosynthesis during flowering and pod filling when the demand for carbon is high. Hence, the consequence of late spraying can be reduced yields.

Herbicides are essential in intensive faming systems, particularly with the move towards reduced till systems and management should not be compromised. Our work aims to identify which herbicides may put a legume or pasture crop at risk, hence allowing farmers to make more informed herbicide choices. Early control of weeds through the use of post-emergent herbicides may have less impact on legume nodulation, nitrogen fixation and crop yields than late herbicide applications.

*Table 2: Comparison of herbicide effects on nodulation (Nodule score and Effective nodules per plant) and shoot dry matter (SDW) in peas grown at Minnipa in 2003 and 2004. Results are for three weeks after herbicide application (T1). * indicates values significantly (P<0.05) lower than control treatments.*

Herbicide	2003		2004	
	Nodule Score (/5)	SDW (T1) t/ha	Eff nod/plant	SDW (T1) t/ha
Control	3.85	1.64	44.6	0.23
Flumetsulam	*2.95	1.53	28.6	0.23
Diflufenican	3.20	1.71	41.4	0.24
Diuron PSPE	*3.15	1.62	-	-
Metribuzin	*2.25	*1.10	-	-
Imazethapyr	*2.90	1.52	-	-
Butroxydim + Fluazifop P	-	-	35.1	0.25
Clethodim	*2.79	*1.26	32.6	0.26
Sethoxydim	-	-	32.7	0.22
Haloxyfop	*3.05	1.63	42.6	0.22

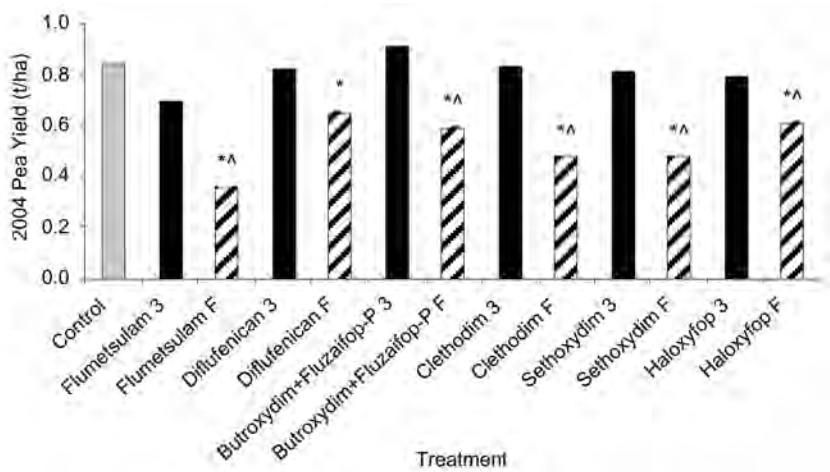

*Figure 1. Herbicide spray time (3 = 3 node, F = flowering) affected yield of Parafield peas grown at Minnipa in 2004. * indicates values significantly (P<0.05) lower than controls and ^ indicates where yield is significantly (P<0.05) lower in flowering application compared to 3 node application of the same herbicide.*

Acknowledgements

Thanks to Amanda Cook and Michael Bennet from the Minnipa Agricultural Centre for their assistance implementing, maintaining and sampling the trial. This work was funded by the GRDC.

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Lupin management on low rainfall sand hills

Research

Leigh Davis[1] and Jim Egan[2]

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

Key Messages

- **Mandelup was the top yielding lupin variety on a non-calcareous sandy soil in a low rainfall environment in 2004.**
- **No evidence of nodulation failure or response to inoculation, where lupins were previously grown.**
- **"Worksburger" fertiliser treatment (high nutrient levels, in fluid form) gave the highest lupin yields, but was the least economic.**
- **Rates of nutrients applied showed a larger influence on lupin yield than placement and fertiliser sources.**

Why do the trials?

Lupins have been grown successfully on sand hills low in calcium carbonate (free lime) for many years but have not always yielded well. Recent variety releases with better adaptation to low rainfall conditions have the potential to lift yields on sand soils, while deep banding of fluid fertilisers has shown great success with cereals on sand hills. Nodulation failure is another potential issue contributing to low productivity on sand hills, and farmers have questioned the value of using new granular inoculant products on pulse crops.

These trials were conducted to investigate the effects of the management factors variety choice, granular inoculants and deep ripping with fluid fertiliser injection on lupin production on low rainfall sand hills on Upper Eyre Peninsula.

Location
Chilpuddie
Closest town: Minnipa
Cooperator: Kenny Gosling

Rainfall
Av. Annual: 300 mm
Av. GSR: 220 mm
2004 Actual: 250 mm
2004 GSR: 206 mm

Yield
Potential: 1.14 t/ha

Paddock History
2003: Chebec Barley
2002: Frame Wheat
2001: Yitpi Wheat

Soil Type
Land System: Dune swale, loamy sand

Plot size
Variety evaluation & inoculation trials: 10m x 1.5m x 3 reps
Fluid fertiliser trial: 22m x 1.5m x 3 reps

Other factors
Hot dry winds and moisture stress at flowering and grain fill

How was it done?

The trial site was chosen on the ridge of a non-calcareous sand hill at Chilpuddie, north of Minnipa. The sand was tested as low fertility (0.27 % organic carbon), and although high pH (8.3 in water), showed no acid reaction down to 50 cm, indicating the absence of free lime to this depth. In this dune-swale land system, the farmer sows lupins on the sand rises (dunes) and peas on the heavier flats (swales).

The variety evaluation trial compared six commercial varieties of narrow-leafed lupins and three promising breeders' lines. Voluntary pasture was also included in the treatments, but medic regeneration was very poor in these plots. All lupin entries were sown at 95 kg/ha, and seed inoculated with Group G inoculum pre-sowing. Plots were sown on May 22, with standard granular 17:19:0 Zn2 % fertiliser @ 70 kg/ha drilled below the seed. Weeds and insects were controlled with the chemical applications listed in *Table 1*, which were the same across all three experiments.

The granular inoculant trial compared the standard wet slurry inoculation treatment of seed pre-sowing, with each of the new granular inoculant products, ALOSCA® and Biocare®, mixed dry with seed at a rate to deliver granules @ 10 kg/ha. All inoculant products contained the specific lupin (Group G) strain. Uninoculated treatments were included as controls, to measure if background soil rhizobium levels were adequate for satisfactory nodulation and lupin growth. The variety Wonga was sown at the rate of 90 kg/ha on May 22, with standard granular 17:19:00 Zn2 % fertiliser @ 70 kg/ha drilled below the seed.

A deep ripping unit was used for the placement of fluids in the fertiliser trial. This machine has 4 tynes which rip to 40 cm depth, with 4 spray jets spaced 10 cm apart down the back of each tyne. The deep ripping and fluid application treatments, listed in *Table 2*, were applied the day before seeding, with a water rate of 540 L/ha. The granular fertiliser (control) treatment was also deep ripped with water. The granular fertiliser was placed just below the seed, when all plots were sown with Wonga lupins at 110 kg/ha on May 22.

Table 1: Weed and insect control measures on lupin trials at Chilpuddie, 2004

TIMING	CHEMICAL AND RATE	DATE
Pre-seeding herbicide	1.0 L/ha Roundup Powermax®, 1.2 L/ha TriflurX® & 70ml/ha Hammer®	May 21
Post-seeding/pre-emergence herbicide	1.0 L/ha Lorsban® & 800ml/ha Simazine	May 22
Post-emergence herbicide	150 ml/ha Brodal® & 180ml/ha Targa Bulk®	August 15
Insecticide	250 ml/ha Fastac Duo®	September 27

Table 2: Treatments and nutrients supplied in fluid fertiliser trial on lupins, Chilpuddie, 2004.

TREATMENT	NUTRIENT RATES (kg/ha)	PRODUCTS USED	TREATMENT COST* ($/ha)
Granular fertiliser (control)	12 N, 13 P, 1.4 Zn	17:19:0 Zn 2% @ 70 kg/ha	$35
Same units of nutrition as granular in fluid form	12 N, 13 P, 1.4 Zn	Urea, TGMAP, $ZnSO_4$	$52
Same cost as granular in fluid form	5 N, 9 P, 1 Zn	Urea, TGMAP, $ZnSO_4$	$35
"Worksburger" - high nutrient levels in fluid form	50 N, 30 P, 4 Zn, 4 Mn, 1 Cu, 1 Fe	Urea, TGMAP, $ZnSO_4$, $MnSO_4$, $CuSO_4$, Supa Iron	$187

** Treatment cost includes only the cost of the product.*

What happened?

Grain yield and seed weight results from the variety comparison are given in *Table 3*. The new WA lupin variety Mandelup was the highest yielding with a mean yield of 1.36 t/ha. Mandelup was also the earliest flowering entry, and was noted as the best in visual appearance ("taller and thicker") during the year. Its yield advantage was matched by producing the largest grain. Other early flowering entries were amongst the better performing varieties, including Quilinock and Moonah. Conversely, the later flowering and maturity variety Jindalee had the lowest yield (0.45 t/ha) and produced the smallest seed.

Results from the lupin inoculation treatments are shown in *Table 4*. No difference in yield or seed weight was measured between the uninoculated control, standard slurry on seed and both granular inoculant products. Other observations of root nodule scores and early top growth weights also showed no response to inoculation and inoculant products.

In the fluid fertiliser trial, seeding depth was too deep and emergence was reduced in those sowing rows that aligned with the deep ripping tynes. As every treatment was deep ripped, these effects were even across the trial. Growth was visibly poorer and the average yield 27 % lower than the lupin inoculation trial immediately adjacent sown with the same variety Wonga. Another factor that may have affected the yield was deep ripping bringing free lime to the surface.

Yield and gross income results in *Table 5* show that the "Worksburger" treatment (high nutrient levels in fluid form) was the highest yielding but least profitable treatment (actually lost money), due to its much higher cost.

There were no yield differences between the other fertiliser treatments, resulting in similar gross income from the granular and same cost fluid treatments, but a lower return from the same units fluid treatment due to its higher cost.

What does this mean?

These results confirm the superior performance of Mandelup lupins in low rainfall /low soil moisture situations, with much better growth and yield than current varieties such as Moonah, Wonga and Merrit. Mandelup also has some anthracnose resistance (not as good as Wonga), and WA results show it has metribuzin tolerance, which may open up other weed management options on our sandy soils. Mandelup seed is expected to be available in SA for commercial sowing in 2006.

No evidence of nodulation failure in sand hill lupins or improved nodulation, plant growth and yield with either slurry or granular inoculants were observed in this trial. This suggests that the background soil rhizobium levels were adequate for satisfactory nodulation in this situation where lupins had been grown previously. Inoculating lupins when sowing onto a paddock for the first time is still essential however to ensure good nodulation in this first crop, and granular inoculants offer a more simple option for achieving this.

On the issue of lupin nutrition on sand hills, it appears that nutrition rate had the largest effect on yields. There was no difference between fluids and granular fertilisers when similar nutrients were applied. With better management, such as rolling after deep ripping to get a level sowing surface, and avoiding bringing free lime to the surface, fluids could achieve higher yields. Further investigations are needed to see if lupin yield responses can be achieved using fluids without ripping, which will save on input costs and the problems associated with deep ripping on this soil type.

Acknowledgements

Thanks to Kenny Gosling for providing his land, tractor and assistance with the trial.

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Table 3: Yield and seed weight of lupin varieties on sand, Chilpuddie, 2004

VARIETY	GRAIN YIELD (t/ha)		SEED WEIGHT (g/100 seeds)	
Mandelup	1.36	a	13.2	a
Quilinock	1.27	ab	12.3	ab
90A061-121-36	1.18	abc	11.9	b
WALAN2118	1.10	abcd	11.8	b
Moonah	1.09	abcd	13.0	a
WALAN2113	1.07	bcd	10.8	c
Wonga	0.95	cd	10.7	c
Merrit	0.85	d	10.2	c
Jindalee	0.45	e	8.9	d
Site Mean	1.03		10.4	
LSD (P<0.05)	0.27		0.9	

Table 4: Yield and seed weight of Wonga lupins inoculated with wet slurry or granular inoculants, Chilpuddie, 2004.

INOCULATION METHOD	GRAIN YIELD (t/ha)	SEED WEIGHT (g/100 seeds)
Control (uninoculated)	0.81	10.4
Slurry on seed (standard)	0.86	10.3
ALOSCA granules	0.82	10.5
Biocare granules	0.80	10.7
Site Mean	0.82	10.5
LSD (P<0.05)	NS	NS

Table 5: Yield and gross income of Wonga lupins with fluid fertiliser treatments, Chilpuddie, 2004

FLUID FERTILISER TREATMENT	GRAIN YIELD (t/ha)		GROSS INCOME ($/ha)
"Worksburger"	0.69	a	-$48
Same cost fluids	0.58	b	$82
Same units	0.58	b	$63
Granular (control)	0.54	b	$72
Site Mean	0.60		
LSD (P<0.05)	0.10		

Gross Income is (Yield x Price delivered to Lock at December 1, 2004) – (Fertiliser treatment cost).

Types of Work in this Publication

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

Type of Work	Replication	Size	Work conducted by	How analysed
Demo	No	Normally large plots or paddock strips	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 & Researchers	Usually summary of research results
Information	n/a	n/a	n/a	n/a

Section 3

Section editor: Neil Cordon

SARDI, Minnipa Agricultural Centre

Pastures

Pasture legumes for Eyre Peninsula

Best practice

Research

Neil Cordon and Ben Ward

SARDI, Minnipa Agricultural Centre

Key Messages

- **Annual medics are still the proven pasture legumes on neutral to alkaline soils with excellent adaptation to a wide range of environmental conditions, good dry matter production and the ability to persist under a pasture cropping rotation.**
- **A medic-seeding rate of 5 kg/ha was considered to be the most viable.**
- **A mix of Herald and Caliph can be used to cover a wide range of seasonal conditions and soil types.**
- **Only sow varieties with aphid resistance.**
- **The average gross margin benefit to the following wheat crop was $86/ha.**
- **Broadstrike® was found to control common broad-leaved weeds without pasture yield reduction.**
- **Weed control in existing stands of medic pastures was more cost effective than sowing a new pasture if those varieties are aphid resistant.**
- **Pasture density drives productivity so aim for 100 burrs per 25 cm x 25 cm quadrant in late March.**
- **Do not waste time and money on unproven alternative pasture legumes.**

Why do pasture legume research?

Pasture legumes still play an important role within farming systems and in the last four years there have been sites chosen to evaluate the productive capacity of a number of alternative pasture legumes and new release traditional species. The program also aimed to identify the best practice for establishing annual medics in the farming system.

This is continued work and is reported in *EPFS Summary 2000 (Pg 44 to 48), 2001 (Pg 54 and 57), 2002 (Pg 54) and 2003 (Pg 47)*.

The wide range of work over a number of years, soil types and farming systems has provided a good indication of "what fits where".

Where were the sites?

Over the years the sites have been at Minnipa, Wirrulla, Cowell, Penong, Mangalo, Port Kenny, Lock and Mount Damper. Some sites have been terminated whilst others are on-going to look at regeneration characteristics. Site details are located in the information box. The project concentrated mainly on slightly acidic to highly alkaline soil types.

Measurements: Visual appraisal, dry matter cuts and seed production.

What happened?

One issue with pasture work on Eyre Peninsula is the contamination of plots with background seed levels due to historic medic production. It shows (without the need for trials) that medic is a very resilient pasture legume and soil seed stocks are greater than reliable estimates.

The pasture species evaluated over the years are Medics, Sub Clovers, Clovers, Biserrulas', Serradellas', Vetch, Balansa Clovers, Gland Clovers and *Hedysarum*.

Hedysarum coronarium cultivar Sulla is a new highly productive forage perennial legume suited to alkaline soils. It is late maturing and more suited to reliable rainfall zones greater than 375 mm, so may have a role in short term phases in a farming system.

Sulla was first evaluated in 2004 on Eyre Peninsula (*Table 1*) and its limitation appears to be growing season length and rainfall.

The data (*Table 1*) confirms exactly what we see in pasture research on Eyre Peninsula with medics the best performing pasture species by a long shot!

The vetch at Mount Damper may have been disadvantaged as it put on a productive "spurt" soon after sampling however vetch is still the best annual forage legume with good hay, forage and seed production.

Newer type pasture legumes such as biserrulla and serradella are not suitable in this environment while clovers (sub, Balansa and Gland) are not as adaptable as medics.

Table 1: Pasture dry matter yields at Mount Damper 2004.

Variety	DM Yield (t/ha)
Caliph medic	7.7
Mogul medic	7.6
Herald medic	6.1
Toreador medic	5.7
Scimitar medic	5.7
Morava vetch	3.6
Sulla hedysarum	1.2

** This site had 261mm for 2004 growing season rainfall of 210mm.*

As far as medics go the varieties Herald, Caliph, Mogul, Toreador and Scimitar stand out. Scimitar's early maturity and soft seeded attributes have seen it regenerate densely in the second year of production.

What does this mean?

There are few alternative pasture legumes that are well adapted to this low rainfall environment.

Clovers in general showed very little potential with poor winter vigour, poor weed competition, late flowering and poor regeneration.

This supports previous work throughout Eyre Peninsula that annual medic is still the best legume pasture option for the low rainfall neutral to alkaline soils.

Further evaluation of Sulla is required in 2005.

References

Pasture Legumes for Temperate Farming Systems – The Ute Guide, PIRSA – Available from Minnipa Agricultural Centre.

Acknowledgements

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Thanks must go to the farmer co-operators over the years, Shaun Freeman, Craig Rule, Chris McBeath, Rob Norris, Simon Guerin, Leigh Gosling and Steve Edwards.

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Site	Co-operator	Av. Rainfall (mm)	Av. GSR (mm)	Soil type
Penong	Shaun Freeman	300	231	Reddish brown calcareous sandy/loam
Cowell	Steve Edwards	285	205	Red sandy loam
Minnipa	Minnipa Ag Centre	325	242	Red Calcareous sandy loam
Wirrulla	Craig Rule	300	208	Red Calcareous sandy loam
Mangalo	Rob Norris	350	250	Shallow acidic red mica schist loam
Mount Damper	Chris McBeath	302	251	Reddish brown sandy loam
Lock	Leigh Gosling	368	280	Light grey non-wetting siliceous sand
Port Kenny	Simon Guerin	375	305	Grey calcareous sand

Extension

Grazing management of medic pastures

Neil Cordon[1] and Tim Prance[2]

SARDI, Minnipa Agricultural Centre[1],
Rural Solutions SA, Senior consultant, Pastures and Grazing Systems[2]

Key Message

Correct grazing is critical to maximise medic seed production, to control weeds and to maximise livestock production.

Start grazing as soon as the medic has 6 leaves and the ground is covered – around 1000 kg/ha dry matter (or 2.5 to 3 cm height of a dense pasture)

Maintain **consistent** grazing pressure during winter and spring – don't let the pasture get away, and don't "crash graze" - that is, spell the pasture for a long period then heavily graze.

Keep pasture between 1200 and 1700 kg/ha dry matter (or 3 – 6 cm) **during winter**.

During spring, **increase grazing pressure** so that pasture doesn't become rank – no more than 3000 kg/ha dry matter (10 cm of a dense well grazed pasture).

This is particularly important following work by Damien Adcock at Tuckey, where bulky medic pastures may put too much nitrogen into the soil, thus promoting excessive winter leaf growth in subsequent cereal crops, in districts subject to a quick finish, if soils have limited capacity to store moisture (*EP Farming Systems 2002 summary p 58*)

Grazing pressure should be backed off whilst seed is setting – that is, as the season dries off. Maintaining grazing pressure during flowering, whilst the soil is still moist, should not reduce seed production, provided the paddock is not "crash grazed". Crash grazing will remove flowers, however consistent and relatively hard grazing pressure, will promote leaf and runner production producing more flowers. Keep spring grazing pressure to between 2000 and 3000 kg/ha dry matter (6 – 10 cm)

Once soil starts to dry out, then back off grazing pressure (or even remove livestock) to allow seeds to set. At this point, livestock can be transferred to spray topped grass pastures, or used to put extra pressure on weedy paddocks.

When seed set is complete, and the medic burrs have hardened, livestock can be re-introduced, provided paddock is monitored to ensure livestock are not eating burrs.

Stock should be removed once they start eating medic burr – at $3,000 per tonne medic seed is an expensive supplement! Pay particular attention in late summer/autumn.

Grazing benchmarks for medic pastures

kg/ha dry matter pasture benchmarks (includes any weeds, as well as medic)

- **Early winter – start grazing at 6 leaf stage – 1000 kg/ha (2.5 – 3 cm)**
- **Winter – maintain at 1200 – 1700 kg/ha (3 - 6 cm)**
- **Spring – maintain at 2000 – 3000 kg/ha (6 – 10 cm)**
- **Reduce stock pressure (or remove stock) during seed set**
- **Monitor burr removal in late summer/autumn**

Aim for 100 burrs per 25 x 25 cm quadrat in late March

Research

Controlling FEH-1 strand medic in-crop

Craig Bell[1], Jake Howie[1] and Ben Ward[2]

SARDI Pastures Group, Waite Campus[1]
SARDI Pastures Group, Minnipa Agricultural Centre[2].

Almost ready

Location
Minnipa Agricultural Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2004 total: 287 mm
2004 GSR: 223 mm

Soil Type
Alkaline reddish brown sandy loam

Location
L & K Cattle, Netherton.

Rainfall
Av. Annual: 396 mm
Av. GSR: 300 mm
2004 total: 225 mm
2004 GSR: 153 mm

Soil Type
Neutral to alkaline grey sandy loam

Key Message

FEH-1 strand medic can be controlled in the cereal crop phase by a range of commonly used herbicides.

Why do the trial?

To demonstrate that the tolerance of FEH-1 to sulfonylurea (SU) residues doesn't extend to other chemical groups.

FEH-1 is a new strand medic cultivar with excellent tolerance to SU residues, however this tolerance has raised some concerns about chemical resistance and the ability to control FEH-1 in a cropping system. This article outlines the results of a trial designed to show the effectiveness of a range of commonly used chemicals that can be successfully used to control FEH-1 in cereal crop. Previous articles (*EPFS 2002, pg 52 and EPFS 2003, pg 45*) show the tolerance levels of FEH-1 compared to its parent Herald.

How was it done?

In 2004, herbicide control trials were established to test the effectiveness of a range of herbicides on FEH-1 (cf. Herald). The cultivars were sown at Netherton (2/7/04) and Minnipa (22/6/04) at 10 kg/ha in a split plot into barley and wheat respectively. Pre-emergent herbicide treatments (triasulfuron) were applied on the 2/7/04 and 15/6/04 and post-emergent treatments on the 11/7/04 and 20/8/04 respectively. Plant establishment counts, visual scores and dry matter production samples were taken to determine what affect the herbicides had on the cultivars in comparison to an untreated plot. The treatments used in the trial are listed in *Table 1* and all herbicides were applied at their recommended rates.

What happened?

The Minnipa results may have been slightly confounded by the presence of pre-existing metsulfuron-methyl residues which had been applied @ 5 g/ha in 2000. This may explain the lower than expected dry matter production from Herald in the nil plots (*Figure 1*) and if so, suggests that unexpected residual activity of metsulfuron-methyl (*nb. this observation has already been noted on the previous trial at Minnipa, EPFS 2002, pg 52*).

Plant Establishment

Both FEH-1 and Herald relatively even emergence at the Minnipa and Netherton trial sites.

Dry Matter

The most effective control at both sites was achieved by 2,4-D, MCPA and dicamba (*Figure 1 and 2*), with both cultivars controlled by over 70 %. The bromoxynil treatment at Netherton also achieved effective control of over 70 %. At Minnipa bromoxynil result was possibly confounded as a result of its delayed application (2 weeks, due to unavailability). Apparent percentage control would have been greater had they been sampled later in the season when the unsprayed controls had made more growth. Of the non-SU herbicides tested, clopyralid was the least effective but still gave reasonable control of 64 % compared to the nil plots.

The post-emergent SU herbicide options (*Figures 3 and 4*) provided reasonable to good control of FEH-1 in crop with a

For Figures 1 to 4 Treatment Numbers correspond to Table 1.

Table 1: Herbicide treatments for FEH-1 control trial at Minnipa and Netherton, 2004.

Treatment Number	Chemical Name	Application Rate	Application date Minnipa	Application date Netherton
0	Nil			
1	2,4-D amine (500g/l)	1.7 L/ha	20/8/04	11/7/04
2	MCPA (500g/l)	2.1 L/ha	20/8/04	11/7/04
3	dicamba (200g/l)	700 ml/ha	20/8/04	11/7/04
4	clopyralid (300g/l)	150 ml/ha	20/8/04	11/7/04
5	bromoxynil (200g/l)	2.1 L/ha	2/9/04	11/7/04
6	glyphosate (450g/l)	1.0 L/ha	20/8/04	11/7/04
7	paraquat (135g/l)/diquat (115 g/l)	1.2 L/ha	20/8/04	11/7/04
8	metsulfuron-methyl (600g/kg)	3.5 g/ha	20/8/04	11/7/04
9	metsulfuron-methyl (600g/kg)	7.0 g/ha	20/8/04	11/7/04
10	triasulfuron (750g/kg)	15 g/ha	15/6/04	2/7/04
11	triasulfuron (750g/kg)	30 g/ha	15/6/04	2/7/04
12	chlorosulfuron (750g/kg)	20 g/ha	20/8/04	11/7/04
13	sulfosulfuron (750g/kg)	25 g/ha	20/8/04	11/7/04
14	iodosulfuron-methyl-sodium (50g/kg)	150 g/ha	20/8/04	11/7/04

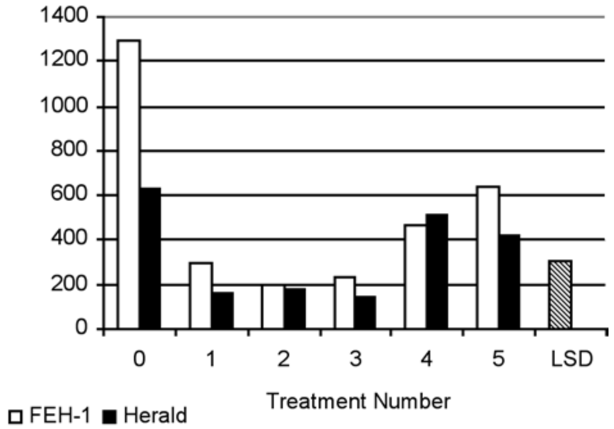

Figure 1: Effect of non-SU herbicide application upon dry matter production (kg/ha) of FEH-1 and Herald at Minnipa, 2004 (LSD=304.8, P=0.05).

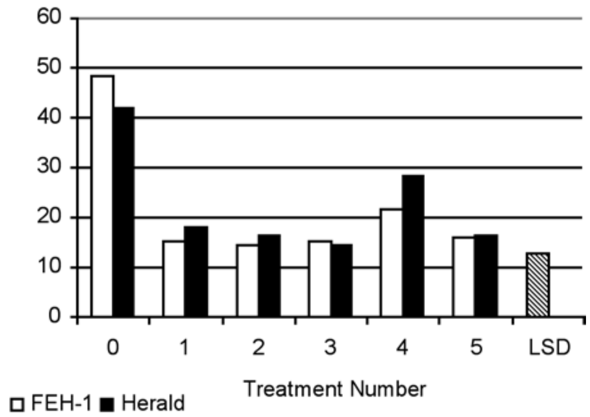

Figure 2: Effect of non-SU herbicide application upon dry matter production (mg/plant) of FEH-1 and Herald at Netherton, 2004 (LSD=12.97, P=0.05).

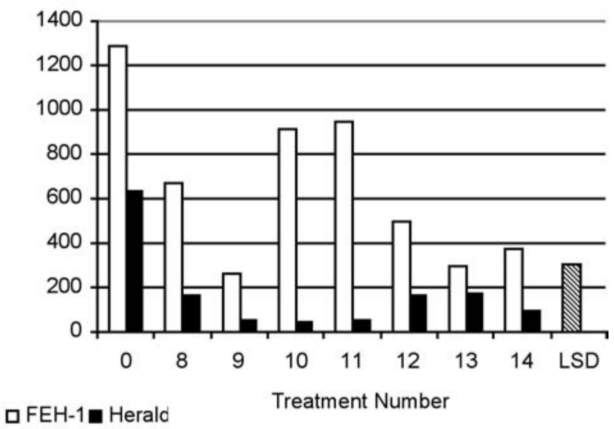

Figure 3: Effect of SU herbicide application upon dry matter production (kg/ha) of FEH-1 and Herald at Minnipa, 2004 (LSD=304.8, P=0.05).

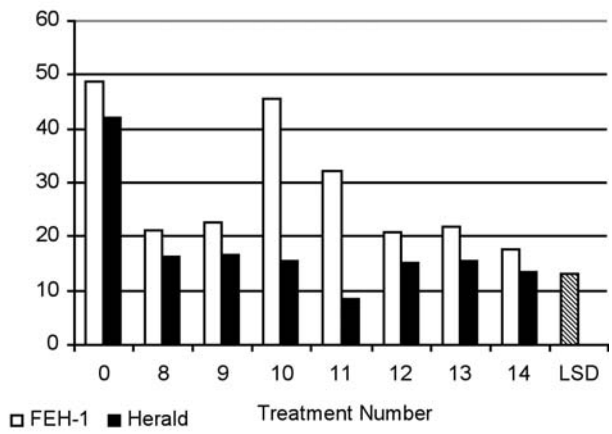

Figure 4: Effect of SU herbicide application upon dry matter production (mg/plant) of FEH-1 and Herald at Netherton, 2004(LSD=12.97, P=0.05).

range from 60 % - 80 % control compared to the nil plots. However while the pre-emergent SU treatments (triasulfuron) achieved control of Herald (55 - 83 %), they we less effective on FEH-1 (6 - 35 %).

What does this mean?

The results from the trial show that FEH-1 can be effectively controlled to an acceptable level in-crop by a range of commonly used chemicals. These control options include both non-SU and post emergent SU applications (excluding Logran,). For the first time, farmers now have a viable pasture legume alternative that can increase productivity through increased dry matter production and N fixation in the presence of SU residues but also be controlled with readily available common post emergent herbicides.

What now?

Both the Minnipa and Netherton trials returned similar results despite the difference in dry matter production. To further assist producers in their decision-making involving FEH-1, additional trials with chemical mixtures will be run to determine what other options are available and can be used to achieve effective control FEH-1 in-crop. These additional mixtures and treatments, as well as the treatments already tested, may also be useful for controlling other in-crop pest weed species. Trials in 2005 will also research possible options for controlling FEH-1 in pulse crops with a range of commonly used broadleaved chemical treatments. These results will then be used to develop an agronomic package for FEH-1 to provide farmers with the best possible advice on where we see FEH-1 fitting in to cropping and pasture farming system.

The agronomic package will be available with the purchase of FEH-1, which is likely to be released in 2006.

Acknowledgements

The funding of this work by GRDC is gratefully acknowledged, as is the valuable assistance provided Neil Cordon.

Grains Research & Development Corporation

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Breeding lucerne cultivars for the Eyre Peninsula

Research

Alan Humphries[1],Zhang Xianguang[1] and Ben Ward[2]

SARDI Pastures Group, Waite Campus[1] and Minnipa Agricultural Centre[2]

Location
Bahlumba, Waddikee: Rob, Damien and Shane Jericho Kelly/Waddikee No Till Farmers

Rainfall
Av. Annual: 337 mm
Av. GSR: 251 mm
2004 total: 213 mm
2004 GSR: 162 mm

Soil Type
Siliceous sand of varying depths over clay

Key Messages

- **New lucerne cultivars, for use in cropping rotations on the Eyre Peninsula, are being bred by SARDI for improved adaptation to local conditions and grazing tolerance.**
- **A trial has been sown at Waddikee to investigate the performance of breeders lines prior to cultivar selection and release. The best plants from this trial will be identified and incorporated into future cultivars, ensuring SARDI cultivars have good adaptation to EP farming systems.**

How is it being done?

A total of 36 entries, including 10 lucerne cultivars and 26 advanced breeding lines were used in this trial with three replicates. Each plot was measured 7 m by 1.5 m. Scarified seeds were sown by machine on 30 May 2003, at a sowing rate of 5 kg/ha. Like all SARDI trials, the trial was sown in the farmers paddock, and remains unfenced so that it receives the same management as the rest of the paddock as applied by the farmer. Grazing management of one year old lucerne has been one to three weeks grazing depending on mob size, and six to eight weeks rest.

The cultivars sown comprise winter dormant cultivars (rating 3-5;Venus), winter active cultivars (rating 7-8; SARDI Seven, Hunterfield, WL525HQ) and highly winter active cultivars (rating 9-10, SARDI Ten, PL90, Alpha Express). The production of the cultivars differs by their amount of winter production, but similar herbage yields over summer can be expected. Winter dormant cultivars are not usually grown in low rainfall environments because of their inadequate production through the growing season rainfall. For short rotations of 3-4 years a highly winter active lucerne would be favoured, whereas a winter active lucerne is better for long term stands of 5-10+ years.

This project, funded by GRDC, has around 20 trials in SA and WA in cooperation with individual farmers or farmer groups. Some of these trials are aggressively grazed to put pressure on the plants and test their performance under hard grazing. Grazing-tolerant plants from these trials have been removed to form new breeders lines, one of which will be released as a cultivar. These superior lines are being evaluated in this trial for their adaptation to the local environment on the upper Eyre Peninsula. A similar trial will be sown in southern Eyre Peninsula next year.

Plant density was scored on 8 September 2004 using boot gaps (3 m by 3 rows) and then transformed to a value ranging

0–100 %. Plant height was measured to estimate the relative rank of winter vigour of each entry. The decline in persistence of each entry will continue to be monitored in the future.

What happened?

Establishment of the trials was excellent, with plant density ranging from 20-30 plants per square metre. Differences were significant ($P < 0.05$) with the density of two breeders' lines being significantly greater than the range of cultivars. However, as we expect, the differences at this stage are very small. Large differences between cultivars are expected to start emerging in the next 6-12 months and will be reported next year.

Dry conditions early in 2004 made reliable density estimates of establishment unachievable until September 2004. Good late rains in 2004 provided out of season forage production in December, which can be used to finish lambs, improve wool staple strength, and maintain ewe body weights for improved joining.

What does it mean?

- Excellent plant establishment (20-30 plants/m^2) has been achieved in this trial, with 10-15 plants being an acceptable lower limit for this rainfall. This is an excellent result considering the site received a late break to the season in the first summer of establishment. The grazing management has also been relatively gentle, and under this management 7-15 years could be expected out of SARDI Seven, a winter active cultivar and 4-8 years for SARDI Ten, a highly winter active cultivar.
- Although small varietal differences to this point were observed, greater changes in plant density will be expected to occur in the next 1-2 years.
- High plant density is considered to be an important indicator of good persistence. Therefore a cultivar or breeding line is considered good if it maintains a relatively high plant density over the season and in years.
- The suitability and usefulness of these cultivars or breeding lines will be further investigated in terms of growth vigour, herbage production (if resources permit) and specific adaptation, such as insect pest and disease resistances.

Acknowledgment

The lucerne breeding project is funded by the Grains Research and Development Corporation. The Jericho family have kindly allowed us to conduct the trial on their property.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

GRDC Grains Research & Development Corporation

Best practice

Location
Minnipa Agricultural Centre

Rainfall
Average Rainfall: 325mm
Average GSR: 242mm
2004 Total: 287mm
2004 GSR: 223mm

Soil Type
Reddish brown sandy loam

Lucerne performs poorly at Minnipa – why?

Demo

Neil Cordon

SARDI, Minnipa Agricultural Centre

Key Messages

- **Subsoil constraints such as salinity, sodicity and boron creates a hostile environment which limits the ability of lucerne roots to utilise soil moisture reserves and therefore reduces its productivity.**
- **Income loss from having a lucerne phase is difficult to justify when compared to the income generated from a cereal/medic pasture system.**
- **Productive agricultural land similar is not suited to lucerne phases unless it is for a specific requirement.**

Why grow Lucerne at MAC?

Lucerne was grown at Minnipa Agricultural Centre (MAC) in a 20 ha paddock to evaluate its role in a low rainfall, hostile soil environment.

Assessing lucerne under field conditions will help identify the merits of such a phase in the cropping system and its limitation to production.

Lucerne has been promoted in cropping regions over the last three to five years to reduce dry land salinity but in areas where water table salinity is not a problem there are other benefits of growing lucerne. These include providing high quality feed for prime lamb production, phase farming to deliver benefits to a cropping phase, increased nitrogen levels, disease reduction, herbicide resistance management or turning poor cropping land into productive grazing land.

Other related articles can be found in the *EPFS Research Summary 2001, pg 58,and MAC Field Day book 2003, pg 39 and 2002, pg 28.*

What did we do?

Three lucerne varieties, Eureka, Sceptre and Super 10 were sown directly into standing stubble at 4 kg/ha on the 18th June 2001 with 55 kg/ha of 18:20:00 fertiliser.

The paddock was under lucerne production for three years until 2004 when it was sown to Yitpi wheat. Throughout the period the lucerne was managed for insects, weeds and grazing. Due to low sheep numbers at MAC, the area was slashed to allow fresh growth and increased persistence over summer. Poor vegetative growth limited grazing the paddock during the three years. Winter cleaning of weeds using herbicide was carried out in 2002 and 2003.

What happened?

Dry Matter Production

Plant establishment was excellent with numbers ranging from 35 to 54 plants/m^2, however dry matter production from the lucerne was poor. From early establishment it was apparent there were large areas of poor growth and small patches with good growth. Dry matter cuts were taken prior to first grazing in early September 2002 and 2003 (*Table 1*).

Costs

Initial establishment costs equated to $98/ha with winter cleaning in 2002 and 2003 costing an additional $28/ha and $13/ha respectively with a mix of Diuron @ 500ml/ha plus Sprayseed® at 1.0L/ha in 2003.

Removal of the lucerne in the spring of 2003 for the cropping year 2004 proved to be a difficult exercise. In the Minnipa environment there are limited opportunities for receiving timely rainfall to firstly promote active growing lucerne, and secondly have the weather conditions suitable for herbicide application. Three herbicide treatments to remove the lucerne were evaluated with Treatments 1 and 2 applied in October 2003 and Treatment 3 in May 2004.

Treatment 1:	Glyphosate (conc) 450 @ 2L/ha	$24/ha
	Cadence® @200gm/ha	
Treatment 2:	Credit + Bonus® @ 2L/ha	
	Cutlass M® @ 300ml/ha	$33/ha
	MCPA LVE® @ 750ml/ha	
Treatment 3:	Roundup Power Max® @ 1L/ha	$27/ha
	Cadence® @400gm/ha	

Prior to sowing wheat in 2004 a knockdown herbicide and trifluralin was required and a post emergent spray of MCPA amine was used to remove any remaining lucerne plants.

Some lucerne plants still remain in the paddock and future control will be necessary.

Poor growth area vs good growth area

Soil tests taken in April 2003 (*Table 2*) identified higher levels of salinity, boron and sodicity especially at depths greater than 45 cm in the poor growth areas.

Table 1: Average Dry Matter production of Lucerne at Minnipa in 2002 and 2003 compared to annual medic in 2003.

	DM Yield t/ha
Poor growth area 2002	1.0
Good growth area 2002	3.1
Poor growth area 2003	1.2
Annual medic 2003	1.5

For comparison a good medic stand at M.A.C. can produce between 3.0 to 6.0 t/ha.

Each year the lucerne appeared to be struggling to grow with visual signs of wilting and growing tips dying. Moisture stress caused by the subsoil constraints was not allowing the roots to access moisture lower in the profile. This coupled with high soil salts and boron produced an environment unsuitable for lucerne root growth.

Soil profile moisture levels were similar for both areas (*Table 3*).

Nitrogen and Soil Moisture

It has been widely reported that early lucerne removal allows for a greater breakdown and release of nitrogen as well as leaving greater soil moisture reserves for the following crop. In the low rainfall environment there is a trade off between increased nitrogen and soil moisture and loss of production for grazing and being at risk to soil erosion. The lucerne had higher levels of nitrogen, *Table 4*, in the profile compared to a pasture however the moisture at sowing showed little difference. The position of the nitrogen within the soil profile was different, with lucerne having half the nitrogen located below 45 cm depth, but the medic pasture having two-thirds in the top 45 cm.

Crop Yields and Rotation

Rainfall for 2004 was below average at MAC which reduced potential yield and hindered crop growth. Yitpi wheat was sown on the lucerne paddock in 2004 and its yield was lower (0.67 t/ha) compared with Yitpi grown on all other paddocks at Minnipa that averaged 0.94 t/ha.

There was no difference in grain quality between Yitpi paddocks.

The economics of growing lucerne does not "stack up" when comparing crop yields of other rotations at MAC (*Table 5*) in the last four years.

Table 3: Comparison of soil profile moisture (mm) for good and poor lucerne growth at Minnipa April 2003.

	Good growth area	Poor growth area
Depth cm	Volumetric Moisture (mm)	Volumetric Moisture (mm)
0-10	4	4.1
10-45	21.7	21.3
45-70	24.2	21.1
Total	49.9	46.5

Table 4: Comparison of nitrogen and moisture to 70cm prior to sowing at Minnipa 2004.

	Nitrate Nitrogen (kg N/ha)	Volumetric moisture (mm)
Early lucerne removal	129	69
Late lucerne removal	146	81
*M.A.C. Average	51	72

**This is the average recorded at M.A.C. after a medic pasture in 2004.*

Table 2: Comparison of soil data from areas of lucerne good and poor growth at Minnipa, April 2003.

	Good growth area			Poor growth area		
Depth (cm)	0-10	10-45	45-70	0-10	10-45	45-70
Conductivity (ds/m)	0.17	0.23	0.87	0.16	0.2	0.86
Boron (mg/kg)	2	2.3	4.7	2.2	2.9	17.2
Chloride (mg/kg)	56	115	912	28	58	822
Ca:Mg Ratio	9:1	8:1	3:1	8:1	6:1	2:1
E.S.P. (%)	2	3	16	1	3	25

Levels considered to impede root growth.

Pastures

Table 5: Comparison of crop yields at Minnipa since 2001 with Lucerne paddock.

	Lucerne Paddock		Cont. Wheat Paddock		3 year Crop Paddock		Average Wheat Yields (t/ha)
Year	Crop	Yield (t/ha)	Crop	Yield (t/ha)	Crop	Yield (t/ha)	
2001	Lucerne	-	Wheat	2.11	Pasture	-	2.53
2002	Lucerne	-	Wheat	1.32	Wheat	2.91	1.36
2003	Lucerne	-	Wheat	1.24	Peas	1.31	1.22
2004	Wheat	0.67	Wheat	1.11	Barley	1.46	0.98

What does this mean?

Lucerne established well at Minnipa and over three years it increased soil nitrogen levels however herbage production was poor, which meant full grazing potential could not be achieved.

The increased soil nitrogen following lucerne will largely be inaccessible as at least 50 % is located in the hostile soils that are not conducive to cereal root growth.

Lucerne has a limited role in this environment where dry land salinity is not a problem and productivity is far greater from a medic based cropping system.

Profile soil measurements need to be taken to identify any subsoil constraints, which will effect lucerne production, and if subsoil constraints exist it should not be grown.

Farmers who wish to grow lucerne on these soil types should adopt a "winter cleaning" regime after the first year.

For phase farming the removal of lucerne from the cropping phase may prove to be difficult especially if no-till and no livestock are system practices.

References

"Success with Lucerne" – P.I.R.S.A.

"Lucerne Pest and Disorders: THE Ute Guide" Q.P.I.

These publications are available from Minnipa Agricultural Centre.

Acknowledgements

Cadence & Sprayseed – Syngenta

Credit, Cutlass M, MCPA LVE, and Roundup Power Max - Nufarm

SARDI South Australian Research and Development Institute

GRDC Grains Research & Development Corporation

Section 4

Section editor: Jonothan Hancock

SARDI, Minnipa Agricultural Centre

Rotations

A summary of the "Low Rainfall Agriculture Genius Day 2004"

Extension

Best practice

Annie McNeill

University of Adelaide

Key Messages

- **Extension of what is already known about best practice farming system management from the EPFS and other low rainfall projects should be an important component of any future project.**
- **Future research needs to be targeted at specific issues but, at the same time, integrated in a whole system evaluation in order to achieve the best outcomes in terms of providing useful and relevant information for EP farmers. This will enable the appropriateness of decision tools developed from other regions to be assessed.**
- **A research project should have some flexibility to allow for whacky ideas and concepts to be tested – this is where the genius comes out from under a rock!!**
- **Management philosophy has a big impact on the economic performance of individual farms - an important question is whether the focus of the system should be on minimising the crash in bad years and maximising the good years rather than going for the average? Research projects should be about providing the best possible option for growers.**

Why have the genius day?

GRDC funding for the current Eyre Peninsula Farming Systems Project (EPFSP) ceases at the end of June 2005. Consequently, the EPFSP has been conducting a comprehensive evaluation and future planning process to assess the need and scope for a new project beyond this time. The annual review process with farmer groups in 2004 identified the need to consolidate and summarise information gained to date and that this may generate some future directions for the next five years. The idea of a "Genius Day" workshop was born.

An eclectic mix of participants (farmers, consultants, researchers, extension staff) were invited to a workshop in order to generate energetic discussion and to identify revolutionary ideas for substantially improving low rainfall farming systems in the long term. It was hoped that the day would be an excellent chance for all participants to explore future scenarios for low rainfall farming systems and that the interactions would spark original and exciting ideas for low rainfall agriculture. The organisers (Neil Cordon, Sam Doudle and Nigel Wilhelm) were looking for inspired innovations rather than conservative projections.

In the context of the workshop the Low Rainfall Zone was defined as those agricultural areas of southern Australia where:

- pastures are a common phase in the rotation
- soils are neutral to strongly alkaline in the surface and subsoil
- subsoil constraints are common and often severe
- growing season rainfall is too low to allow reliable production of break crops for cereals

Who was there?

Neil Smith, former GRDC southern Panel representative facilitated the day. Participants were GRDC consultants Phil Price and Ann Hamblin; Geoff Thomas, Low rainfall collaboration project manager; GRDC Southern panel representative Mark Peoples; Bill Bowden, a senior research scientist from AgWA; Vadakattu Gupta and David Roget from CSIRO Land & Water and the Mallee Sustainable FSP; agribusiness consultants Brenton Lynch and Ed Hunt; EP farmers Peter Kuhlmann and Bruce Heddle; myself (Annie McNeill) and Damien Adcock from The University of Adelaide; Steve Barnett and Sharon Taylor from the SARDI Crop Pathology unit at Waite and a number of SARDI staff from Minnipa including Michael Bennet, Amanda Cook, Sam Doudle, Ali Frischke, Jon Hancock, Bob Holloway and Nigel Wilhelm.

What happened?

Neil Smith opened the proceedings by giving a short background on the current situation, as he sees it, for Australian broadacre farmers generally, and particularly for EP. He highlighted that any ideas for the future need to consider the operating environment with low commodity prices, the heightened threat of wheat rust epidemics, higher livestock prices, higher relative land prices, few new herbicides and fertility technologies coming on the market and potentially large increases in fertiliser and fuel costs. On upper EP the properties are large (and getting larger), generally the soils are poor and rainfall is low, but Neil believes, reasonably reliable (some may disagree after the last couple of years!!). He finished with the call for research ideas that aim to benefit in the medium and long term and that address the triple bottom line of profitability and sustainability.

Ed Hunt and Bruce Heddle introduced three main themes for overview (*see following sections*) that had been identified by the farmer groups as the most important aspects of EP farming systems. They wanted discussion in terms of what is already known that can contribute to management currently and what still needs to be researched. They stressed that in their opinion stock were still an important part of most systems.

The feeling amongst growers was that although subsoil constraints were also recognised as important, the solutions currently being researched could be too expensive or not yet well tested or identified. Finally, Ed and Bruce put up some 'hard' questions for consideration in the context of the themes for the day:

- If we want to live with a high legume N input system how do we do it and avoid burn-off?
- How important are livestock in these high N systems?
- How do we stay in business when trying to develop 'disease suppressive' soils?
- Do low rainfall areas have enough organic matter to produce disease suppression?
- We know no-till is good for soils but is it always good for productivity?
- Are weed problems increased under no-till?

Water use and canopy management

- Canopy management is about optimising BOTH water and nutrient use - there is information 'out there' on directly or indirectly managing water and N in low rainfall farming systems – the trick is to work out how applicable it is to individual situations on upper Eyre Peninsula!

The presentation (by yours truly) attempted to summarise information coming out of the MSFP and the EPFSP in relation to nitrogen and water dynamics in low rainfall farming systems. It stimulated a fair bit of discussion on the first theme of water use and canopy management. It is important to remember that these semi-arid environments are dominated by an atmospheric demand for water (potential evapotranspiration) that is always greater than rainfall, and thus water not lost via the plant is generally lost by evaporation from the soil unless the leaf area index (a measure of the ground cover) is greater than 2.5 to 3.0. The maximum Damien estimated at Rudall over four years was around 2.0 at the crop row spacings being used. It was noted that the EP data largely comes from one site on eastern upper EP (near Rudall) and that the large variability in soil types across the peninsula limits the direct transferability of the results but does provide some general rules of thumb.

Some of the key differences between the EP and the Mallee sites were also shown, namely:

1. Well-managed legumes in EP systems are capable of relatively high dry matter production and fix large amounts of N so that residues contribute to high plant available (nitrate) N levels in soil. However, the nitrate is often produced either too early or late for crop growth or causes excessive early season growth at the expense of grain yield.
2. Average growing season rainfall tends to be lower in the Mallee than the EP so in theory maybe that is why better legume productivity is supported. It may also be a factor in the generally greater biological activity and slightly higher organic matter levels recorded for EP soils compared to the Mallee.
3. Potentially limited effective rooting depth (70 - 80 cm at Rudall) on upper EP restricts the likelihood of exploiting any soil moisture that moves deep after heavy rainfall events.

The major take-home was that each grower needs to get a handle on how much plant available water the soil is capable of holding and how much N and water are there at the start of the season in order to make suitable management decisions regarding row spacing, depth of sowing, plant density, fertilisers, crop type, reduced tillering cultivars, green manuring etc.

Bearing in mind that there are some differences in the regions, as alluded to before, it was recommended that having a go with The Mallee N calculator from Jeff Baldock and colleagues (http://www.clw.csiro.au/products/ncalc/) and/or taking part in the 'Your Soils Potential' program being run by PIRSA are two ways for EP growers currently to start getting to grips with how to manage their own soils. Targeted research across the region, if the project is refunded, could also contribute to the pot of knowledge and enable the EPFS project to develop it's own decision tools.

In his thoughts after the meeting Bill Bowden made the point that canopy management and tactical N decisions may be related but are not necessarily the same thing! Canopy management is about trying to achieve 'measured' or steady water use during the season to avoid burning or 'haying' off due to running out of moisture. Tactical N decisions are about providing N when it is required by the crop to minimise waste and maximise uptake. Clearly tactical N management is easier in a situation where there is a low background of plant available N in the soil and we may need to think about modifying EP systems to achieve this.

Disease suppression and organic matter cycling

- Farming for disease suppression requires a productive intensive cropping system and disease suppression (on western upper EP in particular) is currently unlikely to develop due to low crop residue returns caused by limited productivity of aboveground biomass – is it the chicken and egg syndrome?

Although the incidence of root disease on upper EP is high with *rhizoctonia* being a major player, David Roget highlighted in his presentation that he believes there are multiple constraints operating (such as P and Zn nutrition, tillage operations etc) that combine to increase the negative effect of disease on yield. These other constraints to yield need to be addressed before the system will provide sufficient organic matter inputs to enable development of disease suppression. Peter Kuhlmann noted that the grey soils in particular have not seen the three-year rolling average increase in yield that the rest of upper EP has seen.

David defined disease suppression as a function of population, activity and composition of the microbial community in soil with development and expression related to carbon and nitrogen dynamics. He described how available carbon in soil, together with short periods of favourable moisture levels, drives the development of disease suppression (due to a complex series of micro-organisms) in farming systems. He also pointed out that anything that results in increased available N (and hence a lower soil C:N ratio) can eliminate or mask suppression, and this includes practices such as legume pastures, green manures, non-harvested crops or stubble removal, as well as multiple low intensity rainfall events. However he emphasised that usually there needs to be several seasons of these practices before there is a big problem in terms of disease control, and that, for example, a pasture once in every four years is probably not an issue.

David outlined his ideal low rainfall system farming for suppression as a productive intensive cropping system (high C input, N export in grain, N immobilisation by high C:N residues) dependent on N fertiliser for crop establishment and with the later requirements of the crop met by mineralisation. He finished by advocating that the best returns in terms of understanding how to develop and maintain disease suppression on upper EP would be obtained by carrying out disease control research within a whole farming system evaluation context.

Key points made during the discussion were the potential for growing high biomass cover to 'jump start' suppression or the use of canola over a two-year period to act as a natural fumigant.

Effect of no-till on crop productivity and soil condition

- Whilst there is no doubt about the benefits of 100% no-till in terms of reducing soil erosion and accompanying problems, the overall benefits to system productivity of rigidly sticking to the philosophy in low rainfall areas are still questioned, particularly where the grazing animal remains an integral part of the farming system.

Nigel Wilhelm introduced the no-till topic as a high profile one that is essentially a seeding operation, although it is generally considered more of an overall management philosophy that includes stubble retention, rotation choices and potentially exclusion of the grazing animal. Canadian research has shown yield and protein increases as well as soil quality improvements. 'Hot spots' for no-till development in SA appear to have been in response to an environmental problem (erosion) and the primary driver has not necessarily been productivity. In SA it is still relatively early in the game to assess the long-term (> 10 years) impacts of no-till in many situations. A lot of the research trials have been in high rainfall areas and have shown clear improvements in soil condition with generally no yield reductions even though seedling development may be slightly delayed. An occasional burn has not seemed to adversely affect the system. Herbicide resistance appears to be the key problem for no-till systems.

Key questions that arose in the discussion concerned the role of livestock, if any, in no-till systems and also the management of these systems for disease suppression.

In summary, the day provided a good overview of what is already known and stimulated a great deal of discussion on the three themes. It was felt by many of the participants that the day was lacking in overt displays of genius but there were clearly some bright sparks present that given the right incentive would burn brightly and contribute innovative and valuable ideas to a new EPFS project.

I leave the final word to our invited expert from WA, Bill Bowden, who wrote *"And here I will insert a philosophical point: - that we (as "experts") should only outline the options and detail our best bet, for a range of seasons, of the yield, quality and dollar outcomes of any chosen path the grower wants to take. We do not try to get into the grower's shoes because only they can do that. The grower has to make the choices in an uncertain environment. I have a favourite example (1978 light on the road to Holleton) which turned my classical "give them a recipe or a package they can use" philosophy into the "options and consequences" one above. Neighbours in identical biological/soil situations took opposite extremes in management choices. One had a well-justified rationale for being a low input farmer ("cash flow is crook in crook years and I do well enough in good years"). The other had an equally justifiable case for being high input ("removing constraints in a good year well and truly pays for the losses to over fertilising in crook years"). And when it comes to choices influencing dollars and cents, Such choices can change for any individual. So let us not be in the business of giving the growers answers. Let's give them options and answers to "what if?" questions."*

What happens next?

Based on feedback from all parties with a vested interest, the management committee for the EPFS project are drafting a proposal for a new EPFS project that essentially keeps the same partnerships working but incorporates some of the new ideas for research direction generated during the existing project. After reading this article and others in the Research summary it is up to each of you to provide further feedback. Maybe you can contact someone at Minnipa or bring your views to the 2005 reference group meetings.

Acknowledgements

The comprehensive notes taken by Penny Day, the ideas freely expressed by all those present at the Genius Day, and the subsequent summary thoughts provided by Bill Bowden all contributed substantially to this article and are gratefully acknowledged.

GRDC Grains Research & Development Corporation

MAC farming systems competition

Michael Bennet, Sam Doudle and Mark Bennie

SARDI, Minnipa Agricultural Centre

Try this yourself now

Location
Minnipa
Cooperator: MAC

Rainfall
Av. Annual total: 326 mm
Av. GSR: 241 mm
2004 total: 288 mm
2004 GSR: 223 mm

Yield
Potential: 2.25 t/ha (wheat)
Potential: 2.65 t/ha (barley)
Potential: 3.00 t/ha (barley grass)

Soil
Sandy clay loam, pH 8.5

Plot size
2.6 ha

Key Messages

- **Researchers win the battle, but not the war!**
- **Farmers successfully trial companion cropping wheat and barley grass.**
- **Clients lead the charge, leaving Consultants in their dust.**

Why do the competition?

This is the fourth season of a broad scale farming systems competition on Minnipa Agricultural Centre (MAC). The competition aims to compare the effects of different agronomic decisions on profitability and sustainability. Each team in the competition has taken separate approaches.

How was it done?

The competition is divided in to three teams. The Farmers (Minnipa Ag Bureau), The Consultants (Rural Solutions SA and private advisors) and The Researchers (MAC Staff). A paddock was allocated to each team with an extra paddock assigned as "District Practice." Each team is responsible for the decision making for their paddock to maximise sustainable profit in the short and long term.

What happened?

In a shock discovery, a major secret was uncovered which had been plaguing the competition since its inception. THE PADDOCK SIZES WERE WRONG!!!!!! The paddocks were actually smaller than first realised. This in turn makes the historical yields from the paddocks significantly higher. In the tradition of the competition, the researchers have had the short end of the stick (but what else is new!). Our paddock was the smallest by far. Upon investigation it was calculated that the yields have been underestimated by 8.5 % for the consultants, 3.4 % for district practice, 9.0 % for the farmers and 13.1 % for the researchers. This also means that the input costs were also over calculated as well. This new information has sent shock waves through the research community, discovering that it was not our own fault that we were coming last at all. The debate now is whether to retrospectively adjust the gross margins, or to carry on, now utilising the correct paddock sizes for all future calculations. The fans can rest easily knowing that this season's results reflect the true competition paddock sizes.

Disease levels were varied due to the differences in rotation. The researchers' canola reduced the take all and *Rhizoctonia*, present in last year's testing results. However Pratylenchus levels have increased. Disease levels for the Farmers have not increased, apart from their crown rot risk. *Rhizoctonia* still plagued the Consultants and Farmers, yet the consultants still produced a satisfactory feed barley crop.

May 2004 found both the humble researchers and farmers scratching in the dirt trying to convince themselves that it was moist enough to sow. A decision to sow on minimal weed germination was the result, a difficult decision that most growers themselves were faced with last year.

At this stage in the game the Researchers would like to dismiss the past yields and gross margins and start fresh on a clean slate. Focusing on a single victory and losing sight of the dismal big picture may be the only joy the researchers will get in this competition.

Team 1: The Farmers (The Not Too Cocky Cockies)

Team motto: to farm profitably today, while giving our kids the chance to do the same tomorrow.

What did we learn last year?

Our options for the 2004 season were severely restricted, simply by lack of moisture in the first five months of the year. With almost no summer rain, subsoil moisture levels were close to zero. There were no significant rainfall events in April or May which took away our opportunity for a legume or canola crop.

We again chose wheat, which was sown in late May, after a Roundup knockdown and then a heavy dose of Diuron/Trifluralin in an attempt to control our increasing barley grass problem. The eventual low yield of our crop can be attributed mainly to a dry, harsh spring period but we have to admit that barley grass competition was also a major factor. Cereal diseases didn't seem to present much of a problem, even after four successive wheat crops. The variety choice of Wyalkatchem helped in this regard, although stripe rust was a very real threat at one stage.

In terms of nutrition, we supplied extra N to the crop with 50 kg/ha of urea down the tube at seeding time as well as the 40 kg/ha 18:20:0 application. This contributed to good winter crop growth but didn't push up screenings level too much in

2004 Root Disease Testing Results

Paddock	CCN Risk	Take All Risk	*Rhizo* Risk	*Prat neglectus* Risk	*Prat thornii* Risk	Crown Rot Risk (Provisional Risk Category)
Rearchers	BDL	BDL	Medium	Medium	Low	Medium
Farmers	BDL	BDL	High	Low	Low	High
Consultants	BDL	BDL	High	Low	BDL	High
District Practice	BDL	BDL	Medium	Low	Low	Medium

BDL = Below Detectable Level

the sample. In summary, our gross margin was a reasonable result considering the climatic conditions and current low wheat prices. It was beaten only by the researchers who have a lot of catching up to do anyway. We still hold our comfortable lead. In terms of the sustainability of our paddock, we believe that our practises have had no detrimental effect, and our nutrition and tillage regimes are working well.

2005 Plans

Grass weed control this year has become of paramount importance and we have probably reached the end of the line with continuous wheat. As always, there are a few other options available to us such as peas, beans, canola or a medic pasture. Our choice of crop will again depend on the timing of the break to the season. We will also consider the indicator price of each commodity, which could be important, especially this year.

Paddock management could include a hot autumn burn to help with barley grass seed bank reduction, and perhaps a shallow working or tickle just prior to the season break to encourage a good weed germination. Sowing method will again involve a pre seeding knockdown, followed by one pass seeding with points and controlled traffic. Nutrition will be supplied according to the needs of the crop grown.

Another late break to the season could see us pull out another trick and grow Clearfield Stiletto wheat to gain grass control in crop. Be assured that our decisions will always be carefully considered, with the future in mind, and we intend to protect our lead in the competition. Our kids deserve it.

Team 2: The Advisers (De$perately $eeking $olutions)

Team motto: If we get trounced, please blame Ed Hunt

What did we learn last year?

Because of the late fickle break to the season, we decided to go with Keel barley. Keel has performed well at Minnipa and again last year under a tight finish it still produced 1.25 t/ha. We were also keen to grow some barley because of its competitive nature, as barley grass is becoming a bigger issue in our paddock. Our other main strategy for barley grass control was an early tickle to encourage germination. The Keel was sown on the 17th of June, well after the other competitors, but we were keen to get some control of the barley grass prior to seeding. We were banking on Keel's early maturity to come through. Overall we were pleased with the lack of barley grass in our paddock and the ability of Keel produced in such a short season on heavy soils. Where we came unstuck (up for debate) was the Feed 3 grade we received and the consequent price of $108.42 /tonne. It appeared when we checked the records that we had locked in our barley at $180 /tonne for Feed 1 (Feed 3 would be around $145 /tonne) (All other parties cannot remember our very progressive marketing strategies and been hence disallowed.) Our appeal is still in progress.

2005 Plans

At this early stage we are considering a crop of peas for 2005. Our principle aim is to continue our control strategies on the barley grass, however we have the right to change our minds completely as many options are being considered. Apparently barley shoots ground up to drink, is high in nutrients and very profitable (*ED's comment: Ask Nigel – he has been drinking some green looking stuff to clean his liver*). We are still working out the labour component of this operation.

Another cereal may still be considered especially in a late break. From a neutral point of view, we are maintaining an average yield approach, but are flexible if the season looks promising.

Team 3: The Researchers (The Starship Enterprise)

Team motto: Boldly going where no man has gone before

What did we learn last year?

The Researchers have finally gone where no researcher has gone before. The somewhat less humble researchers turned a profit in the 2004 season! This makes it the first time in the competition when the researchers have come in front of the friendly neighbour cockies and consultants. Now we're not really in a position to boast at this point in the competition, however we will milk this small victory for all it's worth!

Following on from the second highest yielding paddock of canola on record at Minnipa (0.5 t/ha) the team began their struggle back in to the competition. The Enterprising Researchers however did not fail to disappoint the fans with an impressive agronomic package. Relying on a haircut spray of Gramoxone, as the only knockdown nearly brought the team to its knees (again). Adding to the excitement, a late application Diuron + MCPA failed to control volunteer canola. Despite our attempts to stuff up, we were impressed with our crop all season (while it kept raining anyhow!) It was looking so good in fact that one researcher (who will remain nameless as he wrote this article!) suggested that an application of urea would help our team rise to the challenge of such an excellent season! In this case, democracy saved the day and kept our crop from being cooked with too much N. The late finish to the season had us wondering if the choice of a long growing season variety such as Yitpi was wise. As with most crops, ours finished on absolutely no moisture, yet we were extremely blessed to harvest the quality of grain we did.

2005 Plans

We are planning for an Anzac day break to the season of 25mm or more. From there we will wait for a good germination of weeds, sowing on a full profile of moisture. After seeding we plan to tend to our pigs and train them in the graceful art of flying. This would make the ideal start for the season, however we will be in the same boat as the rest of the cropping industry. We will have to sit and wait, and take what ever comes our way.

Debate in the research camp has already began for the plans for 2005. Suggestions such as Kaspa peas and wheat, wheat, wheat, wheat, wheat and more wheat are the main ideas being thrown around at the moment. So it is most likely that we will go with a run of wheat, hoping to aim for a break crop in the future (before our paddock looks like the neighbours). We aim to continue no till as our establishment method. However weeds such as Marshmallow are becoming more of an issue, which will need close attention. Nitrogen will need consideration during this season due to our "low" protein levels last year. We're aiming to make the best of season 2005 and our relatively clean paddock to hopefully make up some more of the lost ground between our competitors and us.

Acknowledgements

AWB Ltd for their continued sponsorship of the competition. Brett and Ted McEvoy for sowing, spraying and harvesting the paddocks. Mark Bennie for his tireless patience dealing with indecisive teams over the years of the competition!

	Date	Farmers	Consultants	Researchers	District Practice
1999		Parafield Peas @ .36 t/ha	BT Schomburg Wheat @ 1.33 t/ha	Wallaroo Oats @ .67 t/ha	Chemical Fallow
2000		Chemical Fallow, Summer Crop, Legend Sorghum @ yield 50 kg/ha. GM = - $56.89 /ha	Chemical Fallow/summer weed spray, GM = - $21.48 /ha	Chemical Fallow, GM = -$12.61 /ha	Chemical Fallow, GM = - $10.78 /ha
2001		Yitpi Wheat: Yield- 2.75 t/ha, Prot- 13.6%, Scrn 5.6% & TW-75.4. GM = $599.77 /ha	Yitpi Wheat: Yield- 2.77 t/ha, Prot- 11.6%, Scrn- 4.6% & TW- 75.4. GM = $571.66 ha	Broadcast Frame Wheat: slashed and baled (wild oat problem). Yield:22 round bales. GM = $207.16/ ha	Yitpi Wheat: Yield- 2.79 t/ha, Prot- 12.3%, Scrn- 4.9% & TW- 75.6. GM = $574.71 /ha
2002		Krichauff Wheat Yield – 1.48 t/ha, Prot – 12.4%, Scrn – 1%, TW – 77.2, % Pot Yield – 68%, GM = $315.73	Krichauff Wheat, Yield – 1.25 t/ha, Prot – 11.8%, Scrn – 3.3%, TW – 74.4, % Pot Yield – 58%, GM = $231.09	Barque Barley, Yield – 1.36 t/ha, Prot – 11.4%, Scrn – 34.8%, TW – 72.6, % Pot Yield – 53%, GM = $195.36	GM = -$3.70
2003		Krichauff Wheat Yield – 1.21 t/ha, Prot - 13%, Scrn - 4.1%, TW – 76, Pot Yield – 66%, GM = $163.06	Krichauff Wheat Yield – 0.99 t/ha, Prot – 12.1%, Scrn - 5.6%, TW – 77.2, Pot Yield – 54%, GM = $117.60	Rivette Canola Yield – 0.50 t/ha, Oil – 40.7%, Foreign Matter – 5.7%, TW – 64.2 GM= $64.92	Yitpi Wheat Yield – 0.85 t/ha, Prot – 14.3%, Scrn - 5.9%, TW – 78.6, Pot Yield – 46%, GM = $117.37
Running Gross Margin, After 2003		**$1021.67☺**	**$898.87☺**	**$479.84☹**	**$677.60☺**
2004 Management	18/5/04		Worked Up		Worked Up
	25/5/04	Roundup Powermax® @ 1.25 L/ha then 1.25 L/ha Diuron + 1.25 L/ha Triflur480		Diuron @ 630 ml/ha + Triflur480 @ 1 L/ha	
	25/5/04	Wyalkatchem @ 50 kg/ha + 18:20:0:1 @ 40 kg/ha + urea @ 50 kg/ha		Yitpi @ 60 kg/ha + 18:20:0:1 @ 55 kg/ha	
	7/6/04			Gramoxone® @ 400 ml/ha + Chemwet 1000	Sprayseed® @ 1 L/ha + Triflur480 @ 1 L/ha
	7/6/04				Krichauff @ 50 kg/ha + 18:20:0:1 @ 50 kg/ha
	17/6/04		Sprayseed @ 1 L/ha + Triflur480 @ 1 L/ha		
	17/6/04		Keel @ 75 kg/ha + 27:12:0:10 @ 80 kg/ha + 2L Broadacre ZM seed treatment		
	27/7/04	Tigrex® @ 350 ml/ha + Hasten + 1.5 kg/ha Zinc Sulphate		Diuron @ 400 ml/ha + MCPA 500 @ 350 ml/ha	Diuron @ 450 ml/ha + MCPA 500 @ 450 ml/ha
	18/8/04		MCPA LVE @ 600ml/ha	MCPA LVE @ 1 L/ha	
		Wyalkatchem Wheat: Yield- 1.01 t/ha, Prot- 13.3%, Scrn 7.8% & TW-74 GM = $84.38 /ha	Keel Barley: Yield- 1.35 t/ha, Prot- 12.4%, Scrn- 32.8% & TW- 58.4 GM = $67.48 /ha	Yitpi Wheat: Yield- 1.25 t/ha, Prot- 11.7%, Scrn- 6.6% & TW- 77.2 GM = $132.21 /ha	Krichauff Wheat: Yield- 0.82 t/ha, Prot- 16.3%, Scrn- 26.9% & TW- 68.2 GM = $40.93 /ha
Running Gross Margin, after 2004		**$ 1106.05 ☺**	**$ 966.35 ☺**	**$ 612.05 ☹**	**$718.53 ☺**

Section 5

Section editor: John Hancock

SARDI, Minnipa Agricultural Centre

SAGIT

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Disease

Rust on the Eyre Peninsula

Extension

Hugh Wallwork

SARDI, Plant Research Centre, Waite

Key Messages

- **The new WA strain of stripe rust is more aggressive than previous strains and more capable of surviving over summer on volunteer hosts.**
- **Volunteer cereals from summer rains are scattered across the state and present a threat for rust in 2005.**
- **Avoid growing Westonia and H45 and use 2005 to investigate the merits of varieties with improved resistance.**

The stripe rust epidemic of 2004 came as something of a surprise to many growers on the Eyre Peninsula who have been used to hearing of the rust causing problems in crops in other areas and only arriving, if at all, in their crops too late in the year to cause much trouble.

Almost certainly surviving in the Far West Coast on some sparse host, the rust in 2004 started early, much closer to home and upwind of almost everyone. The consequent rush to chemical fungicides certainly reduced the rapid spread of the disease and also led to some acute shortages of product around the state. Having access to these fungicides was a great benefit in many cases although in some instances use of them got carried too far.

The benefit of fungicides in 2004 is difficult to quantify due to the dry and warmer conditions experienced in later spring. Some crops were sprayed needlessly because the level of infection was too far advanced and some varieties were sprayed that had adequate levels of plant resistance.

The speed at which the rust spread, and quite likely also the summer survival, was greatly aided by the extreme susceptibility, and therefore spore producing potential, of varieties such as Westonia and H45. Without these varieties the whole scenario on the EP would have been less dramatic. It is for this reason that we are trying to avoid the release and growing of similar highly susceptible varieties in the future.

Some individuals are promoting the idea that these varieties are not a problem and that, with cheap fungicides at hand, growers can manage rust quite simply. This argument is understandable but misses the point that these varieties provide the best hosts for summer survival and increase the probability of new and worse strains emerging. Also, given the signal that yield is all important, breeding companies will be obliged, or at least tempted, to reduce their guard against both leaf and stem rust to develop their market share of new varieties. This would in time lead to much greater dependence on chemical control and a less sustainable industry in the long term, especially for growers in lower yielding environments.

And so to the other rusts… Stem rust occurred in crops in the Ceduna and Penong areas of the Far West Coast. The strain involved is virulent on Camm, Yitpi and Pugsley and was first detected in Western Australia in 2002. Leaf rust was present at a very low level and only two crops were identified with any rust in 2004. While this low level of stem and leaf rust was welcome and provides encouragement that we will not have a problem in 2005, it is wise to be mindful of the great ability of rusts to develop from an extremely low base to become a widespread problem if environmental conditions and susceptible varieties favour their growth.

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Rhizoctonia – scenarios of 2004 and control strategies

Alison Frischke[1] and David Roget[2]

SARDI, Minnipa Agricultural Centre[1], CSIRO Land and Water, Adelaide[2]

Rhizoctonia damage was significant in many areas of Eyre Peninsula and the south-eastern wheat belt of Australia in 2004. This has been particularly so on lighter, less fertile soils and where the seasonal break came late and was patchy.

Scenarios for *Rhizoctonia* damage in 2004

In many cases, there appears to be two different scenarios for the occurrence of significant levels of *Rhizoctonia* in crops and much of it can be related to the very dry summer/autumn period. There can be exceptions to the scenarios, where soil type, weather events and paddock history will quickly change the soil conditions and consequently *Rhizoctonia* behaviour.

1. Cereal following pasture.

In areas such as the Mallee region, small and infrequent rainfall events from harvest to sowing allowed for some net N mineralisation, however nearly all the mineralised N remained in the topsoil as there was not sufficient rainfall to leach it down the profile. This resulted in relatively high mineral N levels in the top 10 cm, which reduced the soils natural suppressive activity against *Rhizoctonia* and other fungal pathogens. For most of Eyre Peninsula where rain did not fall before seeding, suppressive activity was maintained following pastures and crops were generally not greatly affected by *Rhizoctonia*.

2. Intensive cereals.

Good yields or at least good biomass production in 2003 used all available soil N reserves and with dry summer/autumn conditions there was minimal N mineralisation and little opportunity for the breakdown of large stubble loads.

Sowing was generally undertaken on marginal moisture conditions. The incorporation of stubble in the sowing processes would have tied up any available N in the system, exacerbating the low N status and any added N fertiliser would have been quickly immobilised. With a June sowing into cold soils that were N deficient and the release of N from mineralisation only occurring 3 or 4 weeks after sowing, early plant growth was slow.

Rhizoctonia, being a very oppurtunistic disease, is greatly favoured by slow growing plants. The *Rhizoctonia* fungus, which resides in the top 10cm of soil, penetrates roots through their growing tips. Any factor that slows root growth therefore increases the exposure of roots to the disease as they spend more time in the zone of infection.

These conditions also favoured the development of yellow leaf spot in wheat on wheat rotations that further delayed development in some areas and developed into a vicious cycle of constraints. Barley is particularly susceptible to *Rhizoctonia* and the combination of barley after a wheat crop sprayed with SU herbicides and with a very low soil N level was a worst-case scenario.

The low N status in the topsoil over summer/autumn would have optimised the disease suppressive activity of the soil and in paddocks where suppression levels are high, disease is not a problem. However, in paddocks where suppression levels are low to moderate, the other factors contributing to disease previously mentioned, will outweigh any suppressive activity.

The 2004 season has highlighted the critical importance of summer rainfall in intensive cropping systems on our low fertility soils. Moderate summer rainfall is critical to mobilise N in these systems and this should be kept in mind when summer conditions similar to 2003-4 come along.

Controlling *Rhizoctonia* root disease

Factors that promote fast and vigorous plant establishment will aid faster root development and reduce the level of root infection for the amount of *Rhizoctonia* inoculum present. These factors include:

- Good nutritional management
- Timely control of grasses in the year prior to sowing, and of weeds after the break and up to sowing
- Ensuring good seed to soil contact
- Timing of sowing (dependent on soil type)
- Avoiding sulfonylurea herbicides on highly alkaline soils
- Tillage below the seed
- Deep banding urea in direct drill systems
- Retaining stubbles
- Increasing carbon turnover

Farmers who put the suite of control measures together have been successfully managing *Rhizoctonia* in the past. However, for many areas in 2004, the late break and slow growing conditions in the first few weeks created conditions so favourable for *Rhizoctonia* development that even these farmers had some *Rhizoctonia* damage.

Other *Rhizoctonia* control strategies for consideration:

Impact of canola.

The impact of canola as a break crop for *Rhizoctonia* was quite dramatic in 2004. This appears to be due to:

1. Canola is the only crop type that can reduce *Rhizoctonia* inoculum in some soils. Leon Mudge of Miltaburra has DNA tested his paddocks for the past four seasons (*refer to article "5 years of whole farm monitoring" on page 75*), and is recording reductions in *Rhizoctonia* DNA levels of around 60 % compared to paddocks of cereal or broadleaf free pasture.
2. Canola significantly increases early N mineralisation due to a greater bacterial domination in its rhizosphere.

Improving soil biological function

Changes in management which increase cropping intensity and productivity impact on non-symbiotic N^2-fixation, nitrogen and phosphorus dynamics and suppression of cereal root diseases. Management changes that increase productivity and return higher levels of microbially available carbon to the soil are the driver for greater soil microbial activity and improved suppression of root diseases.

Seed treatments

Fungicides for *Rhizoctonia* suppression being released overseas are showing some promise in some countries, but are not showing the same benefits in Australia as yet. Lyndon May found yield increases between 2 - 3 % in wheat and 12 % in barley by using Dividend™ in Syngenta trials on Eyre Peninsula in 2003. However in 2004, with very favourable conditions for *Rhizoctonia*, there has been little suppression, even when zinc levels have been good (*refer to article on page 78*).

Lyndon generally found that responses were achieved on properties with grassy pastures, less stubble retention and lower carbon cycling, whereas farmers who had a good rotation using grass free pastures and/or breakcrops did not achieve a response.

Further information

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SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

CSIRO

Five years of whole farm monitoring soilborne disease inoculum at Miltaburra reveals a possible solution to *Rhizoctonia*

Searching for answers

Location
Closest town: Miltaburra
Cooperator: Leon Mudge

Disease

Survey

Alan McKay[1] and Leon Mudge[2]

SARDI, Waite Campus[1], Farmer, Miltaburra[2]

Key Messages

- **Canola crops reduced *Rhizoctonia* inoculum at Miltaburra between 2002 and 2004,**
- **Pre-seeding *Rhizoctonia* inoculum levels accounted for up to 50 % variation in wheat yields between paddocks.**

Why do the trial?

- To determine which soilborne diseases were most prevalent at Miltaburra and monitor changes in inoculum levels through each stage of the rotation across five seasons to identify practices that were either providing useful control or creating problems.
- Development of DNA tests by SARDI and CSIRO mean we can simultaneously monitor inoculum levels of a broad range of soilborne diseases prior to seeding. Before this it was usually only possible to study one disease at a time.
- In 2001 there was strong interest in the role of soilborne diseases, especially *Pratylenchus neglectus,* limiting crop yields on EP. We decided to use all the tests we had to monitor changes in inoculum levels across a whole farm for at least five years to determine which soilborne diseases were most important and look for impacts of rotations that warranted further investigation. This worked was funded as part of the SAGIT project to develop new tests for the RDTS.

How was it done?

Each summer, soil samples were collected from 39 paddocks across Leon Mudge's farm at Miltaburra and sent to SARDI to be tested to assess inoculum levels of Take-all (wheat and oat attacking strains), Cereal cyst nematode (CCN), *Rhizoctonia solani AG8, Pratylenchus neglectus, P. thornei*, Crown Rot (*Fusarium pseudograminearum and F. culmorum*) and recently Common Root Rot (*Bipolaris sorokiniana*). The results for disease inoculum were examined for patterns that corresponded to previous crop/pasture history and to performance of the next crop.

Table 1: Summary of soilborne disease inoculum detected by DNA assays on Leon Mudge's farm 2001 - 2005

Root Disease	2001 (Min Max)	2002 (Min Max)	2003 (Min Max)	2004 (Min-Max)	2005 (Min Max)
Take-all	13 (0 – 28)	4 (0 - 23)	0	1.5 (0 – 27)	8.7 (8.7 – 52)
CCN	0.3 (0 – 3)	0.2 (0 – 3)	1 (0 –13)	0.26 (0 – 2)	0.6 (0 – 9.2)
Rhizoctonia	88 (0 –144)	78 (22-122)	82 (11-136)	89 (23 – 147)	119.2 (21 – 156)
P. neglectus	11 (0-37)	19 (2-86)	8 (0-27)	8.1 (1 – 39)	10.5 (0 – 37)
P. thornei	0.5 (0-9)	2 (0-34)	1 (0-19)	0.2 (0 – 11)	0.3 (0 – 3.0)
Crown Rot		0.7 (0 - 16)	0	0.1 (0-3)	0.3 (0 – 3.0)
Common Root Rot*				347** (25 – 1208)	440 (0 – 1577)

Table 2: Disease risk categories

Root Disease	Units	Low	Medium	High
Take-all	Standardised units	<50	50 to <100	>100
CCN	eggs /g soil	<5	5 to <10	>10
Rhizoctonia	Standardised units	<40	40 to <80	>80
P. neglectus	nematodes /g soil	<20	20 to <60	>60
P. thornei	nematodes /g soil	<20	20 to <60	>60
Crown Rot (bread wheat)*	pg DNA /g soil	<100	100 to <300	>300
Common Root Rot*	pg DNA /g soil	<300	300 to <650	>650

** Provisional risk categories*

What happened?

The DNA results indicate *Rhizoctonia* was consistently the most important soilborne disease between 2001 and 2004 (*Table 1*). The risk categories for each disease are summarised in *Table* 2. Take-all inoculum was only detected at low levels in a few paddocks, CCN levels were also low, though in the K3 paddock it reached 13 eggs/g soil following two susceptible wheat crops. Crown Rot inoculum was mostly below detection levels and only occasionally detected at low levels. *Pratylenchus neglectus*, while present in most paddocks was usually at low to medium levels. The more damaging *P. thornei* was detected at low levels in 25 % of paddocks. Common Root Rot inoculum, assessed for the first time in 2004, was present in all paddocks with around 15 % in the provisional high-risk category.

Rhizoctonia

Wheat yields were lower in paddocks with high initial *Rhizoctonia* levels. The strongest correlation between the pre-sowing *Rhizoctonia* level and yield was in 2004 and the weakest was in the drought year of 2002. The paddock K9 was separated from the main results in 2004 and 2003 as it has very shallow soil and only performs well in the wetter seasons.

The slopes of the regressions (*Figures 1-4*) indicate wheat yields declined between 2.8 and 5.8 kg / ha for each unit increase in *Rhizoctonia* inoculum detected prior to seeding. This suggests *Rhizoctonia* was causing yield losses of around 50 % in the worst affected paddocks. These results are similar to those obtained by Taylor *et al* (2004) in a replicated trial in 2003 on the same property.

Effect of rotation on *Rhizoctonia* levels

Rhizoctonia levels following canola (9 crops) were generally lower than following wheat (15 crops per year), barley (5 to 7 crops per year) and pasture paddocks (11 – 16 per year) (*Figure 5*). There were fewer triticale and oats but the *Rhizoctonia* levels following these were similar to wheat, barley and pasture. There was one safflower crop and *Rhizoctonia* levels following it were low.

Canola is unreliable around Miltaburra so it was mostly used to try to improve poor performing paddocks. It was also grown in two better performing paddocks, 15 and 17, the latter to help control brome grass. In each case wheat followed the canola crop. While no test strips were left to confirm potential yield responses, five of seven wheat crops (two more to be sown in 2005), yielded above the farm average for each respective year. All of the paddocks except K9 yielded 10 to 60 % the average of the other wheat crops grown in that season (*Table 3*). The paddock was K9, which had a low *Rhizoctonia* level of 58 before canola, and although inoculum levels declined after canola, the following two wheat crops did not

Figures 1-4: Correlation between wheat yields and pre-sowing Rhizoctonia inoculum levels detected by DNA assays for the 2001 to 2004 growing seasons.

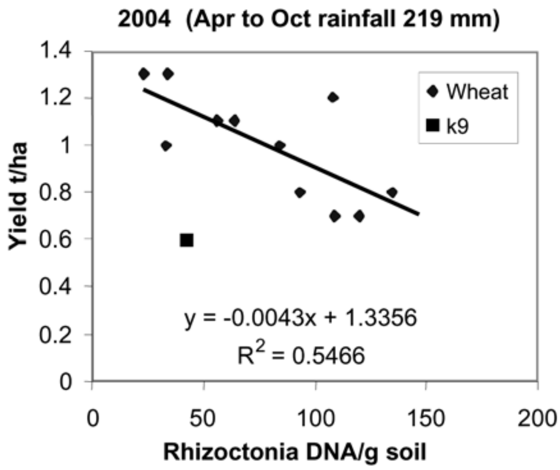

Figure 1:

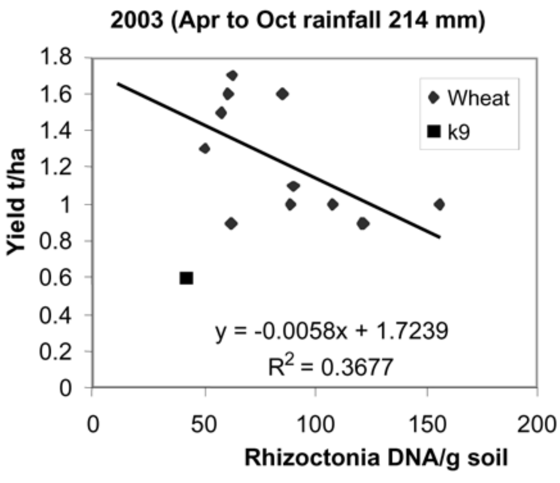

Figure 2:

perform well. The shallow soil in this paddock is probably more limiting than *Rhizoctonia*. Six of the nine canola crops grown between 2002 and 2004 failed, so better adapted varieties are needed. However, it appears that as few as 2-3 canola plants/m^2 may be all that is required to provide useful levels of *Rhizoctonia* control.

The yield responses in wheat following canola in *Table 3* are comparable to the response observed in a replicated trial conducted in paddock 5 on the same property in 2003 (Taylor *et al* 2004).

Broad-leaved weeds are common in the pasture phase and are usually sprayed out early in the season, but in 2003 they were

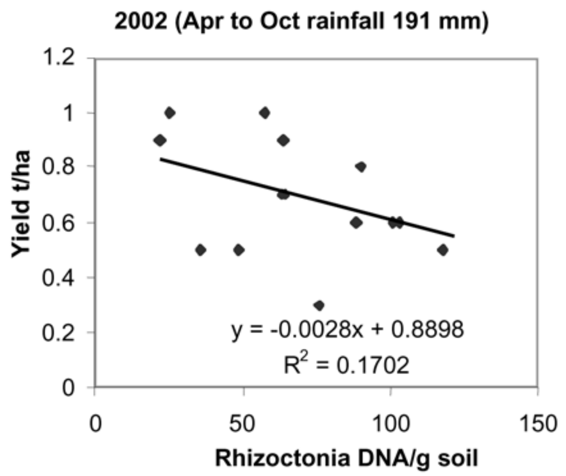

Figure 3:

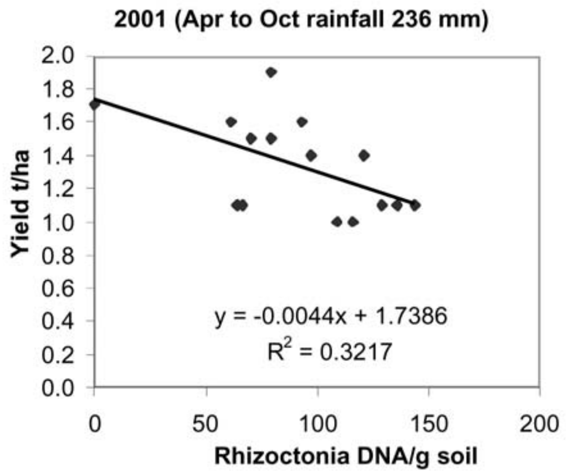

Figure 4:

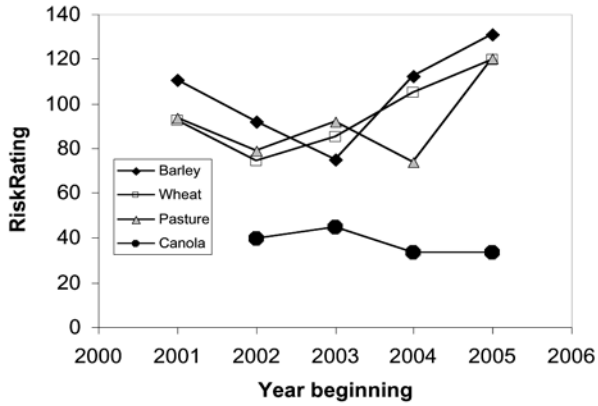

Figure 5: Average Rhizoctonia inoculum levels following various crop and pasture

Table 4: CCN resistant cereals grown on Leon Mudge's farm 2001-2004.

Cereals	2004	2003	2002	2001
Total	23	20	24	26
CCN resistant	15	13	10	14
% CCN Resistant	65%	65%	42%	54%

left until spring and then spray-topped to see if this provided useful control of *Rhizoctonia*. This may explain the slight dip in *Rhizoctonia* levels detected in early 2004, but it does not match the decrease in *Rhizoctonia* following canola. In 2004 paddock 21, initial *Rhizoctonia* level of 120, was sown with forage turnip and forage rape, however the level detected following these in 2005 was 96 and 115, which suggests they are not an equal alternative to canola.

Pratylenchus

P. neglectus was detected in most paddocks in most seasons at levels that may have contributed to yield losses, but these are hard to measure in a background of *Rhizoctonia*. Yield losses in intolerant varieties caused by *P. neglectus* vary between seasons and range from about 0.5 to 1.3 % for each *P. neglectus* per g soil (*Sharyn Taylor pers com.*).

Cereal Cyst Nematode

CCN can cause large yield losses on EP. The results of paddock monitoring show that CCN is being kept under control by the crop rotation, which included 42 % to 65 % CCN resistant cereal varieties each year. CCN was also detected in 15 paddocks, and in three of these it was detected in four out of five years. One of these paddocks had three resistant cereals and two pastures. This is a good example of how CCN resistant cereals actually maintain low numbers of CCN, which can then increase between 5 and 10 times on a susceptible variety.

What does this mean?

- *Rhizoctonia* is probably causing yield losses of up to 60 % in heavily infected paddocks with no other significant limitations to growth.
- High risk paddocks can be identified by the DNA tests before seeding.
- Canola appears to provide useful control of *Rhizoctonia*, but the effect declines quickly after the first wheat crop.
- Preliminary paddock trial, with forage rape and turnip suggest they do not provide useful control of *Rhizoctonia*.

Table 3: Wheat yields and Rhizoctonia levels following canola

Paddock	Year	Wheat Yield following Canola t/ha	Average other wheat crops t/ha (No.)*	% Yield response relative to average	Average initial *Rhizoctonia* level across 39 paddocks	Initial *Rhizoctonia* level for wheat following canola
15	2002	1	0.6 (17)	60%	78	57
17	2002	0.9	0.6 (17)	44%	78	22
K9	2003	0.5	1.1 (12)	-53%	82	11
9	2003	1.7	1.1 (12)	60%	82	63
19	2003	1.6	1.1 (12)	50%	82	61
K3	2004	1.0	0.9 (14)	10%	89	33
18B	2004	1.3	0.9 (14)	43%	89	34

** Average excludes the yield of wheat crops following canola.*

How does this relate to previous information?

- Reductions in *Rhizoctonia* levels after canola have been observed previously in field trials conducted on the EP by Dr Damien Adcock (1999 to 2002 pers com.) and by Dr Sharyn Taylor (*Eyre Peninsula Farming Systems 2003 Summary*).

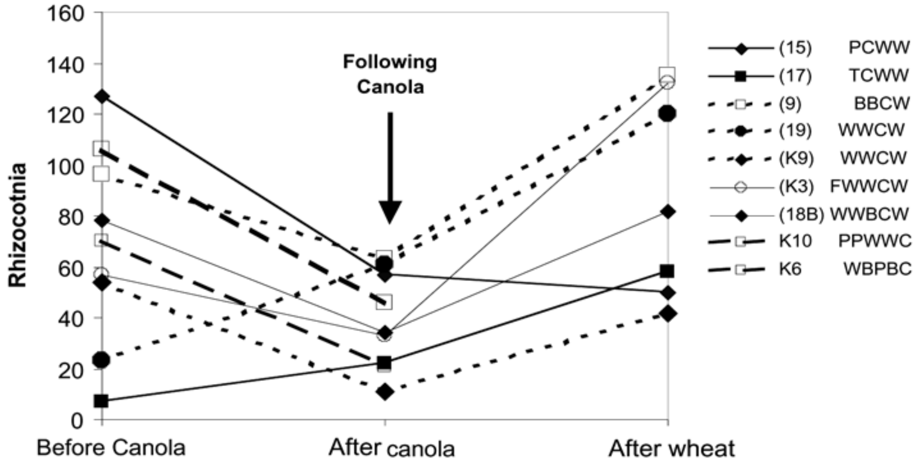

Figure 5: Average Rhizoctonia inoculum levels following various crop and pasture.

- Two years of soil fumigation trials (GRDC National Fumigation Project) on Eyre Peninsula identified *Rhizoctonia* as the primary disease constraint, with yield responses up to 100 % where nutrient requirements were met.

Will it require further research or a change in direction?

- Above observations should be validated in replicated field trials on other properties.
- Early maturing canola varieties and a broad range of forage brassicas should be evaluated in replicated trials for reducing levels of *Rhizoctonia* inoculum. Current varieties are too unreliable for cropping.
- Further work is required to determine which brassicas provide the best control of *Rhizoctonia*, and determine how best to use them (i.e. in crop and/or as a pasture species in the year prior to cropping).
- The mechanism of control needs to be identified to determine on which soil types canola will deliver the desired effect.
- Whole farm monitoring for disease is a useful research strategy to assess the impact of different rotations.

Any recommendations or take home messages?

- *Rhizoctonia* appears to be causing yields losses up to 60 % and while there are other soilborne diseases present capable of causing significant yield loss, their impact is probably relatively small when *Rhizoctonia* damage is severe.
- High risk paddocks can be identified before seeding by using PreDicta B.

Acknowledgements

The authors would like thank the Crop Pathology staff, Ina Dumitrescu, Russell Burns and Aidan Thomson for processing the samples, acknowledge SAGIT for providing funds to support this work, and the critical role they played in helping to establish the Root Disease Testing capability at SARDI. Bayer Crop Science has supported further development of the assays and market the technology as PreDicta B.

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SAGIT

DIVIDEND™ trials and demos for 2004

Neil Cordon and Alison Frischke

SARDI, Minnipa Agricultural Centre

Key Messages

- ***Rhizoctonia solani*** **is a major root disease affecting crop production and as yet there is no "silver bullet" for its control.**
- **Seed dressing should not be relied upon to control** ***Rhizoctonia*** **but may offer some suppression, which needs to be investigated in the future.**

Why do the trials?

To determine the effect of the seed dressing Dividend™ on the root diseases *Rhizoctonia* and Take all.

Both diseases have been identified as major constraints to the yield of cereals over the last 30 years throughout Eyre Peninsula.

Agronomic techniques such as good nutrition (especially zinc), cultivation below the seed zone and removal of the green bridge prior to sowing have all aided in reducing the extent of *Rhizoctonia* however the disease still causes problems in the paddock.

Syngenta Crop Protection Pty. Ltd. released their new seed dressing Dividend™, registered in Australia to control Pythium, Flag Smut and Loose Smut in wheat and seed borne Net Blotch, Covered Smut and Loose Smut in barley. North American experience has suggested that there could be useful suppression for the root diseases *Rhizoctonia*, Take all and Fusarium.

The active ingredient of Dividend™ is Difenoconazole and metalaxyl-M.

Research

How was it done?

Replicated plots were sown to Krichauff wheat either treated with Dividend™ or left untreated (control).

What happened?

- Emergence at 21 days was not affected at either site by Dividend™ application to the seed.
- Both sites suffered *Rhizoctonia* damage, however there was no difference in plant or root damage between treatments.
- Grain yield, which averaged 1.18 and 1.32 t/ha at Piednippie and Streaky Bay respectively and grain protein was unaffected by treatments.

What does this mean?

In these trials in 2004, the treatment of seed with Dividend™ did not improve the performance of wheat plants. This is consistent with results from Syngenta trials, conducted by Lyndon May that also found that Dividend™ offered little suppression under the very favourable conditions for *Rhizoctonia* in 2004, even when zinc levels were good.

In 2003 however, other Syngenta trials on Eyre Peninsula showed that the use of Dividend™ increased grain yield by 2-3 % in wheat and 12 % in barley. This indicates that crop responses from Dividend™ may be season dependant. It was generally found that responses were achieved on properties with grassy pastures, less stubble retention and lower carbon cycling, whereas farmers who had a good rotation using grass free pastures and/or breakcrops did not achieve a response.

Acknowledgements

Thanks to Lyndon May for provision of Dividend™ for our trial purposes, and for his comments. Thanks also go to Wade Shepperd, Leigh Davis and Kaye Brace for trial management, and to the Cronin and Williams families for providing the trial sites.

Demo

How was it done?

Sites were selected at Streaky Bay and Minnipa and root disease D.N.A. tests were conducted in March to establish background disease levels (*Table 1*).

At Minnipa, Krichauff wheat was sown at 60 kg/ha on the 9th June. A control strip was sown with seed treated with Raxil® at 100 gm/100 kg seed whilst an adjacent strip was treated with Dividend™ at 130 ml/100 kg seed, on seed already treated with Raxil®.

At Streaky Bay, Excalibur wheat was sown at 50 kg/ha on the 22nd June. The seed was treated with either Vitaflo C® at 125 ml/100 kg seed or Dividend™ at 200 ml/100 kg seed.

The recommended rate for Dividend™ is 130 ml/100 kg seed and at this rate, the cost to treat 100 kg of seed is $5.20. In North America, the rate is recommended at 260 ml/100 kg seed to get *Rhizoctonia* and Take all.

The site at Minnipa was harvested at maturity and grain yields were calculated.

Table 1: Root disease levels at Minnipa and Streaky Bay, 2004.

	Minnipa	Streaky Bay
	Risk	Risk
Take all	Below detection	Low
Rhizoctonia	Medium	Medium
Common Root Rot	Medium	High

Table 2: Wheat yields, emergence and screenings from Dividend™ demo at Minnipa 2004.

Seed Treatment	Emergence (plants/m2)	Screenings (%)	Yield (t/ha)
Raxil®	155	15.0	1.26
Dividend™ plus Raxil®	143	12.3	1.18

What happened?

At both sites there was little visual differences between treatments, however at Streaky Bay symptoms of *Rhizoctonia* damage were evident throughout the treated and untreated areas. In August, root examinations at Streaky Bay showed severe root tipping in the patches of poor growth for both treatments. Patches of good growth had little evidence of the disease.

No symptoms of *Rhizoctonia* or Take all were seen at Minnipa. The yield of Dividend™ was lower than the control (*Table 2*) however that may be compounded by the Dividend™ treatment being applied on grain already treated with Raxil®. Lower plant counts for this treatment also suggests the dual rate of dressing affected seedling establishment and also yield. There was little difference in grain quality measurements except for screening levels with the control having nearly 3 % higher screenings.

Acknowledgements

Lyndon May of Syngenta Crop Protection for supplying the product. Neil Williams, Mark Bennie, Brett McEvoy and Kym McEvoy for doing the demos. Dividend™ - a registered trademark of Syngenta Crop Protection Pty. Ltd. Raxil® - a registered product of Bayer Crop Science. Vitaflo C® - registered Hannaford.

Location
Piednippie - Cronin family

Rainfall
Rainfall total 2004: 316 mm
Rainfall April-Oct: 268 mm

Soil
Grey calcareous sandy loam
Rhizo RDTS risk rating: Medium

Plot size
18m x 1.8m

Other factors
Dry spring

Location
Streaky Bay - Williams family

Rainfall
Rainfall total 2004: 289 mm
Rainfall April-Oct: 252 mm

Soil
Grey highly calcareous sandy loam
Rhizo RDTS risk rating: Low

Plot size
18m x 1.8m

Other factors
Dry spring

Location
Minnipa Agricultural Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2004 total: 287 mm
2004 GSR: 223 mm

Soil Type
Alkaline reddish brown sandy loam

Multiplication of root lesion nematodes under medics

Research

***Barbara Morgan*[1], *Ross Ballard*[1], *Rachel Hutton*[1] *and Ben Ward*[2]**

SARDI Pasture Pathology, Waite Campus[1] *and Minnipa Agricultural Centre*[2]

Key Messages

- **Medics limit the multiplication of root lesion nematodes (*Pratylenchus neglectus*) in soils.**
- **Annual medics offer a good management option for the control of root lesion nematodes in cropping soils.**

Why do the trial?

Root lesion nematodes (RLN) are commonly found in South Australian cropping soils where they cause root damage and ultimately yield loss in intolerant cereals and oilseeds. SARDI's Root Disease Testing Service detected the nematode in more than 90% of soils samples received in 2003/04. In 27 % of these soil samples nematode levels exceeded 20 per gram of soil, a level likely to result in significant yield loss, especially in intolerant varieties of wheat.

- A question you might ask is whether medics limit or promote the multiplication of root lesion nematode in the soil?

Field trials have been undertaken to clarify what happens to the number of root lesion nematodes in the soil under medics compared to susceptible and resistant cereals.

How was it done?

Two field sites were established in South Australia near Two Wells (2001) in the Mid North region and near Maitland (2003) on Yorke Peninsula.

At the Two Wells site 14 annual medics, Tahara triticale (known to be resistant to root lesion nematode) and Machete wheat (know to be susceptible to root lesion nematode) were sown.

At the Maitland site 16 annual medics, Tahara triticale and Machete wheat were sown.

More recently field sites were established at Minnipa Agricultural Centre and at Smoky Bay on Eyre Peninsula (2004).

At Minnipa seven annual medics were sown, whilst at Smoky Bay the focus was restricted to the cultivars Herald and Toreador. The cereals Tahara and Machete were sown at both sites.

The numbers of root lesion nematode were measured in the soil under each variety of medic and cereal, two weeks after sowing and again at the end of the growing season. All soil samples were analysed by SARDI's Root Disease Testing Service to determine numbers of nematodes in the soil.

What happened?

Data from both Maitland and Two Wells clearly show that the medics limit nematode multiplication, behaving similarly to Tahara triticale, which is classified as resistant. Some data from Maitland is shown in *Figure 1*.

- Plots sown to Machete wheat, which is susceptible to root lesion nematode, resulted in very high multiplication rate of nematodes in the soil (11.5 times).
- Plots sown to Tahara, which is resistant to root lesion nematode resulted in low-level nematode multiplication (2.5 times).
- Plots under the 16 medics (4 shown) resulted in a low nematode multiplication rate, similar to Tahara.
- Some nematode multiplication occurred similar to Tahara in unsown buffer plots.

The two sites on Eyre Peninsula have all had the initial assessments completed. The final nematode count to enable the determination of nematode multiplication rate will be measured early March 2005. Here, we point out that the initial nematode numbers have varied enormously between plots indicating the need for both researchers and farmers to sample carefully to get reasonable estimates of nematode numbers.

What does this mean?

So far, data from two of the four trials shows that the medics limit the number of root lesion nematodes in the soil, relative to the resistant and susceptible cereals. In this regard the medics offer farmers a good management option for nematode control.

The data from Maitland indicate that some nematode

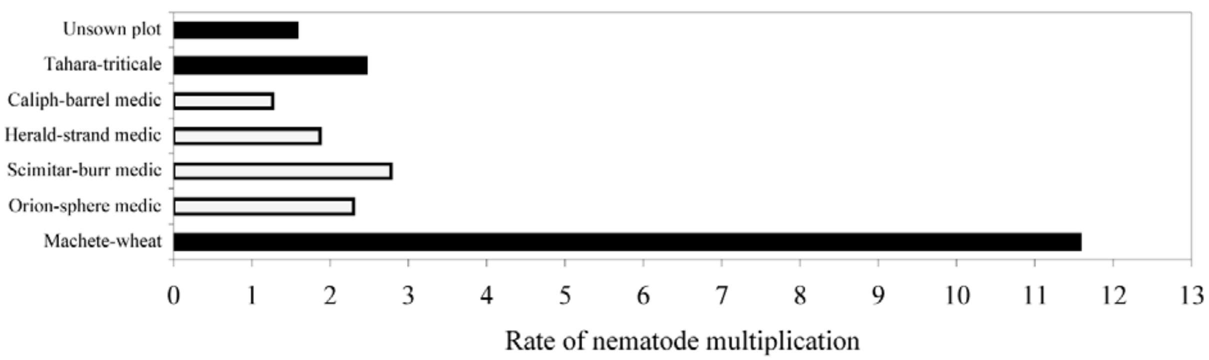

Figure 1: Multiplication rate of root lesion nematodes under various annual medics and cereals.

multiplication may be possible (as occurred in the unsown plots) independent of the plant host. If this is taken into account nematode multiplication under the medics was negligible.

Another field site at Minnipa Agriculture Centre is planned for 2005. This site will feature six medics and two cereals and will complete a comprehensive data set describing nematode multiplication under medics by 2006.

Acknowledgements

The authors would like to gratefully acknowledge the support of the Grains Research and Development Corporation, the South Australian Grains Industry Trust Fund and SARDI. Also Ben Ward, Jake Howie and Peter Schutz who have helped established and maintain the sites and assisted with measurements throughout the growing season.

GRDC Grains Research & Development Corporation

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Research

Crown rot management trials on EP, 2004

Margaret Evans and Hugh Wallwork

SARDI, Plant Research Centre, Waite Campus.

Location
Wharminda
Co-operator: Ed Hunt
Group: Wharminda

Rainfall
Av. Annual total: 306 mm
Av. GSR: 235 mm
Actual annual total: 185 mm
Actual GSR: 133 mm

Yield
Potential: 0.9 t/ha
Actual: 0.2 t/ha to 0.7 t/ha

Soil
Land System: Dune swale
Major soil type description: Siliceous sand over clay

Plot size
20 m x 1.5 m

Other factors
Dry conditions and some very hot days during grain fill. Copper deficiency in the rotation trial.

Key Messages

- **Trace element application may reduce crown rot infection in the year of application but not in the longer term.**
- **Barley significantly raised soil inoculum levels of crown rot for a longer period than durum or bread wheats.**
- **Kukri provided a useful level of resistance to crown rot and raised soil inoculum levels of crown rot less than Frame.**
- **Canopy management treatments were inconclusive but were promising enough to be pursued in 2005.**
- **Soil sampling methods for assessing crown rot inoculum levels in the soil and the risk categories associated with those inoculum levels need to be reviewed for EP and other low rainfall, light soil regions. This will happen as part of normal review processes within the National Crown Rot Initiative.**

Why do the trials?

To assess the effects of crop type, rotation and canopy management on crown rot development and survival on eastern EP.

Crown rot is an increasing problem with closer cereal rotations and increased stubble retention. Yield and quality are generally most affected where there is adequate moisture at the start of the season followed by moisture stress at the end of the season. This means crown rot control will be assisted by the development of rotations which avoid inoculum build up and development of crop management strategies that reduce moisture stress at the end of the season.

How was it done?

Rotation trial.

This trial was in its second year, with Kukri (moderately susceptible to crown rot) and Frame (susceptible to crown rot) treatments sown for the second year and all other plots coming out of cereal or pasture into pasture. Frame and Kukri were sown at 75 kg/ha with 60 kg/ha DAP. Soil samples were taken from all plots to check crown rot levels. Disease scores and harvest details were taken for the two cereal treatments.

Table 1: Growth, crown rot expression and yield in two wheat varieties with different susceptibilities to crown rot.

	Tillers per plant	% Infected plants	Disease score	% White heads	Grain Yield (t/ha)
2003					
Frame (susceptible)		32		65	1.6
Kukri (moderately susceptible)		19		134	2.2
lsd (P=0.05) for 2003 only		7		38	0.2
2004					
Frame (susceptible)	0.4	26	0.9		0.2
Kukri (moderately susceptible)	0.4	13	1.1		0.4

Canopy management trial.

Treatments were:

1. Wyalkatchem 100 % (sown @ 70 kg/ha)
2. Wyalkatchem 80 % + oats 20 % (oats selectively removed)
3. Wyalkatchem 66 % + Oats 33 % (oats selectively removed)
4. Wyalkatchem with high Nitrogen
5. Wyalkatchem @ 40 kg/ha
6. Wyalkatchem @ 55 kg/ha

Shoot (main stem plus tillers) counts and dry matter cuts were taken at mid-tillering (August) followed by disease scores in October and yield, protein and screenings at harvest.

Disease score: main stem only on a scale of 0-3:

0 No visible signs of crown rot.

1 Some discolouration on first internode.

2 First internode completely discoloured and second internode significantly discoloured.

3 First and second internodes completely discoloured and third internode significantly discoloured.

The rotation and canopy management trials were sown on 24th June with 1 L/ha glyphosate & trifluralin pre-sowing and 60 kg/ha DAP at sowing. They were harvested on 3rd December.

Trace element and crop type trial.

In 2001, durum (Tamaroi), barley (Schooner) and bread wheat (Frame) were sown using granular fertilizer (40kg urea predrilled, 60kg DAP at sowing) alone or with trace elements applied as a liquid on or below the seed. In 2002 the trial plots were in pasture. In 2003 the plots were sown to durum and assessed for percentage infection and percentage white heads. In 2004 the soil was sampled for crown rot inoculum levels.

What happened?

Rotation trial.

The resistance of Kukri to crown rot is supported by its lower percentage plant infection rates when compared with Frame (*Table 1*). However, Kukri had higher white head counts than Frame in 2003 and this is not easy to explain, particularly as Kukri still yielded better than Frame (*Table 1*). Frame normally yields better than Kukri on EP but yields of the later maturing Frame may have been more affected by high temperatures and moisture stress during grain fill than Kukri in both 2003 and 2004. Copper deficiency at the site may have played some role in these unexpected results.

Soil inoculum levels were highly variable from plot to plot pre-treatment in 2003 (4-677) and for Frame (18-893) and Kukri (17-1130) in 2004. For this reason, median (not mean) values are presented in *Table 2* and no statistical analyses have been undertaken. Median crown rot inoculum levels for the site (50 in 2003 and 68 in 2004, both falling in the low risk category) were lower than what might have been expected given the problem crown rot causes on eastern EP. Pasture decreased crown rot inoculum levels, Kukri (moderately susceptible) increased inoculum levels slightly and Frame (susceptible) and Schooner increased inoculum levels more (*Table 2*).

Canopy management trial.

Most results were not significant due to the poor finish to the season, although treatments that promoted early crop growth (high nitrogen, higher sowing rates) did have slightly higher disease scores and early dry matter than the other treatments (*Table 3*).

Trace element and crop type trial.

There were limited long term effects of a single trace element application on soil inoculum levels, although there was some effect on % plant infection in 2003 (*Table 4*). Barley seems to have a longer term effect on soil inoculum levels than durum or bread wheat (*Table 4*).

What does this mean?

Rotation trial.

Eyre Peninsula rotation trial findings are supported by results from the Murray Mallee which showed that Kukri increased soil inoculum levels less than Frame or Schooner and that the more resistant wheat, 2/49, actually decreased soil inoculum levels a little. This suggests that cereal varieties may have different long term effects on disease levels as well as performing differently in-season when crown rot is present. More research is needed to explore the relative contribution of varietal resistance levels and of plant material produced to this effect of varieties and crops on soil inoculum levels.

Table 2: Crop and variety effects on crown rot inoculum levels in soil (median figure, not means).

Crop and variety	Crown rot inoculum in the soil		
2003	**March 2003**	**March 2004**	**% change 2003-2004**
Pasture	85	47	-45
Kukri (MS)	43	55	28
Frame (S)	52	96	85
Schooner	42	81	92

Table 3: Canopy management effects on Wyalkatchem wheat growth, crown rot and yield.

Treatment	Tillers per plant	Dry matter per m row	% Infected plants	Disease score	Grain Yield (t/ha)
Wyalkatchem with high Nitrogen	3.3	na	79	1.6	0.4
Wyalkatchem 100%1	0.7	19.5	83	1.5	0.4
Wyalkatchem @ 55 kg/ha	1.2	15.1	87	1.5	0.4
Wyalkatchem 66% + oats 33%	0.8	9.7	79	1.4	0.3
Wyalkatchem 80% + oats 20%	0.7	12.0	79	1.3	0.3
Wyalkatchem @ 40 kg/ha	1.7	11.7	79	1.3	0.4
lsd (P=0.05)	1.26	3.6	NS	NS	NS

Table 4: Long term effects of crop type and trace elements on crown rot expression and yield in Frame and on crown rot inoculum levels in soil.

2001	2003 (Frame over the whole site)			2004
Crop type	**% Infected plants**	**% Whiteheads**	**Yield (t/ha)**	**Crown rot inoculum**
Durum	50	64	1.7	188
Barley	51	52	1.7	341
Frame	52	45	1.7	117
lsd (P=0.05)	NS	NS	NS	140
Trace element treatment				
No trace elements	53	55	1.7	175
Trace elements on the seed	58	50	1.7	237
Trace elements below the seed	42	57	1.7	232
lsd (P=0.05)	12	NS	NS	NS

Risk categories for assessing soil inoculum of crown rot are provisional and are reviewed regularly. As part of this normal review process, it will be recommended that the risk categories for EP and other low rainfall regions be considered specifically. Sampling procedures for assessing soil levels of crown rot inoculum are also in a developmental stage and it will be recommended sampling methods for EP and other low rainfall, light soil regions be reassessed.

Canopy management trial.

Although not conclusive due to seasonal conditions, results from the canopy management trial were encouraging enough to support continuing this line of research.

Trace element and crop type trial.

Results from treatments applied in 2001 suggest trace elements need to be applied regularly to achieve significant benefits and that the effects of crop type on soil inoculum levels may take different periods of time to decrease, with barley raising soil inoculum levels for a longer period than durum or bread wheats.

Acknowledgements

I would like to take this opportunity to highlight the contribution Jerry Dennis (Plant Research Centre) has made to crown rot research and management on Eyre Peninsula (and more widely across South Australia) over the last seven years. Sadly, Jerry died in April 2004.

This work was funded by GRDC and would not have been possible without the assistance of Wade Shepperd (Minnipa Agricultural Centre) and Jose Alvarado (Plant Research Centre). The SARDI Diagnostic Group provided support in testing soil samples.

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Types of Work in this Publication

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

Type of Work	Replication	Size	Work conducted by	How analysed
Demo	No	Normally large plots or paddock strips	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 & Researchers	Usually summary of research results
Information	n/a	n/a	n/a	n/a

Section 6

Section editor: Nigel Wilhelm

SARDI, Minnipa Agricultural Centre

Nutrition

You might think that after using manures and soil conditioners for thousands of years and super fertilisers for over one hundred years that we would have had crop nutrition stitched up by now! And perhaps we would have if the goal posts had not kept shifting. New crops (eg canola and durum wheat), new seeding technologies (eg no-till and double shooting), new pressures (eg increasing cost of fertilisers, market signals for higher protein and lower cadmium wheat, community concern about waterway contamination from agricultural nutrients) and new fertilisers (eg fluid products) have all contributed to keeping us on the hop in the fertiliser management game.

Bob Holloway, Fox Frischke and the rest of the fluid fertiliser team have been major players in the last uprooting of the goal posts – they are now offering the possibility of actually overcoming phosphorus deficiency in crops of the upper EP with their catalogue of fluid products and delivery techniques. Although there are quite a few bugs to iron out still, a meeting was held early in 2005 at Minnipa Ag Centre to discuss what their major discoveries have been so far. This meeting concluded that –

1. The use of trace elements and nitrogen in fluid phosphorus fertiliser solutions banded at seeding is strongly recommended where deficiencies for these other nutrients exist.
2. On highly calcareous grey soils in low rainfall environments (up to 400 mm annual rainfall), clear fluid phosphorus fertilisers banded at seeding are a superior and more efficient form of supplying plant phosphorus needs. The use of fluid fertilisers on these soil types is highly likely to provide a yield benefit. With a low-priced source of fluid P fertiliser, an additional profit is highly likely.
3. On red-brown calcareous soils in low rainfall environments (up to 400 mm annual rainfall), clear fluid phosphorus fertilisers banded at seeding have also produced yield responses that indicate their use on these soil types may provide a yield benefit. With a low-priced source of fluid P fertiliser, an additional profit is possible.
4. For all other soil types the use of clear fluid P fertilisers banded at seeding is not yet recommended.
5. The equipment and technology to deliver fluid based fertilisers in the seed zone efficiently and effectively is readily available and easy to adapt to existing seeders.
6. The differences in performance of the various fluid forms of phosphorus fertilisers are small.
7. The effectiveness of 'Suspension' Fertilisers is still being evaluated. There have been some encouraging yield responses so far. Suspensions are a low cost option.
8. Best practice with all phosphorus fertilisers is to maintain rates at levels which will at least match removal by the farming system.

Note there is also a batch of articles in the soils section which address the issue of deep placement of nutrients for improved productivity.

Plant nutrition trials and demonstrations – things you ought to know

Bob Holloway, Brendan Frischke and Dot Brace
SARDI Minnipa Ag Centre

Did you know that........?

- **if you tried to correct a P deficiency on the grey highly calcareous soils with one application of 100 kg granular P/ha, the crop would probably still need more?**
- **for every 4,000 ha of these soils, more than $1m of fertiliser phosphorus may have been fixed and be present in the soil?**
- **the current soil test for phosphorus is not a reliable indicator of available P for cereals on the grey highly calcareous soils?**
- **YEB tissue tests may not tell you what you really need to know about the phosphorus status of plants on calcareous soils?**
- **hidden deficiencies can lead to wrong conclusions about nutrition trials?**
- **too much of one nutrient can lower the intake of another?**

What's this about soil tests?

The standard soil test in South Australia for 40 years has been the Colwell P test. On the grey highly calcareous soils, Colwell P is a very poor indicator of P availability. Basically it suggests that your soil has a lot more available P than it really has, i.e. a high proportion of the "extracted" P isn't available. What we need now is a reliable and accurate soil test, which is calibrated for local conditions. For instance, we sent some P-deficient calcareous soil to a soil laboratory in the USA for testing. The test "showed" that phosphorus was more "available" than any other nutrient whereas in fact the soil was highly P-deficient. The test (Mehlich III) isn't suitable for our calcareous soils. A much more reliable test is the Resin or Anion Exchange Membrane (AEM-P) method but this isn't available commercially. This leaves farmers on calcareous soils in a difficult position. Some field tests based on colour changes on indicator cards or in solutions can be used as a guide for tissue P but have never found much success amongst advisers. However, it is planned to do some further development work with these in 2005. The ideal would be to have anion exchange membrane tests calibrated in the field for the grey highly calcareous soils.

Well what about tissue tests, don't they tell us all we need to know?

Tissue testing hasn't been around for all that long. In cereals, to assess the phosphorus or zinc status of plants, the youngest emerged blade (YEB) is the standard. With P, it is important to get the growth stage right, because as the plant ages it requires a lower concentration of P for optimum growth. Not that anything can be done (yet) about plants that are low in P –

Phosphorus chemistry in highly fixing soils: can the efficiency of phosphorus fertilisers be improved?

Suspension Fertilisers

Bob Holloway, Brendan Frischke, Dot Brace and Ian Richter
SARDI Minnipa Ag Centre

What nutrients may make fluids work even better?

Methods of trace element delivery

Cereal variety response to fluid fertilisers

Fluid Fertilisers – farmer based demonstrations

Which fertiliser N strategy is the best for cereals?

Can UAN improve head retention in barley?

Pushing the system with nitrogen at Mount Cooper

Bio-control agents can improve field crop performance

Impact of alternative fertilisers on wheat at Tuckey in 2004

Seed quality – building block for your next crop's future!

Section 7

Section editor: Liz Guerin

Rural Solutions SA, Streaky Bay

Soils

Value of subsoil amelioration at Darke Peak

Research

Damien Adcock[1], Terry Blacker[2], Brenton Growden[2], Ian Richter[3] and Nigel Wilhelm[3]

University of Adelaide, Roseworthy[1], SARDI, Pt. Lincoln[2], SARDI Minnipa Agricultural Centre[3]

Almost ready

Location
Closest town: Darke Peak
Co-operator: Alan & Mark Edwards
Group: Darke Peak No-Till Group

Rainfall
Av. Annual total: 380 mm
Av. GSR: 286 mm
Actual annual total: 247 mm
Actual GSR: 168 mm

Yield
Potential: 1.38 t/ha for wheat and 1.78 t/ha for barley.
Actual: 1.12-1.36 t/ha for wheat and 1.25-1.42 t/ha for barley

Paddock History
2003: Pasture
2002: Barley
2001: Wheat

Soil
Land System: Dune-Swale
Major soil type: Siliceous sand over sodic yellow clay.

Key Messages

- **On soils with low water holding capacities, rapid early canopy development may not reduce the risk of 'haying-off' despite reducing soil evaporation prior to anthesis.**
- **In a low rainfall year, less dry matter production prior to anthesis resulted in greater grain yields and harvest indexes.**

Why do the trial?

There is an increasing awareness that some subsoil properties may limit crop production. The Darke Peak Subsoil project is part of a larger GRDC funded project, 'Improving the profitability of cropping on hostile Subsoils', which aims to assist growers to identify, understand and manage subsoil constraints.

How was it done?

A replicated three-phase rotation of wheat, barley and lupins was established on siliceous sand over sodic yellow clay subsoil with a series of subsoil amelioration treatments (*Table 1*). These treatments were compared to the district "best practice" in terms of dry matter production at tillering and anthesis, water use, grain yield and harvest index. Additional measurements will be made in 2005 and 2006 to determine the extent of any residual benefits to crop performance from these subsoil amelioration treatments.

Table 1: Subsoil amelioration treatment details

Treatment	Description
1	District practice as described above
2*	Deep ripping and injection of liquid nutrients to 0.4m
3	Deep ripping and organic matter (2 t/ha lupin pellets) at 0.4m
4	Deep ripping and Calcium (equivalent of 4 t/ha of Gypsum) at 0.4m
5	Surface application of approx. 20 t/ha of composted piggery bedding straw
6	'The Works' a combination of treatments 2-5.

**Liquid nutrients contained 60 kg N/ha, 20 kg P/ha, 2 kg Zn/ha, 4 kg Mn/ha and 2 kg Cu/ha.*

All crops were direct drilled with a soil wetting agent on the 16th June 2004:

Wheat - (Clearfield STL) @ 80 kg/ha with Midas®

Barley - (Sloop SA) @ 60 kg/ha. Metribuzin (Pre-sowing/post-emergent)

Lupins - (Quilinock) @ 90 kg/ha. Simazine @ 2L/ha (post-sowing/pre-emergent)

All crops received 50 kg/ha DAP + Zn (5 %) banded, with a further 25 kg/ha as a starter with the seed. In addition the Lupins received a foliar application of Manganese.

The wheat and barley plots were harvested on the 19th November. Due to poor establishment and the risk of erosion the Lupin plots were not harvested.

What happened?

Rainfall and yield potential

Before discussing the potential benefits of any subsoil amelioration treatment the effect of rainfall on yield potential should be considered. Average annual rainfall at Darke Peak is

380 mm and average growing season rainfall (1st April – 31st October) is 286 mm. Using the French and Schultz method to determine yield potential for an average year the expected yield of wheat is 3.5 t/ha. However, Darke Peak received less rainfall in 2004 than in the 1982 drought. The modified yield potential using the actual growing season rainfall of 168 mm is 1.38 t/ha for wheat and 1.78 t/ha for barley.

Shoot dry matter production

Shoot dry matter production for both wheat and barley (*Table* 2) at tillering and anthesis differed significantly between treatments. At tillering the 'Works' treatment for wheat and barley produced more dry matter, and hence leaf area, than any other treatment. Again at anthesis the 'Works' produced the greatest amount of shoot dry matter for both wheat and barley. However, the deep ripping + organic matter treatment also produced similar amounts of dry matter for wheat and barley, while the deep ripping + nutrients also produced similar amounts of dry matter in barley only.

The district practice consistently produced the least amount of shoot dry matter for both wheat and barley (*Table* 2). However, at anthesis the differences in the amount of dry matter produced compared to the other treatments was less than at tillering.

Grain yield and harvest index

Despite the large differences in shoot dry matter production no significant differences in grain yield were determined between any treatments for either wheat or barley (*Table* 2). The 'Works' treatments, for both wheat and barley, had the lowest grain yield, despite the additional shoot dry matter produced at anthesis. The highest wheat grain yield was achieved by the deep ripping + nutrition treatment, which reinforces the earlier work of Sam Doudle and Nigel Wilhelm (*refer to previous Eyre Peninsula Farming Systems summaries*). Although not different to the yield of other treatments, the highest yielding treatment for barley was deep ripping + Calcium.

The harvest index (HI) results provide a measure of how efficiently the crop converts shoot dry matter into grain yield. The treatments that produced less dry matter at anthesis generally had greater harvest indexes. The district practice had a significantly greater harvest index than the 'Works' for both wheat and barley. The percentage of yield potential achieved ranged from 70 - 81 % for barley and 81 - 99 % for wheat.

Water use

As with some other trials on the upper Eyre Peninsula (e.g. the Tuckey rotation trial) cereal crops that produced large amounts of shoot dry matter prior to anthesis often experience water stress during grain filling, due to early water use low water holding capacity soils, and hence reduced grain yields. One month after sowing (16th July) the soil water content to a depth of 0.6 m for all wheat treatments was similar (*Table 3*). Up until anthesis (12th October) the 'Works' and the other deep ripping treatments used an additional 5 - 14 mm of soil water compared to the district practice and surface application of composted piggery litter treatments. However, after anthesis it appears that the 'district practice' treatment used more soil water the other treatment, while all other treatments actually seem to have gained soil water between anthesis and the 4th November (two weeks before harvest).

Table 2: Darke Peak crop growth and grain yield (2004)

Crop	Treatment	Tillering (t/ha)	Anthesis (t/ha)	Grain Yield (t/ha)	Harvest Index
Wheat	1	0.73	3.88	1.25	0.43
	2	0.94	5.08	1.36	0.36
	3	1.04	5.81	1.15	0.31
	4	0.76	4.66	1.35	0.40
	5	0.78	4.04	1.12	0.36
	6	1.47	6.74	1.13	0.28
	lsd	0.26	1.24	0.39	0.10
Barley	1	0.72	4.98	1.42	0.44
	2	1.19	6.30	1.40	0.40
	3	1.26	6.67	1.31	0.35
	4	0.76	5.18	1.44	0.43
	5	0.78	5.62	1.39	0.42
	6	1.84	7.46	1.25	0.35
	lsd	0.26	1.62	0.20	0.07

Table 3: Total soil water content (mm) to 0.6m for wheat at selected times in 2004.

Treatment	16 July	12 October	4 November
1	51	44	38
2	50	32	33
3	52	31	43
4	51	38	45
5	49	41	46
6	45	33	38

What does this mean?

All treatments that included ripping increased shoot dry matter production to varying degrees compared to the district practice. Such responses are probably due to one of two factors:

1. Deep ripping improves soil structure by eliminating zones of soil compaction in deep sands, thus improving soil water availability and reducing resistance to root penetration.
2. Deep ripping creates zones with improved hydraulic properties in the clay subsoil that increases water movement and aeration so roots can function more effectively.

Although deep ripping alone improves soil structure and provides a soil environment where roots can penetrate the soil more effectively, its effects are usually short term and do nothing to alleviate the inherent low fertility of these soils or the hostile nature of the subsoil. The amendments added to the ripping treatments also have an effect on crop response. In addition to soil structural improvement deep ripping + nutrients provides a zone of nutrients at depth (0.4 m), which may encourage root growth in this layer and increase the amount of soil water that the crop can extract from the surrounding volume of soil. Such a management practice may improve water use but it does not necessarily alleviate any subsoil constraints. Nonetheless, this may be a sound management practice that attempts to maximise soil water use before it enters the hostile subsoil. Deep ripping + organic matter (lupin grain) has a similar effect, in that it provides an area of greater nutrient availability and encourages root proliferation. Similar results, reported by the Yorke Peninsula Alkaline Soils Group, are believed to be associated with the decomposition of lupin pellets, which improves water holding and nutrient exchange capacity at depth. The results for the 'Works' treatment were probably due to a combination of all of these improvements.

Unlike the other deep ripping treatments, deep ripping + Calcium did not provide large increases in dry matter production compared to the 'district practice' treatment. This treatment aimed to reduce the sodicity of the clay subsoil by removing sodium and replacing it with calcium. It does not provide any additional nutrients to the non-fertile sandy soil above. While no results are available to determine if sodicity (ESP) was actually reduced, the increase in grain yields for both wheat and barley for this treatment suggest that some improvements were achieved.

The surface application of piggery bedding litter has provided outstanding yield improvements on heavy clay soils in Victoria, however for sandy soils in environments with numerous small rainfall events like Darke Peak it may actually impede infiltration and increase the amount of evaporation from the soil surface.

Although it was clearly demonstrated that these treatments provide significant improvements in pre-anthesis growth and yield potential, without sufficient rainfall after anthesis or soil water storage the full benefit of such treatments cannot be achieved. In contrast, the district 'best' practice and the surrounding buffer crop (Frame wheat) yielded 1.25 t/ha and 1.4 t/ha (7 bags) respectively, and demonstrates that for some scenarios (Decile 1 rainfall year) that a low input approach may be better than a higher input approach. This research is on-going and further measurement in 2005 and 2006 will determine the extent of any residual benefits to subsequent crops.

Acknowledgements

I would like to thank Matt, Mignon and Peter Dunn for their continued support and hospitality, and all the staff at SARDI Pt. Lincoln and Minnipa Agricultural Centre who assisted with sampling.

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Buckleboo – "subsoil enhancer" demonstration (1st year)

Buckleboo Farm Improvement Group, Samantha Doudle

SARDI, Minnipa Agricultural Centre

Searching for answers

Location
Closest town: Buckleboo
Cooperator: Bill Lienert
Group: BIG FIG

Rainfall
Av. Annual total: 325 mm
Av. GSR: 250 mm
2004 total: 259 mm
2004 GSR: 187 mm

Yield
Potential: 2.02 t/ha (barley)
Actual: 1.98 t/ha (Loam site)

Paddock History
Loam Site
2004: Mundah Barley 70 kg/ha
2003: Carnamah Wheat
2002: Medic Pasture
Grey Site
2004: Pasture
2003: Carnamah wheat

Soil
See Table 2

Key Messages

- **BIG FIG gained sponsorship, sought advice and developed their own seeder to do trial work in conjunction with Minnipa Ag Centre and sponsoring companies.**
- **There is a potential for yield increases, as shown on four soil types in the Buckleboo district, with various management treatments.**

Why do the trial?

In 2003, the Buckleboo Farm Improvement Group (BIG FIG) developed a five year plan to more thoroughly investigate the variability of subsoil constraints and options for managing these constraints, based on their recent subsoil investigations (2002, 2003, 2004) and GPS Technology Field Day (2003, 2004).

They aim to conduct a range of activities to see if they can increase the depth of soil profile accessible to their crops to improve yield and reduce haying off in dry springs.

This plan involves:

- Electromagnetic (EM) mapping of Buckleboo soils and yield mapping of crops from these soils to delineate soil zones. This will allow accurate assessment of the nature and extent of subsoil constraints.
- Broad scale trials and demonstrations using fluid fertilisers and subsoil nutrition across a range of soil types.
- Collaborative research to test new crop breeding lines and blue sky research options for subsoil constraint management.
- Build on GPS technology day to include all aspects of precision agriculture.
- One day workshops on specialised problems, eg particular weeds.
- Summer crop trials.
- Group tour, possibly of the Victorian mallee.

The key to success of this five year plan was the conversion of a combine to a one pass, no-till machine capable of delivering both fluid and granular fertilisers over a range of depths – the

Searching for answers

Location
Closest town: Buckleboo
Cooperator: Tony Larwood
Group: BIG FIG

Rainfall
Av. Annual total: 325 mm
Av. GSR: 230 mm
2004 total: 248 mm
2004 GSR: 141 mm

Yield
Potential: 1.02 t/ha (wheat)
Actual: 1.4 t/ha (wheat)

Paddock History
2004: wheat
2003: lupins
2002: barley

Soil
See Table 2

Buckleboo Farm Improvement Group Subsoil Enhancer Machine.

Three sites representing major soil types in the area were identified and used for trial work in 2003 – red, loam and grey soils. Added to these three sites was a sandy soil profile, to make a total of four research sites for the 2004 season.

The same trial was sown on each of the soil types, designed to generate answers to the following questions over a number of years and a number of soil types:

- Is there a response to deep ripping?
- Are fluid fertilisers more effective than granular fertilisers?
- Is there a difference between fluid products?
- Is deep placed fertiliser (40 cm) better than conventionally placed fertiliser (5 cm)?
- Are higher rates of deep placed fertiliser better than standard rates?
- Does the application of gypsum improve yield and/or access to subsoil moisture by improving soil structure?

Table 1: Nutrition & Placement Treatments for Buckleboo Trials

Treatment Number	Name	Fertiliser rate & type			Fertiliser Placement
		Granular @ seeding	Fluid @ seeding	Foliar @ 3 leaf	
Treatment 1	District Practice	65kg /ha 18:20 (12 N + 13 P)	-	0.15Zn, 0.65Mn, 0.05Cu	Shallow
Treatment 2	Rip Only	65kg /ha 18:20 (12 N + 13 P)	-	0.15Zn, 0.65Mn, 0.05Cu	Shallow
Treatment 3	Shallow Fluids (brew 1)		11.7 N + 13 P + 1Zn + 1Mn, + 0.5Cu	-	Shallow
Treatment 4	Shallow Fluids (brew 2)		11.7 N + 13 P + 1Zn + 1Mn, + 0.5Cu	-	Shallow
Treatment 5	Deep Fluids	25 kg /ha 18:20 placed shallow	7.2N + 8 P + 1Zn + 1Mn, + 0.5Cu	-	Fluid placed deep
Treatment 6	Deep Fluids - super brew	25 kg /ha 18:20 placed shallow	20 N + 15 P + 1Zn + 1Mn + 0.5Cu	-	Fluid placed deep

Table 2: Soil analysis for the four Buckleboo demonstrations.

Site	Depth	Soil Characteristics related to subsoil constraints					
		Texture	pH (water)	CaCO3 % (measure of soil fizz)	Boron (mg/kg)	Approx Ece (measure of salt)	ESP% (measure of sodicity)
					Critical Level 12	Critical Level 6-8	Critical Level 6-12%
Sand	0-10	sandy loam	7.5	0.2	1.6	1.1	2%
	10-20	sandy loam	8.5	0.3	0.8	1.0	2%
	20-50	heavy clay	9.3	3.5	3.6	1.1	5%
	50-60	heavy clay	9.7	13.1	10.8	2.8	**19%**
Loam	0-10	sandy clay loam	6.9	0.1	0.7	0.8	1%
	10-20	sandy clay loam	7.5	0.2	0.7	1.2	2%
	20-50	clay	9.2	2.8	3.6	2.8	**11%**
	50-60	clay	9.4	11.8	**12.2**	4.8	**16%**
Grey	0-10	clay	8.5	17.2	2.7	1.7	0%
	10-20	clay loam	8.5	17.2	2.7	3.2	4%
	20-40	clay loam	8.8	32.9	3.8	4.6	7%
	40-60	clay loam	9.4	51.2	**13.5**	**6.8**	**14%**
Red	0-10	clay	8.7	10.0	2.7	3.3	5%
	10-20	clay	8.7	17.0	5.3	**7.8**	**13%**
	20-40	heavy clay	9.2	36.2	13	**10.8**	**16%**
	40-60	heavy clay	9	44.6	**18.4**	**11.9**	**17%**

How was it done?

The BIG FIG successfully sought sponsorship to create the machine and support demonstration work conducted with the machine. Unfortunately the construction of the machine was slightly more complex than first envisaged which meant that the first season of demo work was sown very late and the granular fertiliser delivery system was not yet working (meaning that the granular fertiliser treatments had to be put down with a plot seeder, hence fertiliser not necessarily in the same row as the seed). Due to these teething problems, some of the results need to be treated with care, but they do show promising trends for future work with the machine.

Due to the large size of the machinery involved and the fact that these are farmer managed demonstrations, the trial design is more simplistic than other scientific trials that have occurred in the district previously. There are only two replicates of the nutrient treatments, and the gypsum treatments have no replicates. To improve the reliability of the results from this demonstration we used EM mapping to identify the location for the trial sites, so that soil variation across the trial was kept to a minimum. We deliberately targeted areas of the paddock with higher levels of subsoil constraints (chosen from EM maps).

The same sites will be sown and monitored for a period of five years.

Treatments:

All trials were sown with 70 kg/ha of Mundah barley on 24th June. Plot sizes for all trials: gypsum spreading width = 9 m, seeder width = 3.4 m. Gypsum strips applied in one direction, nutrition treatments applied across them in a cross-hatch pattern.

Gypsum – two rates of gypsum were applied on the surface, 2.0 t/ha bi-annually (first application in 2004) and 5.0 t/ha once off application.

Ripping – ripping was done with the modified seeder using the Primary Sales tynes to 40 cm (hydraulic break out)

Nutrition & Placement Treatments – refer to *Table 1* for details. All sites had the same treatments except for the grey site where no treatments were placed deep due to rocks.

Location
Closest town: Buckleboo
Cooperator: Rowan Ramsey
Group: BIG FIG

Rainfall
Av. Annual total: 300 mm
Av. GSR: 210 mm
2004 total: 218 mm
2004 GSR: 167 mm

Yield
Potential: 1.76 t/ha (barley)
Actual: 0.6 t/ha (barley)

Paddock History
2004: Sloop barely
2003 Yitpi wheat
2002: grass free pasture

Soil
See Table 2

Table 3: Summary of results from the four Buckleboo demos in 2004.

Question	Sand Site	Loam Site	Grey Site	Red Site
District Practice Yield (from trial)	1.03 t/ha	1.35 t/ha	0.39 t/ha	0.21 t/ha
Was there a response to deep ripping?	No	Yes (0.2 t/ha)	No ripping conducted – too rocky	No
***Were fluid fertilisers more effective than granular fertilisers?**	*Can't comment – not a fair comparison	*Can't comment – not a fair comparison	*Cautious "yes" – given that comprehensive trials established a fluid advantage on this paddock on 03, this yield increase in 04 appears to be real.	*Cautious "yes" – given that comprehensive trials established a fluid advantage on this paddock on 03, this yield increase in 04 appears to be real.
Was there a difference between fluid products?	No	No	No	No
Was there an advantage in adding fertiliser to the soil profile down the rip line?	No	No	N/a	No
Were higher rates of deep placed fertiliser better than standard rates?	No	No	N/a	No
Did the application of gypsum improve yield/ access to subsoil moisture by improving soil structure?	Yes, yield increase at both rates of 0.2 t/ha.	Yes, at the higher rate yield increased by 0.1 t/ha. No difference at lower gypsum rate.	No	No

** Due to time constraints, the granular fertiliser was put down prior to sowing with a plot seeder, not during the seeding operation with the BIG FIG machine. This means that the fluid fertiliser treatments have the fertiliser placed directly below the seed, but the granular treatments are not necessarily in the same row as the seed.*

What happened?

Given the demonstration teething problems, we haven't included some of the actual yields in the results. The remaining results from all four sites are summarised in *Table 3*.

What does this mean?

As mentioned previously in this article, these results need to be treated with some caution given the late sowing time and the differences between fertiliser delivery systems. These were both teething problems associated with developing a new machine and wouldn't be expected to occur again, however it has meant that the demonstration wasn't monitored closely in 2004 because it was felt results were already compromised so we would just reap it and see what happened, then get stuck into it properly in 2005.

As with all great plans, this strategy has now left us unable to fully explain the unexpected response to gypsum on the sand and loam soils. Rather than speculate here whether it was a sulphur response or whether the gypsum did influence the sodic subsoils of these two sites, we will leave that question to be answered by an analysis of the grain (to be completed) and by the demonstrations in 2005.

There was a positive response to fluid fertilisers on both the grey and the red sites, but not the sand and loam sites. Although the fertiliser delivery systems were different for fluid and granular delivery, there can be some confidence in the results since the same type of result occurred in 2003 in the same paddocks in a more scientific fluid fertiliser trial (*EPFS Summary 2003, pg 85*).

In summary, despite a late and not quite organised start to these long term demonstrations, they have already shown there is potential yield to be gained on each of the four soil types involved – a great beginning!

Acknowledgements

BIG FIG Sponsors. Major Sponsors – AWB Ltd, Rabobank, Primary Sales, KEE. Sponsors – Pringles Ag Plus, Hardie Australia, Fertisol, SARDI, Liquid Systems. Minor Sponsors – Mooses Metalworks, Landmark Kimba, Agsave, K&D Paul, Agrichem. Thanks to Kay Brace, Ben Ward, Michael Bennet and Wade Shepperd of MAC for assisting with seeding and harvest operations.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

GRDC Grains Research & Development Corporation

Subsoil Nutrition – residual benefits?

Samantha Doudle

SARDI, Minnipa Agricultural Centre

Research

Searching for answers

Location
Closest town: Kimba
Cooperator: Gary & John Grund
Group: Kelly/Waddikee No till Group

Rainfall
Av. Annual total: 341 mm
Av. GSR: 242 mm
Actual annual total: 261 mm
Actual GSR: 209 mm

Yield
Potential: 1.98 t/ha
Actual: 0.61 t/ha

Paddock History
2004: Clearfield STL
2003: Clearfield STL
2002: Frame

Soil
Deep siliceous sand over clay

Plot size
2002: 1.5 x 20 m x 4 reps
2003 & 2004, entire area from 2002 oversown with air seeder and plots reapt out with plot header.

Other factors
Poor growing season rainfall

Key Messages

- **Trace elements applied to the soil two years previously benefited wheat in 2004 on a clay spread site at Kelly.**
- **Deep ripping in 2003 produced a small increase in yield on a clay spread site at Balumbah.**

Why do the trial?

To determine if applying fertiliser to the subsoil gives any residual benefit to crops in subsequent years.

For three years we have tried to measure a residual benefit from subsoil nutrition at the Wharminda research sites, always to no avail. Several times we have been able to visually pick out better performing plots during the season and correlate them to some of the better treatments the year before, however we had never been able to reap a conclusive result from any of our trials. Reasons for this over the years have included poor trial set up, nitrogen deficiency and severely drought affected crop. In 2003 we finally jagged two sets of excellent residual trials, one at Wharminda and one at Kelly, both on the 2002 research sites. In 2004 we sowed over both the 2002 Kelly site once again and also the 2003 research site at Balumbah.

The 2003 site from Wharminda was not resown in 2004 due to the severe wind erosion that occurred across the site in 2003 (*see EPFS 2003 Summary, pg 112*).

How was it done?

Deep ripping machine: para plow. All trials rolled or otherwise treated after ripping (*Table 1*).

Treatments: all nutrients applied as fluid fertilisers – Phosphoric Acid ($H^{3}PO^{4}$), Urea, Zinc Sulphate ($ZnSO^{4}$), Manganese Sulphate ($MnSO^{4}$), Copper Sulphate ($CuSO^{4}$), Tech Grade MAP (TGMAP), Ammonium Nitrate (AN)

Treatments

Kelly – Grund (2002 research site) - *Refer to EPFS 2002 Summary for comprehensive treatment list for these trials, pg 115*

Balumbah – Cliff (2003 research site) - *Refer to EPFS 2003 Summary for comprehensive treatment list for these trials, pg 112*

Table 1: Trial Management Details

Location	Kelly – Grund (02 research site)	Balumbah – Cliff (03 research site)
Trial Establishment Details		
Soil Type	Deep sand (over 1m deep). Clay spread @ approx 200t/ha in Sept 2001.	75 cm sand over sodic clay. Clay spread @ approx 200 t/ha in Sept 97
Ripping & Nutrient Placement date	May 3rd 2002	May 6th 2003
Treatment after ripping	Driven over with plot tractor to make area trafficable (seeding 02)	Prickle chained (May 03, prior to seeding)
Trial Management, 2004		
Sowing Date	24th June	5th July
Base Fertiliser	80 kg/ha 32:09	60 kg/ha 18:20
Cereal Variety	Clearfield STL	Wyalkatchem

Table 2: Summary of the yield results from 2004 at both subsoil nutrition sites.

Location	Kelly – Grund (2002 research site)		Balumbah – Cliff (2003 research site)	
Year Trials established	2002		2003	
Number of trials at site	3		4	
2004 District Practice Yield (from trial)	0.3 t/ha		0.3 t/ha	
Was there a residual deep ripping response?	2003	No	2003	-
	2004	No	2004	Yes (average of 0.1 t/ha increase on deep ripped plots compared to district practice)
Was there a residual nutrient response?	2003	Yes Any soil treatment with soil applied trace elements	2003	-
	2004	Yes Across all trials, average yield increase of 0.2 t/ha on treatments with soil applied TE's.	2004	Yes 1 trial out of these four showed a small yield increase (0.07 t/ha) by adding extra nutrients to the subsoil
Were there residual differences between any other treatments?	2003	No	2003	-
	2004	No Depth of TE application had no effect, shallow (5cm) or deep (0-40 cm) equally good.	2004	No
Where are the results from the previous years of these trials?	2002	EPFS 2002 summary, pg 115	2002	-
	2003	EPFS 2003 summary, pg 109	2003	EPFS 2003 summary, pg 112

What does this mean?

Both the Kelly and Balumbah trial sites were disadvantaged by lack of rain (as were the local crops!).

For the second year in a row at Kelly there has been a residual response to soil applied trace elements (either applied shallow at seeding or deep prior to seeding) on a deep sand site that has been previously spread with a high rate of calcareous clay. There was no residual response to deep ripping at this site in 2003, or in 2004. This indicates that the improvements gained from deep ripping in the year the trial was established (2002) could not be maintained by managing the paddock conventionally from then on. More work needs to be done to see if deep ripping advantages can be prolonged using techniques such as controlled traffic.

At Balumbah in 2004, visually, it was easy to see much larger plants along the rip lines laid down in 2003, however when reapt out the difference was only small (0.1 t/ha). This is the

Searching for answers

Location
Closest town: Kimba
Cooperator: Trevor Cliff
Group: Kelly/Waddikee No till Group

Rainfall
Av. Annual total: 340 mm
Av. GSR: 235 mm
2004 total: 200 mm
2004 GSR: 171 mm

Yield
Potential: 1.42 t/ha
Actual: paddock not sown

Paddock History
2004: paddock not sown
2003: Westonia wheat
2002: Yitpi wheat

Soil
Deep siliceous sand over clay

Plot size
2002: 1.5 x 20m x 4 reps
2003 & 2004, entire area from 2002 oversown with air seeder and plots reapt with plot header.

Other factors
Poor growing season rainfall

first time in six years that we have actually measured a residual yield increase from deep ripping in our subsoil nutrition trial work. We know it can happen, farmers know it can happen, other research has shown it can happen, however the fact remains that responses to deep ripping, particularly the longer term responses, are mercurial! They depend on the soil type, the paddock history, nutrient availability, the soil wetting and drying patterns during the growing season, subsequent paddock management after ripping and probably a few other things we aren't even aware of!

In summary, from the last six years of investigations on upper EP through the EPFS project, we can say that we were not able to measure any reliable residual response to either deep ripping or the deep placement of nutrition to 40cm in the profile. In almost all cases on deeper sands there were spectacular yield increases to be gained in the year of application of ripping and/or subsoil nutrition, but using conventional farming systems we were unable to sustain any of these benefits beyond the first year. The residual yield increases that we have measured at Kelly are linked with overcoming trace element deficiencies probably exacerbated by application of high levels of calcareous clay. After two years, the shallower applied trace elements were just as effective as the deeper applied ones.

We hope to continue monitoring both of these sites for several more years, given future funding support through the new EPFS project.

Acknowledgements

- GRDC for providing funding for this research through the Eyre Peninsula Farming Systems Project.
- The Kelly/Waddikee No Till Group, particularly Gary and John Grund and Trevor Cliff, for hosting and managing these trials.
- Ben Ward, Willie Shoobridge, Wade Shepperd and Michael Bennet for technical support throughout the season.

GRDC Grains Research & Development Corporation

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Magnesia trials 2004

Liz Guerin

Land Management Consultant, Rural Solutions SA, Streaky Bay

Demo

Almost ready

Location
Closest town: Kyancutta
Co-operator: Phil McKenna
Group: Central Eyre Ag Bureau

Rainfall
Av. Annual total: 350 mm
Av. GSR: 260 mm
Actual annual total: 206 mm
Actual GSR: 155 mm

Soil
Land System:
Major soil type description:

Plot size
20 m x 150 m (0.3 ha)

Key Messages

- **Applying rates of mulch of 2.5t/ha or less were ineffective in reducing surface salinities.**
- **Gypsum applied to magnesia patches generally increased surface salinities.**
- **Mulches high in organic matter were effective in improving crop establishment and reducing surface salinity, but did not result in increased yield.**

Why do the trial?

To determine the effectiveness of various combinations of low cost surface mulches on the extent and severity of magnesia patches (transient salinity). *This article follows on from Farming Systems 2003 Summary, pg 118; Farming Systems 2001 Summary, pg 123; Farming Systems 2000 Summary, pg 113.*

Background

Accumulation of salts in the root zone of soils where water tables are greater than five meters deep is known locally as magnesia patches (or transient salinity). In low rainfall areas (<350 mm), salts accumulate over summer months due to high evaporation and rainfall is insufficient to leach these salts below the root zone. High salt concentrations can prevent the use of soil water by crops and can affect both crop germination and yield.

Work undertaken in the past has shown that applications of surface mulches prior to summer reduces evaporation and hence further salts being drawn up to the soil surface. Work undertaken by Jim Kelly and Pichu Rengasamy (University of Adelaide) indicated that applications of gypsum may reduce magnesia patch salinity only in areas where sodic subsoils exist.

This field demonstration aims to monitor the effectiveness of various surface mulches and determine the most appropriate rate at which to apply them.

How was it done?

Soil samples were taken from both the magnesia affected land and area unaffected by magnesia to provide a baseline reference. The entire trial site was mapped using an EM38 (electromagnetic) meter to give an indication of the salt concentrations and variations across the site. This was conducted at a depth of 0-75 cm on the 6th April 2004. (*see Figure 1*). Salinity was also measured as electrical conductivity (EC) in a 1:5 mix of soil and water.

Surface applications of various mulch treatments and combinations at different rates were applied on the 19th April 2004. Tillage treatments were undertaken on the 10th May 2004. The entire trial site was sown on the 18th June 2004 with Yitpi wheat at a rate of 55 kg/ha. 18:20 was applied at a rate of 55 kg/ha.

Plant counts were taken for each of the treatments to determine whether there was any difference between the products and treatments applied and the rate of application. Yield data was collected from the individual treatments. Following harvest, soil salinity readings were taken for each of the surface mulch strips. This reading was compared to the initial soil salinity reading and converted to a percentage increase or decrease (*Figure 2*).

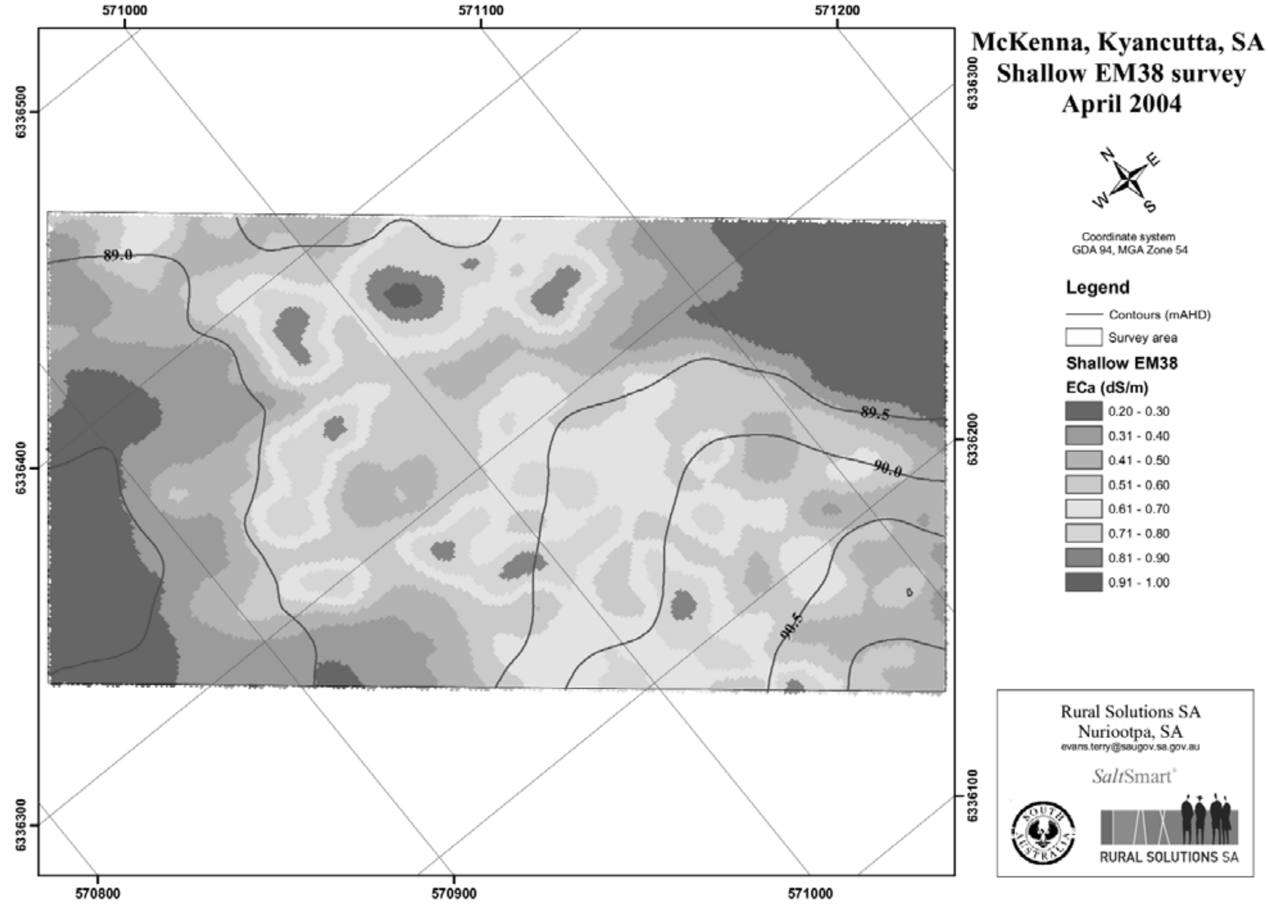

Figure 1: Salinity levels across trial site (Kyancutta).

What happened?

The surface mulch treatments applied in April 2004 were applied much later than desirable following the period of greatest evaporation. Despite the late application and a poor and late start to the season, plant counts varied not only between the different surface mulch products, but also between different application rates of the same product. *Table 1* shows the measured plant counts between treatments. Where the difference is greater than 6.77 (both vertically and horizontally) the influence of the product or rate of application is significant.

The EM map showed that soil salinity varied across the site from 0.2 dS/m (non- saline) through to 1 dS/m (highly saline). Following the application of the surface mulches, salinity levels either increased or decreased. These changes are shown in *Figure 2*.

Yield data was collected from each of the strips and compared to the untreated paddock average. Unsurprisingly, all strips yielded less than the paddock average due to the salty nature of the site. However, of the treated areas, the highest yielding strips, which also resulted in the greatest decrease in salt level was sand. This was applied at rates of both 5 and 10 t/ha. Pig manure at 5 and 10 t/ha was also useful at reducing surface salinity. These treatments had high plant counts and good straw growth, but did not translate into grain yield. A possible reason for this is that the high nitrogen content of the pig manure was not able to be utilised by the plant given the seasonal conditions experienced. Combination treatments of organic mulch (sweepings or pig manure) and gypsum were not as effective at reducing salinity levels as the organic mulch alone.

Table 1: Plant counts/m² per product and rate

Product	Product Rate (t/ha)		
	2.5	5.0	10.0
	Plant counts/m²		
Gypsum	28.12	16.92	17.32
Gypsum + Pig Manure	15.32	19.00	23.80
Gypsum + Sweepings	16.12	0.00	0.00
Pig Manure	19.32	22.40	26.72
Sand	20.20	21.72	21.92
Sweepings	23.40	21.40	24.60
lsd = 6.768			

What does this mean?

Applications of surface mulches can assist in reducing soil salinity levels sufficiently to allow seed growth by preventing evaporation, which draws salts to the soil surface. Salinity levels are generally highest during January and February. Mulch needs to be applied prior to this to prevent salt from moving up to the surface and inhibiting germination and plant growth.

Mulches applied at low rates (2.5 t/ha) were insufficient to inhibit salt laden soil moisture being drawn to the surface resulting in salinity increases over the season. Mulches applied at rates of 5t/ha or greater were more successful at lowering salinity levels. The exception was gypsum, which increased surface soil salinities by 40 % up to 400 %. Magnesia patches often have sodic subsoils and gypsum can address sodicity problems, however, saline conditions in the soil surface over-ride any other problems and need to be addressed first.

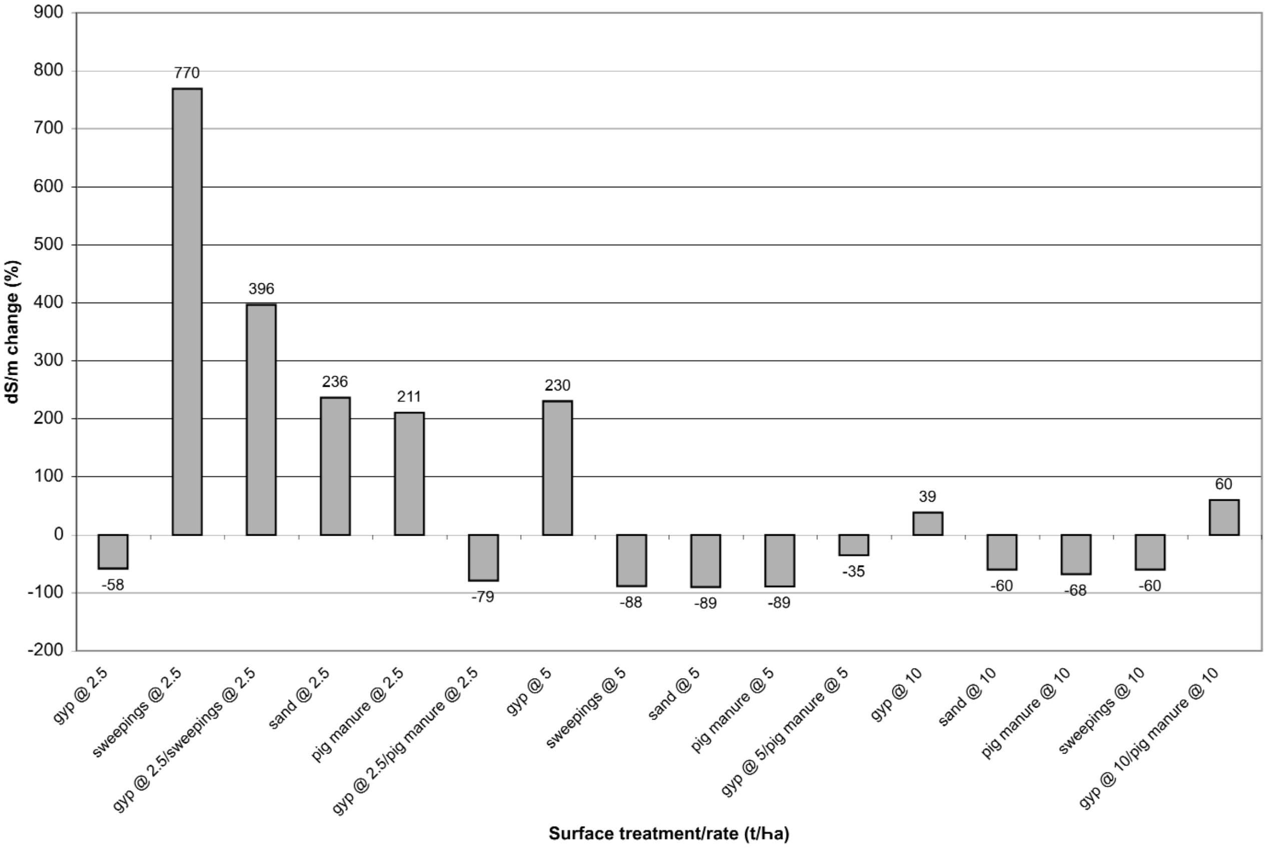

Figure 2: Percentage changes in surface salinities

Applications of gypsum in past trials did not appear to substantially improve emergence, crop establishment or total yield in the year of application. Work conducted by Rengasamy and Kelly (2003) indicated that gypsum may reduce transient salinity levels (only where there is a sodic subsoil) and only after a number of seasons.

Mulch treatments may need to be in place for more than one season to effectively reduce soil surface salinities for crop production. Mulches high in organic matter can lead to increased infiltration and reduced evaporation. This allows leaching of salts from the topsoil to be maximised. In seasons with low rainfall, applications of high rates of organic mulches can burn emerging crops.

Sand and sweepings at lower rates may not have been as effective, particularly in the topsoil due to the fact that cultivation would have mixed and diluted the sand, therefore reducing the mulching effect. Wind may also have blown fine surface particles away to expose more saline soil beneath.

Gypsum was not effective as the addition of the salts in the gypsum to the soil can have the short-term effect of increasing salinity.

Future Work

The site was spread in preparation for the 2005 season on the 16th December 2004. Two of the cheapest, readily available and most effective mulches, namely sand and pig manure, were applied at three different rates (2.5 t/ha, 5 t/ha and 10 t/ha). The effectiveness of mulch treatments will be compared by measuring surface and subsoil salinity levels. The same strips are being used in order to determine how many years might be necessary before a gypsum effect may be observed.

Acknowledgements

Thanks to Phil McKenna for allowing us to use his property and gear, for running around after us (and supplying great smokos). Thanks also to both the Central Eyre Peninsula Soil Conservation Board and the Soil Conservation Council for funding the project; Ausbulk, who supplied the sweepings and Sophie Keen (Central Eyre Peninsula NRM Co-ordinator) and Tiffany Ottens (Land Management Trainee) for help with site management.

RURAL SOLUTIONS SA

Extension

The after effects of fire - a WA experience

Jeremy Lemon,

Senior Development Officer, WA Department of Agriculture

Key Messages

- **Cultivation to reduce or prevent wind erosion is not recommended unless soils are heavy in texture or the soil is sufficiently wet to sustain germination.**
- **Construction of windbreaks can protect infrastructure.**
- **Applying farm planning principles can improve fencing layout. Temporary electric fencing can be effective.**

Erosion

After fire, wind erosion is likely. On sandy soils especially, there is little that can be done to reduce or prevent erosion. Cultivation is only effective if stable clods are formed on heavier soils. Sowing cover is advisable only if there is likely to be enough rainfall to sustain the germination. This is to be expected from mid April or later, depending on the initial amount of rain. While no-till is recommended as a sowing technique, experience in the Jerdacuttup area of Western Australia in 1994 indicated that no-till sowing is not the complete answer. Disc seeders working slowly will leave a firmer surface than knife points but the surface will be flat and still prone to erosion. There needs to be some form of surface roughness to stabilise the paddock. This can only be formed in sandy soil from root material in soil that is worked slowly and while moist.

Disc seeding cereal seed prior to rain is not suggested. It is better to wait for rain and observe the wetting depth prior to sowing. At least 30 cm of wet soil is required to initiate and sustain germination for a short period.

When sandy paddocks start to erode after a fire it is best to leave the paddock untouched. The practice of cultivating and ridging is not helpful. Cultivation buries the protective layer of loose sand and exposes the more fertile and previously un-degraded soil to wind. If the surface is left alone, little more fertility can be lost except in extreme and persistent winds.

The most important strategy is to only cultivate when there is moisture in the soil and there is a fair chance of dense seedlings establishing and persisting.

Claying is a possibility as the vegetation is removed and incorporation will be easier. Take care to only incorporate clay to a shallow depth in the first season and not lose the surface roughness and crusting effect.

Sand entering dams

Constructing a windbreak to drop the sand behind it will help prevent sand getting into buildings, yards and dams. This deposited sand can be carted away or another barrier constructed. The windbreak can be as simple as a section of fence with brush woven into it or coarse shade cloth attached. Commercial windbreak material can be used but at a greater expense.

Pasture regeneration

Observations of paddocks recovering from fire in the Gibson area in 1994 indicate slow recovery. Seed reserves of grasses were almost destroyed and the pasture composition was restricted to broadleaved weeds and legumes like clover, serradella, capeweed and geranium. The lower plant density and lack of any surface protection leads to very slow pasture production. Carrying capacity will be reduced for the first season and it may take 2 or 3 years to achieve full production from annual pastures.

Opportunities next season

With the likely poor pasture production and lack of grasses there is an opportunity to do more cropping and pasture sowing. Any sowing is at more risk from wind erosion but the risk also exists for regenerating pastures too. Sowing will need to wait until a ground cover and root mass has established to reduce wind erosion risk - it is difficult to describe exactly how to go about it as the seasonal and paddock conditions at the time will determine the safest strategy.

Low weed burden is needed for successful pasture establishment. There is opportunity to introduce new pasture species including perennials. Autumn sowing is suitable for annual species and temperate perennials like lucerne and perennial ryegrass. Spring sowing is required for (sub)tropical species like kikuyu, Rhodes grass and Setaria.

Cropping will provide a cash flow and stubble protection in the next season. Share cropping could be considered if you don't have the gear or inclination to do it yourself. In all cases soil testing will help determine the fertility status. Testing should be delayed till March as a compromise to reflect the status after erosion losses but get results in time for decision making.

Fencing

Fire provides a fairly clean area to reference using farm planning principles. Access around the farm, fencing to soil types and paddock sizes can be planned with the experience of improving on the old system. Electric fencing or using some hot wires reduces the need for heavy fence construction for cattle.

Acknowledgment

Many of these comments are from Nils Blumann who suffered an extensive fire on his Gibson property in WA, November 1993.

Types of Work in this Publication

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

Type of Work	Replication	Size	Work conducted by	How analysed
Demo	No	Normally large plots or paddock strips	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 & Researchers	Usually summary of research results
Information	n/a	n/a	n/a	n/a

Section 8

Section editor: Michael Bennet

SARDI/SANTFA, Minnipa Agricultural Centre

Tillage

Crop safety and efficacy of herbicides in the disc seeding system

Research

Michael Bennet

SARDI/SANTFA, Minnipa Agricultural Centre

Almost ready

Location
Closest town: Wirrulla
Cooperator: Andrew Patterson

Rainfall
Actual annual total: 237 mm
Actual GSR: 212 mm

Yield
Potential: 2.04 t/ha

Paddock History
2003: Pasture
2002: Pasture
2001: Wheat

Soil
Grey calcareous loam

Diseases
Leaf rust

Plot size
3m x 18m x 4 reps

Other factors
Late sown (1st July)

Key Message

IBS Herbicide usage appears relatively safe in the K-Hart disc system

Why do the trial?

The trials were funded by the National Landcare Program and SANTFA with support from their sponsors, ABB Grain and Nufarm, in response to demand from growers for a herbicide package for disc seeders.

How was it done?

Two trials were sown using commercial K-Hart disc seeders. The K-Hart system is a wavy coulter opener with V paired discs followed by a press wheel. Row spacing was the only difference between the set up for the two machines with 8" used at Wirrulla and 10" used at Tooligie. The herbicide treatments were sprayed using a 3m gas propelled hand boom with hollow cone nozzles at a water rate of 50 L/ha. These trials were also replicated on the Yorke Peninsula and Murray Mallee to further investigate the response to soil applied herbicides in the K-Hart disc system and other commercial disc systems.

Herbicides were applied pre-sowing and Incorporated By Sowing (IBS) or Post Sowing, Pre Emergence (PSPE) and a combination of IBS and PSPE.

Most of the herbicides used in the trials are commonly used in regions where trifluralin resistance in ryegrass is becoming a problem. Triallate (Avadex Xtra,), S-Metalachlor (Dual Gold,) and Diuron were included to assess the performance of the disc system in a trifluralin resistant ryegrass situation.

What happened?

The success of herbicides a disc system (in situations requiring ryegrass control) relies on the ability to throw the chemical treated soil out of the crop row in a similar fashion to a knife point. The K-Hart system was able to move enough chemical from the seeder row to achieve a successful result. However the margin for error in the two trials was extremely narrow.

Herbicides such as Diuron and S-Metalachlor can be as effective at controlling wheat as they are at controlling ryegrass. Safe use of these herbicides in an IBS situation relies on clear separation of chemical out of the seeding row, while minimising soil throw to keep the herbicides in the inter-row rather than throwing in to the next row. In the case of these trials, a degree of crop safety was achieved with these herbicides.

Herbicides applied PSPE caused severe damage in both trials. This result was anticipated, as it is common to lose crop safety when applying these herbicides PSPE in systems using press wheels.

Diuron and S-Metalachlor are more active on high pH soils. This brought out differences between the treatments, especially early in the season when crop damage was greatest in the high rate treatments of Diuron and S-Metalachlor.

The herbicide control on ryegrass and its effect on the final grain yield of each treatment is shown in *Table 1*.

Wirrulla

There was no grain yield response to control of ryegrass at the Wirrulla site, however all herbicide treatments reduced the ryegrass population. The low population of ryegrass grass was

Table 1. Herbicide Influence on Ryegrass Control and Grain Yield.

		Wirrulla					Tooligie				
	Treatment	Ryegrass (Spikelets/m^2)		% Ryegrass Control	Yield (t/ha)		Ryegrass (Spikelets/m2)		% Ryegrass Control	Yield (t/ha)	
1	Trifluralin480 1.5L IBS	28	bc	59	0.51	abc	60	bc	70	1.10	bcde
2	Trifluralin480 3.0L IBS	24	bc	66	0.53	ab	47	c	77	1.12	bcde
3	Trifluralin480 1.5L + Triallate 1.6L IBS	32	bc	54	0.44	abcd	46	c	77	1.43	a
4	S-Metalachlor 0.5L IBS	26	bc	62	0.39	bcd	51	c	75	1.13	bcde
5	S-Metalachlor 1.0L IBS	19	bc	73	0.37	bcd	109	abc	47	1.16	bcd
6	S-Metalachlor 0.5L PSPE	40	b	43	0.44	abcd	105	abc	48	1.08	bcde
7	S-Metalachlor 1.0L PSPE	19	bc	72	0.39	bcd	144	abc	29	0.90*	ef
8	Trifluralin480 1.5L + S-Metalachlor 0.5L IBS	17	bc	75	0.50	abc	119	abc	42	1.26	ab
9	Trifluralin480 1.5L + S-Metalachlor 1.0L IBS	14	bc	80	0.37	bcd	69	bc	66	1.04*	bcde
10	S-Metalachlor 0.6L IBS + S-Metalachlor 0.4L PSPE	19	bc	72	0.41	abcd	87	bc	57	1.01*	cde
11	Diuron Liquid 1.0L PSPE	33	bc	52	0.36	bcd	158	ab	22	0.78	f
12	Diuron Liquid 2.0L PSPE	39	bc	44	0.40	abcd	152	abc	25	1.06	bcde
13	Diuron Liquid 1.0L + S-Metalachlor 0.5L PSPE	20	bc	72	0.34	cd	111	abc	45	0.97	def
14	S-Metalachlor 0.5L IBS + Diuron Liquid 1.0L + S-Metalachlor 1.0L PSPE	11	c	84	0.28	d	71	bc	65	1.21*	abc
15	Untreated	69	a	0	0.58	a	203	a	0	1.03	cde
	LSD (Fpr 0.05)	23			0.22		89.7			0.17	

(Values in each column followed by the same letter are not statistically significant at P=0.05)

** These treatments were badly affected by damage from herbicides and benefited from a late rain after the other treatments had ripened.*

not significant enough to cause a yield penalty when untreated. Some degree of crop damage from the herbicides was observed for the majority of treatments, which resulted in the untreated producing the greatest yield. The yield responses may have been vastly different were there a heavier ryegrass burden present at the site.

Tooligie

The Tooligie site suffered a reasonable ryegrass burden which exacerbated the various treatments. However a late rain that benefited some of the treatments confounded the results. Due to herbicide damage some treatments were still green after the other plots had ripened allowing them to finish in favourable conditions that would not often be the case.

What does this mean?

In these two trials, trifluralin offered crop safety and effective ryegrass control at rates of up to 3.0 L/ha. Soil throw from the coulters, even at 10" spacing was sufficient to incorporate the trifluralin and prevent volatilisation to provide sufficient control of ryegrass.

The trials gave a positive response in terms of ryegrass control and yield to the addition of Triallate to trifluralin at the Tooligie site, with the treatment yielding more than other treatments. However this combination of herbicides was not as successful at the Wirrulla site. A variable response to ryegrass control with the mix of Trifluralin and Triallate has been observed in research at Hart.

S-Metalachlor was effective at controlling ryegrass at both sites despite the poor moisture conditions post sowing. Results indicate that crop safety was marginal in the high pH soils.

The remaining question is how a knife point and press wheel combination would have performed in the same situation. SANTFA conducted research during 2004 to assess the potential differences in crop safety for knife point and disc systems. This research will be summarised in the Autumn SANTFA journal. However it could be assumed that if soil throw was minimised (wide rows and moderate sowing speed) then a greater degree of crop safety would have been observed. A knife point should give a wider degree of separation of herbicide from the seeding row, provided that treated soil isn't thrown from other rows.

In the PSPE treatments it would be anticipated that the herbicide damage might have been more severe in a knife point press wheel system. When using press wheels, soluble chemicals such as Diuron and S-Metalachlor can dissolve in rainfall. Heavy rainfall concentrates the herbicide at the bottom of the furrow, which creates an unfavourable environment for emerging wheat. As a general rule, press wheel furrows are more pronounced in a knife point system, so this system would not be favoured for this application. Consequently, most no till growers apply these herbicides IBS to minimise the associated damage.

SANTFA in conjunction with Ag Consulting Co. and the Southern Yorke Peninsula Alkaline Soils Group conducted several similar trials focusing on herbicide performance with various commercial disc seeders. The full outcomes of the study including full assessments from the Eyre Peninsula and Mallee trials can be found in the Autumn edition of the SANTFA No-Till Journal. One finding of the research is that "a leading fluted coulter such as in the K-Hart system appears to be the most effective factor in increasing soil throw, ensuring increased crop safety and chemical efficacy."

The herbicides applied within the two trials are off-label, with registration pending for the legal use of these herbicides in the disc seeding system.

Acknowledgements

Appreciation goes to SANTFA, the National Landcare Program and Nufarm for funding the research, Peter Baker from Rural Directions and John Both from Nufarm. Special thanks to Andrew Patterson and Glen Habner for donating their time, land and machinery for the purposes of the trials.

LANDCARE

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

Nufarm

SANTFA

Location
Closest town: Tooligie
Cooperator: Glen Habner

Rainfall
Actual annual total: 291 mm
Actual GSR: 214 mm

Yield
Potential: 2.08 t/ha

Paddock History
2003: Tamaroi Durum
2002: Canola
2001: Barley

Soil
Sand over clay

Plot size
3m x 18m

Other factors
Late sown (30th June)

Crop safety of soil applied herbicides in broadcast seeding

Research

Michael Bennet

SARDI/SANTFA, Minnipa Agricultural Centre

Almost ready

Location
Minnipa
Cooperator: Minnipa Ag Centre

Rainfall
Av. Annual total: 325 mm
Av. GSR: 242 mm
Actual total: 288 mm
Actual GSR: 223 mm

Yield
Potential: 2.25 t/ha
Actual: 0.91 t/ha (Paddock)

Paddock History
2003: Pasture
2002: Wheat

Soil
Sandy Clay Loam, pH 8.5

Plot size
1.8m x 10m x 3 reps

Tillage

Key Messages

- **Low rates of soil applied herbicides were applied safely in the broadcast trial**
- **Crop safety greatest when herbicides applied at predrill stage or after broadcasting**

Why do the trial?

Broadcast seeding is a system that relies on shallow incorporation of seed which has been broadcast across the paddock. Bob Holloway first used the broadcast seeding system at Minnipa in 1982 and the system has since been used successfully to sow wheat at the break of the season on minimal moisture and has produced some of the highest yielding crops at Minnipa. The weakness of the system however is grassy weed control within the crop. Unless a thorough job of grass control is done in the previous season(s), a broadcast crop may suffer a large weed burden. As the crop is sown very shallow, there is little separation between the crop and weed seeds making weed control a major challenge with current herbicide technology. The intention of the trial was to identify herbicides that may fit the system.

How was it done?

The paddock was prepared for broadcasting by controlling grass weeds the previous seasons pasture with spray topping. Fertiliser (50 kg/ha of 18:20) was predrilled using knifepoints on the 21st of April. Five herbicide treatments were applied prior to pre-drilling and all the treatments were incorporated within two hours of application.

The paddock was broadcast with Yitpi wheat @ 100 kg/ha on the 7th of June. Seven herbicide combinations were applied both before and after the paddock was prickle chained at seeding. Treatments were applied using a 1.5 m-covered boom. Teejet, XR 11002 nozzles were used with a water rate of 70 L/ha.

What happened?

Several of the herbicides caused a severe reduction to wheat emergence and retarded crop growth. As there was little weed competition within the trial, yield differences were due to

Table 1: Emergence and grain yield of Yitpi wheat with alternative herbicides applied in the broadcast seeding system.

Herbicide Treatment	Herbicide Timing	Emergence (Plants/m^2)		Grain Yield (t/ha)	
2.3 L/ha Duet®	After Broadcasting	113	abc	0.93	a
Untreated Control		150	a	0.91	a
0.75 L/ha Trifluralin	Before Predrill	140	a	0.87	ab
1.6 L/ha Diuron	After Broadcasting	142	a	0.85	ab
1.6 L/ha Triallate	Before Predrill	128	a	0.84	abc
0.75 L/ha Trifluralin + 1.6 L/ha Triallate	Before Predrill	143	a	0.78	bcd
275 ml/ha Cinmethylin	After Broadcasting	118	ab	0.78	bcd
0.75 L/ha Trifluralin + 1.6 L/ha Diuron	Before Predrill + After Broadcasting	153	a	0.74	cde
1.5 L/ha Trifluralin	Before Predrill	62	bc	0.68	def
1.6 L/ha Duet	Before Broadcasting	58	bc	0.66	ef
275 ml/ha Cinmethylin	Before Broadcasting	57	bc	0.65	ef
0.75 L/ha Trifluralin + 1.6 L/ha Diuron	Before Broadcasting	53	c	0.62	f
	LSD	63		0.10	

Values in each column followed by the same letter are not statistically significant at P=0.05

Photo 1: Predrilling

Photo 2: Broadcasting

Photo 3: Prickle Chaining

herbicide damage alone. Consequently, treatments with the poorest emergence had the poorest yields.

Application timing had a large bearing on wheat emergence and grain yield results. Treatments applied prior to broadcasting had more damage than treatments applied predrill or after broadcasting. This was anticipated as herbicides applied prior to broadcasting were directly incorporated with the seed. As herbicide performance and crop safety varies according to incorporation method, it is anticipated that shares and knifepoints would create vastly different environments for both the crop and weeds to emerge.

Unfortunately the weed free nature of the paddock did not allow evaluation of the performance of the herbicides in regards to weed control.

What does this mean?

The low adoption rate of broadcasting can be largely attributed to the perceived lack of weed control options within the system. A direct drill system would allow more flexibility in terms of reducing cropped area if the season break is poor, however would require a greater investment in machinery to achieve comparable work rates.

The trial indicated a safe application of some herbicides in the broadcast seeding system, however the margin for error with these herbicides is narrow. Low rates of herbicide may also be insufficient to offer satisfactory levels control of ryegrass.

Herbicides such as Diuron could be anticipated to cause severe damage with shallow sown wheat if there was heavy rain after seeding. This may be as severe as the damage expected with a post sowing pre emergence application of Diuron or Dual when using press wheels.

The results warrant further research in to both crop safety and weed control of herbicides in the broadcast system.

Presently there are no herbicides registered for the broadcast system, which may not change in the near future. Cinmethylin is an experimental chemical currently in development by Nufarm. Cinmethylin is a product that shows promise as a

Trifluralin alternative that is currently undergoing extensive evaluation before commercial release.

Acknowledgements

Much appreciation goes to Ben Ward, Jon Hancock and Willie Shoobridge for their assistance with trial management. The trial would not have been possible without the generous support of Farmoz and Nufarm for supplying Duet, and Cinmethylin respectively. This research was funded by GRDC.

Triflur-X,	480g/L Trifluralin
Avadex,	500g/L Tri-allate
Diuron	500g/L Diuron
Duet,	125g/L Oryzalin + 125g/L Trifluralin

Research

Uncovering the benefits of long term no till farming

Tristan Baldock

Elders, Pt Lincoln

Almost ready

Location
Lock
Cooperators: Andrew Polkinghorne and David Bower

Rainfall
Av. Annual total: 337 mm
Av. GSR: 260 mm
Actual annual total: 262 mm
Actual GSR: 232 mm

Yield
Potential: 2.44 t/ha

Soil
Grey calcareous loam

Diseases
Yellow leaf spot

Plot size
1.57 m x 20 m x 4 reps

Other factors
Early finish

Location
Hart
Cooperator: David Maitland & Grant Crawford

Rainfall
Av. Annual total: 460mm
Av. Growing season: 345mm
Actual total: 430 mm
Actual GSR: 304 mm

Yield
Potential: 3.88 t/ha

Soil
Red brown earth

Plot size
1.36m x 20m x 4 reps

Other factors
Hot dry grain fill period

Key Messages

- **A Canadian study has shown increased yields and grain nitrogen content in spring wheat under long term No Till.**
- **Long term No Till management increases total carbon and nitrogen, microbial biomass and can lower the bulk density in the surface soil. This has a positive effect on the chemical and physical properties of the soil, making soil under long term No Till a more favourable environment for microbial activity and plant growth.**
- **The increased duration of No Till management results in lower additions of fertiliser nitrogen to achieve similar growth responses.**
- **Higher grain yields and grain nitrogen contents are achievable with lower N inputs under a No Till system that is practiced long term, bringing improved gross margins.**

Why do the trial?

No Till farming systems have been researched and practiced for many decades, but the adoption of conservation farming practices has been most significant in the last 10-20 years in Australia. While there have been many diverse studies on No Till, some of which present conflicting evidence, there has been little work done to assess the long term effects of no tillage and stubble retention, particularly in terms of soil nitrogen supply and subsequent grain yield and grain protein.

How was it done?

Field trials, located at Lock on the Eyre Peninsula and at Hart in the Mid North of South Australia, were conducted in 2004 to examine the impact of long term No Till (15 years) on soil nitrogen supply and subsequent grain yield and protein. This trial also examined the effect of five different rates of nitrogen fertiliser to determine if soil nitrogen supply under No Till could effectively reduce fertiliser requirements.

At each of the trial locations two contrasting trial plot sites were selected. One meeting the criteria of a long term No Till, with stubble retention system. The other being a conventional system going into its first year of No Till. The two sites were positioned in separate paddocks however they were close enough to each other to minimise variation between the sites. EM38 maps were created for each of the trial sites to determine if there were any detectable differences in soils between the adjacent locations.

Certified Krichauff seed treated with Vincit C® and Jockey® was used for both trials. Fertiliser (18:20:00 2.5 % Zinc granular blend) was applied at standard district rates (with fluid fertiliser used for basal treatment at Lock), the additional fertiliser treatment rates were added as urea banded below the seed.

Emergence counts were carried out at the three-leaf stage, with emergence in long term No Till being retarded at Lock due to heavy stubble load and severe yellow leaf spot infection (the short term site had the stubble burnt). Herbage nitrogen and available soil nitrogen measures were taken at early tillering and again at anthesis to obtain an understanding of nitrogen availability and plant uptake.

What happened?

Total soil carbon and nitrogen

Pre-sowing soil tests taken to a depth of 60 cm showed that long term No Till at Lock had more total

Tillage

carbon throughout the soil profile, particularly at 20 - 40 cm. The historic management practices have allowed carbon to penetrate deeper into the profile, probably through increased root proliferation, as the chemical and physical properties of the soil have changed. The same results were not observed at Hart, as it had higher levels of organic matter, which was protected by clay particles in the finer textured soils. There were no differences in total N observed between tillage treatments in the pre-season soil tests, although a significant decline in N with depth can be noted at both sites.

Microbial Biomass (Nitrogen and Carbon)

There were no clear trends between tillage treatments and soil depth. The Hart site showed higher levels of microbial N and C under the short term history, while the reverse was true at Lock. Microbial activity was far greater in the top 10 cm of soil under short term, a likely result of frequent cultivation acting as a stimulant. Long term No Till has had a positive effect on the Lock soils with an increased microbial biomass in the top soil and at 40 - 60 cm.

Early Tillering Herbage Nitrogen

At early tillering the herbage nitrogen concentration of the plant (stem and leaf) was significantly higher under long term No Till at both Lock and Hart (*Figure 1*). There was also an expected general trend of increasing herbage nitrogen as fertiliser rates increased.

This higher herbage nitrogen concentration indicates a higher concentration of available soil nitrogen through microbial activity. The greatest increase in available soil nitrogen was found at Lock under long term no till with no added nitrogen. This indicates that if nitrogen fertiliser is limited, the soil can provide increased amounts of stored nitrogen to the plant under a long term no till system.

Anthesis Nitrogen Concentration

The herbage nitrogen concentrations at anthesis were similar to early tillering at Hart, but not at Lock as water become extremely limiting, preventing the uptake of nitrogen (*Figure 2*). At both Lock and Hart, the long term No Till had higher levels of available nitrogen across all fertiliser treatments and at most soil depths. This strongly suggests that the soil under long term No Till management is far more capable in its chemical and physical properties to supply nitrogen to the plant.

Dry Matter Yield

The dry matter yield at anthesis (GS 6.1) is an indicator of the final grain yield of that crop, unless water suddenly becomes very limiting (which was the case at both sites). There were differences in dry matter yield at Hart, (*Figure 3*) but not at Lock as water become very limiting, retarding the growth and development of the crop.

At Hart, long term No Till consistently yielded more dry matter in all nitrogen treatments than short term No Till. The difference between the tillage treatments was substantial. Short term no tillage with 80 kg of nitrogen fertiliser yielded significantly less than long term No Till with zero nitrogen fertiliser.

While the trial has only one year's data, it provides some validation to the results obtained by Guy Lafond in a similar Canadian study. In South Australia, long term No Till appears to have a better flow of available nitrogen through the system, increased soil nitrogen available to the plant throughout the season and a consequent increase in plant uptake of nitrogen. Long term No Till management increases total carbon and nitrogen, microbial biomass, as well as lowering the bulk density in the surface soil. This affects the physical and chemical properties of the soil making soil under long term No Till a more favourable environment for microbial activity and plant growth.

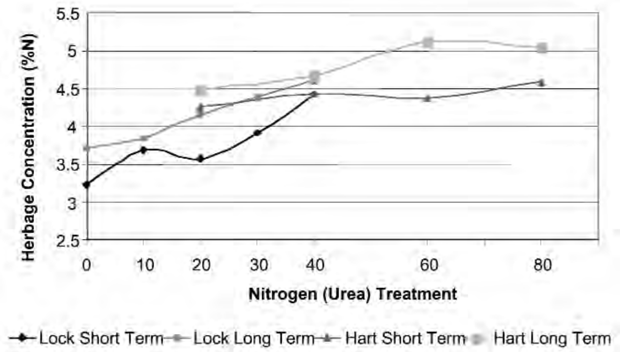

Figure 1: Herbage Nitrogen Content at Early Tillering.

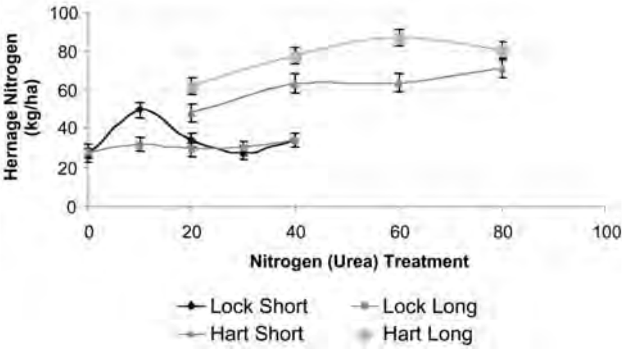

Figure 2: Herbage Nitrogen Content at Anthesis.

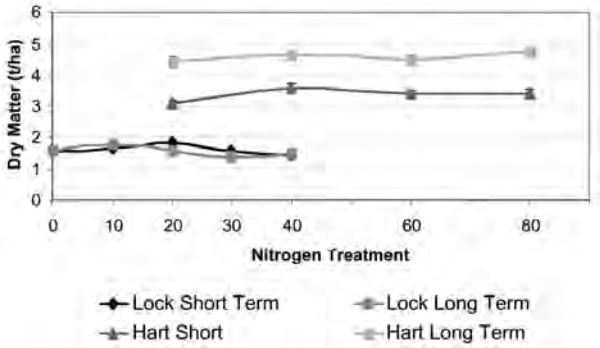

Figure 3: Dry Matter Production at Anthesis.

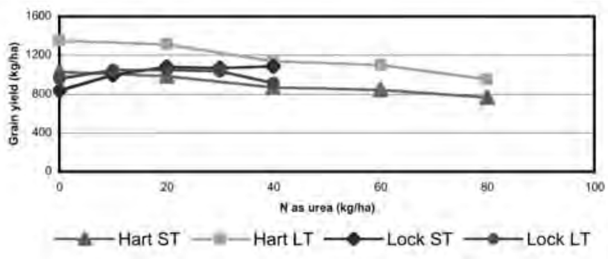

Figure 4: Grain Yield.

The increases observed in soil and plant nitrogen concentrations under long term No Till have not been

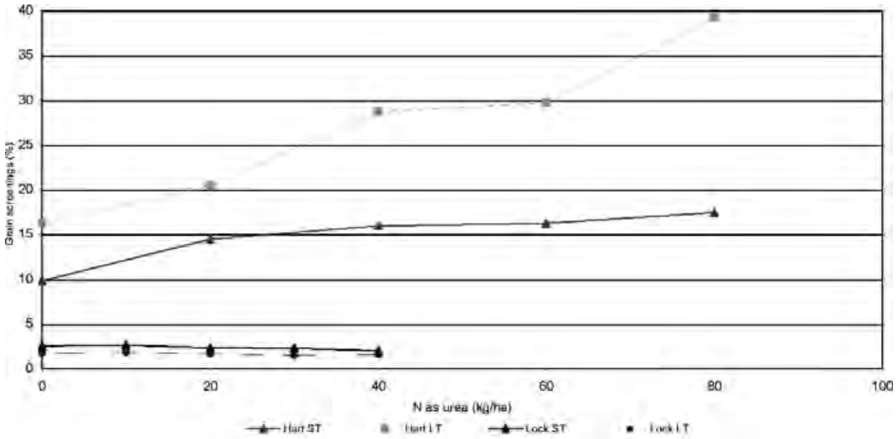

Figure 5: Grain Screenings

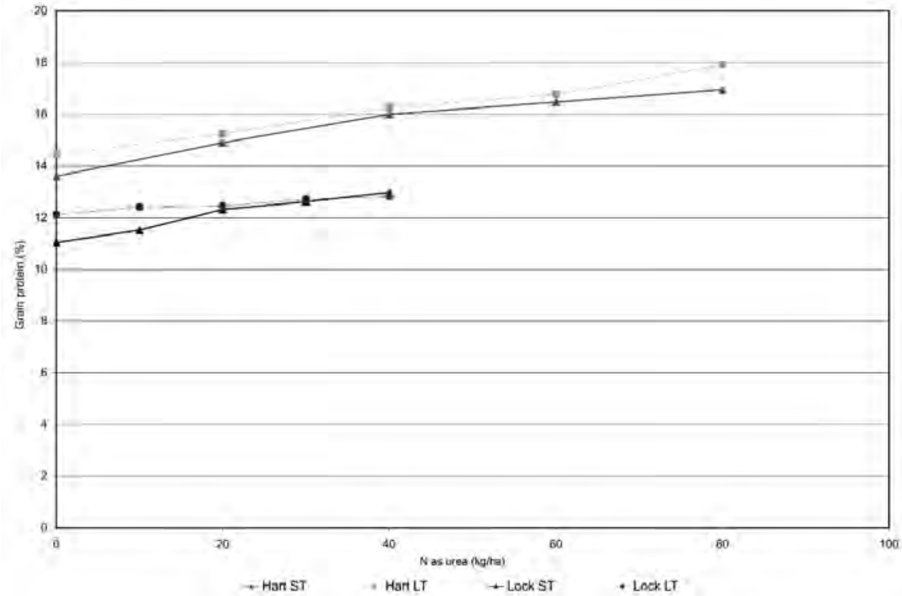

Figure 6: Grain Protein

converted into increases in dry matter yield in a drier than average season where water became very limiting, thus decreasing yield variation between both tillage and nitrogen treatments. It is important to repeat this experiment to reduce seasonal variation and allow the impact of these two tillage treatments on final yield and grain protein to become more apparent in a better season.

Grain yield and quality results

The base soil N rates of the long term No Till and short term No Till site at Hart were sufficient for optimal yield. The dry seasonal finish certainly reduced any potential yield improvement from additional N. Although the yield was higher in the long term site compared to the short term site (*Figure 4*), the grain screenings levels at higher N rates were very high in the long term site (*Figure 5*). The slope of the grain yield and protein N response curve at the Lock long term site was much flatter than the short term site. This is also reflected in protein yield (*Figure 6*), which reflects the effects of both factors. There was a similar effect in grain protein at a low N rate at the Hart site. This indicates that less N was required to achieve a higher grain protein and optimal grain yield at the long term no till sites.

What does this mean?

The preliminary conclusion of this research is a confirmation of grower experience with no till. When first starting a no till program, nutrition (in particular N) should not be compromised. Under a conventional cultivation system, N is mineralised at a rapid rate during the cultivation event. No till however initially lacks this initial burst of nitrogen in the system. It is not until the system is advanced, that mineralisation of N becomes more rapid.

The research is continuing in the 2005 season, and should help to draw out differences in the two systems and areas.

Acknowledgements

Special thanks to: SANTFA, GRDC, Direct Fertilisers (ABB Fertiliser) and the University of Adelaide who jointly funded the project. Special thanks also to Prof. David Coventry, Dr Annie McNeill, Darren Koopman, Dr Rohan Rainbow, Michael Bennet for support. Also thanks to Andrew Polkinghorne, David Bower, David Maitland and Grant Crawford for collaborating with this research.

For further information: contact Tristan Baldock, of Elders Port Lincoln SA on (08) 8682 2755 or email tristan.baldock@elders.com.au

Best practice

Location
Closest town: Minnipa
Cooperator: MAC farm
Group: Minnipa Ag Centre

Rainfall
Av. Annual total: 325 mm
Av. GSR: 242 mm
Actual annual total: 288 mm
Actual GSR: 223 mm

Yield
Potential: (W) 1.92 t/ha
Actual: (W) 1 to 1.5 t/ha

Soil
Alkaline reddish brown sandy loam

Plot size
One metre of crop row for each pair of adjacent tines on one wing and centre section of MAC seeder, 2 paddocks sampled.

Controlled traffic on Minnipa Ag Centre: on track in 2004

Research

Nigel Wilhelm

SARDI Minnipa Ag Centre

Key Messages

- **Controlled Traffic (CT) has been a positive introduction onto the farm because of the ease and comfort of seeding and spraying operations.**
- **Permanent and bare wheel tracks did not cause any loss in paddock yields with wheat in 2004 which was the same as with barley in 2003, providing the tracks were clean of weeds.**
- **Permanent and bare wheel tracks reduced yields of wheat in 2004 by only 40 % of the loss in cropped area (i.e. 2 % across the whole paddock instead of 5 %) where the tracks were weedy (and stony).**

Why do the trial?

To further improve efficiencies in the management of the MAC farm. To monitor the impact of permanent wheel tracks on paddock yields. *See EPFS Summary 2003, pg 129 for results from the 2003 season.*

How was it done?

Controlled traffic systems were introduced onto the MAC farm in 2002. The plan has been to employ a range of CT approaches on the farm, each one onto an individual paddock, and to keep some paddocks under conventional management for comparison. In this way, we hope to monitor the impact of CT systems on crop performance and soil condition in an upper EP environment.

Weeds in wheel tracks have not been controlled except by way of general paddock operations.

At harvest in 2004, two paddocks were sampled for grain yield (two locations in one paddock) to estimate the impact of wheel tracks on paddock yield because one of the most frequent criticisms of CT systems is the reduction in cropped area due to bare wheel tracks (and hence lost income). Grain yield from one metre of crop row from either every pair of tines (one wing of the machine) of the seeder plus every tine on the centre section was measured. Adjacent seeder passes were sampled to ensure that tracks which had, or had not, been used by the boom spray vehicle were both measured. The weediness of wheel tracks at each sampling point was also noted.

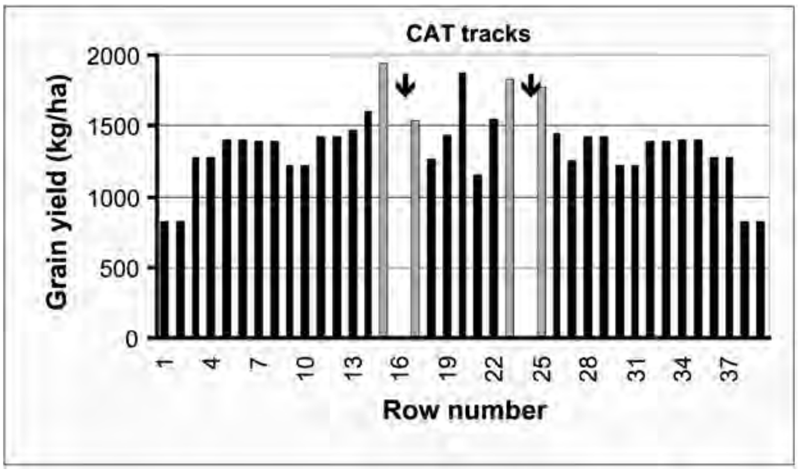

Figure 1: Grain yields of wheat across the Gason 5100 seeder bar, paddock N12, 2004, managed with CT and bare wheel tracks.

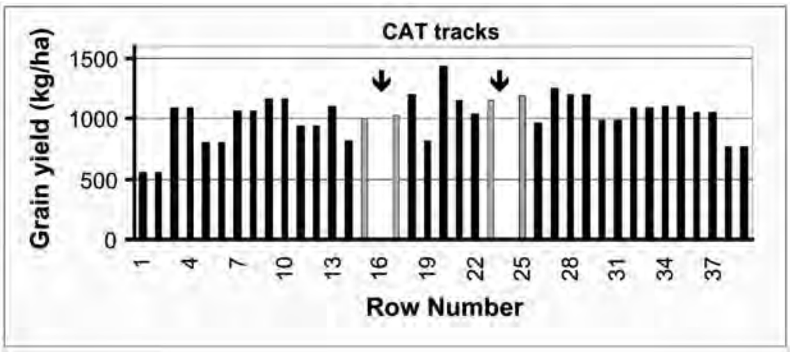

Figure 2: Grain yields of wheat for each row across the Gason 5100 seeder bar, airport paddock, 2004, managed with CT and bare wheel tracks in a weedy and stony patch of the paddock.

What happened?

The rotations on MAC were such that in 2004 only two CT paddocks were in crop. Both of these are being managed with bare wheel tracks, seeded with Beeline autosteer guidance and sown to wheat in 2004.

It was found that yields in the rows adjacent to the bare wheel tracks more than compensated for the loss of the two rows under the wheel tracks (*see Figure 1*) and overall paddock yields were estimated to be 1 - 2 % higher than would have been achieved if the wheel tracks had been seeded. However, where stones and weeds severely restricted wheat performance, only partial compensation occurred (*see Figure 2*) and overall paddock yields would have been 2 % lower. With no compensation at all, overall paddock yields should have been 5 % lower.

Both of these paddocks were in the second year of the permanent track system.

What does this mean?

After two years of monitoring the impact of CT seeding operations on crop production (and three years of CT), we are finding that in areas of the paddock which are clean of weeds and relatively productive, using a bare wheel track system, extra yield in the rows adjacent to the wheel tracks is fully compensating for the unseeded row, resulting in little or no loss in yields with cereals. This raises the possibility that we may gain the benefits of unworked and permanent wheel tracks such as better traction for paddock operations and option of using manual steering for some operations without suffering any loss in production.

However, where weeds are present in the wheel tracks or factors such as stony ground are restricting crop growth, a small loss in yield may result in that area because the adjacent rows do not fully compensate for the uncropped area.

Our plan is to continue to monitor bare wheel tracks for weeds in future years. We hope that the tracks will pack down sufficiently to suppress weed germination and plant vigour but if that does not occur, then we may have to selectively control these weeds to minimise the impact of the loss in crop area on paddock yields (probably with shielded sprayers).

We will continue to maintain CT systems with either bare or seeded wheel tracks because this will give us the best opportunity for measuring the impact of CT on soil condition and whether this results in improved crop productivity.

Now that the auto-steer CT system seems to be emerging as a management system that is easy on the operator and does not appear to cause any major production losses, we are now facing the prospect that all our cropped areas will not have to bear any heavy traffic in the future. Given that penetrometer studies undertaken last year may have identified root restricting compacted layers 5 - 15 cm below the surface of MAC soils, some remedial operations such as deep working points or deep ripping may be justified. CT provides the best chance of any remedial operations persisting beyond the year of operation because there will be no heavy traffic to recompact the soil.

A submission has been placed with SAGIT this year to intensify the monitoring of our CT system and to sample two other properties under CT. Part of this package is to gain sponsorship for a new GPS guidance system on MAC.

Acknowledgements

MAC committee for initiating and supporting the concept of CT on the Centre. To the Centre farm staff for taking on CT with such enthusiasm. Haukaas and Barundo Hill for donation of marker arms. Beeline Technologies for provision of row crop and autosteer unit for the last three years. Ian Richter, Michael Bennet and Jon Hancock for undertaking the sampling process. Michael Bennet for organising the work and collating the data.

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Operating knife point systems for least trifluralin damage

Research

Jack Desbiolles

Agricultural Machinery Research and Design Centre University of South Australia

Searching for answers

Location
Minlaton
Group: Southern Yorke Peninsula Alkaline Soils Group

Rainfall
Av. Annual total: 432 mm
Av. GSR: 343 mm
2004 total: 405 mm
2004 GSR: 332 mm

Yield
Potential: 4.66 t/ha

Paddock History
2003: Medic Pasture

Plot size
Dimensions: 13 m x 1.5 m x 4 reps.

Other factors
Hot and dry grain fill period

Key Messages

- **With knife point systems, significant penalties due to trifluralin can occur on seed rows subjected to soil throw.**
- **Shallower seed boot setting to compensate for the added soil cover tended to decrease plant emergence.**
- **Rolling shield kits can very effectively contain soil throw to allow high sowing speed, however they are not compatible with trifluralin use as they maximise plant emergence losses to all seed rows.**
- **The safest (but not always practical) approach at seeding is to operate at low enough speed to effectively control soil throw (this may be as low as 5-6kph at 0.254m row spacing).**
- **Residual grain yield penalties at harvest reached 5 - 9 % under the higher 2.0 L/ha rate of trifluralin. 1.3 L/ha of trifluralin was found much safer, recording no significant grain yield penalties.**

Why do the trial?

To determine the interaction of trifluralin application rate and knife point seeding system operation on wheat crop establishment, early vigour and yield.

How was it done?

Krichauff wheat at 70 kg/ha with 100 kg/ha DAP Zn and 80 kg/ha urea were sown at 25 cm row spacing. The targeted sowing depth was 25 - 35 mm and tillage depth set at 90 mm.

Treatments

Trifluralin 480 (as Triflur-X,) spray rates: 1.3 and 2.0 L/ha in 100 L/ha and an unsprayed control

Five settings of one commercial double shoot knife point – press wheel seeding system (*see Figure 1*):

Figure 1: Knife point system used in the trial (a), with rolling shield kit closed in 125 mm (b), and 100 mm banked press wheels (c)

- **T1:** Control system (reference seed boot settings and low speed - 6kph)
- **T2:** High speed contrast on T1 (10kph)
- **T3:** modified T2 (ie. front row seed boots raised shallower to compensate for extra soil cover due to soil throw)
- **T4:** as T2 + rolling shields
- **T5:** Modified T4 (ie. all seed boots raised shallower to compensate for extra soil cover due to rolling shield effect)

What happened?

Seeding depth

The reference seeding depth obtained was 25 - 30 mm with an extra 8 mm ridging on T1 and 23mm ridging on T2, measured on seed rows subjected to soil throw.

The addition of rolling shields increased the seeding depth by 20 mm and almost cancelled furrow ridging under the higher speed.

Under the experimental conditions, the seed boot design was unable to achieve a significantly shallower seeding depth (-7 mm for T3 front boot and T5) despite the 65 mm higher seed boot setting.

The variation in seeding depth was least with T1 (±15 mm about the mean), increased to ±19 mm at 10kph, and reached to ±26 - 29 mm under additional soil throw conditions (ridged furrows or with rolling shields).

Crop establishment

Overall wheat establishment reached 188, 156 and 137 plants/m^2 under the 0, 1.3 and 2.0 L/ha trifluralin rates, respectively. In the unsprayed section, crop establishment was not affected by seeding technology except under T5 where a 9 % lower establishment was obtained (ie. 174 plants/m^2, perhaps influenced by a greater proportion of shallow seeds failing).

Plant density readings were taken separately from reference seed rows (ie. corresponding to rear mounted openers, not subjected to soil throw from adjacent rows) and ridged seed rows (ie. from front mounted openers). Under rolling shields (Treatments T4 and T5), all rows were subjected to additional soil cover.

Trifluralin penalties on crop emergence were highest under ridged furrows (ie. from either soil throw or rolling shield effects), with 32 and 51 plants/m^2 lost on average at the 1.3 and 2.0 L/ha, respectively (*see Table 1*).

The greatest emergence loss (85 plants/m^2) occurred on ridged seed rows when combining high trifluralin rate (2 l/ha) and high speed/shallow seed boot setting (eg. T3).

A minimum of 10-20 plants/m^2 loss was still recorded on reference seed rows at the lower trifluralin rate (1.3 L/ha) regardless of operating speed. The addition of rolling shields redirecting part of the soil throw onto the seed row, generated high plant losses on all seed rows, particularly under the deeper seed boot settings (eg. 53 to 72 plants/m^2).

Under two trifluralin rates and five seeding technology settings

Early crop vigour

Plant dry matter measurements made at end-tillering stage showed plant vigour was significantly reduced by trifluralin in the ridged furrows (15 to 20 % lower weight per plant). No bias from deeper seeding depth on ridged rows was highlighted by the data.

Average plant weight was only slightly reduced under the rolling shield treatments (up to 6 % lower weights). Despite smaller plant weights, the tillering ability (eg. tillers/plant) increased by 15 - 25 % under trifluralin applications, likely due to the lower competition of the reduced plant density.

Table 1: Summary of plant/m^2 losses by seed row type relative to unsprayed control

	No soil throw (Rear of seeder)			Soil throw (Front of seeder)			overall means
Technology means (4 reps)	1.3l/ha	2l/ha	mean (n=8)	1.3l/ha	2l/ha	mean (n=8)	(n = 16)
T1 (= control)	**14**	**30**	22	**13**	**39**	26	24
T2 (= 10kph contrast)	**17**	**17**	17	**39**	**63**	51	34
T3 (= T2 + front boots shallow setting)	**11**	**18**	15	**54**	**85**	69	42
T4 (= T2 + rolling shields)	**53**	**72**	62	**55**	**66**	61	61
T5 (= T4 + all boots shallow setting)	**31**	**54**	43	**33**	**62**	47	45
individual spray rate means:	25 a	38 b		39 b	63 c		
Overall spray rate means:	1.3 l/ha : 32 a			2.0 l/ha : 51 b			
Overall soil throw means:		No soil throw: 32 a			Soil throw: 51 b		
LSD10% between technology means (n=4): 20p/m?- (n=8): 14 p/m?- (n=16): 10 p/m?							
Overall means followed by different letters indicate significant treatment effect at 90% confidence level							

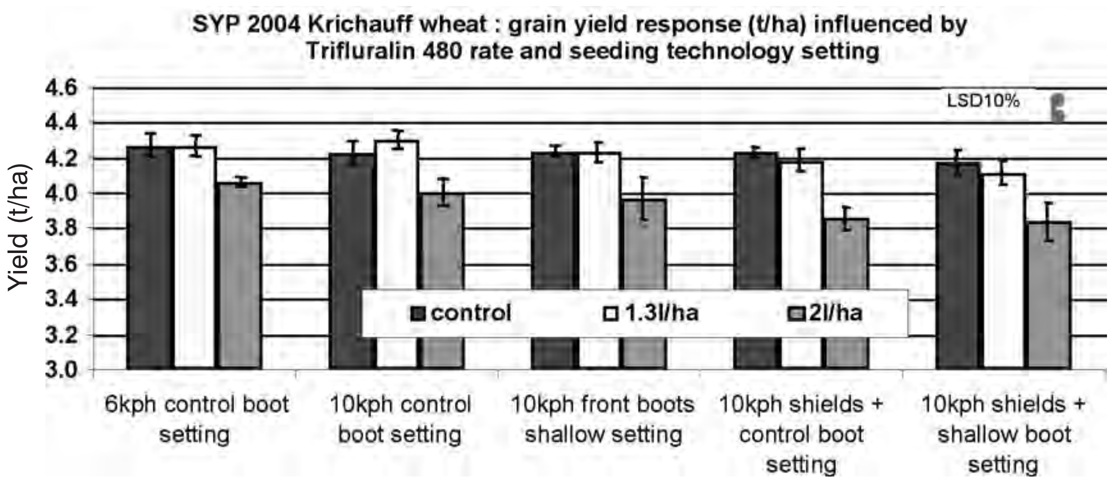

Figure 2: Harvested treatment yield data (error bars are ±1 standard error)

Grain yield residual penalties

Harvested treatment yields (including plot edge row effects) in the untreated reference plots reached 4.2±0.05 t/ha, regardless of seeding technology settings. Applying 1.3 L/ha of trifluralin 480 - IBS - did not result in a significant yield loss under the range of knife point seeding systems. The increased tillering measured early on is likely to have been the factor responsible for this grain yield compensation.

Applying 2.0 L/ha trifluralin IBS, which had generated significant crop establishment losses,- also resulted in significant grain yield loss at harvest (ie. 5 - 9 % or 0.21 to 0.38 t/ha). The highest penalties (0.33-0.38 t/ha) occurred under the rolling shield systems, which had penalised the emergence of all seed rows equally. Under the experimental conditions, the earlier establishment benefits of lower operating speed did not materialise in higher grain yield.

Changing seed boot settings in an attempt to optimise seed placement did not generate significant yield response, likely due to the partial inability of the seed boot design to create a significant change in seeding depth

What does this mean?

The trial highlighted significant wheat grain yield penalties (5 - 9 %) under higher trifluralin rate applications (eg. 2.0 L/ha) incorporated by sowing with a common knife point press wheel seeding system.

When such rates are required for weed control, the grain yield penalties are best minimised by adopting low enough seeding speeds to effectively control soil throw levels. Soil throw control kits (eg. rolling shields) are an attractive option allowing high speed sowing while controlling furrow ridging and leaving a smooth paddock surface after seeding. However they are not compatible with higher trifluralin rates as they maximise high penalties to all seed rows.

Additional strategies able to minimise soil throw issues and likely to minimise trifluralin penalties include:

- shallow tillage depth,
- wider row spacing,
- narrow points combined with narrow shanks,
- preceding deep working disc coulter, and
- sowing between stubble rows which can act as effective containing walls.

Further research work is required to quantify the desired characteristics of point/shank combinations for minimal soil throw. Research to date suggests that shank width is a significant factor exacerbating the extent of soil throw.

Acknowledgements

Research activities assisted by Dean Thiele and Murray Crane at UniSA. Project supported by Bruce Cook (project liaison, paddock preparation and snail control), Stephen Wentworth and Danny le Feuvre at Ag-Consulting Co Pty Ltd (weed/pest control). Research funded by SAGIT.

SAGIT

University of South Australia

Southern Yorke Peninsula Alkaline Soils Group — Growing results for you

Almost ready

Location
Closest town: Lock
Cooperators: Kerry Brown and David Beard
Group: Lock - Murdinga

Rainfall
Av. Annual total: 356 mm
Av. GSR: mm
Actual annual total: 288 mm
Actual GSR: 214 mm

Yield
Potential: 2.08 t/ha
Actual: up to 2.43 t/ha

Soil
Grey calcareous sandy loam

Location
Closest town: Minnipa
Cooperator: Neville Jericho
Group: Central Eyre

Rainfall
Av. Annual total: 350mm
Av. GSR: 245mm
Actual annual total: 220mm
Actual GSR: 189 mm

Yield
Potential: 1.58 t/ha
Actual: up to 0.88 t/ha

Soil
Grey calcareous sandy loam

Rock Crushing on EP

Survey

Jon Hancock

Research Agronomist, SARDI, Minnipa Agricultural Centre

Key Messages

- **Crop growth on stone crushed areas was impressive.**
- **Stony ground was transformed into arable country and successfully cropped.**
- **Stony reefs within cropping areas were crushed to improve machinery passage without any adverse effects on crop production.**
- **Nutrient availability was not reduced through crushing, however nitrogen and phosphorus availability was low at several sites, particularly those on new ground.**

Why do the trial?

Early in 2004, contract stone ripping and stone crushing machines were operating at several locations across Yorke and Eyre Peninsula. These machines have the capacity to crush limestone outcrops and stony ridges to open up new land for agricultural production and make existing agricultural land easier to crop. Several of these sites were monitored to assess the impact of stone crushing on crop growth and yield, in response to substantial interest from many Ag Bureau groups across Upper Eyre Peninsula.

How was it done?

Several sites on Eyre Peninsula that had previously been rock crushed were monitored to assess the impact of rock crushing on crop performance. Rock crushing machines opened up some new ground (Browns) which was previously too stony to crop and also made some previously cropped ground more workable (Beard's and Jericho's) to reduce wear and tear on machinery and make it easier to get through with narrow points.

Two machines were used for the rock crushing operation which are both approximately two metres wide, power take off driven and carried by the three point linkage of a tractor. One of the machines was able to crush material to a depth of up to 40 cm (used at Site 1) and the other could only crush rocks and stumps near the surface (used at all other sites). The process cost around $180/ha for surface crushing to up to $500/ha for the deeper crushing, depending on how quickly the machines can get through the rock.

Prior to sowing, soil samples from the top 10 cm were taken from crushed areas and also from neighbouring uncrushed areas for comparison. The sites were sown during the farmer's normal seeding operation.

Plant samples were taken from crushed areas and from neighbouring good (cropping ground which didn't require crushing) or uncrushed (stony cropping ground that hadn't been crushed) areas at tillering and at maturity. This was used to compare dry matter at tillering, plant nutritional status, dry matter at maturity and final grain yield.

Figure 1: Crop growing in limestone-crushed site.

Table 1: Selected soil test results from crushed and uncrushed sites.

Site	Description	CaCO3 (%)	PH (Water)	Colwell P (mg/kg)
1	New ground, ripped and crushed to 40cm	5.5	8.6	8
2	Uncrushed virgin ground	0.52	8.3	5
3	Stone crushed new ground	2.7	8.4	7
4	Uncrushed virgin ground	0.18	8.1	6
5	Ripped 15 years ago. Crushed in 2004. Not previously cropped	6.34	8.5	8
6	Crushed, predominantly ridges	7.14	8.7	20
7	Crushed Ridges	15.52	8.7	16
8	Uncrushed Ridge	5.98	8.6	23
9	Between ridges	1.42	8.2	25
10	Crushed cropping ground	6.36	8.6	37
11	Crushed cropping ground	3.14	8.5	16
12	Uncrushed cropping ground	1.02	8.5	13

Table 2: Tillering DM, tissue test results at tillering, Maturity DM and Grain yield comparisons.

Site	Description	Crop	Tillering DM (t/ha)	Tissue Test Results (mg/kg) from YEB's1 or YOL's2 at Tillering						Maturity DM (t/ha)	Grain Yield (t/ha)
				N	P	Zn	Cu	Mn	Ca		
KB1	New ground, ripped and crushed to 40cm	Wheat	0.70	26900	1780	25	4.4	27	2500	3.56	1.43
KB1	Good ground	Wheat	0.66	38900	3300	27	5.6	28	3700	5.28	2.14
KB2	Stone crushed new ground	Wheat	0.90	24200	2300	27	4.7	22	2300	2.40	1.00
KB2	Good ground	Wheat	1.86	37500	3000	27	5.9	22	2500	6.16	2.19
KB3	Ripped 15 years ago. Crushed in 2004	Wheat	0.83	28900	2100	19	4.6	26	2500	2.76	1.17
KB3	Good ground	Wheat	1.13	39600	2100	28	8.4	20	2000	4.64	1.66
DB1	Crushed, predominantly ridges	Wheat	1.11	42300	2800	27	3.8	22	3200	5.45	2.43
DB1	Good ground	Wheat	1.62	49500	2700	23	8.4	58	3300	7.25	2.25
DB2	Crushed Ridges	Canola	0.69	49400	5700	29	4.7	43	16500	-	-
DB2	Between ridges	Canola	0.76	52400	6300	26	3.4	31	16300	-	-
DB3	Crushed cropping ground	Wheat	1.56	39000	2600	28	7.1	43	7000	6.43	2.06
DB3	Uncrushed cropping ground	Wheat	1.69	37700	3500	28	8.6	60	6900	5.72	1.60
NJ1	Crushed cropping ground	Wheat	0.52	33300	1900	69	4.6	230	4900	2.49	0.81
NJ1	Uncrushed cropping ground	Wheat	0.69	35000	2000	57	4.8	198	5100	2.49	0.88

[1] A YEB is the youngest emerged blade of a cereal plant *[2] A YOL is the youngest open leaf of a canola plant*

What happened?

Soil pH and available P levels were unaffected by the crushing process but available P was noticeably higher in previously cropped ground than new ground (*Table 1*). Calcium carbonate levels were higher in the crushed areas, probably due to the fact that the crushing process would increase the amount of limestone that could pass through the 5 mm sieve prior to analysis. Fragments in the soil larger than 5 mm are excluded from soil analyses.

Considering the amount of limestone present in the crushed areas, crop growth (*Figure 1*) and final grain yields were generally very impressive (*Table 2*).

Crop growth and yield was lower on the crushed new ground than on the surrounding 'good' ground, probably due to the vast difference in soil type between the two areas and also because of the difference in fertiliser history.

In the new ground, plant concentrations of N and P were marginal and may have impeded crop performance. N and P are considered deficient when concentrations in the YEB's (youngest emerged blade) of wheat plants are below 34000 and 2400 mg/kg respectively. At the two sites where direct comparisons could be made between crushed ground and neighbouring sections of uncrushed stony ground (site 5 and site 6), it was found that crushing had little effect on dry matter production throughout the season and on final grain yield.

What does this mean?

From the observations and measurements taken from these sites, it is evident that development of new ground for crop production through rock crushing results in a dramatic transformation and enables the land to successfully support crop production. However, due to the lower levels of production, the economic return would be substantially lower than surrounding country and it may take years to recoup the cost of the rock crushing.

The crushing of isolated stony patches may have additional advantages as greater efficiencies could be gained by cropping through them, thereby decreasing the double sown area within a paddock and making better use of inputs.

In cropping areas with considerable amount of stone in them anyway, the actual rock crushing process did not seem to affect crop growth or yield but made it easier to crop, reducing machinery wear and tear and break down time.

Acknowledgements

Kerry Brown, David Beard and Neville Jericho for their input and allowing us onto their properties to measure and monitor these systems. Also Willie Shoobridge for technical assistance.

GRDC Grains Research & Development Corporation

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Almost ready

Location
Chandada: Brent Cronin

Rainfall
Av. Annual: 325 mm
Av GSR 212 mm
2004 total: 302 mm
2004 GSR: 273 mm

Yield
Potential: 3.25 t/ha

Paddock History
2003: Barque Barley
2002: Excalibur Wheat
2001: Excalibur Wheat

Soil Type
Grey calcareous sandy loam

Diseases
Rhizoctonia

Plot size
22 m x 1.5 m x 4 reps

Other factors
Early finish

Location
Minnipa: Minnipa Agricultural Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 242 mm
2004 total: 289 mm
2004 GSR: 222 mm

Yield
Potential: 2.25 t/ha

Paddock History
2003: Lucerne
2002: Lucerne
2001: Lucerne

Soil Type
Reddish brown sandy loam

Plot size
22 m x 1.5 m x 4 reps

Other factors
Early finish, drought and late sowing date

Aerway® - a machine for breaking the hard pan?

Research

Leigh Davis

SARDI, Minnipa Agricultural Centre

Key Message

In 2004 the Aerway®, did not produce an improvement in grain yields or quality at two sites on UEP when compared to other treatments.

Why do the trial?

The purpose of the trial was to see if using a machine called the Aerway®, can break up a hardpan or cultivation layer and lead to improved grain yield and quality. A hard pan exists on many EP soils from years of cultivating to one depth. One of the local farmers in the Streaky Bay Ag Bureau, Brent Cronin, sourced a demonstration machine from the Holland Group in Bacchus Marsh (NSW) to use as a tool to breakthrough the hard pan on his property. The consequence of this may be a stimulation of root growth and accessing moisture stored below at depth. Brent conducted a few demonstrations in his paddocks during 2003 with good results which led to a replicated trial program in 2004.

How was it done?

The Aerway®, machine was used at two sites, Minnipa Agricultural Centre (MAC) and Cronin's (Deep Well). It is much like a big prickle chain with a number of long, off set triangle-like blades that penetrate into the ground. The angle of the blades can be adjusted to be more or less aggressive. The blades are fixed to a round hub and can penetrate to around 40 cm.

Minnipa Agricultural Centre Site

The Aerway®, machine was set on the less aggressive setting. There were five different treatments replicated four times: one, two or three passes with Aerway®, one working before seeding and a Control (No Till).

The Aerway® passes were carried out on 28th April and the site was sown on 1st July to Frame wheat at 65 kg/ha with 60 kg/ha of DAP fertiliser.

Cronin's (Deep Well) Site

The Aerway®, machine was set on the most aggressive setting and the same treatments were applied as at Minnipa. The Aerway®, passes at Cronin's were carried out on 28th April and the site was sown on 2nd June to Frame wheat at 60 kg/ha with 60 kg/ha of DAP fertiliser. An wight row knifepoint and press wheel seeder on 7" spacing was used for seeding.

What happened?

At Cronin's, three passes with the Aerway, machine made the soil very fine, buried 80 % of the stubble and dragged the rest to the end of the plot. The treatment of two passes prepared the soil best; it smashed up half the stubble leaving it on top for cover and the other half was buried. With one pass the Aerway®, machine did not operate at full depth and did not bury or smash up stubble. Grain yield or grain quality (*Table 1*) was not influenced by the Aerway® when compared to the control.

At MAC three passes with the Aerway®, machine caused the top soil to powder up and the machine was working at full depth.

The Minnipa site had no stubble present. With two passes the top soil had minor disturbance but the machine was about 10 cm from operating at full depth. With one pass the top soil had very little disturbance and the machine was only penetrating

Table 1: Selected soil test results from crushed and uncrushed sites.

Treatment	Grain Yield (t/ha)	Test Weight (kg/hL)	Screenings (%)	Protein (%)
1 Pass	0.97	81.45	3.58	9.10
2 Passes	0.99	81.80	3.48	8.98
3 Passes	0.96	82.30	3.45	9.30
Control	0.99	81.70	3.68	9.15
Worked	0.94	82.35	3.38	9.30
Mean	0.97	81.92	3.51	9.17

Table 2: Grain yield and quality measurements at MAC site 2004.

Treatment	Grain Yield (t/ha)	Test Weight (kg/hL)	Screenings (%)	Protein (%)
1 Pass	0.36	76.20	2.33	19.23
2 Passes	0.34	76.05	2.38	19.18
3 Passes	0.38	76.10	2.20	19.13
Control	0.38	77.40	2.65	19.15
Worked	0.36	76.25	3.08	19.10
Mean	0.36	76.40	2.53	19.16

to around half its depth. Grain yield and grain quality, was not influenced by the Aerway®, when compared to the control (*Table 2*).

What does this mean?

The replicated experiments at MAC and Cronin's showed no advantages for yield or grain quality by using the Aerway®. In a season like 2004 the Aerway®, did not perform as expected however investigation in a more favourable season may be warranted. The cost of this machine, especially if three passes are needed to break the hard pan, needs to be considered both in dollar terms and effect on soil structure.

Acknowledgements

Thanks to Brent Cronin for providing his land, tractor and assistance with the trial. Also thanks to Wade Sheppard and Willie Shoobridge for assistance with management of these trials.

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

GRDC Grains Research & Development Corporation

Dry Sowing – understanding the risks before taking the punt

Searching for answers

Extension

Greg Secomb

Rural Solutions SA, Streaky Bay

Key Messages

- **There are many risks to consider when making the decision to dry sow a paddock.**
- **Paddock selection and history will largely influence the success of a dry sown crop.**

Background

Many farmers now have large cropping programs and are under pressure to sow as much of their crop as close or as near as possible to an optimum sowing date in an effort to avoid yield penalties from late sowing. When the season is late to break, farmers are faced with the difficult decision to make a start with sowing before opening rains have been received.

Typically agronomic best practice is not to dry sow as the range of associated risks later in the crop can often discount any benefits by the earlier sowing.

As always there always seems to be exceptions to the rules and some farmers on the Eyre Peninsula have used dry sowing with varying degrees of success. This article is to raise the level of awareness of the risks and to help identify some key points to success if the decision is made to put a paddock in dry.

Things to Consider:

- Weed status of the paddock. Is there a large seed bank, especially grass weeds?
- Overall area to be planted in relation to the time and lateness of the season.
- What are the consequences if insufficient rainfall comes after planting? i.e. Patchy and staggered germinations and poor crop establishment.
- The financial commitment to plant a crop in unknown seasonal conditions.
- The presence of non wetting sand

Possible problems that can be encountered after dry sowing

- If a crop is germinating on marginal soil moisture there is a risk of crop damage from wind blasting.
- Many pre-emergent herbicides are ineffective in the absence of soil moisture. This can place increased pressure and reliance on more expensive post emergent chemicals.
- If weeds are present and germinate with the crop, the impact on yield can be high. At the same time these weeds are robbing the crop of the applied fertiliser.
- In the event of staggered germinations, timing of application of post emergent chemicals can be difficult where crops are very sensitive at younger growth stages. Waiting for plants to "catch-up" can cause delays in optimum timing and allows weeds to get bigger which could mean poor herbicide performance.
- Watch out for pests! Mice and ants can take off with your seed while it is sitting in the soil waiting to germinate.
- Poor emergence on non wetting sands.

Getting it right

- Paddock selection will play a big role in success with dry sowing. Paddocks with very low weed seed banks will be far more suitable.
- Choose a paddock that is less prone to drift.

Dry sowing should not be approached in a *"let's just jam it in and see what happens"* fashion. If you consider all the risks carefully dry sowing can fit in to your program if circumstances demand it. However the risks from dry sowing can expose you to a number of problems. If you have any doubts, then my advice would be to wait until the rains come.

RURAL SOLUTIONS SA

Sowing systems field day wrap up

Michael Bennet

SARDI/SANTFA, Minnipa Agricultural Centre

Demo

Location
Minnipa
Cooperator: MAC

Rainfall
Av. Annual total: 325 mm
Av. GSR: 242 mm
Actual annual total: 288 mm
Actual GSR: 223 mm

Yield
Potential: 2.25 (wheat)

Paddock History
2003: Wheat

Soil
Sandy Clay Loam

Key Messages

- **Soil throw minimisation is critical when using herbicides such as Metalachlor and Metribuzin.**
- **Herbicide damage at seeding can vary from season to season.**
- **Yield is lost through wide row spacings.**

Why do the trial?

The Minnipa Research Foundation, now known as the Eyre Peninsula Agricultural Research Foundation (EPARF) organise an annual focus field day as part of the membership. Previous Foundation Days have explored specific issues such as herbicide diagnostics, nutrition and in 2004 the focus shifted to seeding systems.

How was it done?

The trials were sown on the 21st and 22nd of June. All trials except the variety trial were sown with Wyalkatchem wheat at seeding rate of 60 kg/ha with 60 kg/ha of 17:19:0 + 2 % Zn fertiliser.

What happened?

The trials were all unreplicated demonstrations, which doesn't allow for statistical analysis of results. The trials may have been more effective if they were less complicated and replicated. This is the third season in a row that there is regret from the lack of replication in the Foundation Field Day trials!

Seed Bed Utilisation Demonstration

The SBU demonstration was sown using a seven row DBS plot seeder. The 12" plots were sown to five rows to make up the correct row spacing. Outside rows were removed from the plots to remove edge effect from the plots prior to harvest.

Yield decreases were observed when row spacing was increased. This is weighed against a grower combating soil throw (*see herbicide x variety results Table 1*) and the resulting herbicide damage.

For each of the row spacing treatments, there was a positive response in terms of emergence for placing urea under the seed. However given the dry season, a greater response should have been expected than the result in the demonstration.

Herbicide x Variety Demonstration

Yield comparisons from this trial can be taken as trends only, due to the small plot size and un-replicated nature of the trial. Despite this, the key message to come out of this trial was the need to monitor soil throw at seeding.

The trial was sown with an eight row plot seeder on 18 cm (7") spacings sown at 5 km/hr to minimise soil throw, yet the results of the trial indicate that there was damage from soil applied herbicides. The key with herbicides such as Metalachlor and Metribuzin (which can be as effective at controlling wheat as controlling weeds!), is to keep the herbicide within the inter row space. The simplest method of reducing soil throw is to widen row spacing and reduce sowing speed. Build up of material such as straw, wireweed or melon vines around tines can exacerbate the problem. Coulters mounted on the front of the airseeder can help to solve the problem.

Metribuzin was applied at 120, 240, and 500 g/ha with 1.0 L/ha Trifluralin. Wyalkatchem suffered the greatest yield loss, however all wheat varieties including Blade and Eagle Rock experienced some degree of yield loss when Metribuzin was applied incorporated by sowing (IBS). Sloop barley appeared less tolerant to Metribuzin than Keel barley. These results may not be the same in a situation where soil throw can be controlled and keeps the treated soil on the inter-row.

There was little difference in terms of yield loss when applying Diuron and Metalachlor IBS and post sowing, pre emergent (PSPE). This is most likely due to the soil

Table 1: Sbv Demonstration.

Row Spacing	N Placement	N Rate (kg/ha)	Yield (t/ha)	Plants/m²	Emergence % of Nil Urea Treatment
7"	N with seed	0	1.01	111	100
7"	N with seed	10	1.16	92	83
7"	N below seed	20	0.98	76	68
7"	N below seed	20	1.00	102	92
9"	N with seed	0	0.86	104	100
9"	N with seed	10	0.78	77	74
9"	N below seed	20	0.84	73	70
9"	N below seed	20	0.84	101	97
12"	N with seed	0	0.71*	110	100
12"	N with seed	10	0.81	64	58
12"	N below seed	20	0.87	73	66
12"	N below seed	20	0.82	109	99

** Plot incorrectly harvested.*

Table 2: Tillage Demonstration.

Opener	Closer	Treatment	Yield (t/ha) Cultivated	Yield (t/ha) Direct Drill	Direct Drill % of Cultivated
Knifepoints	Press wheels	Just right PW pressure	0.86	1.32	154
Knifepoints	Prickle Chain	Sown Deep	0.92	1.38	150
Knifepoints	Press wheels	Sown Deep	0.84	1.22	145
Knifepoints	Press wheels	Sown Shallow	0.98	1.42	145
Knifepoints	Press wheels	Too much PW pressure	0.95	1.34	140
Knifepoints	Prickle Chain		1.05	1.30	135
Knifepoints	Press wheels	14km/hr	1.04	1.40	135
Knifepoints	Press wheels		1.01	1.30	134
Shares	Prickle Chain	14km/hr	1.09	1.44	132
Knifepoints	Press wheels	Too little PW pressure	0.98	1.30	132
Knifepoints	Press wheels	Snake Chains	1.03	1.29	125
Shares	Prickle Chain		1.03	1.29	125
Shares	Press wheels	14km/hr	1.11	1.36	122
Knifepoints	Prickle Chain	Sown Shallow	1.04	1.27	122
Shares	Press wheels		0.96	1.14	119
Knifepoints	Press wheels	Pre Em Prickle Chain	1.07	1.23	115
Knifepoints	Prickle Chain	14km/hr	1.12	1.26	112
Knifepoints	Prickle Chain	Pre Em Prickle Chain	1.11	1.22	110
Shares	Prickle Chain	Pre Em Prickle Chain	1.27	1.36	107
Shares	Press wheels	Snake Chains	1.13	1.18	105
Shares	Press wheels	Pre Em Prickle Chain	1.24	1.20	97
		Average	**1.04**	**1.30**	

** Plot incorrectly harvested.*

throw that was identified as a major factor within the trial. The dry conditions post sowing may also have contributed to these results. If a significant rainfall event occurred after seeding, then concentration of herbicide at the bottom of the press wheel furrows and the resulting herbicide damage could have been more severe in the PSPE treatment than the IBS.

Tillage Demonstration

No visual differences were observed from the wide range of herbicides applied to the Tillage by Herbicide interaction trial. The trial was harvested without recording any herbicide interactions. The general trend from the tillage trial was a reduction in yield from prior cultivation. The cultivated treatments were worked up with shares then prickle chained level. The direct drill treatments received no paddock preparation. The PSPE prickle chain treatment was done seven days after seeding.

As a general trend, the cultivated plots responded the most to further disturbance at seeding. This is why the greatest differences between the cultivated and direct drill plots were found with the knife point treatments. However the direct drill plots responded best to low disturbance. It was interesting to see the plots did not respond negatively to soil throw generated at seeding, although all the treatments still had excessive soil throw (as was discovered in the herbicide by variety demonstrated). It is planned to conduct this trial again in 2005 with a simpler format, 9” spacings and with fewer herbicide combinations.

Acknowledgements

Appreciation goes to Nufarm and Farmoz for supplying product for the purposes of the demonstrations. Special thanks to Jon Hancock and Neil Cordon for assistance.

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Try this yourself now

Location
Minnipa – Jon & Jerel Fromm
Minnipa Farmers Group

Rainfall
Av Annual: 273mm
Av GSR: 220 mm
2004 Total: 197mm
2004 GSR: 184mm

Yield
Potential: (W) 1.6 t/ha
Actual: 1.25 t/ha

Paddock History
2003: Pasture
2002: Wheat
2001: Pasture

Soil Type
Deep sandy rises to heavy shallow red brown sandy clay loam flats

Other Factors
Take-all, late sowing, severe moisture stress during grain development and filling. Wind damage

Variable rate technology – first impressions

Demo

Neil Cordon

SARDI, Minnipa Agricultural Centre

Key Message

***"The Variable Rate Technology was very easy to use as I didn't need to be a rocket scientist to operate it! In the future we will have the ability to hook up to G.P.S. and paddock plans but at the moment it is not vital on our property. At this early stage we know we have the flexibility to at least increase our fertiliser on the sand whilst cutting back on seed and fertiliser on the stony ground".* Farmer Comment.**

Why do the trial?

Mr Jon Fromm, farmer from Minnipa, purchased a new air seeder in 2004 which had the capability of Variable Rate Technology (VRT), and as a first time user it provided an excellent opportunity to evaluate the sowing system.

The demo was instigated to demonstrate to the farmers in the district the principals of VRT. With a lot of recent publicity from the private and public sector on precision farming it was an ideal opportunity to see it in practice. Farmers with defined soil variability with in paddocks (sand hills merging into heavy flats) may see VRT as an easy, uncomplicated first step into precision agriculture which provides the flexibility for the improved utilisation of inputs at seeding time.

How was it done?

The paddock was sown to Frame wheat on the 18th June with 18:20:00 being the standard fertiliser. The sowing machine was a New Holland Flexi-Coil ST 830 with a sowing width of 15m with a row spacing of 23 cm and using 25 cm shares.

By using VRT the farmer was able to change rates of seed and fertilisers while seeding. Using this method, six different strips with different seed and fertiliser rate combinations were sown. Strips were harvested from each section and grain yield and quality attribute measure to compare the different combinations

What happened?

Limited rainfall in October coupled with hot drying winds severely depressed grain yields especially in the heavy red flats. Despite this, treatment 2 (*Table 1*) achieved 78 % of potential yield with the highest yield (1.25 t/ha) and gross income ($136/ha)

Harvested strips were predominantly from the deeper sandy soil type rather than the heavy red flats, which may have favoured the higher fertiliser rates.

The low seeding rate of (45 kg/ha) and high fertiliser rate (125 kg/ha) went against the trend most probably due to reduced plant numbers caused by crop damage from strong winds in July.

What does this mean?

The data suggests that on sand, a low risk option is a seeding rate of 60 kg/ha and a fertiliser rate of up to 125 kg/ha, which would perform in a good season and be a low risk option in difficult years.

The ability to raise the fertiliser rate from a base rate of 60 kg/ha to 125 kg/ha would achieve $12,000 of extra income over 1000 hectares and potentially even more in a good season. Conversely on the heavy red flats the rates could be adjusted down.

Further reading

In Farming Ahead publication January 2005, Page 30, an article titled "Precision Farming profits hinge on stable yields" summarizes research work on VRT. Their research suggests, "If paddock stability is more than 70 %, then farmers are highly likely to profit from adopting VRT" (Whelan and Mailing). For more information visit Corrigin Farm Improvement web site at http:/cfig.asn.au

Acknowledgements

Jon and Jerel Fromm for setting up and conducting the demonstration. Kondinin publication – January 2005, Farming Ahead, No 156.

GRDC Grains Research & Development Corporation

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Table 1: Grain yield, quality and gross income for VRT demo at Minnipa, 2004

Treatment No.	Sowing rate (kg/ha)	Fertiliser rate (kg/ha)	Test Weight (kg/hL)	Protein (%)	Screenings (%)	Yield (t/ha)	Gross Income ($/ha)
1	60	60	82	11.5	2.5	0.93	124
2	65	125	80	12.5	3.7	1.25	136
3	85	65	81	10.6	3.3	0.89	93
4	85	125	81	10.6	3.1	1.10	102
5	45	65	82	11.2	2.6	1.08	134
6	45	125	81	12.0	2.7	1.04	108

**Gross Income is yield x price (with quality adjustments) less on farm treatment costs delivered Port Lincoln as at 1st December 2004.*

Wirrulla Sports Club cropping 2004

Demo

Wirrulla Sports Club and Michael Bennet[1]

SARDI / SANTFA, Minnipa Agricultural Centre[1]

Try this yourself now

Location
Wirrulla
Cooperator: Andrew Patterson
Group: Nunjikompita Ag Bureau

Rainfall
Actual total: 237 mm
Actual GSR: 212 mm

Yield
Potential: 2.04 t/ha

Soil
Grey calcareous loam

Key Messages

- **Community spirit essential for rural sports club survival.**
- **Teamwork farming can cover a vast area quickly.**

Why do the cropping?

The Wirrulla sports club annually crops 400 hectares to help keep the finances in the black.

Local growers banded together to sow and harvest the crop with plenty of rivalry and fun on the day.

How was it done?

The crop was sown on the 16th of June to Excalibur wheat at approximately 50 kg/ha with 50 kg/ha 18:20. The crop was sown in three paddocks donated by Andrew Patterson in a share farming arrangement for the club.

Four contrasting airseeders were used for the sowing operation.

- Andrew Patterson's K-Hart disc machine on 8" row spacing.
- Shane Kelsh's Flexi Coil bar with knife points and rotary harrows on 9" row spacing.
- Andrew Watson's Gason bar with knife point and press wheels on 7" row spacing.
- Fred Watson's Forward bar with sweeps and prickle chain on 7" row spacing.

A knockdown of 800 ml/ha Roundup Powermax, was used pre seeding, which was not sufficient to control spear grass in the disc seeder runs (the other seeders created enough disturbance to control the grass).

At harvest time seven local headers made short work of the operation reaping 1100 acres in just five hours. The combination peeled the grain off with ease and it was incredible to see the grain come off so quickly.

The MAC weigh trailer was used to weigh the grain from 200 m long strips of each seeder to determine grain yield. Grain samples were retained to measure protein and screenings.

What happened?

The Sports Club crop attracted great interest from locals and all who attended the sticky beak days.

The grain yields obtained (*Table 1*) showed little difference between the seeders in the stubble paddock, however greater differences were observed in the "new ground" where the disc machine had the highest yield. The disc machine was less affected by *Rhizoctonia*, which may have contributed to the yield difference.

What does this mean?

Due to small differences in seeding rate, fertiliser rate and sowing depth (single seeders are difficult enough to calibrate with precision, let alone four different seeders), it is difficult to draw concrete conclusions out of the results. However the results were remarkable for the first season of a disc seeder in the district.

The sticky beak days highlighted the importance of seeder setup. It was surprising to observe the disc seeder less affected by *Rhizoctonia* than the other seeders in the "new ground" paddock , as often the reverse is true. The disc seeder created the most interest on the sticky beak days and it may not be long until we see a few seeders of similar design, hard at work in the district.

Acknowledgements

I would like to thank the Wirrulla Sports Club for allowing me to be involved with the proceedings at seeding and harvest. Special appreciation goes out to all the people who donated their time, machinery and expertise to make this fund raising exercise possible.

Table 1: Yield and quality of the Wirrulla Sports Club Crops 2004

	"Stubble Paddock"			"New Ground"		
Seeding System	**Yield (t/ha)**	**Screenings (%)**	**Protein (%)**	**Yield (t/ha)**	**Screenings (%)**	**Protein (%)**
K-Hart Disc + Press wheels	0.77	7.8	15.0	0.94	3.2	14.6
Knife Points + Press Wheels	0.79	8.4	15.1	0.82	3.8	14.4
Knife Points + Rotary Harrows	0.74	6.8	14.5	0.69	3.4	14.1
Sweeps + Prickle Chain	0.70	7.9	14.6	0.72	4.6	14.8

Section editor: Greg Secomb
Rural Solutions SA, Streaky Bay

Weeds

Herbicides for the control of brome grass in wheat and barley

Research

Sam Kleemann and Dr Gurjeet Gill
University of Adelaide

Key Messages

- **Tank-mixes of Lexone® at 180 g/ha with either Trifluralin or Stomp® Incorporated By Sowing offered a safe and effective option for the control of brome grass in barley.**
- **Rates of Lexone® >180 g/ha caused crop phytotoxicity in barley and caution is required when applying this herbicide to light sandy soil types of low organic matter and of high pH.**
- **Effective use of metribuzin in tolerant wheat varieties could provide an alternative to growing "Clearfield" wheat for controlling brome grass.**
- **Use of imidazolinone herbicides Midas® and Clearsol® in "Clearfield" wheat resulted in complete brome grass kills (100 %), providing an excellent option for brome control in the cereal phase.**

Why do the trial?

Brome grass (*Bromus rigidus* and *B. diandrus*) has increasingly become a problem for grain growers on the upper Eyre Peninsula where adequate control is difficult to obtain in cereal dominant rotations. Poor control in cereals allows this well adapted weed to aggressively compete with crops for moisture and nutrients. Studies have shown that brome grass densities of 100 plants m^2 can result in yield losses as high as 50 % in wheat.

Herbicide options for the control of brome grass in both wheat and barley have been few are far between in the past. In recent years more options have become available and different tank mixing options with current products are being explored. The aim of the trials reported here are to evaluate the herbicide options currently available for the control of brome grass in wheat and barley.

How was it done?

Trial details:

Two herbicide efficacy trials were established at Rudall to assess herbicide treatments for the control of brome grass in wheat and barley. The trials were sown on 18th of June with Clearfield STL wheat and Sloop SA Barley.

In barley all treatments were applied by Incorporated By Sowing (IBS) method and comprised:

- Lexone® (750 g/kg metribuzin) at rates of 180, 270 and 360 g/ha
- Lexone® @ 180 g/Ha + Trifluralin 1.5 L/ha
- Lexone® @ 270 g/Ha + Trifluralin 1.5 L/ha
- Lexone® @ 180 g/Ha + Stomp® @1.8 L/Ha
- Lexone® @ 270 g/Ha + Stomp® @ 1.8 L/Ha

In wheat, Pre emergent treatments were Incorporated By Sowing (IBS) and included:

- Trifluralin (480 g/L trifluralin) @ 1.5 L/ha
- Stomp® (330g/L pendimethalin) @ 1.8 L/ha) + Cinch® (735g/L Cinmethylin) @ 275 ml/ha

Post-emergent applications were applied on 22nd July and included:

- Atlantis® (30g/L mesosulfuron methyl) @ 330 ml/ha)
- Atlantis® @ 330 ml/ha in combination with Trifluralin @1.5 L/ha pre
- Midas® (288.5 g/L MCPA + 22 g/L Imazapac + 7.3 g/L Imazapyr) @ 900 ml/ha
- Clearsol® (a different formulation to Midas) @ 85 ml/ha.

A third experiment was established at Verran on the 21st June to evaluate brome grass control and tolerance of wheat cultivars to Lexone®. Lexone® was applied IBS at rates of 180, 270 and 360 g/ha to wheat cultivars, Eagle Rock, Blade (tolerant), Westonia and Spear (sensitive) and barley cultivar Sloop SA.

Table 1: Rudall 2004. Effect of herbicide treatments on plant density (plants/m²), grain yield of barley (t/ha), density of B. rigidus (plants/m²), and panicle number (panciles/m²) and net returns over the untreated weedy control.

Treatment	**Chemical cost ($/ha)**	**Barley plants/m² (%)**	**Brome Plants/m² (%)**	**Brome Pannicles/m² (seeds/m²)**	**Grain Yield (t/ha)**	**Net Return ($/ha)**
Trifluralin @1.5 L/Ha	10.00	144 (84)	135 (57)	144 (2363)	0.99	**18.80**
Stomp® @ 1.8 L/ha	15.00	139 (81)	122 (61)	134 (2685)	0.98	**12.60**
Lexone® @180 g/ha	13.14	161 (94)	134 (57)	129 (1935)	1.14	**33.70**
Lexone® @ 270 g/ha	19.71	143 (83)	40 (87)	29 (579)	1.51	**71.50**
Lexone® @ 360 g/ha	26.28	105 (61)	40 (87)	12 (258)	1.47	**60.10**
Trifluralin 1.5 L/ha + Lexone® @ 180 g/ha	23.14	135 (79)	78 (75)	72 (1492)	1.31	**44.10**
Trifluralin @ 1.5 L/ha + Lexone® @ 270 g/ha	29.71	129 (75)	83 (74)	56 (1004)	1.36	**44.00**
Stomp® @ 1.8 L/ha + Lexone® @ 180 g/ha	28.14	155 (90)	80 (75)	83 (1723)	1.25	**31.90**
Stomp® @ 1.8 L/ha + Lexone® @ 270 g/ha	34.71	148 (86)	39 (88)	18 (324)	1.51	**56.50**
Weedy Control	0	172 (100)	314 (0)	344 (7642)	0.75	**0**
l.s.d (p= 0.05)		23	70	73	0.33	
F pr		<0.001	<0.001	<0.001	<0.001	

**(%) - Percent of untreated weedy control.*
_ *- Net returns over the untreated weedy control; barley price (feed) = $120/t, herbicide prices used are recommended retail prices for the 2004 growing season.*

Table 2: Rudall 2004. Effect of herbicide treatments in Clearfield® wheat on B. rigidus plant and panicle density (m²).

Treatment	**Chemical cost ($/ha)**	**Brome Plants/m²**	**Brome Panicles/ m²**
Trifluralin @ 1.5 L/ha	10.00	199 (57)	832
Stomp®@ 1.8 L/ha + Cinch®@ 275 ml/ha	-	227 (51)	411
Atlantis®@ 330 ml/ha	25.70	210 (54)	795
Midas®@ 900 ml/ha	35.90	1 (100)	0
Clearsol®@ 85 ml/ha	∇T.B.C	1 (100)	0
Trifluralin®@ 1.5 L/ha + Atlantis®@ 330 ml/ha	35.70	101 (78)	805
Weedy control	0	459	1093
l.s.d. *(P=0.05)*		60	225
F pr.		<0.001	<0.001

∇ *- Retail price of Clearsol® T.B.C.*
- Herbicide prices used are recommended retail prices for the 2004 growing season.

What happened?

Brome control in Barley (Rudall):

High rates of Lexone® (270 and 360 g/ha IBS) were more active on brome grass and resulted in higher grain yields (P<0.05). However the highest rate of 360 g/ha caused significant crop phytotoxicity reducing the plant density of barley by 39 % (*Table 1*). IBS tank-mixes of Lexone® at 180 g/ha with either Trifluralin or Stomp® were safer on the crop and provided significant brome control (75 %) and increased grain yield.

Brome control in Clearfield STL wheat (Rudall):

Post-emergent applications of imidazolinone herbicides Clearfield Midas® and Clearsol® provided excellent control of brome grass (100 %). Post-emergent herbicide Atlantis® applied alone or in combination with IBS Trifluralin gave 54 -78 % control of brome grass in comparison to the weedy control. However, surviving brome seedlings, although suppressed, continued through to maturity producing several viable panicles. The brome grass density presented at this site (459 plants/m²) far exceeded the maximum population density (150 plants/m²) to which Atlantis® herbicide should effectively be used (*see label*). A tank-mix of Stomp® and Cinch® applied IBS gave some brome control (55 %) but caused crop phytotoxicity.

Brome grass control and tolerance of wheat to metribuzin (Verran):

IBS Lexone® at rates of 180, 270 and 360 g/ha all gave excellent brome control in comparison to the weedy control (data not presented). However, the wheat cultivars tested differed markedly in their responses to high rates of Lexone® (270 and 360 g/ha)(*Table 3*). Eagle Rock, a new cultivar from Western Australia and Blade, an old South Australian cultivar, were by far more tolerant, while cultivars Spear and Westonia were extremely sensitive and showed significant reductions in grain yield to high rates of Lexone®. All genotypes tested exhibited symptoms of metribuzin toxicity (i.e. leaf chlorosis and necrosis followed by plant death), however the effects were amplified in the sensitive cultivars Spear and Westonia.

Table 3: Verran 2004. Sensitivity of wheat cultivars, cvv. Eagle Rock, Blade, Westonia, Spear and barley cultivar cvv. Sloop SA to IBS application of Lexone® at 180, 270 and 360 g/ha

Cultivar	Grain Yield (t/ha)		
	180 g/ha Lexone®	270 g/ha Lexone®	360 g/ha Lexone®
Eagle Rock	1.02 (130)	1.02 (130)	0.79 (100)
Blade	1.19 (147)	0.75 (93)	0.68 (84)
Westonia	1.38 (143)	0.53 (55)	0.28 (29)
Spear	0.99 (103)	0.49 (51)	0.23 (24)
Sloop SA	1.28 (104)	1.42 (116)	1.12 (91)
l.s.d. *(P=0.05)*	0.4		
F pr.	0.021		

**(Value) - Percentage yield of untreated weedy control.*

What does this mean?

These trials have demonstrated that brome grass can be effectively controlled using selective herbicides in wheat and barley. Tank-mixes of Lexone® at 180 g/ha with either Trifluralin (1.5 L/ha) or Stomp® (1.8 L/ha) Incorporated By Sowing offered a safe and effective option for the control of brome grass in barley. High rates of Lexone® (270 and 360 g/ha) alone provided excellent brome control however unacceptable crop phototoxicity resulted.

Generally barley has been the only cereal crop in which Lexone® has been recommended for safe use. However, results from the trial at Verran indicate that metribuzin could be used safely in wheat when applied to the tolerant cultivars Blade and Eagle Rock. These cultivars were far more tolerant to metribuzin than either Spear or Westonia and showed only small reductions in grain yield to high rates of metribuzin (270 and 360 g/ha), however, further research is required to validate these responses.

Safe and effective use of metribuzin in tolerant wheat varieties provides an alternative to growing "Clearfield" wheats or using fragile Group B herbicides. Nevertheless, Clearfield wheats provide an excellent opportunity to control brome grass, which was evident from the Rudall site, where post-emergent applications of the imidazolinone herbicides Midas® and Clearsol® resulted in complete brome grass kills.

Effective brome grass control in the year(s) prior to growing cereals, in-conjunction with appropriate herbicide management during the cereal phases should help to minimise the detrimental impacts of brome grass on the EP.

Acknowledgements

- Thanks to the Burton and Bammann families who allowed the trials to be conducted on their properties.
- Technical assistance provided by Daniel Radulovic.
- The Grains Research and Development Corporation (GRDC) for project funding.
- Cinch® is an experimental herbicide currently being evaluated prior to commercial release

GRDC Grains Research & Development Corporation

Brome Grass – A persistent but manageable weed

Research

Sam Kleemann and Dr Gurjeet Gill

University of Adelaide

Key Messages

- **Assessments of somatic chromosome number confirmed *Bromus rigidus* as the dominant species of brome grass infesting cereal crops of the upper EP.**
- **Fence-line populations of *B. diandrus* showed a rapid loss of dormancy in comparison to in-crop populations of *B. rigidus*.**
- **Exposure to light resulted in strong inhibition of germination of *B. rigidus* seed collected from in-crop situations.**
- **Slow dormancy release in conjunction with inhibition of germination by light, appears to be important in the increasing prevalence of *B. rigidus* under no-till. Under no-till brome seeds remain on the soil surface and are exposed to the inhibiting effect of light until burial with the seeding pass, which stimulates germination.**
- **Seed-bank persistence of *B. rigidus* is likely to be beyond two years on non-wetting soils and carry over of viable brome grass seed from one season to the next could be as high as 30 %.**

Why do the trial?

Brome grass has been infesting crops for many years, however its status as a troublesome weed in cereal crops of the Eyre Peninsula has risen dramatically in recent years. There is common farmer perception that their brome grass problem has worsened following their progressive movement towards cereal dominant rotations and adoption of no-till.

The three species of brome grass commonly found across the Eyre Peninsula are *Bromus diandrus*, *B. rigidus* and *B. rubens*. Following the results of a field survey of brome grass across the Eyre Peninsula in the spring of 2003, *B. rigidus* was determined to be the dominant species infesting crops. Consequently studies have been undertaken at Roseworthy Campus to examine the mechanisms responsible (e.g. dormancy status) for the proliferation and persistence of brome grass (*Bromus rigidus and B. diandrus*) on the Eyre Peninsula.

How was it done?

Experimental details:

Brome panicle samples (n=40/site) were collected from both in-crop and fence-line habitats from sites at Arno Bay (AB), Waddikee (W) and Lock (L) in the spring of 2003. Seed of the populations were stored at 25°C in the dry and then used to:

a) Confirm the species of brome grass sampled as either *B. diandrus* (2n=56) or *B. rigidus* (2n=42) by determining somatic chromosome number, and

b) Assess for rates of dormancy loss of each population after germinating in petri dishes in light/dark and continuous dark (20/12°C) regimes in germination cabinets from April to October (2004).

What happened?

Species clarification:

Assessments of somatic chromosome number confirmed each in-crop population (AB, W and L) of brome grass sampled to be *B. rigidus* (2n=42). Conversely each fence-line population from the three sites was confirmed as *B. diandrus* (2n=56). This result supports the findings of last year's field survey, which identified *B. rigidus* as the dominant brome grass species infesting crops of the upper EP.

Dormancy status of *B. diandrus and B. rigidus:*

Fence-line populations of B. diandrus (AB, W and L) showed a significantly ($P<0.001$) rapid loss of dormancy in comparison to in-crop populations of *B. rigidus* when germinated under light/dark conditions from April to September (*Figure 1*).

The germination of fence-line populations of *B. diandrus* ranged from 80 - 100 % in April, while no subsequent germination was reported for in-crop populations of *B. rigidus*. In-fact, the germination of *B. rigidus* populations were not

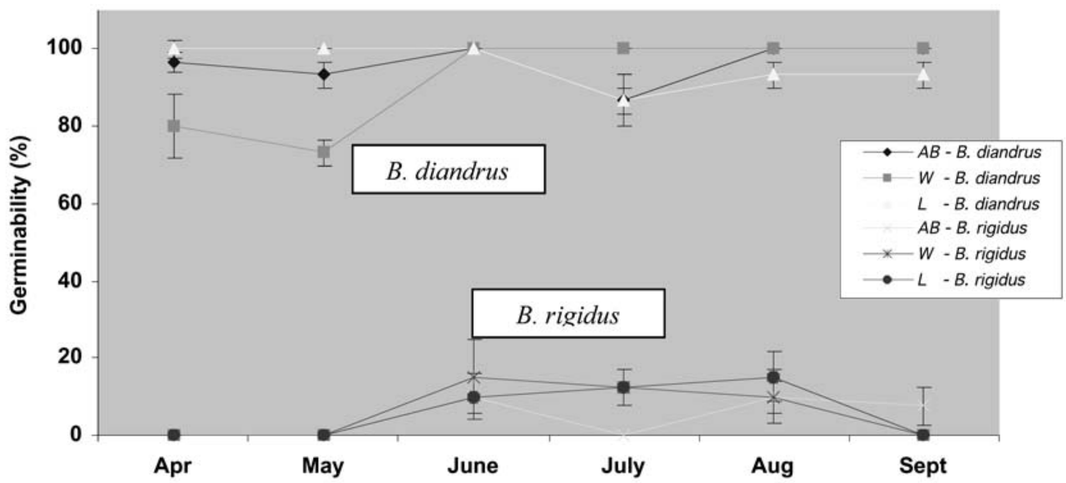

Figure 1: Germinability of populations of B. diandrus (Fence-line) and B. rigidus (In-crop) from Arno Bay (AB), Waddikee (W) and Lock (L) in light/dark regime from April to September (2004).

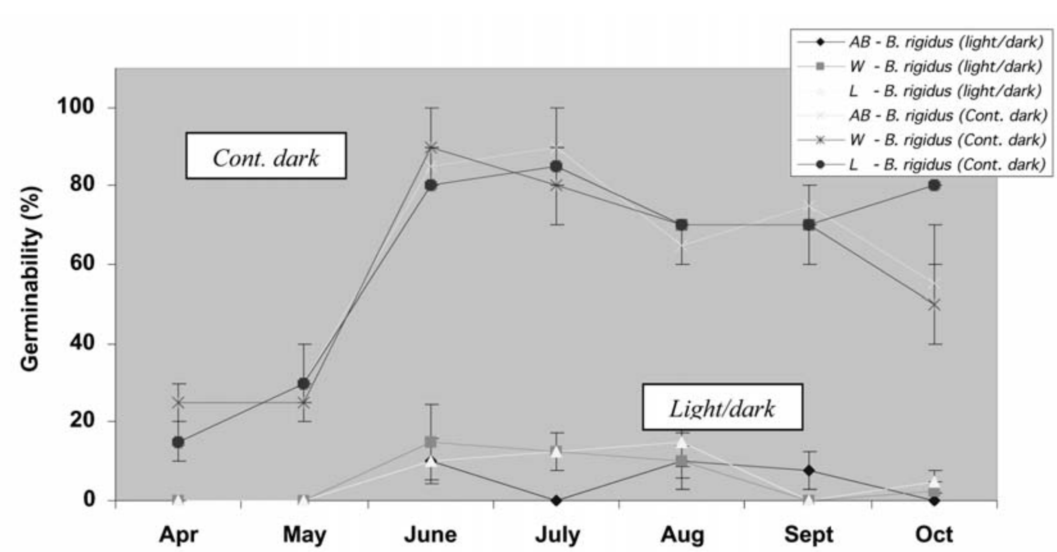

Figure 2: Germinability of populations of B. rigidus (In-crop) from Arno Bay (AB), Waddikee (W) and Lock (L) in light/dark and continuous dark regimes from April to October (2004). Vertical bars =SE

reported until June, regardless of seed origin, with only a small percentage of seeds germinating (10 - 15 %) in comparison to *B. diandrus* (100 %) for the same period.

Interestingly, in-crop populations of *B. rigidus* (AB, W and L) showed a significantly (P<0.001) rapid loss of dormancy when germinated in continuous darkness. The germination of *B rigidus* in June ranged from 75 - 100 % in continuous darkness compared to 10 - 15 % for populations germinating under light/dark conditions (*Figure 2*). Differences in germinabilty of populations of *B. rigidus* germinating under continuous darkness compared to a light/dark regime were maintained in the proceeding months (July-Oct). The results indicating that germination of in-crop populations of *B. rigidus* from the EP are strongly inhibited by exposure to light.

What does this mean?

Assessments of somatic chromosome number confirmed *B. rigidus* as the dominant species of brome grass infesting crops of the EP, with *B. diandrus* tending to proliferate along fence-line habitat. The dominance of *B. rigidus* in-crop results from its slow dormancy release, allowing for greater persistence with late germinations evading control and invariably infesting crops. On the other hand, populations of *B. diandrus* show a rapid loss of dormancy, which ensures high germinability of this species upon opening rains and subsequent control with knockdown herbicides. Furthermore, the germination of *B. rigidus* appears to be strongly inhibited by light. From a practical point of view this means brome seed that remains on the soil surface under no-till systems may not germinate until burial with the seeding operation, prompting a larger in-crop flush of brome grass. This result supports the growing evidence for increasing prevalence of brome grass following adoption of no-till.

Further research is currently being conducted on the seed-bank persistence of *B. rigidus*, particularly on the non-wetting soils. Preliminary results have shown that seed-bank persistence is likely to be beyond two years on non-wetting soils and that carry over of viable brome grass seed-bank from one season to the next could be as high as 30 % for *B. rigidus*. Considering these initial findings, management of *B. rigidus* would therefore need to focus on achieving high levels of seedling death over consecutive years via the development of strong crop rotations, which continually exhaust the residual seed-bank in the soil.

Acknowledgements

- Technical assistance provided by Daniel Radulovic.
- The Grains Research & Development Corporation (GRDC) for project funding.

GRDC Grains Research & Development Corporation

Summer weeds –control early or it may be a waste of money

(A review of research from EP and the Murray Mallee)

Extension

Graham Fromm

Rural Solutions SA, Murray Bridge

Best practice

Rainfall
Av. annual: 300-360 mm
Av. GSR: 180-285 mm

Soil Type
Grey calcareous sands to Reddish brown sandy loams over limestone to siliceous sands over sodic clay

Key Messages

- **Summer weeds need to be managed at some stage prior to seeding unless disc-seeding equipment is used.**
- **Management issues such as machinery blockages at seeding, stock poisoning and wool contamination are valid reasons for summer weed control, rather than for economic benefits only.**
- **Any yield benefits obtained from controlling summer weeds are strongly linked to soil moisture – there are virtually no effects on soil fertility or the carryover of root diseases.**
- **Average stored moisture ranges from 8 mm to 20 mm.**
- **The method used to control summer weeds is not important to the end result - there is no difference between mechanical and chemical control, other than potential erosion risks.**
- **Early control has the potential to give greater benefits than late control.**
- **The control of, or management of top growth of, perennial weeds will give yield benefits to following crops in the majority of years.**
- **There is an apparent relationship between rainfall events in late autumn and whether or not a yield benefit will result from the control of summer weeds.**

How was it done?

Trials were set up on Eyre Peninsula starting in 1998 to look at issues specific to the region and to complement trials being done at the same time in the South Australian and Victorian mallee regions. The trials on Eyre Peninsula were part of the Farming Systems Project and those in the South Australian and Victorian mallee were part of a GRDC funded project on summer weeds.

The trials were designed to determine what effects, if any, the control of summer weeds had on soil moisture, soil fertility, crop root disease carryover, subsequent grain yield and quality and income.

The basic treatments at all sites were complete control, early control only, late control only and no control (untreated) of summer growing weeds. In addition mechanical control (cultivation) was compared to chemical control either in separate trials or as extra treatments at selected sites.

Weeds studied include caltrop (*Tribulus terrestris*), potato weed (*Heliotropium europaeum*), Lincoln weed (*Diplotaxis tenuifolia*), afghan melon (*Citrullus lanatus*), prickly paddy melon (*Cucumis myriocarpus*) and couch grass (*Cynodon dactylon*).

What happened and what does this mean?

Soil Moisture and Rainfall Interactions

Unless sufficient rainfall to wet the soil beyond 30 cm is recorded in one event, the amount of moisture stored would be limited!

The minimum amount of rainfall required to wet the soil to 30 cm is;

Sandy soils	14 mm
Loamy sands	17 mm
Sandy clay loams	30 mm

The trials suggest that if such a rainfall event or events occur during summer and summer weeds are controlled then, in the majority of years, a yield response will occur. However, if a late autumn rainfall event of similar proportions occurs and wets the soil profile to a similar depth then the yield response to the control of summer weeds is variable.

If these results are looked at in conjunction with work done by the SARDI Climate Risk Management Unit some interesting observations can be made. For example, in years where the total January to March rainfall is in the top 1/3 of all historical totals there is a reasonable relationship between that rainfall and above average grain yields. They do not have data on whether or not summer weeds were controlled in those years but, given the tendency for farmers in the past to perform a cultivation with the first reasonable rain from January onwards, one may conclude that in many of those years summer weeds were controlled.

In addition, work on EP in the past has shown that there is a strong relationship between April 1 to April 15 rainfall and final crop yields.

The above comparisons support the trends observed in the summer weed trials - that late autumn rainfall may reduce the size of the yield response to summer weed control and that significant summer rainfall events can result in above average crop yields.

Where yield responses were recorded they were greatest if the weeds were controlled early (eg before end of December or in early January depending on the timing of the rainfall event) as opposed to late control (eg March).

Benefits from stored moisture through the control of summer weeds is only possible provided there are no subsoil constraints preventing the crop accessing the moisture.

Summer weeds can or will use most of the moisture in the top 30 cm and moisture to this depth which is not used is likely to evaporate, controlling summer weeds after small rainfall events may not be warranted for reasons of moisture conservation alone!

Chemical vs Mechanical Control

There were no differences in the yield response in the following crop between mechanical and chemical methods of control. Irrespective of the weed control method used, the plots which had early weed control outyielded those which had later treatments!

Plants which escape a control technique can have such prolific growth (due to no competition) that they create machinery blockages as great as no control at all.

Disease

There were no significant differences in the disease risk between any of the treatments and there was little evidence suggesting that summer weeds are a major factor in disease carryover (this comment does not include self sown cereals).

Soil Nutrition

The effect on soil nutrition was variable.

There was no effect on extractable P or organic C (EP data), however, the effect on nitrate nitrogen varied. In some instances the control of summer weeds increased the level of nitrate nitrogen and in other seasons the levels were lower where summer weeds had been controlled. A reduction in levels may have been the result of leaching where large rainfall events occurred during the summer period.

Crop Yields

There is a trend in the trials conducted in both the South Australian Mallee and on EP that the early control of, or the management of, the top growth of perennial weeds such as Lincoln weed, silver leaf nightshade, skeleton weed and couch grass will give yield benefits in the majority of years. Perennial weeds have the ability to use moisture from greater depths than annual weeds and can therefore use more of the moisture that may be available for following crops.

Using Herbicides

Be aware of:

- Plant growth stage
- Previous rainfall events
- Weather conditions (Delta T)
- Ground Conditiones (dust)
- Herbicide resistance
- “Off Target” damage

Basic tips when spraying summer weeds:

- Spray young actively growing weeds –ie as soon as possible after a rainfall event (except Lincoln weed).
- Be aware of the quality of water you are using. The addition of water conditioners may be necessary to get the most out of the chemical. When using products containing glyphosate the addition of ammonium sulphate is recommended. This is particularly important if the water contains high levels of dissolved salts.
- Spray in cooler parts of the day, such as early morning before the temperature becomes too high and the humidity drops too low. Be aware of the Delta T value of the conditions at the time. It is recommended to spray in conditions with a Delta T value of 10 and below.
- Delta T is the difference between the wet and dry bulb and provides a guide of how long a droplet will survive. When

conditions reach Delta T 10, you need to make the decision of whether to stop spraying or use a nozzle with a larger droplet size, apply higher water rates and increase chemical rates.

- It may also be worthwhile to consider spraying at night.
- The result obtained depends on product reaching the target especially with contact herbicides. Therefore it is important that the correct nozzles are selected for summer weed control and that water volumes (at least 60 L/ha) are sufficient to give good coverage. Refer to article in this book on page 151.

Herbicide Selection

Spraying conditions, chemical rates, plant growth stage and target weeds may have a greater impact than the type of chemical used. It is therefore difficult to recommend specific products at specific rates due to the huge range of variables that influence summer spraying.

The following are some "best bets" that research and experience has shown to give good results:

- A combination of glyphosate and 2,4-D (preferably a non volatile ester formulation) will give good control of most annual weeds and the top growth of perennial weeds. Some of the sulfonylureas will give residual control if applied prior to the germination of some weeds such as caltrop, potato weed, roly poly and Lincoln weed.
- **Melons:** Remember that the two species of melons can behave differently to different products:
  - Higher rates of 2,4-D based products are needed to control prickly paddy melons (the small fruited melon with spikes on them)
  - Higher rates of triclopyr based products (eg Garlon®) are needed to control afghan melons (the large fruited melons)
- **Lincoln weed:** The trial work on EP suggests that Lincoln weed can be managed. The best time to spray is when the plants are at 20 % flowering after a summer rain. To avoid possible development of resistance to SU's it is preferable to use a metsulfuron methyl / LVE MCPA mixture.

References

Trial data is available in the past EPFS research summaries of 1999, 2000, 2002 and 2003.

Acknowledgements

Farmer Cooperators M Franklin, Cowell; A Fitzgerald, Kimba; N May, Elliston; J Burton, Rudall; J Frischke, Koongawa; H Feltus, Piednippie; B Millard, Wharminda; N Markey, Minnipa; D Johnson, Courela.

GRDC Grains Research & Development Corporation

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SAGIT

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Research

Successfully surviving summer spraying

Michael Bennet

SARDI/SANTFA, Minnipa Agricultural Centre

Searching for answers

Location
Minnipa
Cooperator: MAC

Rainfall
Nov-Dec: 42.6mm

Paddock History
2004: Spraytopped Pasture
2003: Wheat

Soil
Sandy Clay Loam

Plot size
8m x 20m

Key Messages

- **Early timing is critical for successful summer weed control.**
- **Do not compromise on herbicide rate when aiming to control stressed summer weeds.**
- **Water rate is important but no less than nozzle selection.**

Why do the trial?

Most aspects of summer weed control has been well established in previous EPFS and Rural Solutions SA experimental work (*see the "Summer weeds, control early or it may be a waste of money" article in this section*). This begs the question of how should boom sprays be set up for best control of summer weeds. The trial was targeted to deal with the combination of droplet size, water rate, herbicide rate and their influence with favourable and unfavourable summer spraying conditions.

How was it done?

A trial site was selected in paddock S8 of MAC that had an excellent germination of potato weed (*Heliotropium europaeum*). The weeds germinated in a spray topped pasture paddock after 12mm of rain between the 7th and 13th of December. The target population was 100 plants/m^2.

On the 22nd of December 2004 the trial was sprayed. The

Weeds

Table 1: Herbicide timing and rate influence on Potato Weed control at Minnipa 2004.

Timing	Temperature	Relative Humidity	Delta T	Herbicide Rate	% Weed Control	
Morning	18.7	57.2	5	Low	40.6	b
Afternoon	32.4	17.5	16	Low	38.7	a
Afternoon	32.1	16.4	16	High	88.3	b
				LSD	8.93	

(Values in each column followed by the same letter are not significant at P= <0.001)

Table 2: Droplet size and water rate influence on Potato Weed control at Minnipa 2004.

Droplet Size	Nozzle	Pressure (bar)	Water Rate L/ha)	Speed (Km/h)	% Weed Control	
Medium	02 Turbo Teejet®	3	100	9.6	69.2	a
Coarse	025 Airmix	3	100	13.2	57.7	ab
Coarse	025 Airmix	3	60	22	55.8	b
Medium	02 Turbo Teejet®	3	60	16	51.5	b
Fine	02 Extended Range	3	60	16	50.5	b
Fine	02 Extended Range	3	100	9.6	50.5	b
				LSD	12.64	

(Values in each column followed by the same letter are not significant at P=0.06)

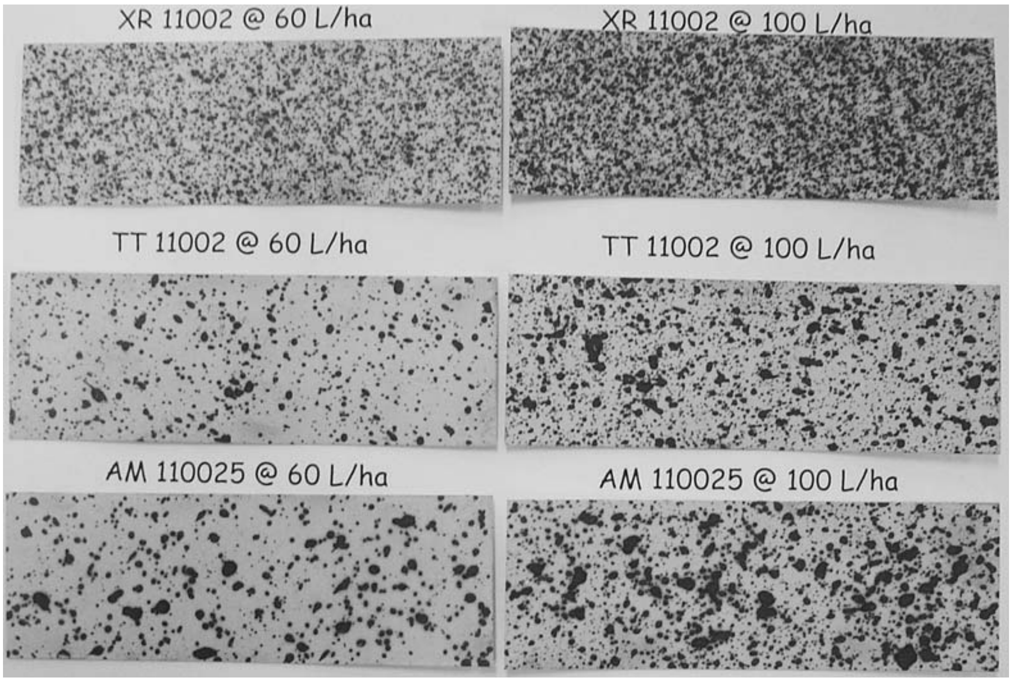

Figure 1: Droplet response to water rate.

morning conditions were ideal for spraying, however the afternoon conditions presented a major challenge for weed control with temperatures at 35°C and relative humidity down to 16 %. As Tod water was used for the trial, the ammonium sulphate in Bonus®, was necessary to maximise the potential of the Glyphosate.

Three nozzles were selected for the fine, medium and coarse droplet sizes. These were Teejet®, XR11002 (standard flat fan nozzles), Turbo Teejet®, TT11002 and Agrotop®, Air Mix AM110025 respectively. A pressure of three bar was selected to suit all three nozzles for the range in droplet size required. Water rates of 60 and 100 L/ha were applied for each nozzle and herbicide mix. A variation of speed was used to maintain constant droplet size and water rate for the respective treatments (*Table 2*). Two herbicide mixes were used for the purposes of the trial. A commercial rate of 450 ml/ha Credit®, + Bonus®, and 1.2 L/ha Surpass®, was used in the morning and afternoon. A robust rate of 1 L/ha Credit®, + Bonus®, and 1.8 L/ha Surpass®, was only used in the afternoon to help define differences between the other treatments.

What is Delta T?

Delta T is the temperature difference between a wet bulb and a dry bulb thermometer. Delta T can be calculated by using a weather meter (eg Kestrel) and recording temperature (dry) and relative humidity. The corresponding value represents a measure of the conditions and their suitability for spraying. Low temperatures and high relative humidity represent low delta T values. High temperatures and low relative humidity values result in high delta T values. Ideal conditions for droplet survival are delta T values between 2 and 8. Values between 0 and 2 may cause the droplet to survive (not evaporate) and travel to a sensitive area and a delta T 8 and above may cause the droplet to evaporate before arriving at the target. (Graham Betts)

The trial was sprayed under both ideal and unfavourable conditions with delta T values ranging from 7 in the morning and up to 16 in the afternoon. The morning treatments were sprayed between 7.00 and 8.00 am. The afternoon treatments were sprayed between 4.30 and 6.00 pm.

What happened?

The various nozzles used successfully produced a wide range of droplet sizes, which was recorded using water sensitive paper when spraying the morning plots (*Figure 1*). The fine droplets visually gave the most even coverage.

Surprisingly there was little difference in weed control between the morning and afternoon treatments, although control was vastly improved by the higher herbicide rate (*Table 1*). The low herbicide rate was used to challenge water rate and droplet size in weed control. The robust rate was aimed to help draw out any differences in the weed control in the heat of the afternoon. Poor control was achieved with all of the low herbicide rate treatments. Excellent weed control was achieved in the high rate treatments. It was surprising to not observe a significant reduction in weed control in the afternoon with the low herbicide rate compared to the morning treatment.

Weed control was assessed initially by counting surviving weeds in quadrats for each plot. However the statistics were improved by counting both the surviving weeds and the dead weeds within the quadrat. This analysis helped to draw out the marginal differences between the treatments.

Increasing water rate only had a significant impact on the performance of the Turbo Teejet, the other nozzles were unaffected by water rate. This may be due the reduction in travel speed to achieve the correct water rate.

What does this mean?

This trial was designed as a preliminary insight to the dynamics of sprayer set up and its affects on herbicide efficacy. It highlighted the amazing ability of herbicides to achieve a successful result under extremely adverse conditions (don't try this at home kids!).

It was most unexpected that sprayer set up would not have had a greater influence on weed control. Although control was improved with a medium droplet size at 100 l/ha, this level of control is still unsatisfactory for a grower viewing to contain a summer weeds issue.

The weeds in the trial were under moisture stress at the time of application. This may have limited herbicide uptake so that a successful control could only be achieved with a higher herbicide rate. Sprayer setup may have more influence in favourable growing conditions but further trial work is required to confirm this theory.

The change in travel speed for the various treatments may have also caused differences in weed control and confounded the results. The Airmix nozzles were used at a 30 % greater spraying speed than the TT's and XR's. The Turbo Teejet nozzles were also aimed backwards which may have had a bearing on the results.

It could also be stated that a grower is not likely to spray at 9km/hr. Which raises the issue of how the results would have been influenced by using a standard speed of 20 km/h with 02 nozzles at 3 bar for the 60 L/ha treatments and using 03 nozzles at 4 bar for the 100 L/ha treatments. This question alone warrants further research.

Acknowledgements

The trial would not have been possible without the assistance of Len Horne at Mr Nozzle, Ken Webber and Nufarm Ltd, Graham Fromm, Graham Betts, Jon Hancock, Wade Shepperd and Willie Shoobridge.

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Grains Research & Development Corporation

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Weeds

Herbicide resistant Lincoln weed prevalent on Eyre Peninsula

Survey

Andy Bates

Lynch Farm Monitoring

Key Messages

- **Herbicide resistant populations of Lincoln weed (Diplotaxis tenuifolia) are prevalent on Upper Eyre Peninsula.**
- **57 % of paddocks tested contained Lincoln weed resistant to Group B sulfonylurea herbicides.**
- **As few as 3 - 4 applications of a sulfonyl urea herbicide can lead to the development of resistant populations.**
- **Resistance to sulfonylurea herbicides develops regardless of tillage methods used.**
- **With resistance now confirmed, Integrated Weed Management practices will be essential for future Lincoln weed management strategies.**

Why do the trial?

- Sulfonylurea (Group B) herbicide resistant Lincoln weed was first identified on Western Eyre Peninsula in 2003. Conventional thinking in the district assumed that the development of herbicide resistance in a biennial/perennial plant species would take many applications over many years. Poor weed control was often blamed on application error, lack of coverage, inappropriate timing of application, inappropriate chemical choice, environmental conditions etc.

- To determine how widespread sulfonylurea resistant Lincoln weed populations were on Eyre Peninsula, Lynch Farm Monitoring was commissioned to conduct a survey.

How was it done?

- Farming Systems/Agricultural Bureau groups were asked to nominate farmers with Lincoln weed populations for sampling. 30 paddocks were selected in an area from Elliston to Nundroo and mature seed collected over the 2003/04 summer.
- Paddocks were grouped by farmers into the following three categories:
  1. Paddocks with high Sulfonylurea herbicide history.
  2. Paddocks where herbicides have failed to control Lincoln weed.
  3. Random paddocks selected on a farm with high Lincoln weed populations and a history of some SU use.
- Chris Preston's herbicide resistance group at the University of Adelaide germinated the seeds and treated grown plants with 20 g/ha chlorsulfuron 750 g/kg active ingredient (Glean®) post emergent. Surviving plants were treated with another 20 g/ha chlorsulfuron. Plants were assessed visually as resistant or susceptible.
- 30 g/ha triasulfuron 750 g/kg active ingredient (Logran®) was applied to soil in another experiment prior to sowing viable Lincoln weed seeds. Seedlings emerged in this experiment were also assessed visually as either resistant or susceptible to Logran®.

What happened?

- 17 out of the 30 weed populations sampled were resistant to sulfonylurea (SU) herbicides.
- Where a population was resistant to Glean® it was also resistant to Logran®.
- Resistance to chlorsulfuron and triasulfuron developed even when Ally® (metsulfuron - methyl) was the only SU or group B chemical applied to the paddock.
- All paddocks with identified group B resistant Lincoln weed populations had at least two applications of a group B chemical in the previous five years.
- Sulfonylurea resistant populations can develop after as few as three applications of a SU herbicide.
- All populations sampled that had two group B chemicals applied in the same season showed resistance.

Figure 1: Resistant plant on left side, compared to susceptible plant on right 14 days after treatment with 20g/ha Glean®

What does this mean?

- Group B chemicals have been widely adopted for Lincoln weed control on Eyre Peninsula, as they are perceived to be more effective and reliable than some other chemical control options available. Due in part to over use and the residual nature of some of these chemicals on many Eyre Peninsula soil types, large populations of herbicide resistant Lincoln weed have developed. Populations of Lincoln weed resistant to group B chemicals are easily found on Western Eyre Peninsula.
- Where sulfonylurea herbicides have been regularly applied (e.g. 3 – 4 applications in past 10 years) to paddocks containing Lincoln weed, it is likely that a level of resistance exists within the weed population, regardless of tillage frequency or intensity.
- If a Lincoln weed population is resistant to one Group B chemical, it can be assumed that it will be resistant to all other common Group B chemicals used for Lincoln weed control.
- Farmers with Lincoln weed need to reduce reliance on SU's for Lincoln weed control. The rapid development of resistant populations may be minimised by using other chemical groups and non-chemical methods to minimise seed set in spring and summer. Low weed numbers mean that the selection pressure for resistant individuals is low when a group B chemical is applied.
- The key to long term Lincoln weed management is to keep weed numbers low during all phases of the rotation to minimise the weed seed bank.

Acknowledgements

Thanks to the farmers who contributed seed and paddock histories to the survey. Thanks to Dr Chris Preston and his team at the CRC for Australian Weed Management, University of Adelaide, for processing all the samples. This work was supported by NHT through Western Eyre Community Landcare.

Reference

EPFS 2002 Research Summary, page 150, "2002 Herbicide Resistance Summary"

Table 1: Survey Results

Paddock Group	Number of Paddocks	Paddocks with sulfonyl urea herbicide resistant Lincoln weed	Minimum sulfonyl urea applications in previous 5 years
High sulfonylurea history	10	7	3
Herbicide failure observed	10	6	2
Randomly selected paddock	10	4	2

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Section 10

Section editor: Greg Secomb

SARDI, Minnipa Agricultural Centre

Risk Management

Early season rainfall as a forecasting tool in Southern Australia

Best practice

Research

***Melissa A. Rebbeck*[1]*, Peter Hayman*[1]*, Jim Egan*[2]**

SARDI, Waite Research Precinct, Urrbrae, SA[1]*,*

SARDI, Crop Improvement Centre, Port Lincoln, SA[2]

Key Messages

- **High early season rainfall does indicate a better chance for the coming wheat crop on the Eyre Peninsula and Upper North.**
- **There has been a weak relationship between high early season rainfall and the remainder of season rainfall over some time periods on the Eyre Peninsula and Upper North.**
- **We need to be mindful of changes over time (decadal variability).**
- **We need to be mindful of changes from one location to the next. You can have your early season rainfall and wheat yield data analysed by SARDI to find out the relationship on your own property.**

Why do the research?

Many farmers and agronomists view rainfall early in the season as a good sign for the coming grain crop. Early season rainfall is likely to boost yields for agronomic reasons (earlier sowing, N mineralisation, weed control and water stored in the soil), but some have suggested that it might also be an indication of the remainder of the season rainfall. We set out to investigate what early season rainfall told us about final wheat yields and rainfall in the rest of the season.

Upper Eyre Peninsula farmer-cum-geographer Ron Hill, promoted the value of early season rainfall as an indicator of total growing season rainfall back in the 1980's. Wudinna farmer Allen Lymn progressed this concept by developing a sowing rule based on rainfall from April 1 – June 15. In 1992, Dr Samsul Huda and colleagues investigated this rule using historical weather and wheat yield data from Minnipa Agricultural Centre. They concluded that it would be beneficial to increase the area sown to cereals in high early season rainfall years and decrease it in low early season rainfall years. Jacqui Balston and Jim Egan in 1997 collected 25 years of yield and rainfall data from nine farmers on the Eyre Peninsula and found that rainfall greater than 10 mm during the first two weeks of April identified most of those years which yielded above the long term median, while rainfall below 40 mm from April 1 – May 31 identified most of the below median yielding years.

How was it done?

We collected additional daily rainfall and wheat yield data sets to expand the database to 25 producers on the Eyre Peninsula, 22 producers from the Upper North of SA, and a further 50 from elsewhere around southern Australia. We used this database to examine the relationship of early season rainfall to final wheat yield. We also used 67 years of daily rainfall data, from all official rainfall stations on the Eyre Peninsula and Upper North, to further examine the relationship of early season rainfall to rest of season rainfall. In this report we discuss our results for the Eyre Peninsula and Upper North.

What happened?

Using farmers' data from the Eyre Peninsula and Upper North we found a reasonably strong relationship between early season rainfall and the 25 years of farm wheat yields, but a much weaker relationship between early season rainfall and the rest of season rainfall. *Figures 1 and 2* show the relationship between early season rainfall and rest of season rainfall at all official rainfall stations on the Eyre Peninsula and the Upper North. The relationship, as measured by the 25 year moving average of the correlation (r), changes over time and was generally better in the latter half of the 20th century. When the r-value is over about 0.4 the correlation is viewed as useful for forecasting. An r-value of 0.4 means that low (high) early season rainfall is followed by low (high) rainfall in the rest of the season, about 65 % of the time. That is, it will be right twice as often as it is wrong.

Figures 1 and 2 show that r-values were generally higher for April-May rainfall and the rest of season rainfall than for April rainfall with rest of season rainfall. We also found a weak relationship between January-March rainfall and May rainfall and rest of season rainfall (not shown here)

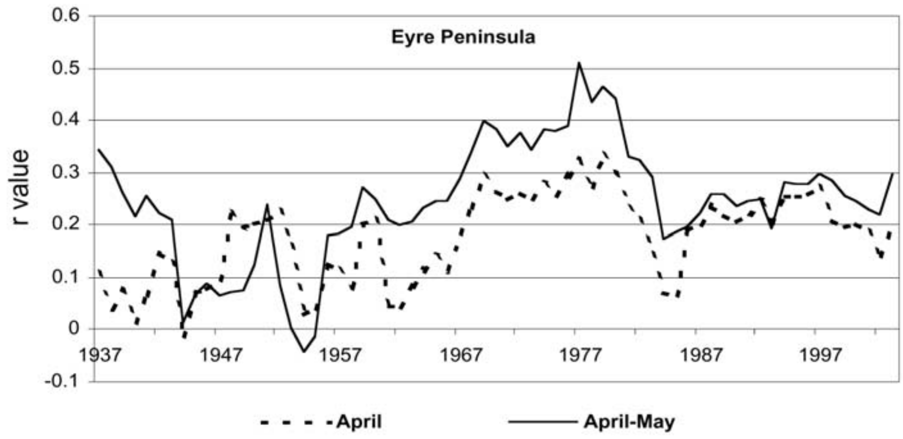

Figure 1: The 25 year running mean correlation (r value) of April and April to May rainfall with May to October and June to October rainfall respectively on the Eyre Peninsula of SA.

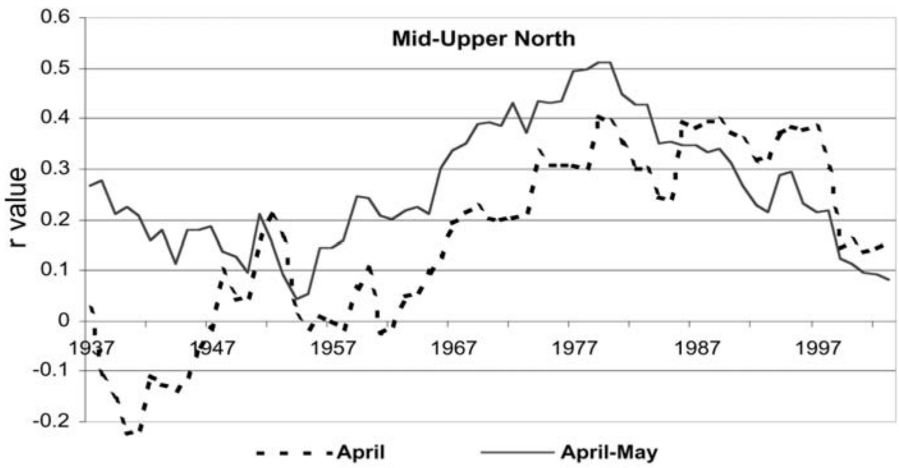

Figure 2: The 25 year running mean correlation (r value) of April and April to May rainfall with May to October and June to October rainfall respectively in the Upper North of SA.

What does this mean?

High early season rainfall does indicate a better chance for the coming wheat crop on the Eyre Peninsula and Upper North. We believe this is mainly due to the agronomic effects on crop growth and yields, including:

- Contribution to stored soil moisture and allowing earlier sowing
- Early stimulation of organic residue breakdown and N mineralisation
- Opportunity for early weed control.

This relationship is likely to improve over time as farmers become better equipped and skilled at using early sowing opportunities.

The relationship between early season rainfall and the remainder of season rainfall varies over time, so we need to be mindful of changes over time (decadal variability). The relationship between early season rainfall and wheat yields/rest of season rainfall changes from region to region, due to spatial variability in soil type and the nature of rainfall distribution. For example there was a stronger relationship between early season rainfall and growing season rainfall in the Murray Mallee. You can have your early season rainfall and wheat yield data analysed by SARDI, to find out the relationship on your own property. You can also contact us for advice on using early season rainfall as a trigger point to make management decisions in your region.

Acknowledgements

Our thanks to Dr Warwick Grace for his statistical analyses on the early season rainfall / remainder of season rainfall linkages. Thanks also to Jacqui Balston, Dr Samsul Huda, Allen Lymn and Ron Hill for their ground-breaking work in this area.

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Research

Unravelling the frost mystery – the value of paddock management

Christopher Lynch and Melissa Rebbeck

SARDI, Climate Risk Management, Waite Campus

Key Messages

- **Modifying the soil surface offers useful frost protection on sandy soils.**
- **Adding clay and rolling the soil surface gave additional frost protection.**
- **Management that reduces crop canopy density via lower seeding rates, wider row spacings and lower nitrogen rates has not shown a reduction in frost risk but needs further research.**

Why do the trial?

Previously, the only practical frost minimisation options available to broadacre growers have been avoidance measures such as delaying flowering, growing more tolerant crops, and using reduced levels of inputs. These avoidance strategies,

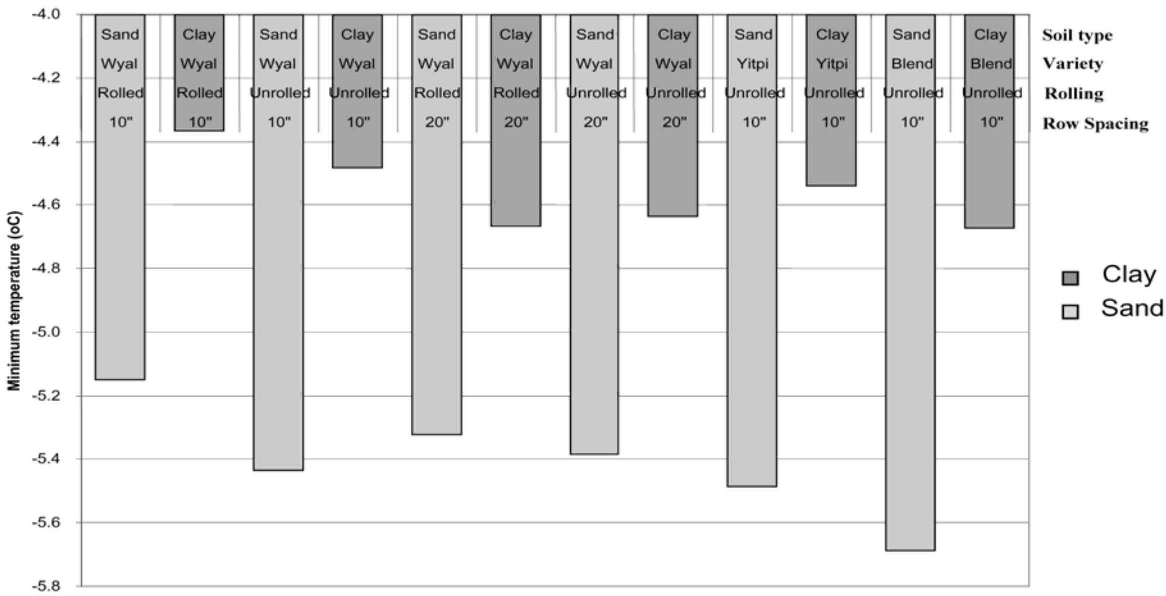

Figure 1: Minimum temperatures around crop heads on 16th Oct 2004 at Keith.

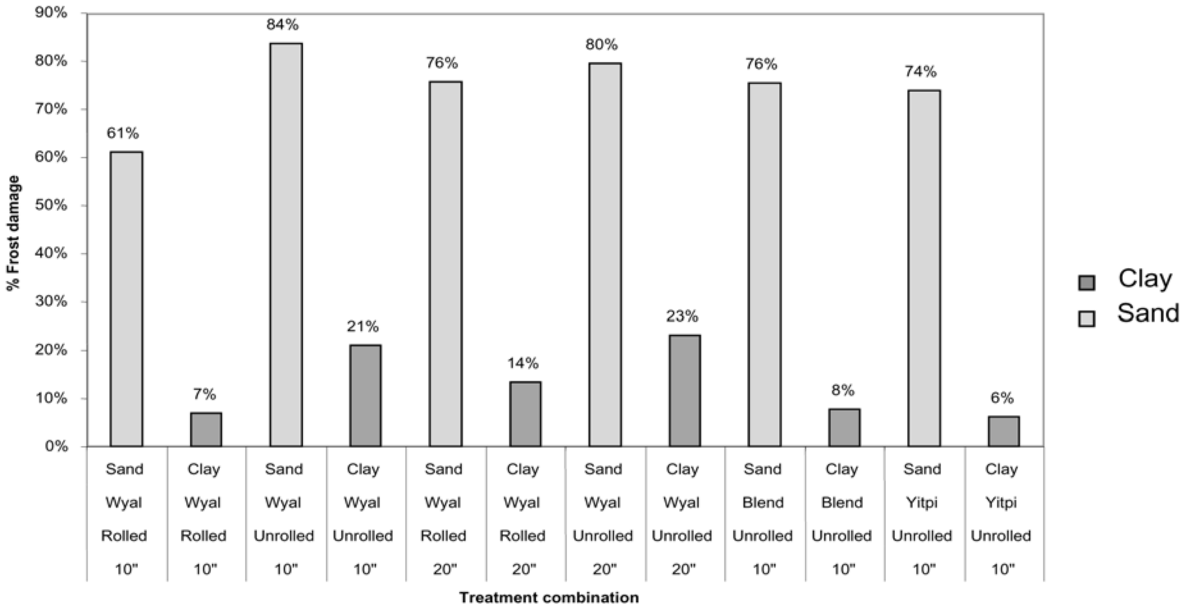

Figure 2: Amount of frost damage in all treatments at Keith 2004.

while still important as part of the whole farm frost risk plan, are often not totally effective and tend to compromise yield potentials and profits.

The purpose of this GRDC funded research is to explore and evaluate other agronomic practices that may have an influence on frost risk in broadacre agriculture. We know the warmth from the sun during the day is held in the soil at night and buffers night-time minimum air temperatures. Therefore, the areas of research included factors that may affect the interception and absorption of solar radiation, its storage as heat in the soil, as well as its release again at night to warm the crop heads. We have been investigating the role of crop canopy density via modifications to crop row spacing, seeding rates, nitrogen rates and varieties. Also we have been altering the soil surface properties by rolling, adding clay, and stubble.

So far we have shown that frost risk can be influenced by paddock management. The greatest impact is from practices that modify the soil properties via rolling or claying a sandy soil. We are yet to find evidence of frost protection when crop canopy density is altered.

See EPFS 2002 Summary, pgs 169-170, and EPFS 2003 Summary, pgs 147-148 for more background information.

How was it done?

Our research in 2003 found that rolling and claying sandy soils reduced frost risk while maintaining yield. However modifying the crop canopy by using different seeding rates, row spacings, nitrogen rates and sowing a mixture of varieties did not influence frost risk.

In 2004 we hoped to achieve similar results and further evaluate interactions. Of particular interest was to determine whether the frost protection benefits from claying and rolling are additive.

The trial was established on a sandy soil at Keith in the South East of SA. The trial investigated three varietal options (Yitpi, Wyalkatchem and a blend of both), two row spacings (10" vs. 20"), two soil textures (undelved sand vs. delved clay) and +/- rolling the soil surface. A randomised block design was used with three reps. Ten metre wide plots were sown with farmer machinery.

Measurements taken included temperatures at the soil surface and at crop head height, grain yield, grain quality, and a visual frost damage score.

What happened?

A severe frost occurred on the 16th October with temperatures at head height getting down to –5.7°C and causing severe frost damage. Minimum temperature data for all treatments on this night are shown in *Figure 1*. These temperatures correlate well with the amount of frost damage in *Figure* 2, with colder treatments having more frost damage.

Claying proved to be the most effective treatment in reducing frost risk as it had up to 1°C warmer minimum temperatures around the crop heads (*Figure 1*) and had around 60% less frost damage (*Figure* 2). Rolling the soil surface also showed frost benefits being around 0.3°C warmer around the crop heads and up to 23 % less frost damage on the sand. Rolling was less effective on the clay delved sand than on undelved sand, but the additional effect of both claying and rolling resulted in the warmest temperatures and least amount of frost damage. The value of rolling was lost on the wider (20") row spacing and temperatures tended to be colder.

GRDC Grains Research & Development Corporation

Section editor: Greg Secomb

Rural Solutions SA, Streaky Bay

Sharing Information

Grain & Graze – Eyre Peninsula

Information

Alison Frischke

SARDI, Minnipa Agricultural Centre

Key Messages

- **Grain & Graze is a new project for Eyre Peninsula for mixed farming enterprises.**
- **The project will focus on the role of livestock and their management within the farming system, and their impact on the economic, social and environmental health of the farming enterprise.**

Grain & Graze is an exciting new initiative for Eyre Peninsula this season. Eyre Peninsula has a number of challenges to face in the future in regard to natural resource management. With the increase in cropping intensity and the renewed interest in livestock it has led to a frequently asked question:

'What is the impact of livestock in modern cropping systems on production, profit, management and the environment?'

Grain & Graze will enable mixed farming businesses to evaluate the role of livestock in their business, explore best-practice and identify opportunities for improving the farming enterprise.

The project is jointly funded by Meat and Livestock Australia (MLA), Australian Wool Innovation (AWI), GRDC and Land & Water Australia, the first time a partnership between these groups has been established. The project will run similarly to, and in line with the EP Farming Systems Project (EPFS), which has a cropping and soils focus. In essence Grain & Graze gives producers the opportunity to increase livestock and pasture research, demonstration and extension effort on EP. On upper EP we will work with the EPFS and Ag Bureau groups and on lower EP with Ag Bureau, Landcare and lamb producer groups. An overall steering committee will manage the project, made up of farmers, SARDI and PIRSA project members and other expertise as required.

For the past two seasons we have been documenting livestock related issues at post harvest/EPFS planning meetings, which have been considered in establishing the project. These include looking at the impact of livestock on herbicide resistance and brome grass control, and the interaction of livestock with no-till seeding systems.

We will be establishing a number of demo farms across EP, which will represent a wide variety of farming systems and pasture bases (i.e. lucerne, annual medics, puccinelia, areas of native grasslands). They will be monitored and used to create focus on some of the following issues:

- Definition of the feed profile – when is and what type of feed available?
- Definition of the animal enterprise – how does it match feed supply and demand?
- Land utilisation – 'production per ha'
- Genetic background of livestock
- Preparation for cropping enterprises
- Labour requirements
- Profitability
- Environmental issues (water budget, leakage, soil erosion potential, nutrients).

Other issues producers may wish to explore could include managing feedlots, livestock nutrition and health, better lambing percentages, introduction of new genetics or a new enterprise, establishing new pasture species, livestock handling skills or improving the condition of natural resources.

Like the EPFS, Grain & Graze will be a *farmer driven* project, and issues explored will be *determined by you*, the farmer. To get involved, please come along to the post harvest/EPFS planning meetings in your area soon, where issues affecting your farming system will be discussed and a plan developed to best address the issue. We look forward to your involvement.

Further information on the Grain and Graze project can be obtained from Minnipa Agricultural Centre, phone 8680 5104 or Senior Livestock Consultant, Brian Ashton, phone 8688 3400 at Pt Lincoln.

Low Rainfall Collaboration Group

Information

Geoff Thomas

Project Manager

The purpose of the Low Rainfall Collaboration Group is to enable the sharing of results and information between various Farming Systems Projects that are located in similar agricultural environments across Australia.

The Collaboration Group, which is funded by GRDC, includes the Farming Systems Groups on Eyre Peninsula, Upper North of SA, Central West NSW, Western Wheat NSW and The Mallee Sustainable Farming Group (SA/Vic/NSW). Under the revised program commencing in early 2005, the Birchip Cropping Group will also participate in the combined group's activities.

There are several core components:

- **Better Coordination Between Groups:** Increase the interaction of farmers and staff between project groups through field visits, establishing regular communication between groups, and a workshop to share information on a range of technical and group management issues.
- **Maintain the Science:** Our aim is to identify the major constraints to sustainable and profitable production from across the project areas and to then form teams of people with the best expertise and experience to tackle them. This can involve outside contributions from national experts and other farmer based groups such as SA No Till Farming Association and the Southern Yorke Peninsula Alkaline Soils Group.
- **Whole Farm Systems Approach:** Developing ways to pull together all the technical information available to achieve total farm benefits - not only from crops but also by integrating livestock enterprises.
- **Broaden the Impact:** which will develop ways to reach more farmers either directly or through working more closely with advisers and farm consultants.
- **Measuring the Results:** To determine the impacts and benefits of the Farming Systems projects in terms of on farm income, the environment and the community. Commonly called a triple bottom line approach.
- **Building Capacity:** Through shared experiences and information, the skills of project participants will improve. This will help avoid the burn out of key farmers and staff involved in the management of the Farming Systems projects.
- **Broaden the Financial Base:** With the combined group efforts we aim to reduce the reliance on the current narrow range of funding support in order to secure a better long-term future.

The individual Farming Systems Groups will continue their activities as before. This project will not interfere but add value by transfer of information and experiences from others and by improving communication with the various funding sources. At present there is a lot of great work being done from which farmers from right across the low rainfall farming zones can benefit.

The project will be managed by Geoff Thomas of Thomas Project Services and will run until 2006.

GRDC Grains Research & Development Corporation

Searching for answers

Cereals in the Upper North

Research

Ali Cooper

Rural Solutions SA, Jamestown

Key Messages

- **Most barley varieties out yielded wheat at Warnertown.**
- **The early maturing varieties of wheat had the highest gross income over all cereals at Warnertown.**
- **Higher screenings in barley varieties at Morchard resulted in low gross incomes.**
- **Yitpi was the best performer with the highest gross income for the Morchard cereal trial.**

Why do the trials?

Choosing a cereal variety to suit local environmental conditions can be difficult when there has been a lack of locally based research. At the request of many growers in the north, cereal variety trials were established at two locations, both in low rainfall areas but with differing climates.

How were they done?

Treatments:	nine commercial wheat varieties, four commercial barley varieties and one commercial triticale variety.
Sowing date:	Warnertown sown on June 4, 2004 and Morchard sown on June 8, 2004.
Fertilizer:	All varieties received 75 kg/ha of DAP (18:20:0:1.6), drilled with the seed.
Herbicides:	Pre-emergent/knockdown: Roundup® @ 1

MORCHARD CEREAL TRIAL

Table 1: Grain yield and quality of cereal varieties at Morchard, 2004.

Variety	Yield (t/ha)	Screenings (%)	Protein (%)	Pay Grade	Gross Income ($/ha)*
Yitpi	1.63	2.86	14.98	AH	361.80
Carnamah	1.60	3.93	14.44	APW	331.78
Clearfield Janz	1.48	3.68	14.58	AH	327.97
Pugsley	1.53	2.64	15.12	APW	320.62
Frame	1.50	2.82	14.92	APW	316.01
Wyalkatchem	1.50	2.76	14.82	APW	315.18
Krichauff	1.55	4.37	14.92	ASW	308.58
Kukri	1.40	4.29	15.18	AH	301.38
Halberd	1.40	3.25	14.74	APW	293.03
Maritime	2.26	10.51	14.82	Feed	291.72
Mundah	2.15	13.58	14.41	Feed	277.20
Sloop SA	1.75	23.08	14.37	Feed 2	208.92
Keel	1.90	31.26	12.62	Feed	188.08
Speedee	1.43	5	14.84	TRIT	200.30
LSD (P=0.05)	0.38	9.26	NS	-	

**Based on AWB estimate pool returns and ABB cash price delivered to Pt Pirie.*

WARNERTOWN CEREAL TRIAL

Table 2: Grain yield and quality of cereal varieties at Warnertown, 2004

Variety	Yield (t/ha)	Screenings (%)	Protein (%)	Pay Grade	Gross Income ($/ha)*
Wyalkatchem	1.94	4.15	16.30	APW	401.08
Westonia	1.64	3.12	15.56	APW	342.32
Carnamah	1.51	5.92	16.12	AGP	293.02
Krichauff	1.42	11.11	16.16	ASW	264.33
Blade	1.07	7.22	16.52	AGP	202.96
Clearfield Janz	1.23	14.86	16.08	Feed	183.81
Yitpi	1.21	18.34	16.64	Feed	181.72
Pugsley	1.11	21.32	15.90	Feed	166.93
Frame	1.00	14.57	16.52	Feed	149.81
Speedee	1.23	2.99	15.72	TRIT	172.68
Mundah	2.10	9.09	15.05	FEED	271.59
Keel	2.20	15.50	13.97	FEED	261.64
Sloop SA	2.16	16.53	14.98	Feed	257.82
Maritime	1.47	25.24	15.84	FEED	145.68
LSD (P=0.05)	0.36	5.43	1.01	-	-

**Based on AWB estimate pool returns and ABB cash price delivered to Pt Pirie.*

Location
Closest town:
Morchard and Warnertown
Co-operator:
Morchard Community,
Brendon and Graham Johns
Group:
Upper North Farming Systems

Rainfall
Av. Annual total: 330 mm,
330 mm (Morchard, Warnertown)
Av. GSR: 233 mm, 236 mm
Actual annual total:
233 mm, 327 mm
Actual GSR: 153 mm, 236.5 mm

Yield
Potential:
Wheat = 1.10 t/ha
barley = 1.54 t/ha
wheat = 2.53 t/ha
barley = 2.93 t/ha

Paddock History
2003: Grass pasture, Vetch (mulched)
2002: Grass pasture, Barley (1.3 t/ha)
2001: Barley (3.6 t/ha)

Soil
Morchard:
alkaline, red clay loam.
Warnertown:
alkaline, grey light sandy clay loam

Land value
$650/ha, $1875/ha

Plot size
5 replicates, 5 m x 1 m

Other factors
Frost damage to Speedee at Warnertown

L/ha and Trifluralin @ 1 L/ha, post emergent for Morchard: Broadstrike® @ 25 g/ha and MCPA Amine @ 1 L/ha.

Measurements: Grain yield and quality attributes.

What Happened?

Low subsoil moisture and a late break to the season reduced the potential yield at both locations. Warnertown is an early maturing area, while Morchard is late.

What does this mean?

Whilst two of the barley varieties, Maritime and Mundah, had the highest yields, Yitpi and Carnamah wheat had lower screenings and the highest gross income. Kukri and Halberd were the poorest performers in terms of yield. Barley had higher screenings than wheat with Sloop SA and Keel having highest screenings (>20 %). No disease problems were observed, however a salinity problem exists at 40 - 60 cm.

What does this mean?

As the Warnertown district is an early finishing area, mid to late maturing varieties are going to suffer moisture stress at grain fill. Yitpi, Pugsley and Frame, are all genetically related and are mid to late maturing. These varieties performed most poorly having the lowest yields and highest screenings for the wheats. The highest gross income was achieved by the early maturing varieties, Wyalkatchem, Westonia and Carnamah. It would seem that these Western Australian wheat varieties are better suited to the Warnertown region due to similar climatic and soil characteristics.

Head loss was observed in the barley treatments at Warnertown due to delays in harvest. Taking this into account, barley clearly out yielded wheat in this environment, particularly Mundah, which suffered the highest head loss rate, but is the second highest yielding cereal. Again, no disease problems were observed and no subsoil toxicities, which indicates that the performance of each variety reflects their ability to handle moisture stress.

Acknowledgements

Thanks go to Gilmour Catford and Brendon and Graham Johns for the trial sites and cooperation. Thanks also to David Cooper for his help in the seeding and harvest of the trials. The Grains Research and Development Corporation (GRDC) made this research possible through funding of the Upper North Farming Systems project.

Searching for answers

Location
Closest town: Nyngan
Cooperator: Will Carter
Group: CWFS regional sites

Rainfall 2004
Av. Annual Total: 444 mm
Av. GSR: 192 mm
Actual annual total: 258 mm
Actual GSR: 111 mm

Soil
Major soil type description: The trial was located on red soils; acidic in the surface 0-10 cm with an effective cation exchange capacity (eCEC) of about 9 meq/100g. They have low to medium phosphorus status (Colwell P 10 – 25 mg/kg). The organic carbon status is low (0.5 – 1.5%) which is typical of soils in low rainfall environments.

Plot size
1.8 m x 30 m

Other factors
The major yield limiting factor for 2004 was drought.

Wheat: susceptibility of varieties to common root rot

Research

Sharon Taylor and Catherine Evans

Central West Farming Systems

Key Messages

- **Common root rot (CRR) is a fungal disease that has the potential to reduce yield in susceptible wheat, barley and oat varieties.**
- **Moderately resistant CRR varieties, such as Strzelecki and Sunstate, did not suffer grain yield or grain quality losses due to CRR in 2004.**
- **Drysdale, Combat and Hunter showed moderate resistance to CRR, although as yet they have no disease rating**

Why do the trial?

The aim of this trial was to evaluate the susceptibility of new wheat varieties, which currently have insufficient trial data to provide a disease score to CRR, compared with varieties with known disease ratings.

How was it done?

The trial site was established on a property 12 km west of Nyngan, in NSW. The trial site consisted of two blocks, Block A and Block B. Prior to sowing, both blocks were tested for diseases levels, which showed that Block A had a low level of CRR whilst Block B had a high level of CRR. CRR is caused by a fungus, Bipolaris sorokiniana, which causes browning of the roots, particularly on the sub-crown internode, in wheat, barley and oats. Cereal varieties vary in their susceptibility to CRR, with moderately resistant varieties unlikely to suffer yield loss.

Due to the different levels of CRR in the two blocks the same varieties were sown in each block to determine each variety's susceptibility or resistance to the disease. The varieties used and their disease scores for CRR (1 = susceptible, 9 = resistant) were Strzelecki (7), Sunstate (6), while Drysdale, Combat and Hunter. All varieties were sown at 35 kg/ha on the 26th June 2004 with 100 kg/ha DAP fertiliser (district rates). The only measurements taken for this trial were grain yield and grain quality.

What happened?

The grain yield and grain quality results in *Table 1* show that the yield, protein and test weight of each variety does not significantly differ from Block A to Block B. The two varieties with known disease scores, Strzelecki (7) and Sunstate (6), have confirmed in this trial that they are moderately resistant to CRR as no significant yield, protein or test weight losses have occurred due to CRR in Block B. The three varieties without any disease scores, Drysdale, Combat and Hunter, have shown that they could also be moderately resistant to CRR as their yield, protein and test weight have stayed the same across Blocks A and B.

Results are shown in *Table 1.*

Table 1: Grain yield and grain quality results from the CRR trial at Nyngan, NSW.

Variety	Yield (t/ha) Block A	Yield (t/ha) Block B	Protein (%) Block A	Protein (%) Block B	Test Weight (g/hL) Block A	Test Weight (g/hL) Block B
Combat	0.68	0.52	16.85	17.32	74.67	74.67
Drysdale	0.54	0.37	16.92	17.40	75.33	75.50
Hunter	0.62	0.41	15.82	16.78	73.17	74.33
Strzelecki	0.73	0.40	16.40	17.47	74.50	72.50
Sunstate	0.63	0.43	17.07	17.50	76.83	76.32
Significance (variety*block)	NO		NO		NO	

What does this mean?

Although this trial has found that Drysdale, Combat and Hunter can maintain their grain yield and quality in the presence of CRR it is not being recommended by CWFS that farmers sow these varieties in known CRR paddocks, as disease scores have not been published for these varieties. In a paddock with known CRR problems it is recommended that resistant wheat varieties are sown, such as Strzelecki and Sunstate, or that break crops are included in the rotation, such as pulses, oilseeds or pasture legumes. Host grass weeds should also be controlled.

Acknowledgements

These trials are part of the CWFS Nyngan regional sites. The trials are sponsored by the Grain Growers Association and GRDC. Greg Brooke and Tom Fitzgerald provided Technical assistance. Thanks to the cooperating farmer Will Carter.

GRDC Grains Research & Development Corporation

Wheat: fungicide for strategic and tactical control of leaf disease

Ken Motley[1], Karen Roberts[1], Rob Griffith[2], Gordon Murray[1], Andrew Rice[3] and Catherine Evans[4]

NSW Department of Primary Industries[1], Bayer Crop Sciences[2], Ivey ATP[3], Central West Farming Systems[4]

Research

Searching for answers

Location
Closest towns: Forbes and Parkes
Cooperator: Bill Scott (Gunning Gap), Kim and Wendy Muffett (Wirrinya), Geoff McCallum (Goonumbla)
Group: CWFS regional sites

Rainfall 2004
See table

Soil
All soils are red soils with a sandy loam surface and heavier clay subsoil. 0-10 cm pHCa was 5.8 (GG), 4.6 (W), 5.4 (G). CEC of surface soils was 6.5 (GG), 8.0 (W), 7.9 (G).

Plot size
1.8 m by 15 m

Other factors
Drought has limited production in this area for the past 4 years. In general there has been little to no subsoil moisture, late sowing rains and dry springs.

Key Messages

- **H45 proved more susceptible to stripe rust than Diamondbird in 2004.**
- **With the dry conditions of 2004, when yields were higher (2-3 t/ha) stripe rust infection significantly decreased yields in H45 by 16 % - 17 %.**
- **Only the combination of seed applied + foliar fungicide resulted in a significantly higher yield than the nil treatment in H45.**

Why do the trial?

The aim of these trials was to assess the potential for yield and quality responses from controlling stripe rust in Central Western NSW. This follows on from an article last year – *FS2003, p. 167*.

How was it done?

Three trials sites were sown - Gunning Gap, Wirrinya and Goonumbla as randomised blocks with three replicates. The Gunning Gap and Goonumbla sites were wheat on wheat, while the Wirrinya site was pasture/fallow in 2003. The varieties H45 (very susceptible to stripe rust; well suited to this climate) and Diamondbird (an older variety with some acid soil tolerance and moderately susceptible to stripe rust) were sown at 60kg/ha with 100kg/ha of DAP (18N; 20P). Sowing occurred after opening rains (late May to mid June). Herbicides were applied as required, using Tristar® + Jaguar®. Fungicides were applied at Z45 (~20th September) and at Z70 (~20th October). Detailed assessment of the flag leaves occurred at Z70, with estimates given of the percentage of leaf area infected by stripe rust.

Table 1: Average yield data for untreated wheat at the 3 trial sites in central western NSW

Location	Diamondbird Yield (t/ha)	H45 Yield (t/ha)	5% lsd
Gunning Gap (GG)	0.52 a	1.5 b	0.14
Wirrinya (W)	1.8	1.8	n.s.
Goonumbla (NP)	3.1	3.3	n.s.

What happened?

H45 yielded higher than Diamondbird at Gunning Gap, but similar at Wirrinya and Goonumbla (*Table 1*). Stripe rust was first detected in trials in early September but not until late September at Gunning Gap. At the higher yielding sites of Wirrinya and Goonumbla there was a significant yield response (17 % and 16 % respective) to stripe rust control. This suggests that when yields are low, fungicide application has negligible effect on grain yields.

In all trials, there were significant differences in stripe rust infection between fungicide treatments used on the H45 wheat

Rainfall 2004 - North Parkes = Goonumbla

	Rainfall (mm)																	
	Monthly Rainfall														Annual	Fallow	Growing season	Water limited yield potential [A]
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	(Nov - Mar)	(Apr to Oct)	t/ha
Gunning Gap	29	32	58	26	23	0	29	49	12	29	31	62	5	105	428	167	212	2.04
Wirrinya	0	14	72	66	4.5	6	16	63	21	25	31	54	29	95	482	157	216	2.11
North Parkes	26	34	61	45	21	4	46	52	27	52	44	38	31	82	503	187	263	3.06

[A] water limited yield potential = (Growing season rainfall -110)mm X 20 (kg grain/mm) / 1000

Sharing Info

Table 2: Effect of fungicide treatments on leaf area infected, and on grain yield (t/ha), of H45 (susceptible) wheat in central western NSW by trial sites (Gunning Gap, Wirrinya and Goonumbla).

Fungicide Treatment	**FungicideRate**	**Application Timing**	**Infected leaf area (%) by Site**			**Grain Yield (t/ha) by Site**	
			Gunning Gap	**Wirrinya**	**Goonumbla**	**Wirrinya**	**Goonumbla**
Nil			0.54 c	8.9 c	6.9 b	1.8 a	3.3 ab
Jockey®(Fluquinconazole)	450 mL/t	sowing	0.54 bc	4.0 b	2.1 a	2.0 ab	3.5 bc
Jockey® + Tebuconazole	145 mL/ha	Z45	0.00 a	0.6 a	0.4 a	2.1 b	3.8 c
Triadimefon	1 L/ha	Z45	0.27 b	1.7 a	1.3 a	2.0 ab	3.3 a
Tebuconazole	145 mL/ha	Z45	0.00 a	1.2 a	0.6 a	1.9 ab	3.5 bc
Tebuconazole	290 mL/ha	Z45	0.00 a	0.7 a	0.2 a	2.0 ab	3.6 bc
Propiconazole	250 mL/ha	Z45	0.01 a	1.5 a	0.6 a	1.9 ab	3.4 ab
Propiconazole	500 mL/ha	Z45	0.00 a	0.9 a	0.5 a	1.9 ab	3.4 bc
Propiconazole	250 mL/ha	Z70				1.8 a	3.0 a
Propiconazole	250 mL/ha	Z45+Z70				1.9 ab	3.5 bc
5% lsd			*0.27*	*2.3*	*2.0*	*0.25*	*0.37*

(*Table 2*). Only at Goonumbla was there an effect of fungicide treatment on the incidence of stripe rust on Diamondbird (*data not shown*). At the sites showing the higher incidence of stripe rust, Wirrinya and Goonumbla, all fungicide treatments provided significant control of stripe rust. As yet, the analysis of grain quality data has not been finalised. When this is complete, gross margins of each treatment will be calculated to guide farmers in deciding control options.

What does this mean?

H45 proved far more susceptible to stripe rust than Diamondbird. However, when yield potentials (and stripe rust infection pressure?) are low (e.g. Gunning Gap) stripe rust infection did not have a negative effect on H45 yield. The combination of seed applied and foliar applied fungicide resulted in yields significantly higher than the nil. Seed dressing alone does not control stripe rust infection when the infection occurs late. We plan to continue these trials in 2005 if funding is available.

Acknowledgements

These trials are part of the CWFS regional sites. The trials are sponsored by the Grain Growers Association and GRDC. Greg Gibson (NSW DPI) provided technical assistance. The data was analysed by Helen Nicol. Thanks to the cooperating farmers including Bill Scott, Kim and Wendy Muffett and Geoff McCallum. Sharon Taylor (CWFS) assisted with editing this paper.

GRDC Grains Research & Development Corporation

Research

Alternative production systems in Central West NSW

Rachael Whitworth[1], Sharon Taylor[2] and Catherine Evans[2]

District Agronomist, Griffith, NSW[1], Central West Farming Systems[2]

Location
Closest town: Rankins Springs, Griffith.
Cooperator: Bartter family
Group: CWFS regional sites

Rainfall 2004
Av. Annual Total: 438mm
Av. GSR: 239mm
Actual annual total: 197 mm
Actual GSR: 125mm

Yield
Potential: 1.03 t/ha
Actual: 0.75 t/ha

Soil
Red kandosol with acidic surface, tending to more alkaline subsoil. Typically low in phosphorus and organic carbon.

Plot size
32.5m x 103.3m

Other factors
Drought has limited production in this area for the past 5 years. In general there has been little to no subsoil moisture, late sowing rains and dry springs.

Key Messages

- **High cost initial inputs, although they may have a long-term benefit, can take a long time to pay for.**
- **The conventional district practice, is performing as well or better than any of the alternative production systems and better than many.**

Why do the trial?

The aim of this trial is to investigate some of the alternative production systems available to farmers. The trial measures both the profitability and sustainability of the different systems.

How was it done?

The trial is located on a farmer's paddock at Rankins Springs in central-western NSW. The trial covers seven ha, with each system occupying three replicates of 0.33 ha (1 ha in total). Farmers run the trial and liaise with the alternative production systems people. The seven systems are:

1. Conventional (run by the local growers using district practices)
2. Albrecht (managing soil chemistry)
3. Soil Management Riverina (a local company managing soil using realistic inputs)
4. Alroc (using mineral fertilisers)
5. Nutri-Tec (balancing nutrients)
6. Bio-Ag (using biological inputs and micro-organisms)
7. Organic (running as an organic farm)

What happened?

The trial started in 2000, along with the drought. The trial has continued since then but yields have been low due to the extremely dry conditions. Yield and gross margins for the systems are presented in *Table 1*. Soil was sampled in 2000 and sampling will occur again in the future to look at sustainability indices.

What does this mean?

Yields on the trial are low because of the dry years. There was no difference between yield in 2000. In 2001 Alroc and Soil Management Riverina were lower yielding than the other systems. In 2004 the organic system was lower yielding than all other systems. The dry seasons and low yields have had a negative effect on the gross margins, particularly those systems that have large inputs, with long-term benefit. For example, a lime application may have residual benefits for up to 15 years but the cost of application is included in the gross margin of the year of application. It may take some years for the benefits of these applications to be seen. After five years, the conventional system (i.e. district practice) is slightly ahead of the other systems. There is little difference between the conventional system, the Soil Management Riverina and Organic systems in terms of gross margin. It should be noted that the organic system has low input costs.

Acknowledgements

The trials are run by the CWFS Rankins Springs regional site committee. The trials are sponsored by the Grain Growers Association and GRDC. The Bartter family host the trial site. Michael Pfitzner is the Chairman of the committee.

Grains Research & Development Corporation

Table 1: Grain Yield (t/ha) and Gross Margins ($/ha) for the seven alternative production systems at Rankins Springs, NSW.

System	Grain Yield (t/ha)					Gross Margin ($/ha)					Average Gross Margin
	2000	2001	2002	2003	2004	2000	2001	2002	2003	2004	2000-04
Crop	wheat	lupins	wheat	fallow	wheat						
Conventional	1.7	0.43c	0.00		0.78b	3.5	-13.3	-78.9		-17.8	-26.62
Albrecht	1.2	0.33b	0.00		0.96b	-6.0	-414.7	-78.9		8.96	-122.65
Soil Management	1.7	0.20a	0.00		1.0b	48.6	-114.0	-76.7	costs included in 2004	1.42	-35.15
Alroc	1.8	0.20a	0.00		0.66b	-135.7	-114.1	-102.3		-62.7	-103.71
Nutri-Tec	1.9	0.35bc	0.00		0.70b	39.2	-149.9	-344.6		-72.7	-132.02
Bio-Ag	1.8	0.39bc	0.00		1.0b	-92.3	-69.7	-123.5		0.9	-71.18
Organic	vetch (conversion to organic)		0.00		0.15a	-80.5	13.0	-39.0		-67.8	-43.56
5% lsd	*n.s.*	*0.082*			*0.40*						

Sharing Info

Types of Work in this Publication

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

Type of Work	Replication	Size	Work conducted by	How analysed
Demo	No	Normally large plots or paddock strips	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 & Researchers	Usually summary of research results
Information	n/a	n/a	n/a	n/a

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GRAIN INDUSTRY RESEARCH UPDATE

TARGETED RESEARCH FOR SA GROWERS

SAGIT

The SA Grain Industry Trust invests more than $1.2 million a year in supporting research crucial to the advancement of the SA grain industry with funds coming from a 15c a tonne contribution on all grain delivered by SA grain growers.

In 2004-05 the SAGIT is supporting 32 projects, including:

- **Cereals**

  Fast tracking – Wheat breeding with combined disease resistances – Molecular Plant Breeding CRC
  Disease control – Leaf rust control in barley – YP Alkaline Soils Group

- **Pulses and pastures**

  Pastures – improving Pratylenchus tolerance in annual legumes – SARDI
  Herbicides – Southern Yorke Peninsula pulse crop herbicide tolerance trials – YP Alkaline Soils Group

- **Oilseeds**

  Selection – oilseed and pulse selection for low rainfall Upper Eyre Peninsula – SARDI

- **Other priorities**

  No-till farming – support for the SA No-Till Farmers Association
  Snail control – in the southern region – SARDI
  Higher returns – using Precision Agriculture to increase returns – Southern Precision Agriculture Association
  Fertiliser – trialling and establishing suspension fertilisers as an economic option
  Future – Plant breeding scholarship
  Human Health – Physiological effects of Selenium on male smokers: clinical trial – University of Adelaide

Trustees of the SA Grain Industry Trust

Chairman Malcolm Sargent, Crystal Brook

Members Peter Kuhlmann, Mudamuckla
Robert Rees, PIRSA, Adelaide
Colin Rowe, Golden Grove

The trustees are assisted in project allocation decisions by SAFF nominees John McEvoy, Waroooka, and Simon Ballinger, Wolseley; and scientific adviser, Dr Alan Dube

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SAGIT

Notes

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