Acknowledgements

Welcome to another edition of the Riverine Plains trial book.

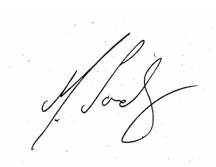
2007 was yet another challenging year for farming and research across the Riverine Plains. Whilst the season started strongly with good rains during early-mid winter, this early promise quickly faded as the expected spring rains failed to eventuate. As a result, many of the trials established by Riverine Plains Inc and other collaborators failed to live up to early expectations. But even in the most trying of conditions, there is always something to be learnt! As such, we hope you will gain some insights from the research presented in the 2007 Trial Book.

Research doesn't always go to plan, particularly when droughts get in the way! Given the challenges involved in research, I'd like to thank, on behalf of Riverine Plains Inc, all the people who contributed to the research that fills the following pages. This includes the authors, the organisations that sponsored the research, and the farmers who provided the land (or the personal and/or life experiences) which enabled this research to take place.

Given the limited number of successful local trials during 2007, we've also included the results of other scientific and social research conducted outside the Riverine Plains. I'd like to thank the authors of these articles for their contributions and for ensuring the articles maintained their relevance to our region.

While many individuals contributed to this publication, some special thanks are due. Many thanks to Fiona Hart (Riverine Plains Inc) and Barbara McAllister (NSW DPI) who did much of the leg work in contacting potential authors and compiling the book. We also value the annual contributions from NSW DPI and DPI Victoria staff. John Sykes from John Sykes Rural Consulting has also made a significant contribution to articles given his collaborative work with Riverine Plains Inc and the Grains Research and Development Corporation.

We hope you find the information useful, and wish you all the best for the 2008 cropping season.



Michelle Pardy
Editor

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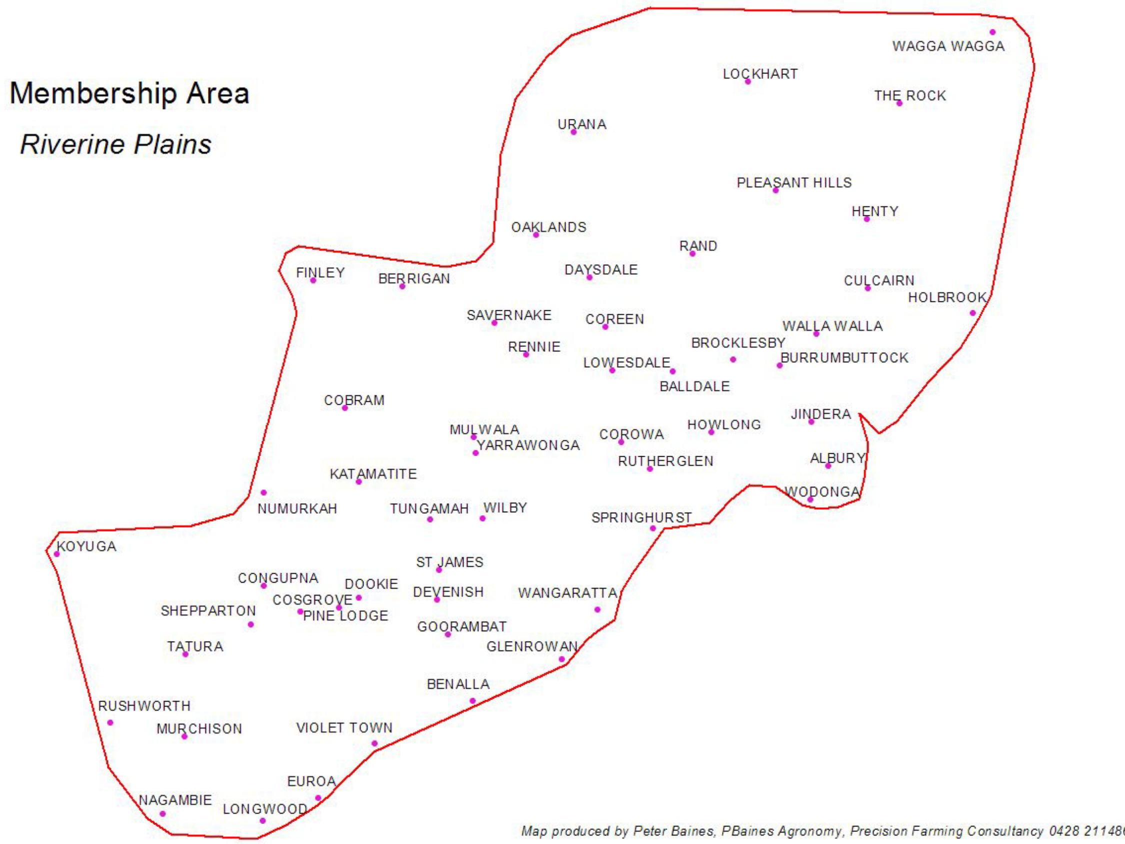

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Preface

Trials versus demonstrations - what the results mean

Research on the Riverine Plains takes different shapes and forms, each of which has the potential to make an important contribution to increasing the understanding about agricultural systems in the area. However, it is important to keep in mind results from the different forms of research need to be analysed and interpreted in different ways.

It is important to understand the difference between trials and demonstrations in the use of results for benefit on farms. A replicated trial means that each treatment is repeated a number of times and an averaged result is presented. The replication reduces outside influences producing a more accurate result. For example, trying two new wheat varieties in a paddock with varying soil types and getting an accurate comparison can be obtained by trying a plot of each variety, say four times. Calculation of the average yield (sum of 4 plots then divided by 4) of each variety accounts for variations in soil type.

Statistical tests (eg. Analysis of Variance -ANOVA, Least Significant Difference - LSD) are used to measure the difference between the averages. If there is no significant difference between treatments the results will be accompanied by the mark NS (meaning not significantly different). A statistically significant difference is one in which we can be confident that the differences observed are real and not a result of chance. The statistical difference is measured at the 5% level of probability, represented as "$P<0.05$".

Table 1: Example of a replicated trial with four treatments

	Treatment	**Avg Yield (t/ha)**
1	Variety 1	4.2
2	Variety 2	4.4
3	Variety 3	3.1
4	Control	4.3
	LSD ($P<0.05$)	0.5

Table 1 shows an LSD of 0.5 t/ha. Only Variety 3 shows a difference of greater than 0.5 t/ha, compared with the other varieties. Therefore Variety 3 is the only treatment that is significantly different.

A demonstration is a comparison of a number of treatments, which are not replicated. For example, splitting a paddock in half and trying two new wheat varieties or comparing a number of different fertilisers across a paddock. Because a demonstration is not replicated results cannot then be statistically validated. For example, it may be that one variety was favoured by being sown on the better half of the paddock. We can talk about trends within a demonstration but cannot say that results are significant. Demonstrations play an important role as an extension of a replicated trial that can be tried in a simple format across a large range of areas and climates.

Demonstrations are accurate for the paddock chosen under the seasonal conditions incurred. However, care must be taken before applying the results elsewhere.

Trials and demonstrations play a different role in the application of new technology. Information from replicated trials is not always directly applicable but may lead to further understanding and targeted research. Demonstrations are usually the last step before the application of technology on farm.

INTRODUCTION

A word from the Chairman

Adam Inchbold, “Grand View”, Yarrawonga

Since becoming Chair in 2005, I have written many times about the importance of continual productivity improvements, the knowledge that allows good objective decisions to be made, my famous love of hard data, a positive attitude etc etc etc. I have also reflected during these last, very difficult years about our character, the difficult times which when lived through that are heart breaking, but when survived have been a big part of forming the character of Australian agriculturalists.

All of these thoughts and themes swirl together now as I reflect and report on the year that has been for Riverine Plains.

In spite of the pressures of the 2006 drought, and previous dry years placed on members coming into 2007, 2007 was one of the most successful years Riverine Plains Inc has had. In 2007, member numbers rose to nearly 300, more events then ever before were organized, and at least two seminars drew nearly 200 attendees each.

In general, Riverine Plains Inc continued to take a multi-pronged approach to the provision of information. Large seminar days, smaller workshops, discussion groups, field days, applied research and development, the bi-monthly newsletter and the annual research compendium have once again made up the mix of services provided.

Riverine Plains continues to put together its two ‘marquee’ seminar days each year where there is an array of information presented to update members on the latest technical information and thinking. It is a credit to those who have attended these days in such large numbers.

None of these seminar days have had drought on the agenda, and yet people have attended in droves. Clearly, this shows that agriculturalists in this area have remained enthusiastic about being updated on the information, while in such a time of drought. I believe this is a great sign for the long term future of our industry locally. Even if significant adaptation is required to better equip our systems to function in a more variable climate, the expertise, flexibility and enthusiasm of you all will get us through.

Beyond these two days, the group continues to support targeted discussion groups in the area of Precision Agriculture (PA) and Biological Farming. Both of these subject areas have been previously identified by the committee as of particular interest by members.

The protocol established by Riverine Plains Inc to guide farmers getting started in PA is now well proven, and has been extremely successful in promoting the adoption of PA technology. The committee anticipates that demand for the extension of this protocol will continue for some time. At the same time, early PA adopters are continuing their ‘PA’ journey and are now contemplating more sophisticated spatial analysis and variable rate prescriptions. Riverine Plains Inc will endeavour to support both of these broad requirements in the coming year.

The group has also continued to run trials in the area of canopy management, and general best practice tactics to improve the profitability of crops grown on wheat stubbles. The latest results from this part of our Grains Research and Development Corporation funded project are contained within, as well as being regularly updated in newsletters.

This work will be expanded, along with our PA work in the new project that is to come on line in the second half of this year. In the new project, trial work will be conducted in the presence of stubble, helping members to gain confidence in adapting their existing systems to no-till stubble retention in a relatively high rainfall environment. Additionally, new PA technologies will be tested, keeping Riverine Plains at the forefront of offering advice to our members on the efficacy or otherwise of PA technologies for farming systems in this area.

It is the case that in each generation there are challenges and opportunities that are the catalysts for change. This has been the case throughout history, in all sectors and industries including agriculture.

At the beginning of the 20th century, in the face of 20 years of average or below average rainfall, agriculture moved from squattocracy to selectors to a more ordered, less subsistence industry with the breeding of the first Australian line of wheat, Federation.

In the 30's and 40's, the heartbreak of severe droughts in close succession combined with the first tractors to see a mechanical revolution in Australian agriculture. Then in the 50's and 60's, more reliable rainfall, the advent of superphosphate, sub-clover and multi-cylinder tractors produced a revolution in productivity in a post war Australia and the beginnings of modern broadacre farming systems.

In this area, in the 70's and 80's, the challenge of wet winters combined with the opportunities of machinery and chemical innovations, resulted in the move to direct drilling.

Through all of these generations, external factors have combined with technological advances to force change, but also allow change. It is a push and pull type situation. Challenges arise and cause pain, but then there are improvements in knowledge and ability and the new circumstances are adapted to.

It sounds a bit melodramatic, but I think it is fair to say that we are living through a period of time that will be retrospectively cited as this generation's period of change. The factors that are impacting on our systems are many. They are large, persistent and difficult to address. They include all the usual suspects affecting our environment, our productivity and our profitability. Additionally, all of these challenges are now occurring in the light of a revaluation of resources including fertilizer, water and food.

The opportunities however are also there. Technological advances now allow us to attempt at least to adopt no-till stubble retention in high rainfall environments, apply inputs more efficiently with PA technology, evaluate soil moisture profiles easily and inexpensively to make better input decisions, model yield potential, adopt canopy management strategies that reduce risk without jeopardizing yield potential, offer a range of crop types and varieties that result in a large window for planting times and much more.

Additionally, we are blessed with a strong group of motivated, capable members. The collective enthusiasm, intelligence and will of the Riverine Plains membership should not be underestimated as a resource in facing up to the challenging times ahead.

For the contributions made to the group in the last 12 months, I would like to thank many people and organizations. Firstly, the general membership. The character of the membership makes up the character of the group, and ultimately is responsible for Riverine Plains' success. Secondly our sponsors and those that choose to fund our work. Their efforts, financial and otherwise are a vital line of support but also a great link into the wider agricultural industry, bringing with them their own expertise and experience.

Finally, my very sincere thanks to the committee, including Fiona and our great supporters from the Vic and NSW DPI. The committee continues to go from strength to strength in my view. Its enthusiasm to keep Riverine Plains delivering the best service possible to its members is unwavering, even in these difficult times. It remains politics free, a rare but admirable feat, and is an absolute pleasure to work with.

Annual report for the Albury agronomy district – 2007

Author: Janet Wilkins

Contact No: 02 6051 7700

Organisation: NSW DPI, Albury

The details of this report are based on the NSW DPI Albury agronomy district. The weather data in the report is sourced from Bureau of Meteorology Silo weather data.

Seasonal summary

The year started warm and dry with some late summer rain. The first sowing opportunity was in mid March on the eastern side of the district but the main break came at the end of April. The break in April allowed early crops to be sown on time. The rain continued for main season sowings and warm conditions allowed for good early growth. Little rain fell during late winter and with one of the driest springs on record, the potential for higher yields early in the season was not realised.

Monthly maximum and minimum temperatures were above average for most of the year with the exception of the winter months, which were close to average (Figure 1). Minimum temperatures in September were below average. This is typical of drought years which generally have a higher than average number of frosts (Figure 2).

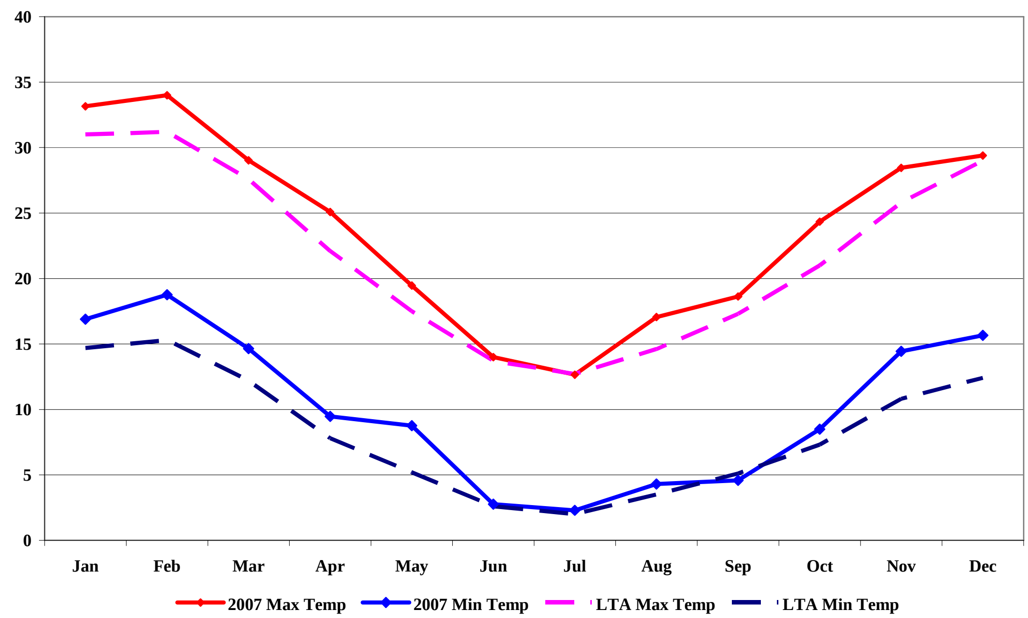

Figure 1. Minimum and maximum temperatures for 2007, compared to long term averages (LTA)

Rain towards the end of the season improved figures despite the dry spring. Total rainfall for the year was in decile two (Figures 5 and 6) with 507.7 mm and 436.6 mm for Albury and Corowa respectively (Figures 3 and 4). The cumulative growing season rainfall for Albury and Corowa was again in decile two for both towns (Figures 7 and 8).

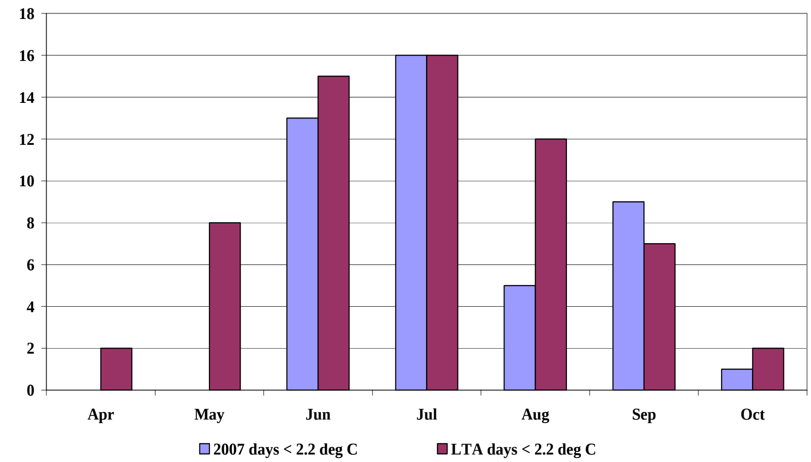

Figure 2. Frosts in Albury 2007 compared to long term averages

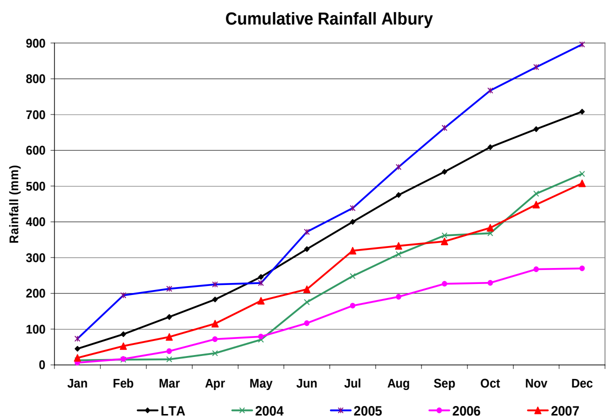

Figure 3

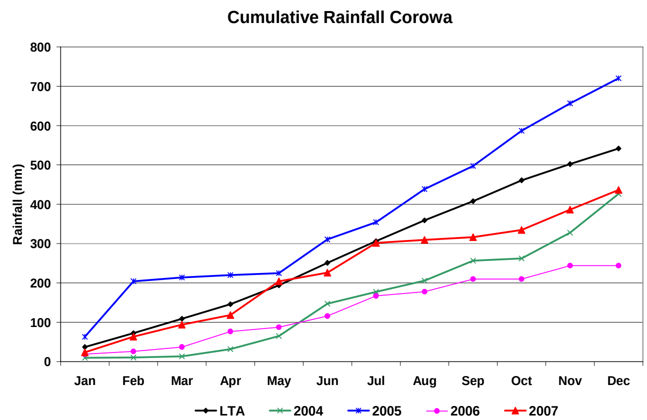

Figure 4

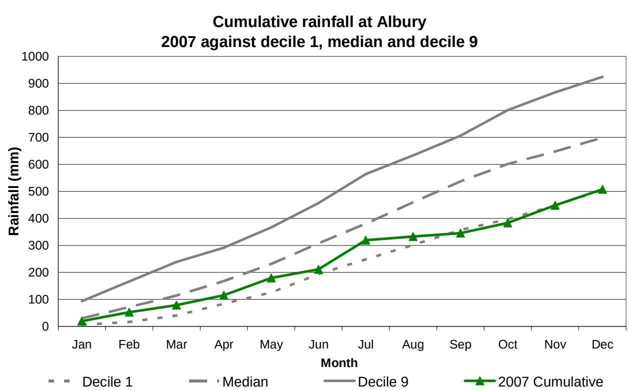

Figure 5

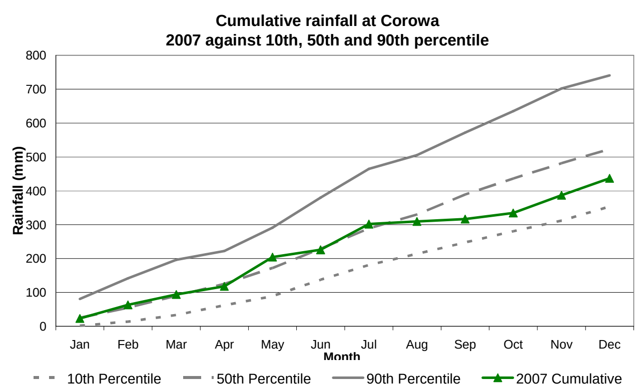

Figure 6

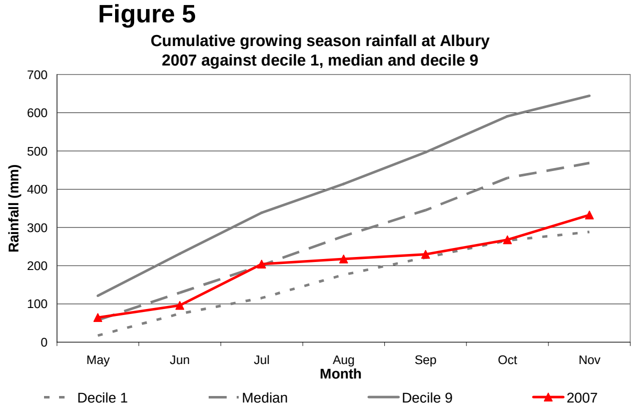

Figure 7

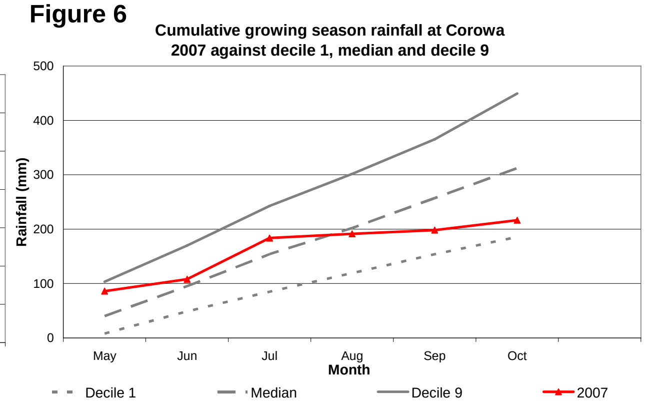

Figure 8

Cropping

The late April rain was in good time for sowing canola, lupins and early wheats. Continuing rain led to timely main season plantings and allowed good weed control prior to sowing. Warm conditions until late May resulted in good early growth with the potential for high yields.

The lack of late winter or spring rain resulted in many crops being cut for hay in September and early October. As in 2006, frost damage again played a role in these decisions. Unlike the previous season, the decision to cut crops was made early in many cases. Crops cut early for silage generally produced good quality feed. The good early crop growth resulted in dry matter yields higher than the previous season. However, many crops cut later were still on the ground during the rain events which occurred in late October. Hay made after this period was poorer in quality, with weather damage meaning some crops were not baled at all. There were also problems with the moisture content of some hay, which resulted in an increased number of hay fires across the district.

The lack of rain in spring, coupled with a frost, reduced yield potential. Rain during late October and November was in time to benefit crops on the eastern side of the district, however this rain was too late for most western area crops and served only to damage crops cut for hay in paddocks.

With the dry spring there was little stripe rust, though some crops with lower resistance ratings were sprayed in early spring. The warm, dry conditions which followed meant there was unlikely to have been a yield benefit from this spray. Unexpectedly, there was stripe rust in many triticale varieties, though few were badly enough effected to warrant spraying. This stripe rust was later confirmed as a new pathotype, which will now have implications for stripe rust management in triticale.

Some disease issues at establishment occurred, with seedling blackleg confirmed in paddocks where there had been only one season break between canola crops in the rotation. This was confirmed as blackleg surviving on 2005 canola crop stubble as the lack of rain in 2006 suppressed spore development. Diseases such as sclerotinia and blackleg were not a problem later in the season because of dry conditions.

Higher yield potentials were not realised with the lack of rain. Lack of rain in spring favoured the early maturing wheat varieties, hence crop yields varied across the district. Crop yields in the western areas towards Corowa were low, while some crops on the eastern side of the district yielded 2.5-3 t/ha. Cereals in the western area on heavy country were low yielding, with some producing just 0.1-0.3 t/ha. On lighter soils, yields were generally higher at 0.5-0.8 t/ha. As harvest moved further east, yields rose to 1.6-2.2 t/ha, with crops in the east that benefited from later October rain yielding as high as 3 t/ha. Barley crops in the western areas yielded lower as they gained no advantage from late rain. Many western crops, particularly barley, had high screenings up to 50-70%.

Canola crops were among the first cut for hay following the lessons learnt in 2006. With the majority of canola crops cut for hay, yields of harvested canola varied across the district, however yield and oil content were generally low. Many lupin and pea crops were frosted in October and were cut for silage or hay. The few taken through to harvest generally returned low yields of less than 0.5 t/ha.

Pastures

There was some pasture growth over the 2006-2007 summer where there was lucerne, but generally little feed was available and most graziers were supplementary feeding coming into autumn.

The timely April break, accompanied by above average temperatures and few frosts, resulted in excellent clover germination and pasture growth. The good moisture conditions into winter allowed maximum pasture growth for this period of the year. Many cereal crops were not grazed to their full potential during this time. There was reasonable growth in early spring but this quickly declined with the lack of rain.

Failed crops provided the only hay or silage available, with the quality of these varying depending on time of cutting. Newly established perennial pastures and lucerne struggled to establish and many died out before the late rain, failing for the second year in a row.

The late rain was perfect for lucerne pastures with subsequent lucerne growth prolific. Where the decision to sell stock had been made early, stocking rates were low coming into summer. The late and continuing summer rain provided plenty of summer feed in the form of summer grasses, volunteers and weeds. As such, most stock did not require hand feeding over the summer. Dam levels were low which caused some stock water issues. The exception to this was in those areas which received heavy storm rain in late October and November.

Victorian climate and weather patterns - 2007

Key message:

- Following is a simple summary of climate and weather information released by the Bureau of Meteorology for Victoria during 2007.

January

High pressure systems dominated during January. A cold front, combining with moisture from the tropics produced significant rainfall in some areas of the state (predominately in the west) between the 19th and the 22nd. Daytime temperatures were above average in January and nights were also warmer than usual.

February

February was generally hot and dry with extended periods between rainfall events. A stagnant trough system was responsible for the prolonged period of humid conditions experienced in the second half of the month. This system was responsible for a number of thunderstorms which allowed much of the state to achieve close to average rainfall. East and West Gippsland recorded significant falls.

March

Characterised by warmer than normal days and nights. Some sites had their highest March mean daily maximum temperature for at least 20 years. Rainfall returned to the 1961−1990 average across most of the state, with Victoria's Alpine catchments enjoying above average falls. Some sites had their highest total March rainfall on record or their highest total March rainfall for at least 20 years.

April

Useful rainfalls were received over much of the State. Blocking highs prevailed during the first two weeks. However, by the end of April, synoptic situations had become typical for late autumn, with westerlies and embedded fronts racing across the southern ocean. Daytime temperatures were above average whilst minimum temperatures were mostly near average.

May

Much of Victoria experienced a typical autumn break, with pre-frontal rain-bearing northwest cloud bands and strong westerly winds. Contributing to this rain was very cold water over the eastern tropical Pacific (suggesting a possible La Nina) and warm water off the north west coast of Australia which promoted more active jet streams.

June

A sequence of East Coast Lows was predominant in producing higher than average June rainfall totals across Victoria, however the state's north and west received below average rains. Rainfall was well above average in Gippsland, causing most rivers to approach record flood levels. It was generally cold across the state with widespread light to severe frosts reported across the northern and Mallee regions.

July

Had average or above average rainfall and near average temperatures. Conditions appeared to be favourable for the development of a La Niña. There were a number of events with snow down to low levels, and several nights with severe frost and widespread fog. Maximum and minimum temperatures were close to average across the State.

August
Dry across the State with some districts receiving only a small fraction of the usual rainfall. Daytime temperatures were well above normal, whilst night-time temperatures were mostly near normal. Skies were mostly clear, and there were many more days of sunshine than usual.

September
Dry, with warm days and cool nights. Average rainfall was less than half the normal in most districts. Some sites had their lowest total September rainfall on record whilst had their lowest total September rainfall for at least 20 years. Daytime temperatures were mostly between 1 and 2 degrees above normal, whilst overnight temperatures were slightly below normal.

October
Rainfall was again well below normal throughout the State. The driest district was the South Mallee with only 4 mm (normal: 36 mm). The wettest district was the Upper Northeast with 47.9 mm (normal: 104.8 mm). Maximum temperatures were about 2 degrees C above normal in most districts. Widespread damage from strong winds was reported at the end of the month.

A La Niña event was established in the Pacific. The main characteristics were colder than average temperatures along the equator (both on and below the surface), stronger than average Trade Winds and reduced cloudiness. However, this La Niña was late to develop by historical standards (most significant La Niña events are established by winter's end), suggesting that the associated Australian rainfall response may differ from past episodes.

Australia's recent climate was influenced by the unusually cool ocean temperatures to the north, and particularly northwest, of the continent. A marked cooling trend began in June when, historically, these waters would have been expected to warm as the La Niña evolved in the Pacific. These cooler than normal waters inhibited the formation of northwest cloudbands, which are a major source of winter and spring rain for central and southeastern Australia during La Niña years. During October there was a slight warming of the ocean to the north and northwest of the continent.

November
Rainfall was above average in most districts. Most rainfall was associated with a series of low pressure troughs and low pressure systems which moved across the state during the month. Both daytime and overnight temperatures were above average across most of the state.

December
December was a generally warm month in Victoria, both by day and night. Rainfall was above normal in most parts of the state, with the bulk of the rain falling in association with a low-pressure system which approached and then crossed the state between 19th and 23rd December. Most areas north of the Divide, except for the northern Mallee, had rainfall 50% to 100% above normal.

For more detailed monthly summaries visit:
http://www.bom.gov.au/climate/current/month/vic/archive/index.shtml

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Barley maximum yield experiment

Author: John Sykes

Contact No: 02 6023 1666

Organisation: John Sykes Rural Consulting

Location: Balldale
Growing Season Rainfall:
Annual: 392 mm (avg 504 mm)
GSR: 221 mm (avg 319 mm)
Soil:
Type: Red Chromosol
pH (H_20): 4.8
P (Colwell): 37 mg/kg
Deep Soil N: 86 kg/ha
Sowing Information:
Sowing date: 23/5/2007
Fertiliser: 90 kg/ha MAP
Row Spacing: 180 mm
Paddock History:
2006 – Wheat
2005 – Wheat
2004 – Canola
Variety: Baudin
Plot Size: 1.5 m x16 m
Replicates: 4

Key messages:

- Barley responded to inputs of nitrogen (N) and fungicide in 2006 and 2007.
- 20-40 kg/ha of N was required to maximise yield.
- Fungicide response was independent of N application.

Aim:
To assess the level of input required to maximise the yields of barley grown after wheat.

Method:
A replicated experiment was established using differing levels of post emergent N and fungicide to assess yield.

Results:

Table 2: Summary of 2007 yield, protein, screening and retention, gross margin and 2005 to 2007 yield

Treatment Description	Yield (t/ha)	Protein[5] (%)	Retention[6] (%)	Gross Margin[7] ($/ha)	Yield[8] 2005 to 2007 as % of N40 yield
Nil 0N[1]	1.0	11	99	182	69
Nil 20N[1]	1.3	11	98	277	88
Nil 40N[1]	1.7	12	96	380	100
Nil 60 N[1]	1.6	15	82	321	99
Nil 80N[1]	1.5	15	73	262	103
Nil 100N[1]	1.3	15	59	177	100
Nil 120N[1]	1.6	16	45	254	104
SD[2], Z31 + Z39[3] 0 N	1.3	10	97	264	82
SD[2] Z31 + Z39[3] 20 N	1.7	11	97	380	105
SD[2], Z31+ Z39[3] 40 N	2.1	11	97	512	125
SD[2], Z31+ Z39[3] 60 N	1.6	15	64	327	115
SD[2], Z31+ Z39[3] 80 N	1.6	16	60	302	129
SD[2], Z31+ Z39[3] 100 N	1.5	17	38	245	112
SD[2], Z31+ Z39[3] 120 N	1.4	16	46	164	110
SD[2], Z31 40 N[4]	1.9	11	95	453	113
SD[2], Z39 40 N[4]	1.9	11	90	445	123
SD[2], Z45 40 N[4]	1.9	10	94	455	105
SD[2], Z31 80 N[4]	1.6	16	66	293	108
SD[2], Z39 80 N[4]	1.6	16	47	319	106
SD[2], Z45 80 N[4]	1.7	16	74	346	103

Treatment Description	Yield (t/ha)	Protein[5] (%)	Retention[6] (%)	Gross Margin[7] ($/ha)	Yield[8] 2005 to 2007 as % of N40 yield
SD[2], FolZ31 80 N[4]	1.7	15	91	343	118
SD[2], FolZ31+ Z39, 40N	1.9	11	95	440	122
SD[2], FolZ31+ FolZ39, 80N	1.7	16	55	317	113
SD[2], FolZ39, 80N	1.6	15	48	308	108
SD[2], OpusZ31+ Z39, 40N	1.8	12	98	409	123
SD[2], OpusZ31+ OpusZ39, 80N	1.7	15	78	307	114
SD[2], OpusZ39, 40N	1.9	11	92	438	112
SD[2], OpusZ31, 40N	1.9	12	88	463	108
Average	1.6				
LSD	0.1				
CV	14%				

Z – Zadok's Growth Stage. 1- Rate of post emergent N applied at Z23. 2 – SD – Seed Dressing as 1.5 L/t of Baytan. 3 – Two applications of 500 ml/ha of 125 g/L Triadimefon fungicide at Z30 and Z39. 4- One application of 1 L/ha of 125 g/L Triadimefon fungicide at Z30, Z39 or Z45. 5 & 6- Protein and retention one sample from rep 4 only. 7- Gross Margin (whole $/ha) based on $360 /t (del local silo) and N @ $1.50 /kg delivered. 8 - Average 2005 to 2007 yield expressed as a % of the N40 yield of 2.2 t/ha.

Observations and comments:

- N increased the yield to 40 kg/ha. Yield decreased with additional N applications.
- Fungicides increased yield in the absence of additional N. The response was relatively uniform to 40 kg/ha of N at 0.3 t/ha. Above 40 kg/ha of N there was no response to either N or fungicide.
- No N resulted in good protein and excellent retention for the production of malting barley. 40 kg N/ha resulted in protein levels and grain retentions that are suitable for malting.
- A single application of fungicide at about Z31 gave the best results.
- Using 40 kg/ha of N and one fungicide spray (applied by ground) gave the highest gross margin.
- A preliminary extension program for improved growing barley was begun in 2007. There were no results due to the dry conditions. N or fungicide was not used by the cooperating farmers. It will be run again in 2008 and 2009.

Sponsors:
The Grains Research and Development Corporation, Charles Cay and Susie Cay.

Crop comparison after wheat and canola

Author: John Sykes

Contact No: 02 6023 1666

Organisation: John Sykes Rural Consulting

Location: Balldale
Growing Season Rainfall:
Annual: 392 mm (avg 504 mm)
GSR: 221 mm (avg 319 mm)
Soil:
Type: Red Chromosol
pH (H_20): 4.8
P (Colwell): 37 mg/kg
Deep Soil N: 86 kg/ha
Sowing Information:
Sowing date: 23/5/2007
Fertiliser: 90 kg/ha MAP
Row Spacing: 180 mm
Paddock History:
2007 – Wheat
2006/05 – Wheat
2004 – Canola
Plot Size: 1.5 m x 16 m
Replicates: 4

Key messages:

- Wheat on wheat following canola is an alternative that will enable more cereal crop to be grown in a rotation.
- Barley yields best under dry conditions.
- There were responses to additional nitrogen (N) or fungicide treatments in all cereal crops.
- Alternative crops such as canola and lupins yield very poorly in drought seasons.

Aim:
To test if wheat can be successfully grown after wheat and canola and to assess if wheat is the best crop to grow at this point in the rotation.

Method:
A replicated experiment was established in 2007 using expanded treatments to those used in 2004-2006.

Results:

Table 3: Yield and gross margin return of the 2007 crop comparison experiment

Treatment Description	Dry Matter (t/ha)	Yield (t/ha)	GM ($/ha)
Wheat 0 kg/ha of N	2.7	1.2	258
Wheat 40 kg/ha of N	4.0	1.4	305
Wheat 80 kg/ha of N	4.1	1.6	356
Wheat 120 kg/ha of N	3.9	1.5	250
Wheat 0 kg/ha of N & Fungicide	4.4	1.5	390
Wheat 40 kg/ha of N & Fungicide	4.6	1.5	345
Wheat 80 kg/ha of N & Fungicide	4.1	1.2	185
Wheat 120 kg/ha of N & Fungicide	4.5	1.4	180
Triticale 0 kg/ha of N	3.4	1.4	335
Triticale 40 kg/ha of N	3.9	1.8	432
Triticale 80 kg/ha of N	4.1	1.7	333
Triticale 120 kg/ha of N	4.1	1.6	274
Triticale 0 kg/ha of N & Fungicide	4.2	1.6	367
Triticale 40 kg/ha of N & Fungicide	4.1	1.6	331
Triticale 80 kg/ha of N & Fungicide	4.4	1.5	251
Triticale 120 kg/ha of N & Fungicide	4.6	1.5	223
Barley 0 kg/ha of N	3.1	1.1	235
Barley 40 kg/ha of N	3.9	1.6	429
Barley 80 kg/ha of N	3.9	1.6	414
Barley 120 kg/ha of N	3.9	1.6	427
Barley 0 kg/ha of N & Fungicide	4.1	1.5	381

Treatment Description	Dry Matter (t/ha)	Yield (t/ha)	GM ($/ha)
Barley 40 kg/ha of N & Fungicide	4.0	1.6	411
Barley 80 kg/ha of N & Fungicide	4.1	1.4	330
Barley 120 kg/ha of N & Fungicide	4.3	1.4	332
Canola 0 kg/ha of N	1.4	0.4	27
Canola 40 kg/ha of N	1.3	0.4	72
Canola 80 kg/ha of N	1.6	0.4	32
Canola 120 kg/ha of N	1.7	0.4	29
Canola 80 kg/ha of N & Fungicide	1.6	0.3	-10
Canola 120 kg/ha of N & Fungicide	1.6	0.5	58
Lupins	1.1	0.4	-48
Average	3.4	1.2	
Average (cereals)	4.0	1.5	
LSD	0.6	0.2	
CV	0.0%	15.4%	

P applied at 20 kg/ha to all plots as MAP, this included 12 kg/ha N. Fungicide - 3 x 1L/ha of 125g/L Triadimefon (Bayleton®) applied at Z31, Z39 and Z45 for cereals. Canola treated with Rovral® for septoria control at early flowering.

Table 4: 2004/07 average grain yield (% of farmer wheat) and gross margin return of the crop comparison experiment

Crop	Farmer[1]		HiN[2]		HiN+Fung[3]	
	Yield (%)	GM ($/ha)	Yield (%)	GM ($/ha)	Yield (%)	GM ($/ha)
Wheat	100	179	141	212	156	212
Triticale	118	229	161	229	170	253
Barley	103	158	140	205	152	228
Canola	36	61	51	57		
Lupins	37	-16				

1- Normal Farm management. P applied at 20 kg/ha, N at 12-53 kg/ha including 0-40 kg/ha post emergent.
2- HiN Management as for 1 but 40 kg/ha extra N applied post emergent. 3- HiN + Fung - As for 2 plus 2 or 3 x 1 L/ha applications of 125 g/L Triadimefon fungicide applied at Z32, Z39 and Z45 for disease control in cereals.

Observations and comments:

- Addition of N or fungicide (Table 3) significantly increased the yield of wheat, barley and triticale in 2007.
- The fungicide response is unlikely to be caused by the presence of disease but may be caused by the extra green leaf observed to be produced by plants.
- In the last 4 years, (Table 4) the application of N produces a yield rise in wheat, barley and triticale, with economic returns in wheat and barley.
- In the last 4 years, the application of fungicide produces a yield rise in all cereals with a slight increase in gross margin in triticale and barley.
- Canola and lupins yielded poorly in 2007 with low gross margins becoming more negative as inputs were applied.
- Canola has responded positively to N applications but not to fungicide, even in the wetter year of 2005.

Sponsors:
The Grains Research and Development Corporation, Charles Cay and Susie Cay.

Triticale maximum yield experiment

Author: John Sykes

Contact No: 02 6023 1666

Organisation: John Sykes Rural Consulting

Location: Balldale
Growing Season Rainfall:
Annual: 392 mm (avg 504 mm)
GSR: 221mm (avg 312 mm)
Soil:
Type: Red Chromosol
pH (H_20): 4.8
P (Colwell): 37 mg/kg
Deep Soil N: 86 kg/ha
Sowing Information:
Sowing date: 23/5/2007
Fertiliser: 90 kg/ha MAP
Row Spacing: 180 mm
Paddock History:
2006 – Wheat
2005 – Wheat
2004 – Canola
Variety: Kosciusko
Plot Size: 1.5 m x16 m
Replicates: 4

Key messages:

- Triticale responded to nitrogen (N) and fungicide in the last three years.
- In 2007, the response was to either N or fungicide.
- The variety Tobruk yields as well as Kosciusko when not grazed. Tobruk did not respond significantly to fungicide.

Aim:
To assess the level of input required to maximise the yields of triticale grown after wheat.

Method:
A replicated experiment was established using differing levels of post emergent N and fungicide to assess yield.

Results:

Table 5: Summary of yield and gross margin returns for Triticale

Treatment Description	Dry Matter (t/ha)	Grain Yield (t/ha)	GM ($/ha)	Long Term
0 N	2.6	1.2	270	65
20 N[1]	4.0	1.5	349	80
40 N[1]	3.8	1.7	408	100
60 N[1]	3.6	1.6	357	91
80 N[1]	3.3	1.5	284	88
100 N[1]	3.4	1.5	277	84
120 N[1]	3.4	1.3	176	84
Fungicide[2] 0 N	2.8	1.5	365	79
Fungicide[2] 20 N	4.0	1.8	466	101
Fungicide[2] 40 N	3.9	1.9	466	108
Fungicide[2] 60 N	3.6	1.6	348	101
Fungicide[2] 80 N	3.3	1.5	299	95
Fungicide[2] 100 N	3.4	1.5	261	98
Fungicide[2] 120 N	2.9	1.3	171	100
Tobruk + 40 N	3.4	1.5	316	
Tobruk + 40 N+ Fungicide[2]	3.7	1.7	385	
Endeavour + 40 N	2.3	1.1	186	
Endeavour + 40 N + Fungicide[2]	3.0	1.2	227	
Average	3.3	1.5		
LSD	0.5	0.2		
CV	23%	16%		

1 – Rate of post emergent N applied at Z31.
2 – One application of 500 ml/ha of 125 g/L Triadimefon fungicide at Z30, Variety – Kosciusko unless stated.

Observations and comments:

- Addition of 40 kg/ha of N significantly increased the yield of triticale.
- Addition of fungicide did not significantly increase yield where N was used.
- Fungicides increase yield in the absence of N.
- The most economic treatment (gross margin) was 40 kg/ha of N with or without fungicide.
- Tobruk yielded as well as Kosciusko, but Endeavour (dual purpose) yielded significantly worse than Kosciusko.

Sponsors:
The Grains Research and Development Corporation, Charles Cay and Susie Cay.

Wheat fungicide experiment

Author: John Sykes

Contact No: 02 6023 1666

Organisation: John Sykes Rural Consulting

Location: Balldale
Growing Season Rainfall:
Annual: 392 mm (avg 504 mm)
GSR: 221 mm (avg 319 mm)
Soil:
Type: Red Chromosol
pH (H_2O): 4.7
P (Colwell): 39 mg/kg
Deep Soil N: 86 kg/ha
Sowing Information:
Sowing date: 23/5/2007
Fertiliser: 90 kg/ha MAP
Row Spacing: 180 mm
Paddock History:
2006 – Wheat
2005 – Wheat
2004 – Canola
Plot Size: 1.5 m x 16 m
Replicates: 4

Key messages:

- Seed and fertiliser dressings and in-crop fungicides gave responses in wheat that were inconsistent.
- Stripe rust resistant varieties gave less response.
- Generally the best response came from spraying at full tillering (Z31).

Aim:
To assess different fungicide timing and dressings for stripe rust control on the yield of a number of wheat varieties.

Method:
A replicated experiment was established comparing different fungicides and seed or fertiliser dressings for their ability to control stripe rust on a number of varieties.

Results:

Table 6: Summary of 2007 dry matter, grain yield, gross margin return and long term yield

Treatment Description	Dry Matter (t/ha)	Yield (t/ha)	GM ($/ha)	Yield[2] (2005/7) % of Triadimefon (Z31+Z39) yield
Nil	4.2	1.1	234	68
Z31[1]	4.5	1.6	398	96
Z31+Z39[1]	4.7	1.5	385	100
Z39[1]	4.6	1.5	381	81
Z45[1]	4.3	1.2	270	93
Opus Z31	4.5	1.5	374	95
Opus Z31+Z39	4.3	1.4	304	119
Opus Z39		1.4	327	92
Opus Z45		1.4	322	79
Folicur Z31	4.1	1.4	319	119
Folicur Z31+Z39		1.4	306	96
Tilt Z31	4.8	1.5	382	108
Tilt Z31+Z39		1.4	333	89
Tilt Z39		1.5	386	88
Jockey Nil	4.3	1.5	365	80
Jockey Z31	4.4	1.6	389	83
Jockey Z31+Z39		1.6	376	53
Jockey Z39		1.5	361	99
Jockey Z45		1.5	376	93
Impact Nil	4.4	1.5	356	124

Treatment Description	Dry Matter (t/ha)	Yield (t/ha)	GM ($/ha)	Yield[2] (2005/7) % of Triadimefon (Z31+Z39) yield
Impact Z31	4.8	1.6	401	102
Impact Z31 + Z39		1.6	390	
Impact Z39		1.4	337	
Impact Z45		1.4	313	
Triad Nil	4.7	1.6	405	
Triad Z31	4.6	1.5	370	
Triad Z31 + Z39		1.6	407	
Triad Z39		1.4	351	
Triad Z45		1.7	432	
Sunvale	4.4	1.4	353	
Sunvale Z31	4.7	1.4	351	
Sunvale Z31+Z39	4.5	1.4	343	
H45	4.4	1.2	259	
H45 Z31+Z39	4.5	1.4	336	
Ventura Nil	5.2	1.7	460	
Ventura Z31	4.9	1.6	424	
Ventura Z31+Z39	4.9	1.5	388	
Ventura Z39		1.6		
Average	4.5	1.5		
LSD	0.9	0.2		
CV	21%	9%		

Z – Zadok's Growth Stage, 1 – In-crop fungicide at the times nominated – 500 ml/ha of 125g/L Triadimefon (Bayleton®) at the growth stage/s nominated. 2 – Yield as a percentage of Triadimefon applied at Z31 & Z39 (Z31+Z39). Variety - where not stated Diamondbird.

Observations and comments:

- Fungicides produced significant responses in 2007.
- Fungicide products gave variable results, with the best responses coming from sprays to Z31 or Z31 and Z39.
- Observations suggested that plots receiving fungicide stayed greener longer than plots without fungicide. This may explain the higher yield.
- Fungicide did not increase the dry matter yield of wheat.
- Ventura had the best yield and gross margin.

Sponsors:
The Grains Research and Development Corporation, Charles Cay and Susie Cay.

Wheat maximum yield experiment

Author: John Sykes

Contact No: 02 6023 1666

Organisation: John Sykes Rural Consulting

Location: Balldale
Growing Season Rainfall:
Annual: 390 mm (avg 504 mm)
GSR: 221 mm (avg 319 mm)
Soil:
Type: Red Chromosol
pH (H_20): 4.8
P (Colwell): 37 mg/kg
Deep Soil N: 86 kg/ha
Sowing Information:
Sowing date: 23/5/2006
Fertiliser: 90 kg/ha MAP
Row Spacing: 180 mm
Paddock History:
2007 – Wheat
2006/05 – Wheat
2004 – Canola
Plot Size: 1.5 m x 16 m
Replicates: 4

Key messages:

- Wheat responds to up to 40 kg/ha of nitrogen (N), even in dry conditions.
- In dry years, wheat has not significantly responded to fungicides.
- On average, MS susceptible varieties have responded to fungicides.

Aim:
To assess the level of input required to maximise the yields of wheat grown after wheat.

Method:
A replicated experiment was established using different levels of post emergent N and fungicide to assess yield.

Results:

Table 7: Summary of 2007 yield, protein, screenings and gross margin results and average yields (2005/07)

Treatment Description	Yield (t/ha)	Protein[3] (%)	Screenings[4] (%)	Gross Margin[5] ($/ha)	Avg Yield (05/07)[6] % of 40N yield
P20, 0 N	1.0	11	2	121	69
P20, 20 N	1.6	13	2	293	83
P20, 40 N	1.7	15	3	304	100
P20, 60N	1.6	16	6	255	102
P20, 80 N	1.5	15	15	206	105
P20, 100N	1.3	17	32	126	94
P20, 120N	1.0	17	22	-9	91
P20, 0 N, Fungicide[1]	1.2	12	1	198	82
P20, 20 N, Fungicide[1]	1.9	13	4	383	109
P20, 40 N, Fungicide[1]	2.1	15	5	408	119
P20, 60N, Fungicide[1]	1.8	15	10	308	115
P20, 80 N, Fungicide[1]	1.8	15	22	265	117
P20, 100N, Fungicide[1]	1.4	16	41	138	98
P20, 120N, Fungicide[1]	1.1	17	56	34	86
P20 40N, Z25[2]	2.1	14	3	413	
P20, 40N, Z39[2]	1.8	16	3	325	
P20, 40N, Z45[2]	1.7	16	6	298	
P25, 40N, Fungicide[1]	2.2	14	5	386	
P25, 80N, Fungicide[1]	1.6	14	18	199	
P30, 40N, Fungicide[1]	2.0	14	4	331	
P40, 40N, Fungicide[1]	1.9	14	4	304	
Average	1.6				2.2
LSD	0.4				

All seed treated with Jockey® seed dressing, Z – Zadok's Growth Stage, N applied @ Z25 (designed for Z31).
1 - Fungicide - Two applications of 500 ml/ha of 125 g/L Triadimefon (Bayleton®) at growth stages Z30 and Z39.
2 - Z25 or Z39 or Z45 – one application of 500 ml/ha of 125 g/L Triadimefon at that Zadock's growth stage.
3 & 4 - Protein and screenings one sample from rep 4 only.
5 - Gross Margin (whole $/ha, excl GST) based on $400 /t (delivered local silo) and N @ $1.20 /kg delivered.
6 - Average 2005 to 2007 yield expressed as a % of the N40 yield for that year. Avg 2005-07 N40 yield 2.2 t/ha (not all treatments included in each year). Variety – Diamondbird.

Observations and comments:

In 2007

- Addition of 20 and 40 kg/ha of N resulted in a significant increase in yield and gross margin.

- In 2007, addition of fungicide did not significantly increase yield. This may have been due to the Jockey® treatment of seed.

- Protein and screenings were not adversely affected until more than 40 kg/ha of N was applied.

Between 2005 and 2007

- The best yield (119%) was achieved from 40 kg/ha of N and the fungicide treatment.

- N responses occurred up to 80 kg N/ha in 2005. In 2006 and 2007 N responses occurred up to 40 kg N/ha.

- Fungicide responses occurred in 2005 and 2006. In 2005 this was due to high levels of disease.

Sponsors:

The Grains Research and Development Corporation, Charles Cay and Susie Cay.

Wheat trace element experiment

Author: John Sykes

Contact No: 02 6023 1666

Organisation: John Sykes Rural Consulting

Location: Boomahnoomoonah East Victoria
Growing Season Rainfall:
Annual: 360 mm (avg 520 mm)
GSR: 236 mm (avg 320 mm)
Soil:
Type: Red Chromosol
pH ($CaCl_2$): 5.0
Sowing Information:
Sowing date: 5/6/2007
Fertiliser: MAP 70 kg/ha
Urea 80 kg/ha
Row Spacing: 220 mm
Paddock History:
2007 – Logran applied
2006 – Canola
2005 – Wheat
Plot Size: 2 m x 20 m
Replicates: 4

Key messages:

- There was no response to any trace elements or mixtures of trace elements, except zinc.
- Zinc responses may occur in red soils particularly if a Chlorsulphuron herbicide, like Logran, is used.
- Zinc produced significantly more tillers but not a yield response.

Aim:
To test a number of trace elements and mixtures of trace elements for responses in wheat.

Method:
An exclusion experiment was established to test responses to zinc (Zn), manganese (Mn), molybdenum (Mo), copper (Cu), boron (B) and sulphur (S).

Results:

Table 8: Trace element treatment results for wheat, 2007

Treatment	First Tiller Count*	Second Tiller Count*	Yield (t/ha)
Nil (no trace elements)	342	492	2.4
Half rate of Zn, Mn, Cu, B, Mo**	328	471	2.5
Zn Mn Cu B Mo	418	599	1.9
Zn Mn Cu B	423	582	2.1
Zn Mn Cu Mo	422	595	2.0
Zn Mn B Mo	399	601	1.8
Zn Cu B Mo	410	588	2.0
Mn Cu B Mo	328	471	2.5
Zn Mn Cu B Mo S	420	588	2.0
Liquid Zn Mn Cu B Mo S	407	583	2.1
Average for all Full Rate of Zn treatments	342	492	2.4
No Zn	414	593	2.0
Average	403	565	2.1
LSD	62	87	0.4

*- Tillers/m^2, ** - Elements applied at approximately half the recommended rates of the products.

Observations and comments:
No trace elements, except the full rate of Zn, resulted in a significant increase in tiller numbers or yield over the nil treatment. Applications of Zn produced visible responses in early crop growth and significantly more tillers at both the first count (early August prior to Z31) and the second count (late September). This did not relate to a yield response. Plots treated with the full rate of Zn produced significantly less yield than the non Zn treated plots. The visual Zn responses may have been enhanced by the use of a Chlorsulphuron herbicide (Logran) that can induce Zn deficiencies. The lack of spring rain probably resulted in the thicker plots (those with Zn applied) yielding less than the thinner plots.

The response in tiller numbers to Zn application suggests that Zn may produce yield rises, particularly if a Chlorsulphuron herbicide is used. It should be tested by farmers.

Sponsors:
Farmer co-operator: Malcolm Bruce, Boomahnoomoonah East.

Beneficial invertebrates in field crops

Author: Joanne Holloway

Contact No: 02 6938 1605

Organisation: NSW DPI, Wagga Wagga

Key messages:
- Beneficial species assist in keeping pest insect numbers below the economic threshold.
- Beneficial species are an important component of IPM strategies.
- Crop management practices may enhance numbers of beneficial invertebrate species.

Aim:
To increase the awareness of the importance of beneficial species and IPM strategies in the grains industry.

Method:
Ten paddocks, between Shepparton (Victoria) and Henty (NSW) were surveyed three times during the year for both pest and beneficial invertebrate species (i.e. insects, mites and spiders). Samples were collected using pitfalls, yellow sticky traps and vacuum sampling during March (pre-sowing), July (crop establishment) and November (peak crop biomass). Pitfalls and yellow sticky traps were left in place for 1 week, and vacuum sampling (10 minute duration) occurred when these traps were removed. Use of all three types of traps ensured that flying, canopy and ground-dwelling invertebrates were all surveyed. Crops sampled included wheat, triticale, canola and lucerne. Invertebrates were sorted into species to determine the abundance and diversity of species present within the crops. Results will be analysed to determine the effect, if any, a range of management practices, such as stubble management, tillage, native vegetation, and chemical applications, have on the number and diversity of beneficial species.

Results:
Samples have been separated into reference ‘morphospecies’ that will be identified at a later date to species level. Unfortunately, due to the drought, conditions within the crops were not “typical”, with many of the crops harvested prior to the last survey due to poor conditions. This may have affected the number and type of invertebrates collected.

Diversity in the overall number of species was greatest in November, prior to harvest, than during both the pre-sowing or establishment phases, with 185 species types recognised from the November sample compared to 157 in March and 90 in July. The main groups represented in all surveys were Hymenoptera (ants and wasps), Coleoptera (beetles) and Diptera (flies). Of the total species, approximately 40% were beneficial, 30% pest and 30% neutral (neither harmed nor benefited the crop).

Beneficial species collected included several species of wasp (both parasitic and predatory), spiders, predatory beetles, bugs and mites, lacewings and mantids. In all, 55 beneficial species were collected in March, 29 in July and 78 in November. In all samples, wasps and spiders comprised the highest number of species and individuals. The greatest number of beneficial species was present in cereal crops during November (61), while only 8 beneficial species were found in canola crops during July.

The most prevalent pest species throughout the surveys were field crickets, leafhoppers and mites. Lucerne flea was the dominant pest in all crops during July, and Rutherglen bug the most common during November. Aphid swarms were present in some crops, particularly lucerne, during July and November.

The retention of cereal and canola stubble appears to enhance the abundance of beneficial species. While the numbers of beneficial species in all paddocks were similar during the March sample, there were almost twice as many beneficial individuals found in paddocks with stubble compared to a bare cultivated paddock that had previously been burnt. Although a similar result was also found for pest abundance, the average numbers of pests collected were lower than the average numbers of beneficials. The effect of burning on invertebrate numbers appears to be short-term only, with similar numbers of both beneficials and pests found in cereal paddocks 3 months later during the crop establishment survey.

Observations and comments:
The invertebrate community in field crops is diverse, with many species having no effect on the crops. Beneficial species comprise quite a large component of this community. Although numbers may vary, beneficial species are present throughout the year, including periods between harvest and sowing of new crops.

The most common beneficial invertebrates found in crops throughout the Riverine Plains were parasitic and predatory wasps, spiders, predatory beetles and bugs, and lacewings. Stubble retention appears to assist these species to survive from harvest through to the sowing of a new crop. However, this practice may also benefit some pest species, particularly some beetle species such as weevils and wireworms. This may be overcome with the use of selective chemical sprays. With further research and analysis, it should also be possible to determine which crop management practices are most conducive to enhancing the beneficial invertebrate populations in this region, which would be an initial step towards developing an IPM strategy for field crops.

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Boorhaman stubble management project – Nitrogen responses in triticale sown into burnt and retained stubble

Authors: Rob Harris, Phil Newton, Pauline Mele, Andrew Mackie and Tom Goldsmith

Contact No: 02 6030 4500

Organisation: Boorhaman Landcare Group and DPI Victoria, Rutherglen

Location: Peechelba East
Growing Season Rainfall:
Annual: 456 mm
GSR: 258 mm
Soil:
Type: loam over clay
pH (H_20): 4.8
Sowing Information:
Sowing date: 24/5/07
Fertiliser: 100 MAP
Row Spacing: 17.5 cm
Paddock History:
2006 – Wheat
2005 – Canola
2004 – Wheat
Plot Size: 30 m x 100 m
Fertiliser strips: 5 m x 30 m
Replicates: No replicates

Key messages:
- Increased grain yield in response to top-dressed nitrogen (N) was only found where triticale was sown into burnt wheat stubble.
- Grain yield of triticale sown into retained wheat stubble was unaffected by top-dressed N.
- Microbial biomass in the retained stubble treatment supported greater turnover of wheat residue from previous seasons, which provided sufficient soil N to maintain grain yields under water limited conditions.

Aim:
To investigate the interaction between stubble management strategies and rates of N fertiliser top dressed onto triticale.

Method:
Different rates of N (0, 15, 30, 60 and 90 kg N/ha) as urea were top-dressed at the completion of crop tillering (Zadok's stage Z31 on 13th August 2007) onto triticale crops that were sown into retained or burnt stubble. Deep (0-60 cm) plant available soil N was measured at sowing, while soil moisture content and microbial biomass (carbon and nitrogen) were measured on 9th September 2007.

Results:
Less plant available soil N was found at sowing under the retained stubble treatment (Table 9). Soil moisture and microbial biomass (carbon and nitrogen) were approximately 20% higher under retained stubble on 9th September 2007 (Table 9).

The response to fertiliser N was greater where triticale was sown into burnt stubble (Figure 9).

Table 9: Plant available soil N, soil moisture content and microbial biomass at Peechelba East

Treatment	Plant available soil N at sowing (kg/ha)		Soil moisture content (g/g)	Microbial biomass (ug/g) carbon	Microbial biomass (ug/g) nitrogen
	0-10 cm	10-60 cm	0-10 cm	0-10 cm	0-10 cm
Retained	47	12	0.11	81	11.96
Burnt	53	16	0.09	64	9.50

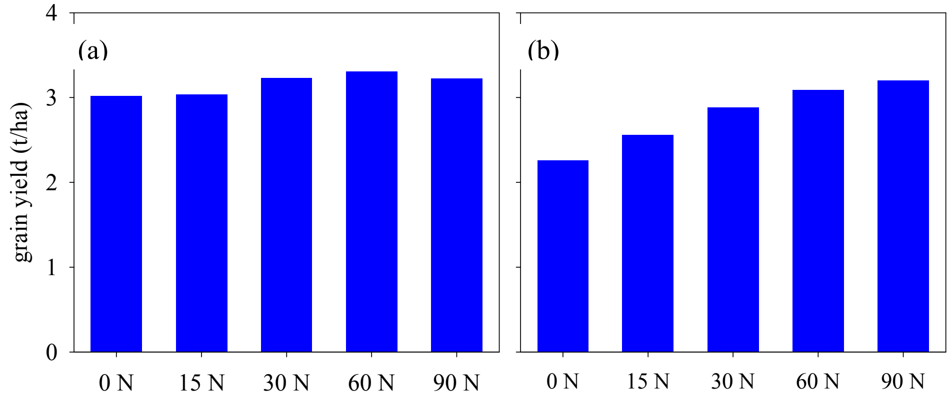

Figure 9. Grain yield (t/ha), of triticale sown into retained (a) and burnt (b) stubble, at different rates of top-dressed N

Observations and comments:

Despite sowing triticale on only narrow 17.5 cm row spacings, crop establishment was not compromised under retained stubble, which was largely due to low loads of wheat residue (2-3 t/ha). This meant that triticale crops performed equally well under both stubble management strategies at the time of N fertiliser application.

Whilst soil microbial biomass levels were relatively low overall due to the dry conditions (with expected values usually around 100-200 µg/g microbial biomass C) there appears to be a treatment effect with lower levels of microbial biomass observed (Table 9) under the burnt treatment. This is most likely attributable to the higher soil moisture found with stubble retention and in contrast, less organic matter decomposition and release of plant available N into soil solution under the burnt treatment. The higher microbial biomass under stubble retention would initially cause N-tie-up leading to less soil N crop uptake and a greater reliance on fertiliser N. However, this tie-up is usually short-lived with release of microbial biomass N when soil moisture increases later in the growing season.

The fertiliser N response of triticale sown into burnt stubble, plateaued at about 45 kg N/ha (Figure 9) due to the lack of rainfall. Crop stubbles had only been retained at the site for two years previously and greater soil moisture retention under the retained stubbled probably encouraged a short-term increase in microbial colonisation and hence, the associated benefits in terms of greater soil N supply. The current dry climatic conditions and escalating costs of N fertiliser provide new reasons for retaining crop residues in local dryland cropping systems; firstly, to conserve soil water and secondly, as a potential source of N.

Sponsors:

National Landcare Program.

Seeder and phosphorus trial – Strathbogie Ranges

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Location: Terip Terip
Growing Season Rainfall:
Long term avg: 565 mm
2007 GSR:(Apr-Nov) 405 mm
Soil:
Type: Granitic sand over loam
pH (CaCl): 4.4 (0-10cm)
Sowing Information:
Sowing date: 16/4/07
Fertiliser: 100 kg/ha MAP
Row Spacing: 23 cm and 13 cm
Paddock History:
2006 – Wheat hay
2005 – Lupins (failed)
Plot Size: 15 m x 420 m
Replicates: nil

Key message:
- Applied phosphorus (P) failed to give a response on a high P soil.
- Narrower row spacing appeared to give a slight yield advantage.

Aim:
To evaluate the performance of two different seeding machines with different row spacings and to determine whether the application of P fertiliser affected yield on a high P soil in a high rainfall area.

Method:
Jackie triticale was sown in plots measuring 420m x 15m (0.63 ha) using a farmer's tyned air seeder on 23 cm spacing and a Vaadestat disc drill on 13cm spacings. Both machines sowed test strips with and without P fertiliser. The plots were sown on 16th April 2007 at 120 kg/ha seed into a drying profile. Plus P plots received 100 kg/ha MAP. Significant rain fell on 28th April 2007. Plots were harvested using the farmer's header and yield measured over a weigh cell.

Results:

Table 10: Yield and quality results

	13cm spacing			23cm spacing		
	Yield (t/ha)	Protein (%)	Screenings (%)	Yield (t/ha)	Protein (%)	Screenings (%)
+ Phosphorus	4.15	10.5	6.7	3.80	10.9	5.1
Zero Phosphorus	4.26	10.9	6.9	3.94	11.1	5.1
Average	4.21	10.7	6.8	3.87	11.0	5.1

Observations and comments:
There was no response to the phosphorus fertiliser at either row spacing however, this was not surprising given a paddock Colwell P level of 74 and a phosphorus buffering index of 79. It is likely that the slight gain where no P was applied is either not statistically different, or these plots may have hayed off less during the dry spring. Interestingly, the protein levels of both nil phosphorus plots was marginally higher than the phosphorus plots, and the nil P plots also had a marginally greater yield.

The wider row spacing (23cm) yielded 9% less than the 13 cm spacing. This is similar to 2007 data from south west Victorian trials which compared 20 cm spacings to 30 cm. This may be on account of having more exposed soil with minimal stubble cover in the dry season, increasing moisture losses through evaporation. Another possibility is narrower rows provided improved access to nutrients and sunlight compared to the wider rows.

Sponsors:
Farmer co-operator: Bruce McLennan, Terip Terip.

North East Victorian phosphorus response trials

Authors: Dale Grey, Dale Boyd and Michelle Pardy

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram and Echuca

Key messages:

- Small responses to applied phosphorus (P) were found at Colwell P levels above 40.
- No response was obtained at Colwell P 78.
- The highest response to P occurred at the latest sowing date.

Aim:
To observe phosphorus responses at a range of soil P levels and P buffering indexes.

Method:
The data obtained is a combination of replicated small plot and large scale strip trials in 2003, 2004 and 2007. In some cases rates have been varied from farmer practice or nil phosphorus has been applied. Yield was measured with a weigh bin or small plot header.

Results:

Table 11: Results of 2003, 2004 and 2007 P trials

Colwell P	PBI	pH(Ca)	Yield at nil P (t/ha)	Yield response to applied P (%)	Amount P applied (kg/ha)	Sowing date and other notes
35		6.6	5.24	-10	8	wheat sown 5th May. Irrigated
35		6.6	5.24	15	16	wheat sown 5th May. Irrigated
35		6.6	5.24	-6	24	wheat sown 5th May. Irrigated
41			2.81 (6kg P)	0	16.5	wheat sown late May
43			2.30	27	18.5	wheat sown early June
44			4.76	9	12	barley sown early May
44			4.76	9	20	barley sown early May
46	59	5.1	2.27	10	5	wheat sown 11th May
46	59	5.1	2.27	2	10	wheat sown 11th May
46	59	5.1	2.27	11	20	wheat sown 11th May
46	59	5.1	2.27	17	40	wheat sown 11th May
74	79	4.4	4.26	-3	22	trit 5"space sown 16th April
74	79	4.4	3.94	-1	22	trit 9"space sown 16th April

Observations and comments:
Until 2007, the north east DPI cropping extension team had not conducted specific P trials on low P soils and only one trial on what could be classified as high P soil. However, from data presented in Table 11, the following statements can be made:

The highest response to P was at the latest sowing date. This is not surprising given root growth and P acquisition by roots is decreased at lower soil temperatures and this makes applied P even more important at a later sowing date. Additionally, good P responses are not uncommon in dry springs as a result of limited P mineralisation. In a dry spring the P obtained at sowing has to effectively last the whole year, so the more put on the better the response.

At all sites with a Colwell P greater than 40, the zero P rate did not lead to disastrous yield reductions, suggesting soil P reserves were adequate to ensure crops yielded close to maximum. The latest phosphorus research theory suggests that 90% maximum yield can still be achieved without any P fertiliser on those soils having a minimum Colwell P of 35mg/kg and which have a Phosphorus Buffering Index (PBI) of between 50-100. Our data supports this, with a number of sites showing an extra 10% yield with the addition of P fertiliser to soils with moderate Colwell P levels. However, on a soil with a high P result (74 mg/kg Colwell), no yield response was obtained to applied P.

At some sites 5-6 kg/ha P has been all that was required to get a significant response. The site with a Colwell P level of 46 mg/kg showed a moderate response at the 40kg P rate. We cannot explain why 10 kg P/ha gave negligible response when 5 kg P/ha had a good effect. Nor can we explain the paddock with 35 Colwell where 16 kg P responded but 8 and 24 did not, but P trials are notorious for often giving strange data due to soil variability over small areas.

Sponsors:
Thanks to all the farmer co-operators.

Seeding rate trial – Youanmite

Authors: Michelle Pardy and Dale Grey

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Location: Youanmite
Growing Season Rainfall:
GSR: (Apr-Oct) 192 mm
Soil:
Type: Red Loam
pH (CaCl): 5.1 (0-10 cm)
Sowing Information:
Sowing date: 11/5/07
Fertiliser: 100 kg/ha MAP
Row Spacing: 17.8 cm
Paddock History:
2006 – Wheat
2005 – Canola
Plot Size: 1.4 m x 20 m
Replicates: 3

Key message:

- There was no significant difference in yield for Gregory wheat sown at plant densities of 50, 100, 150, 200 plants/m².

Aim:
To determine whether seeding rate affected the yield of Gregory, a mid-long season APW variety when sown in mid-May.

Method:
The trial site was prepared with a knockdown weed treatment on 8th May 2007 and was sown using a specialised trial plot cone seeder on 11th May 2007. Gregory was direct drilled into plots at different seeding rates to achieve plant populations of either 50, 100, 150 or 200 plants/m^2. There were three replicates of each treatment and plots measured 20 m x 1.4 m (0.003 ha). The trial was harvested on 14th December 2007 using a plot header.

Results:

Table 12: Yield and quality results from the Youanmite seeding rate trial

Treatment (target plants/m2)	Sow rate (kg/ha)	Plant Popn (Plants/m2)	Yield (t/ha)	Protein (%)	Screenings (%)	Test Wt (kg/hl)	N uptake (NUE)
Gregory 150 plants	71	139	2.03	12.0	3.0	78	39.2
Gregory 200 plants	95	211	1.60	12.0	3.6	77	30.9
Gregory 50 plants	24	52	1.57	12.1	2.9	78	30.3
Gregory 100 plants	47	104	1.57	12.6	2.6	78	31.2
	CV%	5.3	14.5	7.7	21	2.1	14.2
	LSD	14	0.49	1.8	1.27	3.25	9.3
	p=	<0.001	0.147	0.876	0.411	0.964	0.162

Observations and comments:
The crop was direct drilled into marginal moisture. Good rains were received in the days after sowing which ensured good emergence (average 92%). A knockdown pre-sowing herbicide treatment and an in-crop herbicide application provided good weed control throughout the season. Disease pressures were minimal.

Typically, a suitable target population for wheat sown in mid May would be between 150-200 plants/m^2. Plant densities greater than 200 plants/m^2 often create overly dense crops which tend to have their yield limited by a lack of moisture, nutrients or light. This experiment was intended to determine how a mid-late season variety such as Gregory would respond to a lower range of plant populations when sown at an ideal time (mid-May).

The highest yield (2.03 t/ha) was achieved by the 150 plants/m^2 treatment, with the 50, 100 and 200 plants/m^2 treatments all yielding approx 400 kg/ha less. However, the difference between the treatments was not enough to be statistically significant.

The mid May sowing date, combined with good early growing conditions, and relatively high background paddock fertility (Colwell P 45, available N (117 kg/ha N – enough for 3 t/ha)), encouraged early growth across all treatments. This enabled plots sown at the lower seeding rates to compensate by producing extra tillers in response to the favourable early conditions. This suggests that Gregory has the capacity to tiller well, given an early or ideal sowing date and as such, could be sown at a lighter rate in the event of limited seed resources. Later sowing would still require higher seeding rates due to the crop having less time to tiller to produce the recommended 400-600 heads/m^2 at flowering.

All treatments were badly affected by the dry spring, which reduced yield potential to well below early expectations. Ideally, this experiment would be repeated in a more favourable year to determine whether the same response occurred in a normal-wet spring.

There were no significant differences between protein, screenings or test weight results across the treatments.

Using the formula that Potential Yield = Growing season rainfall (Apr-Oct) – 110mm evaporation x 20, the potential yield for this site was 2.0 t/ha, which was close to that achieved by all treatments.

Sponsors:
Farmer co-operators: Wayne and Craig Thomas, Youanmite.

North East Victorian nitrogen stories

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5871 0600

Organisation: DPI Cobram

Key messages:
- Grain water use efficiency was often higher than 20 kg/mm/ha.
- Most hay water use efficiencies were below 55 kg/mm/ha.
- Nitrogen use efficiency varied from 21-50%.

Aim:
To better understand nitrogen demand and dynamics in cereal crops in north east Victoria.

Method:
0-10 and 10-60 cm soil tests were taken with foot probe and hydraulic rig before or after the seasonal break. Farmers provided us with paddock and yield data.

Results:
The data summation is presented in Table 13.

Observations and comments:
In 2007, early sowing did not provide the same yield advantage as it did in 2006. Apart from a few high yielding hay paddocks which removed a lot of nitrogen (N), the remaining grain and hay paddocks removed low amounts of N last year.

The efficiency of N uptake was generally lower than the benchmark 50%. This could be because most of the applied N went on in July or later, which was the last time it effectively rained for the season. As such, much of the applied N probably did not make it into plant, but may still be retained in the soil. These N efficiency calculations don't include mineralisation, which was negligible due to the lack of spring rain. Grain protein was also high due to the low yields and N applications that were ultimately unnecessary. Arguably, N additions may have increased biomass for hay cutting in some crops.

Water Use Efficiency (WUE) figures for grain are deemed close to maximum at around 20 kg/mm/ha. Maximum WUE figures for dry matter (hay/silage) are around 55 kg/mm/ha. Many grain crops, but few hay crops, exceeded these values last year, possibly due to subsoil moisture stored at depth, and which was probably stored beyond the 60 cm we tested to. The fact that fully wet-up soil profiles dried out from top to bottom meant that the stored moisture was available in time for grain filling, making WUE values higher than 20 kg/mm/ha possible. However, there are some notable outliers where crop production was lower or much higher than thought possible. Picola 2 was a failed pea paddock last year and was sown early leading to its higher than expected yield. The sites with low WUE essentially died.

Sponsors:
Many thanks to all the farmer co-operators.

Table 13: Agronomic data for crops sown, deep N, fertiliser and yield for some north east paddocks. Sorted in order of sowing date.

Location	Rotation	Variety	Sowing date	GSR (approx)	Soil N (0-60)	N applied (kg/ha)	Date topdressed	Total N (kg/ha)	Grain Yield (t/ha)	Protein (%)	N Removal (kg/ha)	N Uptake effn %	WUE (kg/mm)
Nathalia irri	wht/wht	Mackellar	15/03/2007	164	52	46	15/08/2007	98	3 heavy grazings		-	-	-
Lake Rowan	can/wht	Whistler	26/04/2007	200	81	56	25/07/2007	137	1.9	16	49	36	21
Picola 1	pea/wht	Janz	1/05/2007	137	90	8	-	98	4.5 hay	-	-	-	82
Telford M	can/wht	Chara	2/05/2007	193	56	67	16/08/2007	123	2.5	13	52	42	30
Telford L	can/wht	Chara	2/05/2007	193	79	76	16/08/2007	155	2	13	42	27	24
Telford H	can/wht	Chara	2/05/2007	193	73	76	16/08/2007	149	1.8	13	37	25	22
Peechelba East 1	pas/wht	Diamondbird	5/05/2007	234	99	10	-	109	1.9	-	-	-	15
Karramomus 2	wht/wht	Ruby	6/05/2007	211	84	44	8/07/2007	128	2.5	12.5	50	39	25
Devenish	can/wht	Whistler	8/05/2007	225	162	22	5/07/2007	184	3 hay	14	67	37	26
Katamatite East1#	can/wht	Ventura/whistler	10/05/2007	150	94	10	-	104	2.5 sge	13	52	50	42
Congupna 2#	bar/hay/wht	Wyalkatchem	10/05/2007	210	198	52	20/06/2007	250	5 hay	14	112	45	50
Rand H	can/wht	Ventura	10/05/2007	134	104	7	-	111	0.5	-	-	-	9
Rand M	can/wht	Ventura	10/05/2007	134	109	7	-	116	0.1	-	-	-	2
Rand L	can/wht	Ventura	10/05/2007	134	109	7	-	116	0.1	-	-	-	2
Katamatite east2#	trit/wht	Muir	11/05/2007	150	60	10	-	70	2.5 hay	-	-	-	42
Dookie	wht/wht	Whistler	11/05/2007	221	118	46	14/08/2007	164	4.9 hay	-	-	-	44
Youanmite	can/wht	Whistler	11/05/2007	192	117	9	-	126	2.25	12	43	34	27
Picola 2	wht/bar/wht	Frame	11/05/2007	137	74	7	-	81	0.2	-	-	-	4
Peechelba East 3	can/wht	Diamondbird	12/05/2007	200	153	45	16/08/2007	198	3.3	12	63	32	37
Boorhaman	lup/wht	Ruby	15/05/2007	259	153	10	-	163	5 Hay	-	-	-	34
Congupna 1#	clover/bar	Baudin	21/05/2007	210	162	32	15/07/2007	194	3.6	12.3	71	37	36
Kotupna	can/wht	Ventura	22/05/2007	164	113	8	-	121	2 hay	-	-	-	37
Yabba South H	can/wht	Diamondbird	25/05/2007	227	72	54	24/07/2007	126	1.8	11.8	34	27	15
Yabba South M	can/wht	Diamondbird	25/05/2007	227	81	54	25/07/2007	135	1.8	11.8	34	25	15
Yabba South L	can/wht	Diamondbird	25/05/2007	227	98	54	23/07/2007	152	1.8	11.8	34	22	15
Katamatite	can/wht	Gairdner	26/05/2007	208	79	8	-	87	2.7 hay	-	-	-	28
Miepoll	can/wht	Chara	28/05/2007	277	126	9	-	135	1.5	12	29	21	9
Peechelba East 2	pas/wht	Ruby	30/05/2007	234	126	22	30/05/2007	148	2.5 Hay	11.2	45	30	20
Karramomus 1	trit hay/trit	Abacus	3/06/2007	211	67	10	-	77	4.8 hay	-	-	-	48

irrig in 2006
H, M, L refers to high, medium and low EM areas of zoned paddocks, approximating differences in clay content

North East Victorian soil phosphorus and sulphur

Authors: Dale Grey and Michelle Pardy

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Key messages:

- Large amounts of sulphur, adequate for many years of cropping, were found in most paddocks.
- Large banks of phosphorus exist in some paddocks.

Aim:
To examine phosphorus (P) and sulphur (S) dynamics in north east Victorian soils.

Method:
Either prior to or just after the season break, soil samples were taken by foot probe and by hydraulic rig at 0-10 and 0-60 cm depth. Cores were dried and then analysed for a range of soil parameters.

Results:

Table 14: pH, P and S status of some north east soils

Location	pH $CaCl_2$	OC (%)	Colwell P	PBI	Total soil P (mg/kg)	% avail. P	Total avail. S (0-60)kg/ha
Rand M	5.5	1.68	35	82	169	21	106
Rand H	5.1	1.84	34	75	205	17	224
Miepoll	4.6	1.39	32	89	254	13	80
Yabba South L	4.7	1.06	81	37	256	32	105
Picola 2	4.9	1.87	48	54	272	18	175
Yabba South M	4.7	1.73	80	52	302	26	180
Youanmite	5.1	1.57	46	59	302	15	277
Picola 1	4.7	2.3	26	51	307	8	202
Rand L	5	1.71	40	77	309	13	127
Katamatite	5.1	1.42	45	71	312	14	173
Kotupna	4.7	1.99	43	88	317	14	153
Yabba South H	4.9	1.85	66	74	335	20	204
Dookie b/w row	5.5	1.91	55	56	340	16	484
Terip Terip	4.4	2.93	74	79	349	21	
Dookie in row	5.2	1.73	112	68	380	29	
Katamatite East 1#	4.7	1.86	43	96	399	11	107
Katamatite East 2#	4.8	2.33	71	87	452	16	205
Telford M	5.5	1.5	62.8				182
Telford H	6.4	1.79	51.1				274
Telford L	5.5	2.3	55.5				113
Peechelba East 2							53

Location	pH $CaCl_2$	OC (%)	Colwell P	PBI	Total soil P (mg/kg)	% avail. P	Total avail. S (0-60)kg/ha
Karramomus							63
Devenish							75
Boorhaman							85
Peechelba East 3							94
Lake Rowan							106
Peechelba East 1							111
Caniambo							130
Nathalia							158
Congupna 1#							175
Congupna 2#							242

L – low conductivity soil, M – medium conductivity soil, H – high conductivity soil.

Observations and comments:

A number of paddocks tested showed a pH below the recommended production threshold of 4.8. Application of lime for soils at this pH is a cheap way of maintaining production instead of letting things drop to 4.5 or less.

The phosphorus buffering index (PBI) results varied from 53-99, which is similar to last years' range. These values are considered low for the lock up of soil P.

The Total P values show large amounts of unavailable P compared to the Colwell values. The results from 2007 show the % P availability from the total pool was marginally higher (8-32%) when compared to our 2006 soil testing values. This could be due to the drought increasing P availability, which is a phenomenon recognised in scientific research.

According to the soil test results, the total available sulphur is very high in some paddocks. Most of the very high paddocks have a gypsum history, but some in the middle range do not. Because sulphur is leached like nitrogen and caught in the clay, much of the sulphur in a profile can be below 0-10 cm, hence it is important to measure S below this, ideally to 60 cm. In the paddocks where it was possible to calculate this, total available S ranged from 3-35%, but commonly only 12% of the available sulphur was in the 0-10 cm. A wheat crop removes only 1.5 kg S/t grain whereas canola can remove up to 10 kg S/t grain. Only a few of the lighter textured soils with the low soil test results (<80-100 kg/ha total S) would benefit from sulphur to maintain crop production into the future.

Sponsors:

Many thanks to all the farmer co-operators.

Variety trial - Miepoll

Authors: Michelle Pardy and Dale Grey

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Location: Miepoll
Growing Season Rainfall:
GSR: (Apr-Oct) 277 mm
Soil:
Type: Grey Loam over heavy clay
pH (CaCl): 4.6 (0-10cm)
Sowing Information:
Sowing date: 28/5/07
Fertiliser: 90 kg/ha MAP
Row Spacing: 20 cm
Paddock History:
2006 – Wheat
2005 – Canola (hay)
Plot Size: 7.6 m x 100 m
Replicates: 'Nearest neighbour' trial design

Key message:
- Several newly released varieties performed well in this trial.
- Due to the dry spring, longer maturing types did not yield as well.

Aim:
To evaluate the performance of several recently released wheat varieties against established varieties in a high rainfall region of north east Victoria.

Method:
A range of varieties were sown in plots measuring 90 m x 7.6 m (0.068 ha) using the farmer's air seeder. The plots were sown on 28th May 2007 and all varieties were sown at the same rate of 85 kg/ha along with 90 kg/ha MAP. Plots were harvested on 8th January 2008 using the farmer's header and yield measured using a weigh bin.

Results:

Table 15: Yield and quality results from the Miepoll variety trial

Variety	Maturity	Yield (t/ha)	Protein (%)	Screenings (%)	Moisture (%)	Test Wt (kg/hl)	WUE (kg/mm/ha)
Guardian	Early-Mid	1.99	11.4	1.9	9.6	78.6	12
GBA Ruby	Early-Mid	1.88	11.5	1.7	9.4	78.4	11
EGA Gregory	Mid-Late	1.8	10.8	1.6	9.7	77.8	11
Pugsley	Mid	1.79	11.7	1.5	9.5	79.6	11
Diamondbird	Mid	1.74	11.4	2	9.7	78.6	10
Whistler	Late	1.62	11.8	1.4	9.5	78.6	10
Sentinel	Mid-Late	1.46	12.1	1.6	9.6	78	9
Bolac	Mid-Late	1.38	11.8	2.3	9.8	77.6	8
Chara	Mid-Late	1.35	11.95	1.4	9.6	78.1	8
	CV	8.9	1.5	10.4	0.6	1.2	
	LSD	0.63	0.78	0.77	0.26	4.2	
	p=	0.14	0.83	0.147	0.114	0.85	

Observations and comments:
The crop was direct drilled into good moisture. Good rains were received in the days after sowing (40 mm) which ensured good germination and emergence. Weed and disease pressure, including stripe rust, were not significant at this site, however some plots were patchy due to early waterlogging damage.

Using the formula that Potential Yield = Growing season rainfall (Apr-Oct) – 110 mm evaporation x 20, the potential yield for this site was 3.3 t/ha. No variety came within 1.3 t/ha of this mark, which is a reflection of the relatively late sowing and particularly dry August, September and October. The GSR rainfall figure of 277 mm is also misleading as it was comprised of many frequent, though small, rainfall events (typically under 3 mm) which failed to reach the root zone before being evaporated.

Guardian was the highest yielding variety, followed by GBA Ruby and EGA Gregory. Observations of grain filling made on 19th October 2007 showed these varieties to have a greater proportion of grain filled than the other varieties, indicating the quicker maturing lines fared better than later types. While the yield difference between the highest and lowest yielding varieties was over 0.6 t/ha, statistical analysis showed the yield of varieties in this trial were not significantly different from each other.

There were not enough differences in protein, screenings and moisture percentages, or test weights, between varieties to draw meaningful conclusions regarding varietal performance.

Sponsors:

Farmer co-operator: Albert Gough, Miepoll.

Variety trial - Youanmite

Authors: Michelle Pardy and Dale Grey

Contact No: 03 5871 0600

Organisation: DPI Victoria, Cobram

Location: Youanmite
Growing Season Rainfall:
GSR: (Apr-Oct) 192 mm
Soil:
Type: Red Loam
pH (CaCl): 5.1 (0-10cm)
Sowing Information:
Sowing date: 11/5/07
Fertiliser: 100 kg/ha MAP
Row Spacing: 17.8 cm
Paddock History:
2006 – Wheat
2005 – Canola
Plot Size: 1.4 m x 20 m
Replicates: 3

Key message:

- As a result of the exceptionally dry spring, the quicker maturing wheats yielded significantly better than the longer season types.

Aim:

To evaluate the performance of several recently released wheat varieties against established varieties in a medium rainfall region of north east Victoria.

Method:

The trial site was prepared with a knockdown weed treatment on 8th May 2007. The site was sown using a specialised trial plot cone seeder on 11th May 2007. Varieties were direct drilled into plots, at different seeding rates, to achieve target plant populations of 180 plants/m^2. There were 3 replicates of each treatment and plots measured 20 m x 1.4 m (0.003 ha). A knockdown pre-sowing and an in-crop herbicide application provided good weed control throughout the season. A preventative application of a tebuconazole fungicide was made on 21st September 2007. The trial was harvested on 14th December 2007 using a plot header.

Results:

Table 16: Yield and quality results from the Youanmite variety trial

Variety	Maturity	07 Rust rating	Seeding rate (kg/ha)	Plant count (plants/m^2)	Yield (t/ha)	Protein (%)	Screen (%)	Test wt (kg/hl)	N uptake (kg N/ha)	N uptake (kg N/t grain produced)
Wyalkatchem	E	2	103	n/a	2.66	11.5	1.6	79	49	18
GBA Ruby	E-M	8	83	135	2.54	11.9	1.7	80	48	19
Diamondbird	M	3	87	n/a	2.36	11.4	2.1	80	43	18
Pugsley	M	6 (4)	75	n/a	2.18	12.0	1.7	78	42	19
Whistler	L#	4	74	158	1.93	11.9	3.3	78	37	19
EGA Gregory	M-L	7	85	n/a	1.92	11.8	3.1	78	36	19
EGA Wedgetail	L#	5	74	n/a	1.46	12.5	2.0	75	29	20
				CV%	12%	4.1	20	1.5	12.7	
				LSD	0.29	0.58	0.515	1.37	6.1	
				p=	0.001	0.008	0.001	0.001	0.001	

Winter habit

Observations and comments:
The crop was direct drilled into good moisture. Plant counts were conducted for only 2 varieties, with Ruby having 68% and Whistler having 79% emergence. These relatively low establishment figures may have been caused by seed quality issues through either low vigour, poorer germination percentage, sowing too deep etc.

As a result of the exceptionally dry spring, the shorter season varieties Wyalkatchem, Ruby and Diamondbird performed significantly better than the longer season varieties. Whistler, Wedgetail and Gregory were attempting to fill grain under severe moisture stress (evidenced by up to 50% head loss through tipping) while the quicker types matured under comparatively less stress.

The very low stripe rust pressure during spring meant the genetic resistance of a variety did not influence yield. As a result, Wyalcatchem, which is quick maturing but very stripe rust susceptible, topped the trial ahead of Ruby.

Protein was significantly higher in Wedgetail than many of the other varieties. This was a case of nitrogen reserves being used for protein at the expense of starch deposition and yield (seen also in the low test weight result), and is a classic response to moisture stress. Protein results for the other varieties were not significantly different.

Screenings were significantly higher in Gregory and Whistler than the other varieties, although both were still well under 5%. Both varieties suffered from tipping though moisture stress, which caused a slight reduction in grain size and the slight increase in screenings.

There were no obvious differences between varieties in their ability to take up and process nitrogen into yield or protein. All varieties removed close to the 20 kg of nitrogen (benchmark rate) for each tonne of grain produced. Minor variations due to yield differences are to be expected.

Using the formula that Potential Yield = Growing season rainfall (Apr-Oct) – 110 mm evaporation x 20, the potential yield for this site was 2.0 t/ha, which was exceeded by half of the varieties. Additional stored moisture may have been stored below the 60 cm we tested, but was not factored in the yield calculations.

Sponsors:
Farmer co-operators; Wayne and Craig Thomas, Youanmite.

Phosphorus trial - Boomanoomana

Authors: Dave Eksteen

Contact No: 03 5883 1644

Organisation: DPI NSW, Finley

Location: Boomanoomana
Growing Season Rainfall:
GSR: (May-Oct) 101.5 mm
Soil:
Type: Grey Loam over heavy clay
pH (CaCl): 6.3 (0-10cm)
Sowing Information:
Sowing date: 24/5/07
Fertiliser: 80 kg/ha MAP
Variety: Ventura
Row Spacing: 17 cm
Paddock History:
2007 – Wheat
2006 – Failed wheat
Plot Size: 7.6 m x 300 m
Replicates: none

Key message:
- There was no phosphorus response from this trial due to the dry conditions of 2007.

Aim:
To test if phosphate fertiliser rates can be reduced when soil tests show medium phosphate levels in soil.

Method:
The grower sowed strips within the paddock with different rates of MAP starter fertiliser. The strips were 300 m long, one seeder width wide but were not replicated. The rates used were; nil MAP, 40 kg/ha MAP, 80 kg/ha MAP and 160 kg/ha MAP. Plots were harvested using a yield monitor on the harvester.

Results:

Table 17: Yield of test strips

Treatment	Applied N & P (kg/ha)	Yield (t/ha)	Return over fertiliser ($/ha)
Zero kg/ha MAP	0N, 0P	0.64	0
40 kg/ha MAP	4 N, 8.7P	0.39	-111.80
80 kg/ha MAP	8N, 17.4 P	0.73	-17.00
160 kg/ha MAP	16N, 34.8 P	0.04	-306

Price MAP $600/t and grain $350/t

Observations and comments:
Using the formula Potential Yield = Growing season rainfall (May-Oct) + stored soil moisture (38 mm) – 110 mm evaporation x 20, the potential yield for this site was 0.59 t/ha. The treatment with no fertiliser reached this potential. The 40 kg/ha MAP treatment yielded less, but this was probably due to soil variation. The 80 kg/ha MAP did increase yield slightly over the nil treatment, but this was not economical. The most obvious response was a total blow out of yield with the high fertiliser input treatment (160 kg/ha MAP). The plants grew better, but used up all the moisture and thus did not have enough moisture to fill grain.

The soil test showed a Colwell P of 28 ppm. This is moderately low for this soil type, with the optimum Colwell P being 35 ppm. However, this was adequate given the low rainfall and low yield potential of this site.

Sponsors:
Farmer co-operator: Thanks to Colin Withers for doing the trial.

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RESEARCH RELEVANT TO THE RIVERINE PLAINS

New inoculant technologies for the nodulation of grain legumes

Authors: David Pearce, Dr Matthew Denton and Bernadette Carmody

Contact No: 02 6030 4500

Organisation: DPI Victoria, Rutherglen

Key messages:

- New inoculant technologies provide an opportunity to achieve excellent nodulation of grain legumes without the hassle of inoculating seed with peat slurries.
- Freeze-dried rhizobial formulations produced nodulation of grain legumes equivalent to that of the traditional peat slurries, with significantly less preparation required when inoculated in furrows. Becker Underwood granules produced less nodules than the peat slurries treatment, but improved inoculation over the nil treatments.
- Granular products varied in their ability to provide nodulation of grain legumes.

Aim:

The delivery of inoculants of root nodule bacteria (rhizobia) by peat slurry application is considered to be a difficult and time-consuming procedure for land holders. There have been a number of new delivery technologies coming onto the market, promising greater ease of application and eliminating the need for manual seed inoculation. These new inoculant products are likely to assist farmers in the effective delivery of root nodule bacteria to legumes.

Four inoculant manufacturers have, or are currently developing, a range of granular carriers and freeze-dried products to meet these objectives. The granular products containing rhizobia are usually applied at sowing in a similar way to grain or fertiliser. Freeze-dried rhizobia can be used as a coating on the seed, or directly injected as a liquid in the drill rows during sowing. Since these inoculants have not had widespread use, the aim of this study was to test these new delivery systems and their effect on nodulation in grain legumes for a range of Australian soils. Similar experiments have been conducted at locations in Victoria and southern New South Wales. In this report, we focus on experiments conducted at Inverleigh and Mininera (Victorian south west), which, although outside the Riverine Plains area, provide similar results to experiments we have conducted in Riverine plains experiments in previous years.

Method:

The trials were conducted at Southern Farming Systems sites located at Inverleigh and Mininera. Granular inoculants used in these trials were either purchased through Bay Classic Pty Ltd (Alosca) or supplied by the manufacturer Becker Underwood Pty Ltd (Nodulator®). Nodulator® was stored at 4°C and the Alosca product stored in a cool room away from direct sunlight according to manufacturers specifications. Granule products were applied with seed or at 2.5 or 5 cm depth.

A freeze-dried root nodule bacteria product supplied by New-Edge Microbials was stored at 4°C prior to sowing according to manufactures recommendations. It was directly applied onto the seed at one small vial / 500 kg of seed, or injected into the drill rows at sowing using a rate of 100L solution/ha.

Table 18: Treatment list

Treatment	Treatment list
A 10	Alosca bentonite clay granule sown @ 10 kg/ha with seed
B 6	Becker Underwood granules sown @ 6 kg/ha with seed
B 6 U 2.5	Becker Underwood granules sown @ 6 kg/ha 2.5 cm below the seed
B 6 U 5	Becker Underwood granules sown @ 6 kg/ha 5 cm below the seed
E-Rhiz inject	EasyRhiz (freeze-dried rhizobia) injected by nozzles @ a rate of 50 l/ha into drill rows at sowing
E-Rhiz on seed	EasyRhiz (freeze-dried rhizobia) applied to seed
Peat	Peat slurry coated on seed
Nil	No rhizobia applied

All trials were set up using a randomised complete block design with 4 replications. Chickpea, faba beans or lupins were sown using plot lengths of 10 m by 1.42 m wide. All trials were sown using a cone seeder, with granules sown through the cone with the seed or placed at depth. Superphosphate was applied from a small calibrated fertiliser box at a rate of 120 kg/ha. After each treatment the cone seeder was sterilised to eliminate any possibility of contamination between rhizobial treatments. Each plot was sampled by randomly taking ten plants from each plot for measurements.

Results:

Table 19: Inverliegh: Chickpeas (Genesis 090)

Treatment	Nil	Alosca 10	B 6	B 6 U 2.5	B 6 U 5	E –Rhiz on seed	E- Rhiz inject	Peat	lsd
Nodule number / plant	0.1	0.4	9.2	6.8	3.5	17.3	17.3	20.1	**5.1**
Nodule score / plant	0.0	0.3	2.3	1.0	1.3	2.7	1.7	2.3	**0.8**
Nodule dry matter (mg / plant)	0.0	7	126	89	50	151	110	142	**40**

Table 20: Inverleigh: Lupins (Mandelup)

Treatment	Nil	Alosca 10	B 6	B 6 U 2.5	E –Rhiz on seed	E- Rhiz inject	Peat	lsd
Nodule number / plant	3.4	1.5	5.9	3.0	16.8	13.3	10.5	**7.0**
Nodule score / plant	1.8	1.3	2.1	1.7	3.2	3.0	2.8	**0.8**
Nodule dry matter (mg / plant)	39	17	62	30	154	97	124	**61**

Table 21: Mininera: Faba bean (Farah)

Treatment	Nil	Alosca 10	B 6	B 6 U 2.5	E –Rhiz on seed	E- Rhiz inject	Peat	lsd
Nodule number / plant	0.1	1.5	8.6	1.5	26.6	20.0	31.1	**7.6**
Nodule score / plant	0.1	0.5	1.7	0.5	3.1	2.9	4.4	**1.1**
Nodule dry matter (mg / plant)	5	51	189	51	461	351	404	**107**

Observations and comments:
Peat inoculation improved the nodulation of lupin, chickpea and faba beans, compared with the uninoculated treatment (Table 19, Table 20 and Table 21). The shoot mass and grain yields between treatments was not significantly different, which was most likely due to the dry conditions during the growing season for 2007.

The freeze-dried inoculants provided similar nodulation to that of the peat inoculants, applied either as a seed coating or injected into the sowing furrow. The newly-released Nodulator® granules from Becker Underwood produced significantly less nodules than the peat slurries, but produced more nodules than the uninoculated treatments. While the product did not work as well as hoped, further development may see this improve.

In this trial, Alosca granules did not improve nodulation compared with uninoculated treatments. This response has also been observed in previous trials conducted in Victoria and southern NSW.

Australia now has four inoculant manufacturers developing or producing inoculants aimed at simplifying the delivery of rhizobium products into farming systems. This gives landholders a greater choice of product that best suits their individual requirements. The results of field trials show that careful selection of inoculant products is crucial to obtaining maximum root nodulation and providing the best results in the soils in Victoria.

Although these trials were not conducted in a Riverine Plains location, the results are consistent with our findings from trials conducted throughout Victoria over the past five years.

Figure 10. Inoculation responses achieved in chickpea, Inverleigh 2007. Note the colour difference between plots, indicating N deficiency in the uninoculated plot.

Figure 11. A well-nodulated chickpea root system, Inverleigh 2007.

Sponsors:
We would like to thank the Grains Research and Development Corporation for their continued support through the National *Rhizobium* program.

Canola hay saved the day – 2007 Better Canola Trial

Authors: Kate Burke[1], Felicity Pritchard[2] and Don McCaffery[3]

Contact No: [1]0429 852 230, [2]03 5382 4396 and [3]0427 008 469

Organisation: [1]John Stuchbery and Associates, [2]Irrigated Cropping Forum and [3]NSW DPI

Canola hay has proved to be a saviour for producers in most grain-growing areas in New South Wales and Victoria for the second year in a row, providing tens of thousands of dollars in income where the crop has otherwise failed.

Latest results from the Victorian Better Canola trials at Longerenong College on the Wimmera plains suggests that cutting a crop for hay in 2007 could have been up to three times as profitable as harvesting it, but at the end of the day, growers are advised to aim from the outset to grow canola for its grain rather than for hay due to volatile markets.

Demand

The prolonged dry period and subsequent water and fodder shortage has created a new opportunity for canola growers to market their failed crops as hay or silage with canola hay becoming more accepted by the dairy industry. The dairy industry has indicated that lucerne and cereal hay are still preferred due to their familiarity with these products, but canola hay could still have a place if priced low enough in comparison and is becoming more accepted as the dairy industry is exposed to it. Canola hay and silage are safe to use as long as feeding guidelines are followed.

Quality in 2006 and 2007

Good quality Canola hay is an excellent source of energy and protein and is highly palatable. Last year, the quality of canola hay submitted to FeedTest was similar to 2006 and with a similar wide range of quality; but the canola hay submitted to the NSW DPI Feed Quality Service (Wagga Wagga) was poorer quality than in 2006 (Table 22). The mean values were higher in protein than typical cereal hay but similar in energy and digestibility.

Table 22: Canola hay quality for 2006 and 2007 (source: Feedtest)

Feedtest				
Baled canola hay		**Crude protein (%)**	**Dry matter digestibility (%)**	**Metabolisable energy (MJ per kg dry matter)**
2007	Average	15.0	65	9.6
	Range	8.7-27.7	35-83	4.4-13.1
2006	Average	15.9	66.4	9.8
	Range	4-27	33-85	4-13
NSW DPI Feed Quality Service				
2007	Average	17.7	63.4	9.1
	Range	8.6 – 33.6	45 - 83	5.8 - 11.9
2006	Average	21	69.4	10
	Range	12 – 31	57.2 - 76	7.9 – 11.6

Better Canola hay trials

Two trials were conducted by the Birchip Cropping Group (BCG) for the Victorian Better Canola project. The steering committee consists of John Stuchbery and Associates, agronomic consultant Kate Burke, Oilseeds Industry Development Officer, Felicity Pritchard and Elmore Landmark agronomist, Greg Toomey. The project is coordinated through Steve Marcroft, funded by the Grains Research and Development Corporation and the Australian Oilseeds Federation.

The first of two trials

Time of cutting

The first two trials compared the effects of time of cutting on hay yield and quality and grain yield in a commercial crop of Tornado TT. In summary, late flowering was the optimal time for cutting canola for hay, with highest hay yields and a good compromise on quality.

Although cutting at mid flowering produced significantly better quality hay (higher protein, digestibility, energy and lower fibre) than cutting at late flowering, the yields were much lower (Table 23). The hay cut at late flowering produced higher yields and good quality feed, with high energy and protein levels. Cutting at mid pod-fill, produced similar dry matter to the late flowering timing, but quality had deteriorated significantly. This detected change in quality is consistent with previous results (Phillips 2007).

Table 23: Yield and quality of canola hay (cv. Tornado TT) cut at early and late flowering in the 2007 Better Canola trial

Time of Cutting	Date cut	Hay yield (t/ha)	Crude protein % (dry matter basis, DMB)	Neutral detergent fibre % (DMB)	Dry matter digestibility (DMD) %	Metabolisable energy (MJ/kg dry matter)
Mid flowering	6 Sept 2007	3.1	28	24	86	13
Late flowering	27 Sept 2007	3.9	18	33	74	11
Mid pod fill	17 Oct 2007	4.0	15	38	68	10
LSD ($p<0.05$)		0.62	2.7	3.43	4.4	0.73

Economic analysis

Hay production - regardless of time of cutting - was more profitable than harvesting the crop. A mid-October frost at the site severely reduced grain yield potential.

In the trials, cutting at late flowering was more profitable than early flowering at a given hay price (Table 24). Despite the better quality, canola cut at early flowering would require a $60/t premium to compensate for the lower yields. The gross margin for the mid pod-fill cut was similar to the late flowering cut (as dry matter production was similar) assuming the same price could be achieved for the hay despite the drop in quality.

Hay production is not without risk (weather damage, volatile markets etc.) but does provide an option in some seasons.

Table 24: Gross margin for canola hay cut at late flowering, or early flowering or grain at two hay prices, based on results from 2007 Better Canola hay trial at Longerenong, using Tornado TT

End Product	Yield (t/ha)	Oil (%)	Commodity Price ($/t)	Gross Income ($/ha)	Total Costs ($/ha)	Gross Margin ($/ha)
Grain	0.4	35.3	535	214	240	-26
Early Flowering Hay	3.1	*	270	837	362	476
"	"	*	200	620	360	260
Late Flowering Hay	3.9	*	270	1053	392	661
"	"	*	200	780	390	390

Costs include $162/ha for haymaking at 3.1 t/ha and $192/ha at 3.9 t/ha; $200/ha production costs (no N applied in this paddock due to high stored N) $40/ha harvesting and windrowing costs. Grain price Marma Lake Dec 07.

Second Trial

Varieties

A second trial compared the effects of varieties and time of cutting on hay yield and quality and grain production.

The Clearfield hybrids produced more hay at both timings and more grain than the triazine tolerant varieties (Table 25). Oil content was unaffected. Although time of cutting made a difference (Table 26), variety choice was not important in terms of hay quality (data not shown).

Table 25: Hay and grain yield for four canola varieties/hybrids at Longerenong 2007

Parameter	Harvest Date	Clearfield Hybrid		TT		LSD (p<0.05)
		45Y77	46Y78	ATRBarra	Tornado TT	
Late flowering Hay (t/ha)	17 Oct 2007	4.4	3.9	3.2	2.9	0.59
Mid pod fill Hay (t/ha)	1 Nov 2007	3.8	3.7	3.1	2.8	0.71
Seed Yield (t/ha)	20 Nov 2007	1.10	1.07	0.66	0.66	0.16
Seed Oil (%)		35.5	36.5	37.1	36.1	NS

Table 26: Effect of timing of hay cutting on quality (mean of four canola varieties) at Longerenong 2007

Timing	Harvest Date	t/ha	Residual dry matter %	Crude protein % (dry matter basis, DMB)	Neutral detergent fibre % (DMB)	Dry matter digestibility %	Metabolisable energy (MJ/kg dry matter)
Late flowering Hay	17 Oct 2007	3.6	91.4	17.1	35.8	71.6	10.7
Mid pod fill Hay	1 Nov 2007	3.4	94.6	15.8	48.5	60.10	8.7
	LSD (p<0.05)	NS	0.54	1.6	3.0	3.8	0.64

Hay is hungry – soil test a must

Growers are reminded that nutrient export from hay crops can be very high and this needs to be considered when planning for 2008 (Table 27). A soil test in autumn is an absolute must for paddocks that were cut for hay last season.

Table 27: Approximate macronutrients present in canola grain, straw or hay when cut at early flowering

Product	N	P	S	K
Grain	30	5	5	10
Straw	4	3	1	3
Hay	30	3 **	8 **	25

** Variable. Source: Rob Norton, University of Melbourne. Data from a range of sources, including measurements form Wimmera-Mallee between 1990-2003.

For further information, please contact Kate Burke on 0429 852 230.

Sponsor:

The Better Canola project is part of a three year national oilseed agronomy project, funded by the Grains Research and Development Corporation and the Australian Oilseeds Federation.

Feed quality comparisons of silage and hay

Authors: Janet Wilkins[1], John Piltz[2] and Nigel Phillips[2]

Contact No: [1]02 6051 7700 and [2]02 6938 1999

Organisation: NSW DPI [1]Albury and [2]Wagga Wagga

Key messages:

- Silage and hay can both produce high quality conserved fodder.
- Timeliness of harvest influences the quality of conserved fodder.
- Choice of hay and silage depends on forage base and the production system on-farm or market.

The dry spring for the last two seasons has seen large areas of crop cut for hay or silage. The decision on whether to make hay or silage has largely depended on farm infrastructure and experience. However, last season saw many crops cut for silage early to take advantage of the demand in the dairy fodder market.

There has since been much discussion on the pros and cons of silage and hay. Although a number of trials have been conducted with the aim of comparing the differences in quality between hay and silage, obtaining comparable data is difficult. This is due to the variation in the optimum cutting time for hay and silage, making it hard to control all the variables so affecting feed quality results.

The data used in this article is from feed test laboratories at Wagga Wagga and Hamilton. There are potential errors in data as it relies on the accuracy of information put on submission forms sent by clients. However every effort has been made to ensure data is only used from forms filled in adequately.

Feed test results show that both methods of conserving forage are capable of producing high quality fodder (Table 28). In general, the average values of silage are higher than that of hay. This is particularly the case with protein as the protein level in cereal hay is often not adequate to meet animal requirements. The higher metabolisable energy (ME) and protein in silage is generally due to the earlier cutting time.

While silage (on average) conserves better quality fodder, quality is more dependent on the ensiling or drying process. The data indicates there is a large range in the quality of feeds (Table 28 and Table 29). This can be influenced by weather conditions particularly in hay, however management decisions also play a role. In fodder conservation, feed quality is highest while it is still standing in the paddock. All management after this is to minimise quality and quantity losses.

Table 28: Quality comparison of different fodder types in silage and hay from Hamilton feed test laboratories. This information is produced using data from FEEDTEST records, derived from samples as submitted by clients.

		No of samples	Crude protein# (%)	Metabolisable Energy# (MJ/kg DM)	DM Digestibility# (%)
Legume	Silage	86	19.5 (6.9 – 28.8)	10.3 (6.4 – 12.6)	68.8 (46 – 80)
	Hay	626	19.1 (6.3 – 30)	10.2 (5.9 – 13.2)	68.6 (44 – 85)
Grass/	Silage	581	15.6 (8.4 – 28.2	10.7 (6.4 – 12.6)	70.9 (39 – 85)
legume	Hay	499	11.9 (3 – 25.4)	9.5 (3.8 – 12.9)	64.9 (45 – 77)
Cereal	Silage	238	12.7 (3.7 – 23.2)	10.3 (6.4 - 11.4)	68.1 (31 – 84)
	Hay	2783	9.2 (1.8 – 22.2)	10.1 (4.2 – 12.9)	68.4 (34 – 84)
Canola	Silage	219	17.7 (7.2 – 28.4)	9.9 (6.8 – 12.4)	65.2 (26 – 67)
	Hay	579	15.9 (4.0 – 27.2)	9.8 (4.1 – 13.1)	66.4 (25 – 78)

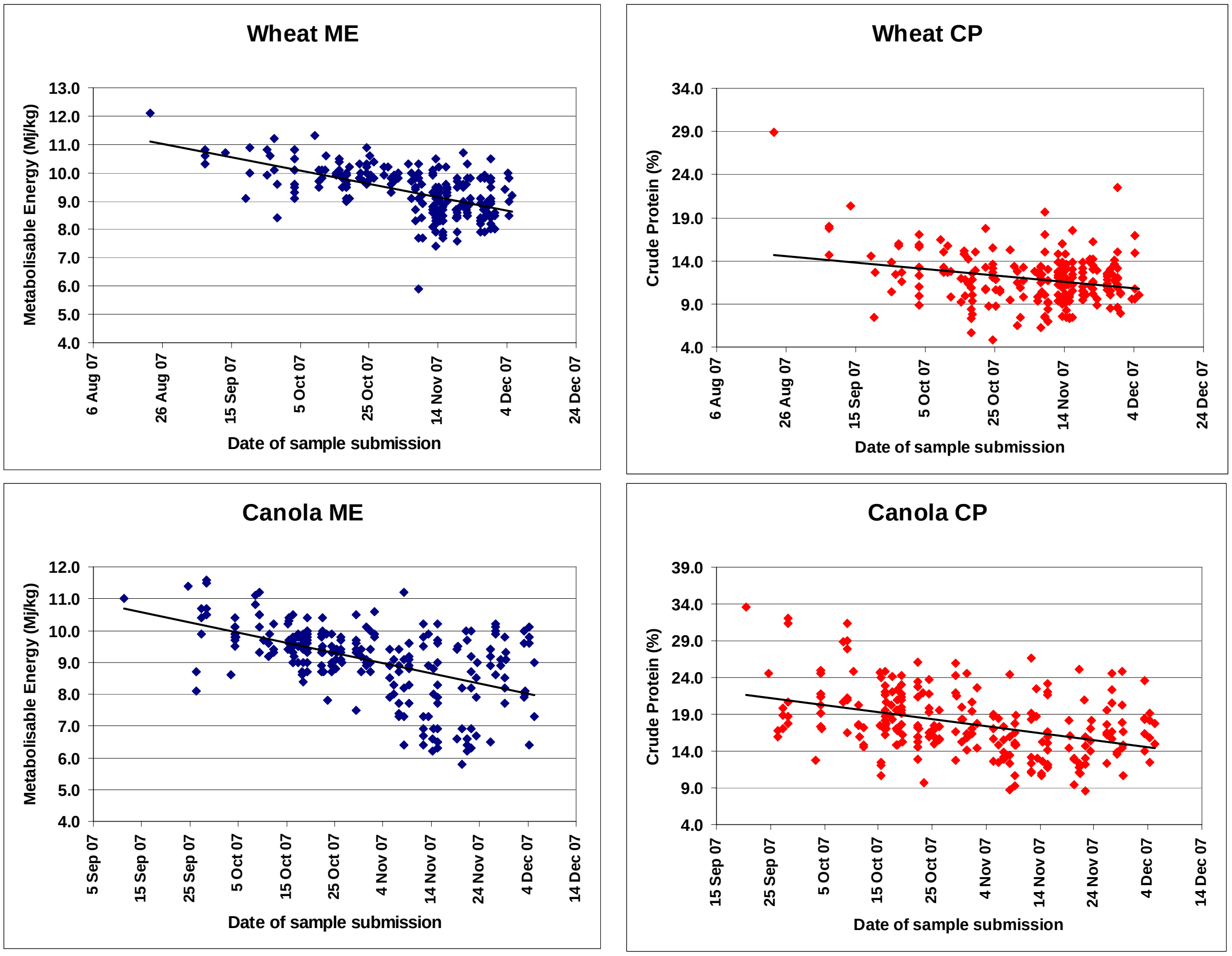
#Data in Crude protein, ME & DMD columns: first number represents the average result, figures in brackets refer to the range of data.

Results from the feed testing service in Wagga Wagga submitted last season backs up this data with the range of feed quality of both wheat and canola quality showing large variation (Table 29).

Table 29: Average feed test results 2007 for canola and wheaten hay (range shown in brackets)

	Crude protein	DM Digestibility	Metabolisable Energy (MJ/kg DM)
Wheat (227 samples)	11.9 (4.8 - 28.9)	64.5 (38 – 90)	9.3 (4.2 – 12.1)
Canola (242 samples)	17.7 (8.6 - 33.6)	63.3 (45 – 83)	9.1 (5.8 – 11.9)

The Wagga Wagga results show the trends in feed quality over the season (Figure 12). There is a general decline in feed quality over the season, therefore the earlier the cut, the higher the feed quality for both canola and wheat samples. There are limitations to this data in that it relies on date of sample submission and it is possible that samples were taken a number of days prior to submission. Lower quality hay samples may have been rain damaged. This variation in the results also highlights the importance of timeliness in fodder conservation.



Data– Averages of feed testing services from Wagga. As much as possible, data was excluded where forms were incorrect or incomplete. Dates are date of submission not date of sampling as date of sampling was not always completed by clients.

Figure 12. Trends in feed quality test results over the 2007 season

Timeliness is important in making both hay and silage, starting with time of cutting and continuing with the time taken in drying and baling or ensiling the forage. The stage of growth at cutting will have a large influence on quality. Quality declines rapidly following boot stage in most crops so the earlier cut, the higher the feed quality. Wheat and barley are the exception where digestibility of feed quality can increase mid grain-fill, however protein is still low at this stage.

Conclusion

The most important consideration in evaluating a fodder is the cost to produce per megajoule of energy stored (c/MJ). There are other considerations such as which option fits the farming system or market. Silage is suited to an early harvest leading to trade off in feed quantity. Hay, requiring the drier weather, suits a later harvest producing feed of lower quality but of greater quantity.

Management decisions in the drying and ensiling processes can have a greater impact on quality than the choice to make hay or silage.

A comparison of herbicide efficacy for summer weed control and the effect of summer weed control on soil moisture and soil nitrogen levels at sowing

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Organisation: NSW DPI, Wagga Wagga

Key messages:

- Available soil moisture is the limiting factor in typical dryland cropping systems.
- Effective control of summer weeds can significantly increase soil moisture and nitrogen available to the following crop.
- Summer weed control may not be economical in every year or situation, eg. in very dry (2004 and 2005) or very wet summers (>300 mm).

Summer growing weeds use stored soil moisture and nutrients reducing the amount available to the following winter crop. This can have a significant effect on grain yield and quality, and reduce profitability. Effective control of summer weeds can increase soil water by 70 mm and soil nitrogen by 33 kg/ha at sowing meaning up to 1.5 t/ha higher wheat yield (Birchip Cropping Group 2000).

Summer weeds should be effectively controlled from harvest until sowing the following crop for maximum benefit. Water retention and infiltration can be increased by maintaining as much stubble as possible, increasing soil organic matter levels, reducing tillage and traffic and adding gypsum to soils prone to crusting. This is particularly important in poorly structured soils as they will lose more moisture through evaporation. Benefits of summer weed control are only seen when there are no sub-soil constraints preventing the crop from utilising sub-soil moisture such as soil sodicity, compaction, salinity and toxicity (eg. boron).

Historically, the two methods used for controlling summer weeds were cultivation and grazing. Both methods are effective, but herbicides are now more widely used due to their effectiveness and the disadvantages of cultivation (eg. increasing erosion risk and soil structural decline) and grazing (high stocking rate needed, compaction, toxic and unpalatable species of low nutritional value and weed seed dispersal). *NB: There is the added risk of herbicide resistance developing with repeated chemical weed control.*

Other benefits of summer weed control include enabling earlier and easier sowing, less disease and fewer pests in the crop due to the absence of a ‘green bridge’, reduced weed seed bank, less contamination (eg. of wool) and less injury to stock (eg. toxicity).

Two environmental issues associated with summer weed control are erosion and deep drainage. Soils prone to these problems may need alternative management strategies.

A needs analysis activity conducted to identify major issues facing landholders in the Murrumbidgee catchment highlighted a need to demonstrate the benefits of summer weed control to maximise adoption of this management practice.

Objectives:

1. To compare herbicide efficacy for the control of summer weeds.
2. To show the impact of effective summer weed control on soil moisture and nitrogen levels at sowing the following season.

Materials and Methods:

The demonstration site is located 5km from Balranald in the lower Murrumbidgee catchment. The soil type is a red sandy loam. The two summer weeds present at the demonstration site were Paddy melon (*Cucumis myriocarpus*) and Button grass (*Dactyloctenium radulans*).

The site received 53.2 mm of rain 10 days prior to treatment application. The rainfall at the demonstration site from November 2006 to May 2007 is summarised in Table 30.

Table 31 describes the herbicides evaluated and the cost of each treatment.

Table 30: Rainfall at the demonstration site from November 2006 to May 2007

Month	**Nov 06**	**Dec 06**	**Jan 07**	**Feb 07**	**Mar 07**	**Apr 07**	**May 07**
Rainfall (mm)	23.8	5.2	114.4	3.0	16.4	44.0	33.0

Table 31: The treatments applied in the demonstration and their cost per hectare (excluding application cost)

Treatment		**Cost ($/ha excluding Liase™)**
1	Control- no herbicide	0.00
2	Glyphosate 450 (1.2L/ha) + Garlon™ (120mL/ha) + LI700™ (500mL/100L spray mixture) + Liase (2L/100L spray mixture).	16.75
3	Glyphosate 450 (1.2L/ha) + Surpass® (600mL/ha) + LI700™ (500mL/100L spray mixture) + Liase™ (2L/100L spray mixture).	15.31
4	Glyphosate 450 (2L/ha) + LI700™ (500mL/100L spray mixture) + Liase™ (2L/100L spray mixture).	16.83
5	Glyphosate 450 (2.7L/ha) + Ally® (7g/ha) + Chemwet 1000 (100mL/100L spray mixture) + Liase™ (2L/100L spray mixture).	17.04
6	Glyphosate 450 (0.8L/ha) + Surpass® (400mL/ha) + Ally® (5g/ha) + Liase™ (2L/100L spray mixture).	7.14

The treatments were applied on 1st February 2007 using a 15 L back pack sprayer, flat fan nozzles and 3 bar of pressure. The water rate was 106 L/ha. The melons were approximately 30 cm in diameter and the Button grass was flowering at the time of spraying (later than the ideal stage of weed growth for maximum moisture conservation).

The demonstration design was a randomised complete block with 3 replicates. Each plot was 6 m x 15 m (0.009 ha).

Measurements:

1. Weed species present and the density (plants/m^2) immediately prior to treatment application.
2. Weed species present and the density (plants/m^2) 10 days after treatment (DAT).
3. Weed species present and the density (plants/m^2) 20 DAT.
4. Soil moisture at sowing (0-25 cm and 25-50 cm). Soil samples were collected on 26th April 2007 using a manual auger. Wet weight and dry weight (following 4 days at 40°C) were recorded and the amount of moisture in the soil calculated.
5. Soil nitrogen at sowing. Samples were collected on 26th April 2007 at sent to a laboratory for analysis.

Results and Discussion:

Weed Control

All herbicide treatments used gave good to excellent control of the weeds present (Table 32 and Table 33; Figure 13). The treatments containing high rates of glyphosate (treatments 4 and 5) gave the best control of the grass weeds (Button grass). A high rate of glyphosate plus Ally (treatment 5) gave the best control of broadleaf weeds (paddy melon) followed by glyphosate plus Garlon® (treatment 2).

Table 32: Paddy melon control 12 and 21 DAT (1 = no control; 10 = total control)

Treatment		12 Days After Treatment			21 Days After Treatment			
		Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Avg
1	Control- no herbicide	1	1	1	1	1	1	**1**
2	Glyphosate 450 (1.2L/ha) + Garlon® (120ml/ha) + LI700 + Liase™	9	9	6	9	10	5	**8**
3	Glyphosate 450 (1.2L/ha) +Surpass® (600ml/ha) + LI700 + Liase™	4	7	5	6	6	5	**5.7**
4	Glyphosate 450 (2L/ha) + LI700™ + Liase	7	2	6	6	3	6	**5**
5	Glyphosate 450 (2.7L/ha) + Ally® (7g/ha) + Chemwet 1000 + Liase™	9	9	6	10	10	6	**8.7**
6	Glyphosate 450 (0.8L/ha) + Surpass® (400ml/ha) + Ally® (5g/ha) + Liase	4	4	9	7	6	9	**7.3**

Table 33: Grass control 12 and 21 DAT (1 = no control; 10 = total control)

Treatment		12 Days After Treatment			21 Days After Treatment			
		Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	Avg
1	Control- no herbicide	1	1	1	1	1	1	**1**
2	Glyphosate 450 (1.2L/ha) + Garlon® (120ml/ha) + LI700 + Liase™	5	7	3	8	8	3	**6.3**
3	Glyphosate 450 (1.2L/ha) +Surpass® (600ml/ha) + LI700 + Liase™	5	8	8	9	10	5	**8**
4	Glyphosate 450 (2L/ha) + LI700™ + Liase	9	9	9	10	10	10	**10**
5	Glyphosate 450 (2.7L/ha) + Ally® (7g/ha) + Chemwet 1000 + Liase™	9	9	9	10	10	10	**10**
6	Glyphosate 450 (0.8L/ha) + Surpass® (400ml/ha) + Ally® (5g/ha) + Liase	6	5	8	8	7	9	**8**

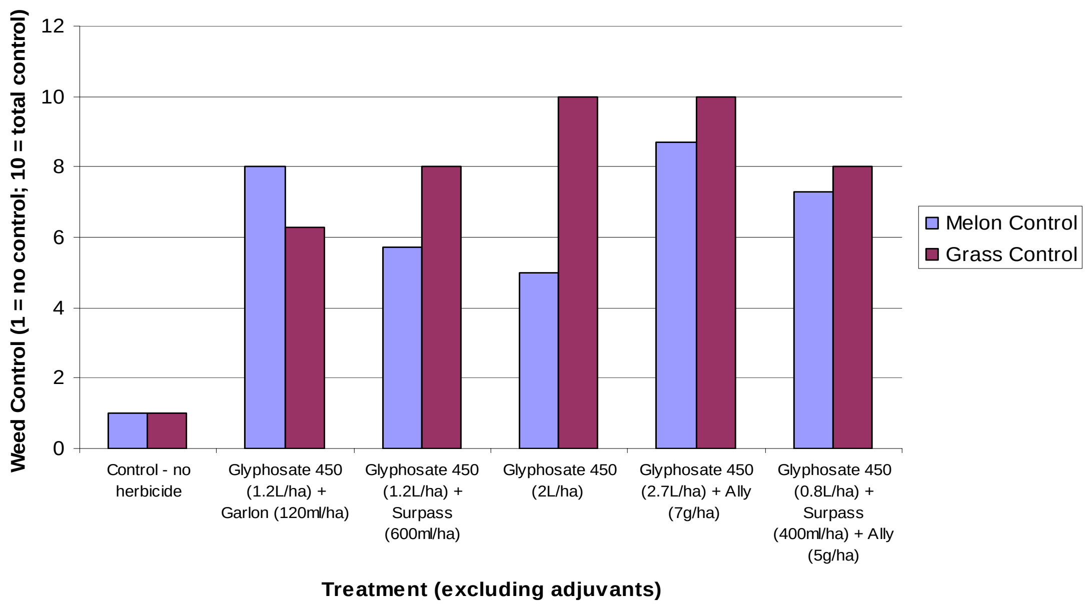

Figure 13. Weed control 10 DAT (11/02/07)

Soil Moisture

The control plots, which remained weedy from spraying (01/02/07) to soil sampling (26/04/07), contained 52% the soil moisture (19 mm) of the plots treated with glyphosate (2.7L/ha) + Ally® (7g/ha) (treatment 5) (37 mm) from 0-50cm. The control plots had 4 mm of water in the top 25cm whereas treatment 5 had 7 mm. From 25-50cm the control plots averaged 16mm of water while treatment 5 averaged 30mm (Table 34).

Table 34: Soil moisture level in the control and treatment 5 plots on 26/04/07

Treatment	Depth (cm)	Wet Weight (g) *A*	Dry Weight (g) *B*	Water Weight (g) *C=A-B*	Soil Weight (g) *D=B-jar**	Gravimetric Water Content *E=C/D*	Bulk Density of Soil *F*	Volumetric Water Content *G=ExF*	Soil Water (mm) *H = GxSample depth (mm)*
Control	0-25	376.02	372.67	3.35	354.47	0.01	1.43	0.01	3.38
Control	25-50	320.28	308.83	11.45	290.63	0.04	1.63	0.06	16.05
Control	***0-50***	***696.30***	***681.50***	***14.80***	***645.10***	***0.05***	***1.53***	***0.08***	***19.43***
Treatment 5	0-25	340.62	334.29	6.33	316.09	0.02	1.43	0.03	6.95
Treatment 5	25-50	438.12	409.07	29.04	390.87	0.07	1.63	0.12	30.37
Treatment 5	***0-50***	***778.74***	***743.37***	***35.37***	***706.97***	***0.09***	***1.53***	***0.15***	***37.32***

*Where jar is weight of jar used to measure soil

The average water use efficiency of dryland wheat (grain yield per unit of water used by the crop) in south eastern Australia is approximately 10 kg/ha/mm. This means that the additional 18 mm of soil moisture conserved by weed control in this demonstration could translate into 178.9 kg/ha of additional wheat yield. Based on AWB Limited's 07/08 APW National No 1 Pool estimate (as at May 2008) of $413/tonne (FOB, GST exclusive) this is an extra $74/ha. After deducting the herbicide cost of treatment 5 ($17.04 at June 2007, excluding application cost) the net benefit is $57/ha. At the maximum water use efficiency of 22 kg/ha/mm the potential yield increase is 394 kg/ha and the potential net benefit is $146. *NB: More than one application per season should be budgeted for.*

Soil Nitrogen
There was no significant difference in nitrogen levels between the control plots and treatment 5 plots (Table 35). This may be due to sampling error or insufficient sample numbers.

Table 35: The effect of summer weed removal on soil nutrient level at sowing time (0-50cm)

Nutrient	Control	Treatment 5 (Glyphosate 2.5L/ha + Ally 7g/ha)
Nitrate Nitrogen (mg/kg)	6.5	10
Sulfate Sulfur (KCl40) (mg/kg)	2.7	3.1
Chloride (mg/kg)	<10	15
Ammonium Nitrogen (KCl) (mg/kg)	3.7	1.5

The maximum benefit of summer weed control on soil moisture and nitrogen level at sowing was not shown in this demonstration for two possible reasons. Firstly, only one herbicide application was made on 1st February 2007 which was probably too late. Ideally, summer weeds should be controlled from December until sowing the following year for maximum moisture and nitrogen savings. Secondly, the entire paddock, including the demonstration site, was grazed from the end of February until sowing, removing the weeds from the control plots. The absence of weeds from the time of introducing the stock means that soil moisture and nitrogen are likely to have been conserved somewhat in the control plots.

NB: Please be aware of the paddock's herbicide history and the herbicide's re-cropping interval when choosing herbicide products.

Conclusion:
Maintaining weed-free fallows between winter crops can significantly increase the soil moisture level at sowing. A review of current literature shows that the increased level of moisture can translate into a significant increase in grain yield and quality. Previous trials have also shown an increase in nitrogen levels however, this was not shown in this demonstration which was most likely due to experimental error.

Chemical control of summer weeds is only one of several methods of control available and should only be used as a component of an integrated weed management programme to delay the onset of herbicide resistance and ensure sustainability and profitability.

Acknowledgments:
Thank you to Brian Nield for allowing the demonstration to be conducted on his property.

Sponsors:
Murrumbidgee CMA, NSW DPI, Australian and NSW Governments' National Action Plan for Salinity and Water Quality.

References:
Birchip Cropping Group (2000) Summer weed control options. BCG Trial Results 2000.

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Canola's future is looking bright and how to reduce risks in 2008

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Organisation: Irrigated Cropping Forum

Canola has proved to be a crop that fits into rotations well as a break crop and can provide high returns, especially with current prices. New varieties and herbicide resistant types, as well strong price signals and as a sound approach to risk management are all signs of an exciting era approaching for the canola industry in Australia.

Impact of new hybrids

Hybrid canola varieties have been in Australia since the early 1990s but it is only in the past few years that hybrids have shown their potential. One reason why we have not seen the impact of hybrids in Australia is due to blackleg and the need to have resistance in both parents.

In the future, with new varieties coming from private companies, we will see more hybrids on the market. Currently, several of the highest yielding conventional and Clearfield varieties are hybrids.

Retaining seed from a hybrid for the next crop brings a big penalty with yields up to 13 per cent lower yielding than the hybrid it was derived from.

Hybrids have generally been sown at lower sowing rates than open-pollinated varieties due to greater seed size and hybrid vigour. Trials conducted at Cummins and Struan in SA as part of the Better Canola project – funded by the Australian Oilseed Federation (AOF) and the Grains Research and Development Corporation - showed that sowing rates as low as 2 kg/ha were adequate for high grain yields from hybrids, provided pests and diseases were controlled.

Specialty varieties

New specialty canola varieties which produce oils that are more stable at higher cooking temperatures, while maintaining very low levels of saturated fats and no trans fats, are now available to growers.

The development of the specialty canola is the Australian Oilseed Federation's top priority as demand continues to grow. Locally there is a market to replace the 10,000 tonnes of palm oil which is currently imported.

Specialty varieties traditionally have a yield penalty associated with them, but some newer Australian-developed varieties have yielded comparably to some of the leading non-specialty conventional or Clearfield varieties. Growers are paid a premium for these products.

Juncea canola for low rainfall environments or spring sowings
This year two juncea canola varieties are available, Dune and the new Clearfield variety, Oasis CL, bred by the Victorian DPI and Viterra in Canada. These are Australia's first canola quality *Brassica juncea* varieties, with major changes to both the oil and meal quality from traditional table mustard. Juncea canola has a number of advantages over traditional canola in low rainfall areas, including faster ground covering ability, heat and drought tolerance and shatter tolerance - thus it may not need windrowing.

The first triazine tolerant *B. juncea* cultivars will hopefully be available in 2011. Hybrids and other herbicide tolerances are also currently being developed.

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

Strategies for reducing the risk
Making informed decisions early may reduce stress levels later in the season.

Variable costs to grow canola were around $300/ha for dryland crops at the start of the year, but, for all crops, have risen dramatically in recent times. The increase in variable costs for successful crops will be offset by high grain prices currently on offer.

Strategies to reduce some of the up-front costs for dryland crops include strategic use of nitrogen fertiliser and deferring herbicide applications to post emergent, where possible, to see if they are really needed. Choosing paddocks with stored nitrogen and stored moisture will also reduce risk associated with growing canola. Timely sowing is extremely important and maximises yield potential and by default reduces risk. Having alternative end uses for canola such as hay and silage also reduces risk by creating another source of income in a season with a dry finish. These strategies are discussed in more detail below.

Time of sowing, sowing rates and subsoil moisture
The ideal sowing time for canola is late April to mid-May for low to medium rainfall areas such as northern Victoria and the north east, but this can be extended until mid-June. In central and southern NSW, mid April to mid May are the optimal times.

If early sowing is not possible, choose an earlier maturing variety if in a high rainfall zone and start to weigh up your options if in medium rainfall zone.

Ideally, sow at the earliest time within the sowing window. Delayed sowing usually reduces oil content and yields due to hotter, drier conditions during pod filling. Canola and *Brassica juncea* yields drop by an average 5% per week delay in sowing, but can be much more in years with a dry spring, and less in years with a gentle finish. Oil content in canola also drops by about 0.5% per week as sowing is delayed beyond the optimum.

Sowing rate is also an area that can be re-assessed. As a general rule 1 kg seed per hectare equates to 25 plants/m^2. The adoption of press wheels has improved emergence of canola. Plant densities of 30-50 plants/m^2 are ideal for the medium rainfall areas, while 50-75 plants/m^2 are ideal in southern Victoria, and many growers are achieving much higher plant densities than this. Re-sowing is not necessary unless plant populations are very low, at or below 10-20 plants/m^2.

Nitrogen management
Nitrogen rates need to be matched to target yields, and a new potential yield calculation has been developed by CSIRO for southern NSW which is simple but 20% more accurate than the French-Schultz model, which is still used by most agronomists. With the new calculation, target yields are 85% of potential yields. Refer to "Maximising Canola Performance" for further details under: http://www.grdc.com.au/director/events/researchupdates.cfm.

Fertiliser, particularly nitrogen, is the biggest single variable cost for canola and carries with it financial risk if the season shapes up poorly. Trials at Wagga Wagga, Forbes, Bendigo, Longerenong, Struan and Condobolin have shown that delaying to the 6-8 leaf stage or splitting N fertiliser applications usually has no yield penalty associated with it when there is at least 40 kg/ha N in the top 50 cm at sowing time.

Fungicides
Fungicide seed treatments have their place, but responses are much less likely with blackleg resistant varieties – and in Victoria, there's usually no advantage in using a fungicide when the blackleg rating is over 7, particularly in low-risk situations.

Retained seed
This is becoming common practice in some regions, and may be fine in the first year if good quality seed is retained. However, sowing retained seed may be false economy and is generally not recommended, as trials have shown an average 12% yield decline with poor-quality (droughted) retained seed.

Grazing canola
Research in the high rainfall zone suggests if canola is sown early (by mid-late April), it can be grazed in winter. The feed is excellent quality. In preliminary trials, the combined value of stock feed and grain can easily be more profitable than grain alone.

Canola hay and silage
In recent years, cutting canola for hay or silage has provided an alternative income source for some growers and in a number of cases has been more profitable than carrying the crop through for grain. It is becoming more accepted by the dairy industry, particularly in Victoria. Hay production is not without risk (weather damage, volatile markets) but does provide an option in some seasons. Canola hay and silage are safe to use as long as feeding guidelines are followed.

Good quality canola hay is an excellent source of energy and protein and is highly palatable.

Table 36: Feedtest - Canola hay quality for 2006 and 2007

Baled canola hay (samples)		Crude protein (%)	Dry matter digestibility (%)	Metabolisable energy (MJ per kg dry matter)
2007	Average	15.0	65	9.6
	Range	8.7-27.7	35-83	4.4-13.1
2006 (579)	Average	15.9	66.4	9.8
	Range	4-27	33-85	4-13

Source: Feedtest Victoria

Better Canola hay trials

Two trials were conducted in 2007 at Longerenong College by Birchip Cropping group, as part of the *Better Canola* project. One trial investigated the time of cutting and its impact on hay quality, and the other compared two standard TT varieties with two Clearfield hybrids for dry matter against carrying the crops through for grain yield. To briefly summarise, cutting at early flowering produced the best quality hay, but cutting at late flowering to early pod fill was the best compromise between hay yield and hay quality - and the most profitable option. Hybrids produced more hay and grain than the TT varieties tested. More detailed results will be published on the Australian Oilseed Federation's website:
http://www.australianoilseeds.com/agronomy_centre/variety_and_agronomy_trials

Hay is hungry – a soil test is a must

Nutrient export in hay crops can be very high and this needs to be considered when planning for 2008. A soil test in autumn is a must for paddocks that were cut for hay last season.

Crop insects and mites: resistance issues and integrated management

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Key messages:
- Chemical resistance and secondary pests are emerging as genuine threats to the grains industry.
- The key to successful integrated pest management is accurate identification of pest and beneficial species.

Pest species within the grains industry pose a serious threat as farming practices change. To avoid costs associated with crop failure and increases in pesticide usage, potential pest species must be identified and their biology determined so effective control strategies can be devised. Underpinning an integrated pest management approach is correct identification and monitoring of both pest and beneficial invertebrates (insects and mites). Misidentification of pests can cost growers money through ineffective control strategies and pesticide applications. Monitoring of pest and beneficial numbers is also critical for making informed control decisions.

Research at the Centre for Environmental Stress and Adaptation Research (CESAR), aims to develop integrated management strategies that focus on all pests within cropping and pasture systems, incorporating control options that minimise effects on beneficial species.

Earth mites and chemical resistance

The redlegged earth mite (RLEM) is a major pest, particularly to establishing crops and pastures. Mite feeding significantly reduces seedling survival and development, and will often lead to entire paddocks needing to be re-sown. For decades, RLEM have been controlled relatively effectively with broad-spectrum pesticides. However, researchers at CESAR have recently discovered chemical resistance in some RLEM populations. Extremely high levels of resistance to several synthetic pyrethroids - detected for the first time using laboratory bioassays - have led to significant yield losses in the field.

This resistance has been shown to have a genetic basis, persisting after several generations of culturing away from the paddock. This means it can be passed on to offspring and could persist in the field indefinitely. In total, resistance has now been demonstrated for five synthetic pyrethroids, all of which are currently registered to control RLEM in Australia. Further surveys of RLEM have also found this resistance to be more extensive than first thought, suggesting that it may be spreading and has potential to be a widespread problem.

Concerns surrounding other establishment pests and chemical use also exist. CESAR researchers have found high levels of tolerance to several organophosphates and/or synthetic pyrethroids in blue oat mites, the lucerne flea and in two emerging mite pests, *Balaustium* and *Bryobia* mites.

Although many of these species can still be controlled fairly effectively, the number of reports of these pests persisting in the field - even after multiple chemical applications - is increasing. These findings show that current pesticide usage is unlikely to be a sustainable practice.

Smarter chemical use is critical; synthetic pyrethroids should be avoided for the control of lucerne flea and *Balaustium* mites may be difficult to control with all currently registered pesticides.

Beneficial species (natural enemies)
Naturally occurring beneficial species play a vital biological control role in many cropping systems. Most species are highly mobile and will move from crop to crop if left unsprayed. They are able to help keep pest populations under control.

Beneficial classifications include:

- Predators: generalist; consume a wide range of prey; free living.
- Parasites: specialised and target species; feed on or in the body of its host.
- Diseases: insect fungal, viral and bacterial infections.

Common beneficial species likely to be encountered include predatory mites, lacewings, hoverflies, ladybird beetles, carabid beetles, damsel bugs, spiders and parasitic wasps.

Whilst there are organisations that breed beneficial insects and mites for release, the most effective strategy is likely to be the preservation (by reducing pesticide use) of those already in the system. Other factors involved in supporting beneficial invertebrates in the system include alternate food sources (eg. nectar sources, non-pest hosts) and refuge habitat (eg. remnant vegetation, shelterbelts, trap crops).

'Softer' chemicals
Although chemical control is still an important part of an integrated pest management strategy, there needs to be a shift from using broad-spectrum pesticides to more selective alternatives. Broad-spectrum chemicals invariably kill non-target (and beneficial) organisms.

The use of more selective or 'soft' pesticides is an effective management tool that facilitates – rather than disrupts – the natural biological control that already exists. By specifically targeting plant-feeding invertebrates, they allow beneficial species to remain in the system to help suppress pest numbers.

Seed dressings may also be an alternative control option and will delay applications of foliar sprays giving beneficial insects time to build up. Seed dressings need some thought process on potential pest pressures prior to sowing as many different dressings are available.

Sponsors:
National Invertebrate Pest Initiative (NIPI), funded through the Grains Research and Development Corporation.

Soil formation and distribution on the Riverine Plains

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Organisation: DPI Victoria, Werribee

Key message:

- Soils across much of the Riverine Plains area can vary dramatically at even a paddock level due to past alluvial deposition and landscape characteristics. By understanding how the soils were formed by prior streams, for example, enables their distribution to be more easily predicted and relevant management implications to be understood.

Across many regions of Australia there is a great diversity of soil types that reflect differences in parent material, topography, climate, organic activity and time (eg. degree of weathering). The distribution of soils on the Riverine Plains is often complex and largely determined by former alluvial (stream) and some aeolian (wind-blown) activity that occurred during many thousands of years of varying climate regimes.

The Riverine Plain is an extensive alluvial plain within the Murray Basin. This basin was formed as a result of uplift of the Eastern Uplands during the Tertiary period. Subsequent erosion of these uplands resulted in sediments being deposited on the Riverine Plain by streams that flowed out of the mountains and hills. The dominant sediments in the area were deposited by an older meandering river system ('prior stream' system) in the Quaternary period (from approximately 1.6 million years ago to recent geological times). These deposits are called the *Shepparton Formation* on geological maps and were mainly derived from rivers and streams, but also include aeolian (i.e. wind-blown) deposits. These aeolian deposits consist of fine calcareous soil material which spread over much of Northern Victoria during drier climatic periods. The *Shepparton Formation* deposits vary from about 50 to 125 metres in depth across much of the Northern Victorian plains and cover the older alluvial (Tertiary) and marine (Ordovician) sediments. There are a number of older soils developed one on top of the other leaving a series of 'buried soils'.

Different landscape units have their own array of soil types. In some of the landscape units, certain soil types are related to each other through their positions in slope sequences (i.e. toposequences). In others, soils vary according to their landscape position with respect to prior streams. Two of these landscapes are discussed below.

Prior Stream Landscape

The theory of prior streams as the main origin of soil formation in the Riverine Plain of northern Victoria and southern NSW was formally presented by Bruce Butler (Butler 1950). This theory postulated the occurrence of a system of prior streams, independent of the present-day stream pattern, whose activity created the present day land surface – in the late Pleistocene to early Present period. These former streams had a different character and usually a different location to the present day streams. The present Riverine Plain has therefore been built up as an outwash plain of gently sloping alluvial fans derived from the mountains and hills to the south and east (the foothills of the Great Dividing Range). The Mallee region forms the western boundary of the Riverine Plain and overlays it in part.

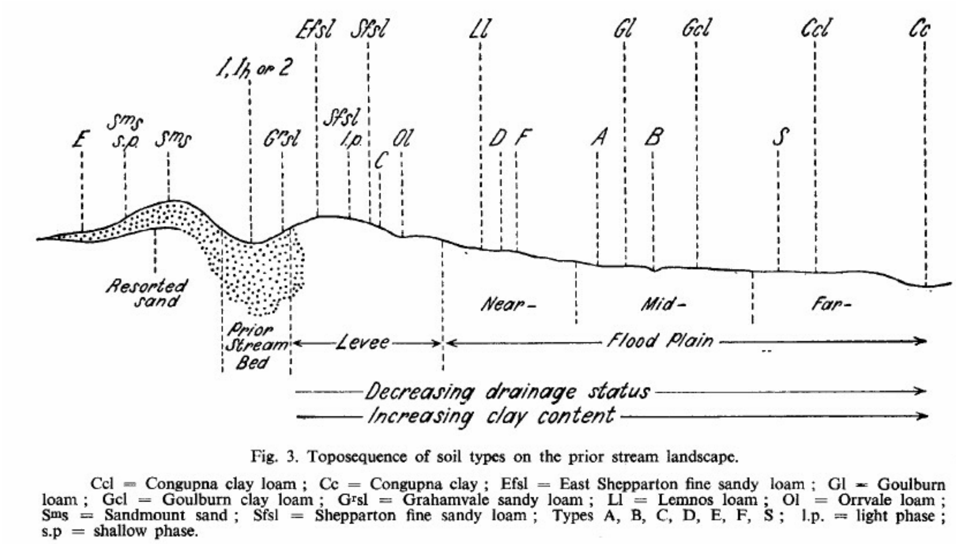

Figure 14. Toposequence of soil types in the prior stream landscape of the Goulburn Valley (Skene and Poutsma, 1962)

The prior stream landscape is a complex array of relict stream lines (called 'drifts' in the earlier soil surveys). The soil types have developed on or near prior streams and are highly variable. Figure 14 shows an example of a toposequence of soil types mapped by Skene and Poutsma (1962) on a prior stream landscape in the Goulburn Valley region of Victoria. Note that the old stream bed has been filled with coarser sand and gravels. The former channel was enclosed by levee banks which are usually fine, sandy in texture. The levee banks may have since eroded away and sometimes only a low ridge of channel sand remains. As the prior stream flooded it would have deposited sediments. Coarser sized sediments settled first in the near flood plain and finer textures settled out on the far flood plain. These deposits could extend up to several kilometres from the parent stream.

Example soil associations

A similar distribution of soils exists in the East Shepparton area which relate to prior stream deposits. Figure 15 below is a small section reprinted from the soil association map of the Skene and Freedman (1944) soil survey. The term ‘soil association’ is used to describe a group of soils that exist in similar parts of the landscape and which have developed on similar parent materials. Note how the soil associations are distributed in relation to the location of the prior stream channel.

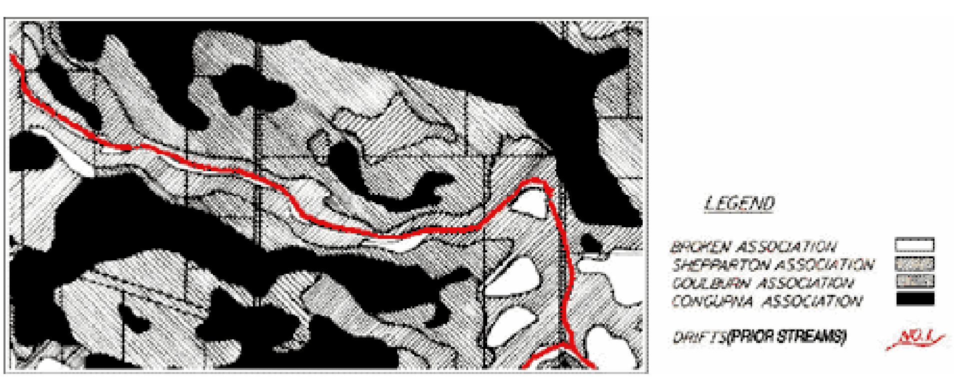

Figure 15. Diagram showing typical location of soil associations in the East Shepparton region (Skene and Freedman, 1944)

Broken association: These soils are light textured (i.e. sandy) soils such as *Broken sand* which have formed on the coarser deposits associated with prior stream channels.

Shepparton association: Soils of intermediate surface textures derived from finer sediments than the *Broken association* soils. These soils include *Shepparton sandy loam*, *Shepparton loam* and *Orrvale sandy loam* and are usually located adjacent to the *Broken association* soils. The soil types on the levees of the prior streams are all soil types with brown surfaces (often fine sandy clay loam in texture), red-brown clay subsoil, and fine sandy clay and lighter textures in the deep subsoil between 50 cm and 120 cm depths.

Goulburn association: Soils of intermediate surface texture that have developed on more clayey sediments. This association includes *Lemnos loam* and *Goulburn loam*. The colour of the subsoil usually reflects drainage status. *Lemnos loam* is generally found on near to mid situations of the prior stream flood plain and typically has a brown-coloured surface and red-brown clay subsoil. *Goulburn loam* occurs at slightly lower (less well drained) levels in the plain, and is a soil type with a grey-brown to grey surface and yellowish grey-brown heavy clay subsoil.

Congupna association: This group includes the heavier (i.e. more clayey) soils of the depressions. It includes *Congupna clay loam*, *Goulburn clay loam* and *Congupna clay*. These soils are usually found on the far-flood plain of a prior stream.

Relationship between landscape, soil and vegetation

Although much of the timber has been cleared from the Prior Stream landscape, sufficient has remained to be able to identify its original woodland character. Grey box was the dominant species with buloke a minor component. The lighter-textured soils on or near the better-drained levees of the prior streams would have carried yellow box as well as grey box. Black box most likely occupied the more pronounced poorer-drained depressions.

Example soil types in a prior stream toposequence

A sequence of soils found in a small area between Mitiamo and Pine Grove is described in Figure 16. It provides an overview of three distinct soil types that can occur across a small area in many parts of the Riverine Plain, reflecting prior stream deposition.

a) This soil is associated with a prior stream bed. It has a high coarse sand content (>50%) and low clay content (<10%) and is slightly acid to neutral throughout. This soil is classified as a Orthic-Brown Tenosol using the Australian Soil Classification and is similar to some of the soils in the *Broken association* described above.

b) This soil type is common throughout the Riverine Plains region and is classified as a Red Sodosol using the Australian Soil Classification (formerly known as 'red-brown earths'). It is characterised by a strong texture contrast between a fine sandy loam (12% clay) surface soil that abruptly overlies a reddish coloured medium clay subsoil. The subsoil is sodic and disperses strongly in water. These soils typically are slightly acid in the surface soil and often become strongly alkaline in the deeper subsoil. The level of soluble salts also increases with depth down the profile. This soil is most likely associated with the near flood plain of a prior stream and is similar to soils that occur as part of the *Goulburn association* described above.

c) This soil is classified as a Red Vertosol using the Australian Soil Classification. It is a cracking clay soil (light medium clay surface texture overlying heavy clay subsoil) that probably represents the far flood plain of a prior stream. Soils such as this shrink and swell considerably during wetting and drying cycles and are often associated with gilgai ('crab-holey') microrelief. These soils are typically slightly alkaline at the surface and become strongly alkaline and sodic in the subsoil. They also often have a high level of soluble salts at depth. This soil is similar to some of the heavy textured clay soils that occur in the *Congupna association* described above.

Figure 16. Overview of three distinct soil types a) Orthic-Brown Tenosol b) Red Sodosol and c) Red Vertosol that can occur across a small area of the Riverine Plain

Treeless Alluvial Plain Landscape

Other areas of the Riverine Plains did not have significant prior stream activity and were originally mainly flat and largely treeless alluvial plains. Black box and red gum occurred in some of the drainage lines as well as lignum bush associated with seasonally inundated lower-lying areas.

The Kerang irrigation area of Victoria is an example of this widespread landscape with a soil toposequence dominated by Vertosols (cracking clay soils) that vary according to drainage status of the landscape. *Macorna clay* occurs on fractionally higher (and better-drained) parts of the landscape than *Kerang clay*. They are distinguished by their subsoil colours immediately below the surface, with *Macorna clay* ranging from dark red-brown to brown, and *Kerang clay* from dark grey-brown to dark yellowish grey. In the uncultivated state, *Macorna clay* has a brown or greyish brown surface, and *Kerang clay* grey-brown or grey, but the surfaces are very shallow and when the soils are cultivated these distinctions are usually lost. Gypsum occurs deeper in the profile of Kerang clay, the usual depth being about 75 cm compared with 50 cm in Macorna clay. *Tragowel clay* occurs on extensive areas of poorer-drained lowland, slightly below Kerang clay in the plain. In the virgin state, it has distinctive features such as a conspicuous gilgai ('crab-holey') surface.

Further Information

The Victorian Resources Online (VRO) website provides information on soils across Victoria – including making available downloadable versions of the major soil surveys conducted across the Victorian Riverine Plains region.

Goulburn Broken region
http://www.dpi.vic.gov.au/dpi/vro/gbbregn.nsf/pages/soil_survey?OpenDocument
Detailed soil surveys: East Shepparton (1944), Rochester and Echuca (1964), Murray Valley, Goulburn (1962), Deakin (1963), Dookie (1949).

North Central region
http://www.dpi.vic.gov.au/dpi/vro/nthcenregn.nsf/pages/nthcen_soil_dssurveys
Swan Hill (1966), Torrumbarry (1979), Mid-Loddon Valley (1971), Rochester (1964)

Soil Health
http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/soilhealth

Soil Management
http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/soil_mgmt

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On-farm storage – resistance makes it harder

Author: Peter Botta

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Organisation: DPI Victoria, Benalla

On-farm grain storage is increasing at a rapid pace. Success depends on a system that will work now and in the future. Two critical drivers for the future must be considered. These are (1) how will you kill insects and (2) what is the market likely to want in the future?

There is no doubt that it is becoming harder and harder to kill insects. There are many ways we can manage and help to control them, i.e. hygiene, limiting moisture, cooling grain, but rarely on their own will they kill them.

One of the biggest challenges facing on-farm storage is resistance to the treatments used to kill insects. Most farm storage is unsealed, which relies on protectants for a given storage period. Where insects are found in an unsealed storage, Dichlorvos is the only treatment which should be used to kill the infestation. The problem facing growers is that resistance is wide spread in the Lesser Grain Borer to Dichlorvos, and is increasing in the Lesser Grain Borer to Methoprene (Diacon®).

The issue for growers is that if they solely rely on unsealed storage, their options to kill insects in the future will rely on sealed gas-tight storage. Whilst the obvious choice is to add sealed storage to the system, getting it right is so important. This means ensuring it is gas-tight.

A silo is really a big bucket to hold grain until needed. The purpose of sealed gas-tight storage is to function as a fumigation chamber too. Gas-tight storage maintains fumigant concentration for a period of time. With on-farm storage this is 10 days at temperatures of 15-25ºC and 7 days at temperatures above 2ºC. Resistance to phosphine is becoming an increasing problem and is due to phosphine not being used in gas-tight storages and or at correct rates. The alternatives to phosphine are more expensive and harder to use.

Alternatives to phosphine all need gas-tight sealed storage. If you are looking to increase your storage system, do your homework, get good advice and buy quality gas-tight storage.

Grain is being stored on farm for longer periods and for many different markets. Meeting market requirements will mean that a combination of gas-tight and aerated storage or a mixture of each will be necessary. This will enable growers to confidently store grain, control insects and maintain quality. This type of system is easier to use and takes away many of the problems when using unsealed storage such as calibration and application of protectants.

When using grain storage treatments be sure you use them correctly and in the proper storage system. There is no reason why growers can't get it right, but it is so important that you do.

DGT as a technique to accurately predict phosphorus fertiliser requirements

Authors: Sean Mason and Ann McNeill

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Organisation: University of Adelaide, South Australia

Key messages:
- The DGT method is an improved soil test for predicting P response from a given soil.
- A reliable soil test for P will improve the efficiency of P fertiliser use.

Aim:
To determine the ability of the DGT technique to predict crop response to an application of P from 20 field sites across southern Australia

Method:
Diffusive Gradients in Thin-Films (DGT) technology has been recently modified for the assessment of available phosphorus (P) and micro-nutrients in Australian agricultural soils. Initial testing of the technology for prediction of wheat response to P in the glasshouse had shown that DGT was more accurate compared to other soil tests for available P (Colwell P, Olsen P and resin).

The DGT test is said to mimic a plant root by only measuring the P in the soil that is accessible by the plant. Placed on top of a moist soil sample a DGT device contains a ferrihydrite (form of iron) gel which binds the P diffusing towards it. The gel is very specific for P and is free of any other element competition. After a certain time of deployment on the soil (typically 24 hours) the P bound to the gel is removed using an acidic solution and the amount of P in the eluted solution is then measured. DGT deployment conditions and the use on an iron based gel sets it apart from other common soil P tests.

Current common soil P tests use a relative small amount of soil to solution ratio and either uses an extracting solution to displace P or an anion exchange membrane to capture P in the solution.

Further extension of this work was performed in 2007 with the main aim of determining if DGT could predict P fertilizer requirements for the field and to compare results from the DGT soil P test with other common soil P testing techniques (Colwell P and resin). With assistance from collaborators, numerous field sites were selected from southern Australia, resulting in the assessment of a diverse range of soils. Soils were tested for available P using DGT, Colwell and resin methods. These measurements were then related to the wheat response to an application of P expressed as the ratio of yield obtained from soil with no added P to the maximum yield obtained with P application (% relative yield)

Results:

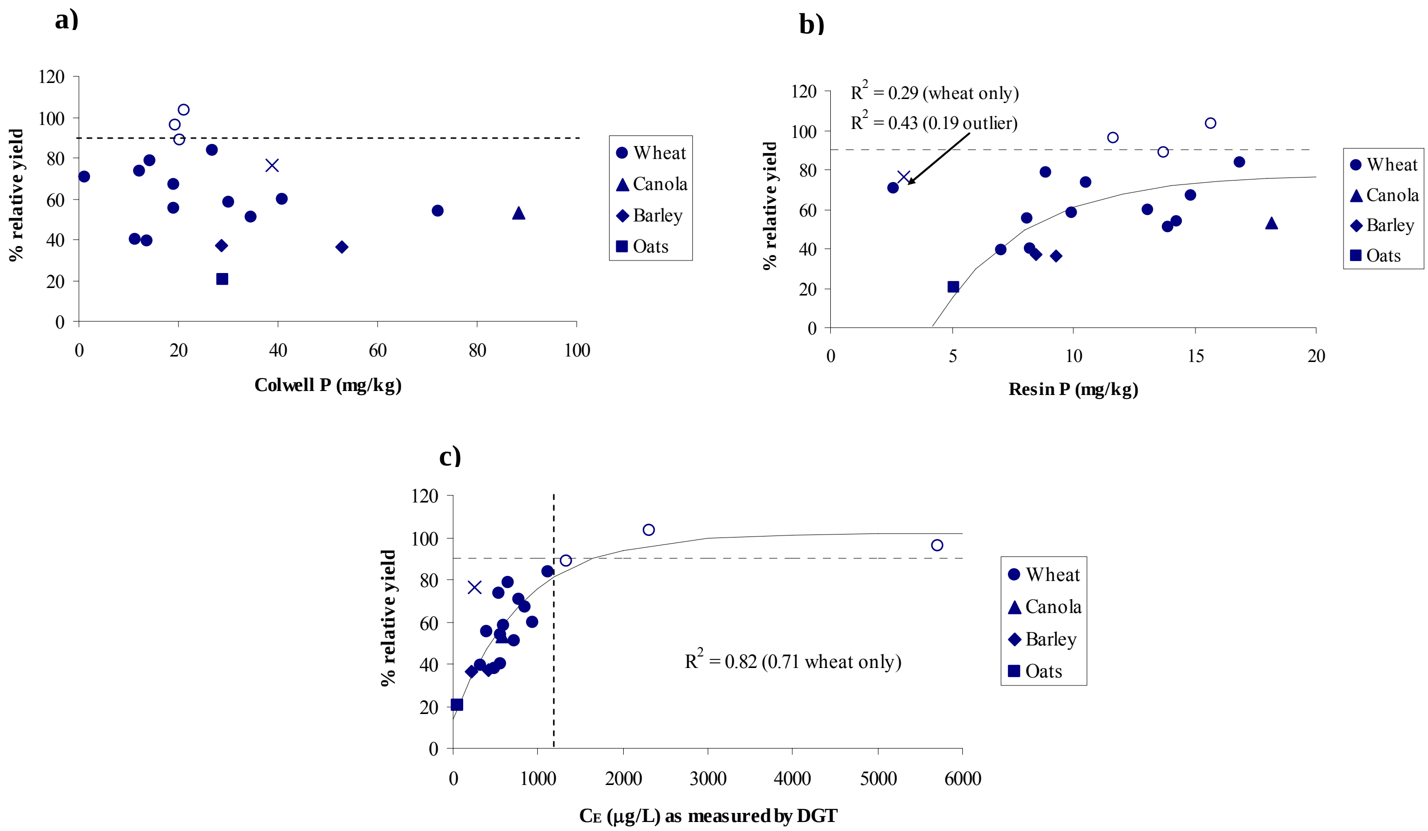

Figure 17. Relationship between soil P test measurements (a) Colwell P (b) resin P and c) DGT with % relative DM yield response. Non-responsive soils are represented by open circles. Outlier represented by (x).

There was no significant relationship obtainable with Colwell P measurements and early dry matter wheat response to P (Figure 17a). The Colwell P method is dependent on soil type and different critical values have been published for certain types of soil. Therefore with the diverse range of soils used in these field trials it is not surprising Colwell P performed poorly. In addition, the method uses an extracting ion (bicarbonate) to assess the 'available P' fraction from the soil. In some cases, the extracting solution can solubilise relatively stable forms of P and hence overestimate the plant available P fraction. As an example, on calcareous soils the Colwell P can overestimate P availability by solubilising a portion of the unavailable P tied up with the high percentage of calcium in the soil. It has been suggested that for more reliable results on various soil types, Colwell measurements can be combined with the P buffering index (PBI) of the soil. Using PBI measurements from these field soils did not improve the uncertainty involved with the Colwell P method.

The relationship with resin P measurements and early dry matter response was poor (Figure 17b). The relative small amount of soil to solution ratio used with the resin P test changes the soil P chemistry differently over a range of soil types. It is hard to directly relate soil solution chemistry to conditions encountered in the field. The anion exchange membrane used to capture P with this soil test is not specific for P and other anions can affect the sorption of P onto the strip.

DGT measurements provided a clear picture of P availability from these field sites as indicated by a good relationship between wheat response to P and DGT measurements (Figure 17c). The DGT method indicates whether a particular soil has sufficient P to maximise crop growth or whether a soil will be responsive to an addition of P fertiliser. Calculated thresholds of P deficiency using DGT measurements from these field trials are comparable to glasshouse trials performed previously which tested wheat response to P in 56 different soils.

The relationship between DGT measurements and grain yield was not quite as strong as with early dry matter production due the dry finish in 2007 but was still an improvement on the Colwell and resin tests.

Observations and comments:
Further field testing is required to assess the performance of DGT under more average seasons and on other soil types. However, DGT is initially showing great promise as a reliable soil test.

With further development DGT also has the potential to assess K, Zn, Mn and Cu availability on agricultural soils.

Sponsors:
We would like to thank the Grains Research and Development Corporation for funding this work and our collaborators, who have kindly let us tag along with their field trials. These people include Sandford Gleddie, Simon Craig, Neil Fettell and Bill Bowden.

Developments in herbicide resistance and new herbicide products

Author: Chris Preston[1] and Peter Boutsalis[2]

Contact No: [1]08 8303 7237 and [2]08 8303 7298

Organisation: [1]CRC for Australian Weed Management and [2]School of Agriculture, Food and Wine, University of Adelaide.

Key messages:

- High levels of herbicide resistance are present in annual ryegrass in Victoria.
- Trifluralin resistance is on the increase.
- There is no cross resistance to the new pre-emergent herbicides Boxer Gold and Bay 191.
- Fencelines and other uncropped areas around the farm are at risk of glyphosate resistance.
- Mataven resistance in wild oats appears related to use of fenoxaprop and clodinafop.

Observation and Comments:

Surveys of herbicide resistant annual ryegrass in Victoria

Recent surveys of cropping regions in Victoria have indicated that many farms have annual ryegrass with resistance to Groups A or B (Table 37). Resistance to the Group A herbicides is high in the Wimmera and north central Victoria, but lower in other zones. Resistance to the Group B herbicides is high in all areas except the north east. Resistance to Select is increasing, particularly in the Wimmera and north central Victoria. Resistance to trifluralin is low across all areas.

The amount of resistance correlates with cropping practices. The more intensively cropped areas like the Wimmera and north central have higher levels of resistance. The north east, with more hay and pasture, has lower levels of resistance. Resistance to Select is higher in regions like the Wimmera that have higher frequencies of pulses and canola in the rotation.

Table 37: Herbicide resistance detected in random surveys of annual ryegrass in Victoria

Region	**Mallee**	**Wimmera**	**North Central**	**North East**
Herbicide	Populations with resistance (%)			
Trifluralin	7	2	2	2
Hoegrass	12	60	63	18
Glean	64	60	68	19
Axial	7	55	63	6
Select	0	26	18	4

Resistance to trifluralin has increased rapidly in South Australia in the past few years. This has put pressure on no-till seeding operations as there has not been a viable alternative herbicide. Continued use of trifluralin will see the incidence of trifluralin resistance increase in Victoria.

New pre-emergence herbicides

A number of field trials have been conducted in South Australia and Victoria looking at alternative herbicides for controlling annual ryegrass pre-emergent in no-till systems (Table 38).

Table 38: Control of annual ryegrass and wheat yield following application of pre-emergent herbicides at Roseworthy in 2007

Herbicide	Rate (/ha)	Annual ryegrass control (%)	Wheat yield (t/ha)
Nil	-	0	2.04
Triflur X	1 L	40.0	2.15
Triflur X	3 L	60.0	2.04
Boxer Gold	2.5 L	83.8	2.44
Dual Gold	300 mL	60.0	2.45
NUL-1493	750 mL	81.3	1.91
Cinch	275 mL	68.8	2.34
BAY-191	166 g	85.0	2.27
Triflur X + Avadex Xtra	1.5 L + 1.6 L	77.5	2.36
Dual Gold + BAY-191	300 mL + 166 g	85.0	2.42
Dual Gold + NUL-1493	300 mL + 750 mL	88.8	2.18
Dual Gold + Cinch	300 mL + 275 mL	73.8	2.05
BAY-191 + Avadex Xtra	166 g + 1.6 L	90.8	2.40

Trifluralin struggled on this site because of the presence of trifluralin resistant annual ryegrass. Boxer Gold (Prosulfocarb + S-Metolachlor), a new product marketed by Syngenta in 2008, provided good control of annual ryegrass. BAY-191, an experimental product likely to be released in 2011, also provided good control. NUL-1493, a Nufarm product likely to be registered for pulse crops, controlled annual ryegrass, but damaged the crop. A pot study has shown that both Boxer Gold and BAY-191 control trifluralin resistant ryegrass populations.

The lack of cross resistance to Boxer Gold or BAY-191 provides the opportunity to use these herbicides in rotation with trifluralin. Neither Boxer Gold nor BAY-191 will be registered for use in canola, so a pre-emergent herbicide will still be required to provide grass control in canola. Saving trifluralin for canola, where trifluralin still works, and using the new products for cereals would make a good strategy for preserving the utility of trifluralin.

Glyphosate Resistance

There are now 75 populations of annual ryegrass from around Australia with known resistance to glyphosate (Table 39). Many of these are from winter fallow systems in northern NSW; however, an increasing number are from fencelines and other uncropped parts of the farm. Glyphosate resistance occurs when annual ryegrass populations are treated intensively with glyphosate, where no other herbicides applied and where there is little or no tillage. In addition to glyphosate resistance in annual ryegrass, two populations of awnless barnyard grass have been confirmed resistant to glyphosate in a summer cropping/fallow situation in northern NSW.

The good news is that despite early forecasts, the number of resistant populations from no-till cropping systems is still low. The glyphosate resistant populations seem not to perform well under crop competition. However, in areas with little competition, like fencelines, resistance does occur. Once resistance is present on the fenceline, it can be dragged into the cropped area with harvest and seeding equipment, creating a problem throughout the paddock.

Table 39: Occurrence of glyphosate resistant weeds in Australia

Situation		Number of sites	States
Broadacre cropping	Chemical fallow	26	NSW
	No-till winter grains	11	NSW, Vic, SA, WA
Horticulture	Tree crops	3	NSW
	Vine crops	14	SA, WA
Other	Driveway	1	NSW
	Fenceline	12	NSW, SA, Vic
	Firebreak	2	SA, NSW
	Irrigation channel	6	NSW
	Airstrip	1	SA
	Railway	1	WA

From Preston, C. (2007) Australian Glyphosate Resistance Register. National Glyphosate Sustainability Working Group.Online. Available from www.weeds.crc.org.au/glyphosate

Cross resistance within Group A herbicides

Axial (active ingredient pinoxaden) a Group A 'den' herbicide for annual grass weed control was introduced in 2006. While Axial has different chemistry to the fops and dims, its resistance profile in annual ryegrass is similar to Sertin and Achieve (Table 40). This means Axial is unlikely to control Dim resistant annual ryegrass.

Table 40: Frequency of annual ryegrass populations resistant to various Group A herbicides. From a collection of 108 populations tested by Plant Science Consulting.

Herbicide	Fops	Achieve	Select	Axial
Populations resistant (%)	78	47	11	31

Herbicide resistance in wild oats

A random survey of wild oats across Victoria identified resistance to Hoegrass in 17% of samples in the Mallee and Wimmera and in 8% of samples in the north central and north east regions. Resistance to Select was not identified in any samples.

The last few years have seen an increase in reports of wild oats with resistance to Mataven. The current thinking is that selection of wild oats with Wildcat or Topik has tended to select for Mataven resistance. A survey of Fop resistant wild oat populations collected in 2005-2006 found 42% with resistance to Mataven, despite many populations not having previous exposure to Mataven (Table 41). In contrast, Mataven resistance was not detected at all in Fop resistant wild oat populations collected in 1990-1992. This data suggests that Matavan may not adequately control wild oats that are resistant to Wildcat or Topik.

Table 41: Survival (%) of selected Fop-resistant wild oat populations to Wildcat, Topik, Axial, Atlantis and Mataven

	Wildcat 300 ml/ha	Topik 75 ml/ha	Axial 200 ml/ha	Atlantis 330 ml/ha	Mataven 2.5 L/ha
Resistant samples (%)	83	63	21*	4*	42

Resistance to 2,4-D in Indian hedge mustard

2,4-D resistance in Indian hedge mustard has been confirmed in South Australia. Plants from this population survived 5.6 kg a.e. ha^{-1} of 2,4-D dimethylamine, whereas two susceptible populations were completely controlled with 250 g a.e. ha^{-1}. This population is resistant to Group B herbicides and to other Group I herbicides (Table 42). This is a worrying development as Group I herbicides are often used to control Group B resistant broadleaf weeds. There is a second population with suspected resistance nearby.

Table 42: Estimated LD_{50}s (g a.i. ha^{-1}) and resistant ratios for populations from Roseworthy (S), Port Broughton (R) and Tumby Bay (R to Group B herbicides only) treated with various herbicides

Herbicide	S	R LD_{50} (g ha^{-1})	R/S	Tumby Bay LD_{50} (g ha^{-1})	R/S
2,4-D	81	2009	25	91	1.1
MCPA	72	1510	21	75	1.0
Chlorsulfuron	0.18	90	545	>1000	>5000
Metsulfuron-methyl	0.18	5.69	32	7.35	42
Imazethapyr	9.5	37	4	>1000	>100
Metosulam	0.45	192	425	232	513
Florasulam	0.31	7.04	23	31.6	103

Sponsors:

Grains Research and Development Corporation Projects UA00075 and UA00088.

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Farming families and Decision-Systems Theory (DST)

Author: Dr Quentin Farmar-Bowers

Contact No: 03 5444 7464

Organisation: Centre for Sustainable Regional Communities, Faculty of Law and Management, La Trobe University, Bendigo.

Key messages:

- DST was developed from in-depth interviews with farming families and provides an explanation of how farming families make strategic decisions about their lives and farming careers.
- DST could be helpful to farming families:
  - To improve their strategic decision processes and gain confidence in negotiating decisions.
  - To guide community action to help families in their region tackle issues such as climate change, regional development, health, education and youth employment.
  - To increase the influence of their communities on Governments' rural policies and programs, especially to ensure viable rural communities and the future for farming families.

Aim:

To show the importance of understanding the processes farming families actually use in making strategic decisions for farmers, rural communities and rural policy development.

Decision-System Theory (DST):

Decision-systems theory (DST) provides a comprehensive explanation of the processes farming families use in making strategic decisions. DST is still being refined and more farmer interviews are planned. DST is based on evidence from interviews and although it is complex, it is much more realistic than current assumptions about decision-making based on economic models.

Decision-systems theory (DST) contains 5 concepts.

Concept 1: 'Motivational Stories'

Farming families have family aspirations that are described in a set of five 'motivational stories'. These stories are what families are working to achieve, or have on an ongoing basis. They are the 'ends' that families are striving for.

Concept 2: Suitability and Availability of opportunities

Farming families actively create opportunities. They seek options that seem 'suitable' for satisfying their family's aspirations (the motivation stories). However, they can only create opportunities from these options if all the components needed for the opportunity are actually 'available' to their family. The components for farming opportunities are (1) Personal; i.e. time, skill, knowledge, land and machinery they own, money they have etc. (2) External; i.e. markets, finance, infrastructure, water to buy, land to lease etc. (3) Random; i.e. droughts, fires, market fluctuations etc.

Concept 3: A two tier hierarchy of decision-systems
Decision-systems describe how different decisions are grouped together and how decisions are made in a sequence. The first tier in this hierarchy, the 'family decision-system', is the clearing house where issues are negotiated within the family and the decisions set the scene for all subsequent decisions. "Shall we stay farming?" is the kind of question negotiated in the family-decision-system and the answer is justified in terms of 'care ethics'; i.e. 'what is best for the family and individual family members.'

There are dozens of decision-systems in the second tier of the hierarchy. The two decision-systems that concern land-use on the farm are the "farm trading business decision-system" and the "land ownership decision-system". These are where technical / economic farming decisions are made. These decisions are justified in terms of business ethics: i.e. 'what are the most profitable options.'

Concept 4: Personal career paths
Family members often work together in farming but individuals have differing interests, capabilities and aspirations that have to be accommodated. Also, the decisions people make alter as they move through life. For example, people about to retire from farming do not normally start up new farm enterprises or take on new debt as they might have done when they were younger. The personal career path concept allows these factors to be recognised and negotiated within the family.

Concept 5: Lenses – how decision makers view options
There may be hundreds of options at any one time but the decision-makers in a farming family whittle them down to just a few by viewing them through a series of 'lenses'. These lenses are (1) personal interest (2) family considerations (3) knowledge of personal components of opportunities (4) social considerations (5) knowledge of and access to external components of opportunities.

An example that follows these five lenses might be: a farmer may (1) be interested in grapes and producing wine (2) grape growing would provide a good family income and allow time for socialising within the family (3) the farmer has suitable land, knowledge and the time to develop a vineyard but not a winery (4) grape growing is socially acceptable (5) there is a market for grapes, vines can be purchased locally and finance is available. Having run through this planning exercise a few times to identify the best options, the farming family may make the decision to get to work and create and implement a grape growing opportunity.

Three ways DST could help farming families and farming communities:
Use one
DST provides a framework to help farming families appreciate how other farming families go about making strategic decision and this can help them develop their own decision-making processes and gain confidence in their own abilities.

Use two
DST shows that an agricultural / rural policy's (or a program's) effectiveness depends on its capacity to make new external components for opportunities that support farming families' aspirations (their motivation stories). In a nutshell, farming families want a fulfilling future for themselves and their children. Farming families recognise that this requires an environment that is fully functioning (i.e. not polluted or deficient) and also a supportive society.

Policies that focus exclusively on the business decision-systems (and not the whole DST) would concentrate on the efficient use of the resources used in farming. These programs may not lead to the continuance of farming families in agriculture, but rather lead to the expansion of farm size, their incorporation, and the entry of large companies aiming to take advantage of the economies of scale in resource use and access to external components of opportunities, especially to markets, managerial skill, new technologies and finance.

Use three
Decision-system theory can be used to guide the shift from government to governance of rural affairs. DST provides an effective social-learning framework for rural communities to work cooperatively with governments to develop external components of opportunities that are relevant to regional rural affairs. An iterative model for this is set out in Figure 18.

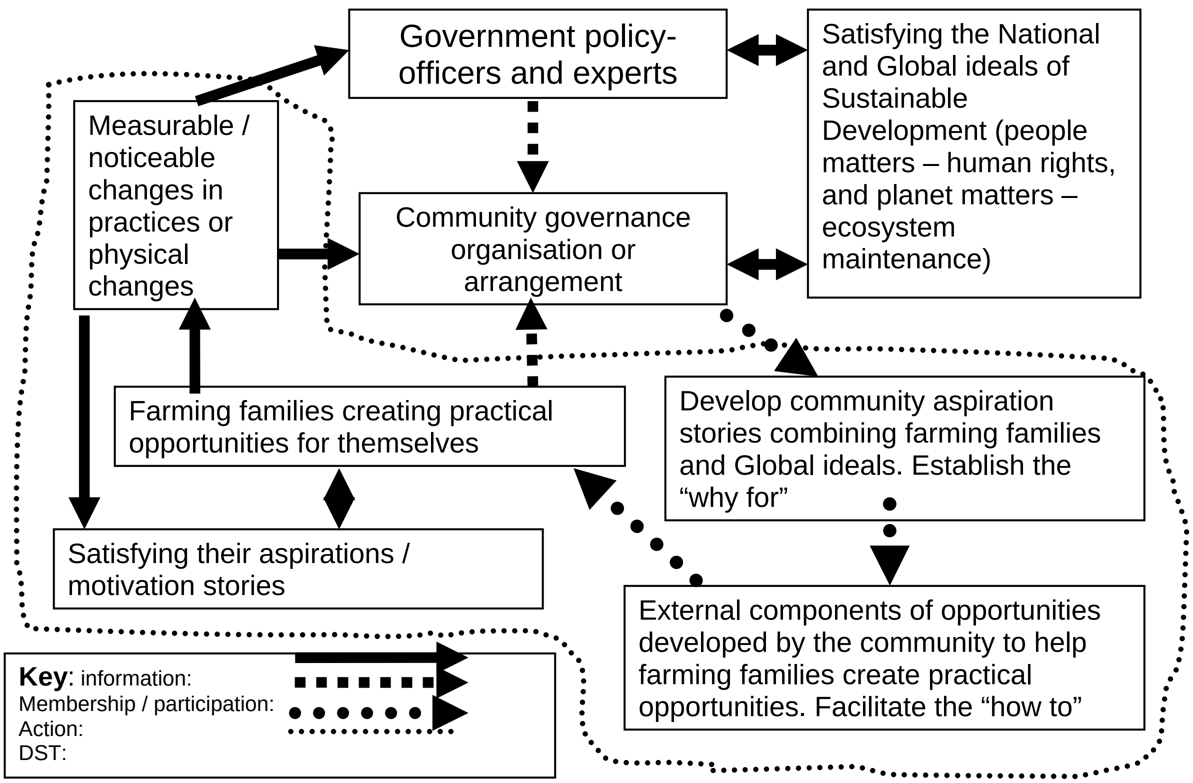

Figure 18. How DST could be used in a community governance approach for sustainable development

More information on DST is available from Quentin. He would be particularly happy to talk to farmer groups or at a meeting. Quentin is seeking more farmers to interview to help him refine and expand DST. He can be contacted by phone, 03 5444 7464 or by e-mail, q.farmar-bowers@latrobe.edu.au.

Acknowledgements:
The initial work was undertaken in the Departments of Primary Industry and Sustainability and Environment as part of the 'Drivers of Land Use Change' Project[1]. Subsequent work was undertaken at RMIT University in collaboration with Dr Ruth Lane and at La Trobe University.

[1] http://www.dse.vic.gov.au/dse/index.htm > Conservation and Environment > Biodiversity > Rural Landscapes > Biodiversity & Agriculture > Drivers of Land Use Change

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The efficacy of Spray Seed® and Axial® herbicides on the narrow-leaved targets annual ryegrass (Lolium rigidum Gaudin) and oats (Avena spp.) when applied with a range of nozzle types and water volumes

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Organisation: Syngenta Crop Protection Pty Ltd

Key messages:

- Results from four field trials indicate that the efficacy of Spray Seed® (135 g L^{-1} paraquat + 115 g L^{-1} diquat) or Axial® (100g L^{-1} pinoxaden) herbicides on *Lolium rigidum* Gaudin (annual ryegrass) or *Avena* spp. (cultivated oats) was not compromised when applied with a coarse spray quality from several air induction type nozzles compared with the industry standard, extended range (XR) or drift guard (DG) nozzle generating a fine - medium spray quality.
- Efficacy of these two herbicides may be compromised if water volumes are not sufficient and/or if droplet size is increased beyond a very coarse spray quality.
- If using air induction nozzles it is important to make sure that line pressure is adequate for the nozzle (especially if using high pressure air induction type nozzles) and the water volume sufficient to compensate for the lower number of droplets produced from these types of nozzles, especially if targeting grasses.
- A guide to pressure and water volume by nozzle type is recommended as: for high pressure air induced nozzles, eg TeeJet* AI, Hardi INJET, agrotop TurboDrop*, Lechler ID, apply at pressures > 4 bar, generally 4-8 bar should be used. For low pressure air induced nozzles, eg TeeJet AIXR, Hardi MiniDrift, agrotop AirMix*, Lechler IDK, apply at pressures > 2 bar, generally 3-6 bar should be used. A water volume > 75 L ha^{-1} is to be used for both high and low pressure air induction nozzles if targeting grass weeds.

Introduction:

Interest in using air induction type nozzles for broadacre spraying has increased dramatically in recent years. It has been well established that the larger droplet size generated from air induction type nozzles can significantly reduce drift and losses due to evaporation. There is increased pressure from the public and regulators to reduce drift and the use of these types of nozzles will help manage drift issues.

It has also been shown that air induction nozzles can provide good levels of weed control when targeting certain weeds with systemic herbicides. However, there has been very little data generated in Australia to show that these nozzles provide adequate efficacy under some of the most challenging scenarios, eg. when using contact non selective herbicides like Spray Seed, or cereal selective graminicide herbicides like Axial on difficult to target and control weeds like annual ryegrass and oats.

Aim:

The aim of these trials was to evaluate the efficacy of Spray Seed and Axial on annual ryegrass and oats when applied with a fine, medium, coarse, very coarse and extremely coarse spray quality from a range of nozzles including air induction type nozzles at up to three water volumes.

Materials and Methods:

Four field trials were established at Mingenew WA and Roseworthy SA in winter 2006. Two trials were also conducted at Paskeville SA in 2007. All trials consisted of 3 replicates each. The rates of Spray Seed and Axial were targeted to give 80–95% control so that differences between treatments became more evident. In 2006, the treatments consisted of an untreated control and three nozzle types, representing three spray qualities; 1. TeeJet extended range XR (fine), 2. Turbo TeeJet TT (medium), 3. TeeJet Air Induction AI (coarse). All nozzles were trialed at 50, 75 and 100 L water ha^{-1} respectively. The Hardi INJET 01 nozzle was chosen for the 50 L ha^{-1} rate only, instead of the TeeJet AI 015 as the 01 was more suited to the speed, volume and pressure combination chosen.

In 2007, the treatments in the trials consisted of two untreated controls and eight nozzle types, representing five spray qualities; 1. TeeJet extended range XR (fine), 2. TeeJet drift guard DG (medium), 3. Turbo TeeJet TT (coarse-medium), 4. Turbo Twinjet TTJ, 5. AIXR, 6. Hardi MiniDrift MD all (coarse), 7. TeeJet Air Induction AI (coarse-very coarse), 8. Turbo Teejet Induction TTI (extremely coarse). All nozzles were trialed at 40 and 80 L water ha^{-1}. In the WA trial in 2006, Spray Seed was applied at 300 g a.i. ha^{-1} for all treatments to 2 leaf to early tillering annual ryegrass on 28th July. Weather conditions at spraying were : Temp. 16 °C, Delta T 2.5 °C, wind calm. Travel speed was kept at 15 km h^{-1}. Assessments were conducted at 10 and 28 days after application.

In the SA trial in 2006, Spray Seed was applied on 31st August at 350 g a.i. ha^{-1} to early tillering annual ryegrass. Weather conditions at spraying were: Temp. 23 °C, Delta T 7.0 °C, wind calm. Travel speed was kept at 15 km h^{-1}. Assessments were conducted at 7 days after application. Unfortunately, due to an error in the SA trial, a Lechler IDK low pressure air induction nozzle was used instead of the Hardi INJET at 50 L water ha^{-1}.

In the SA trials in 2007, Spray Seed was applied at 300 g a.i. ha^{-1} to 4 leaf to early tillering annual ryegrass and oats on 16th August. Weather conditions at spraying were: Temp. 17 °C, Delta T4.0 °C, wind NW 5-10 km h^{-1}. Travel speed was kept at 18 km h^{-1}. Assessments were conducted at 9 and 22 days after application. Axial was applied at 25 g a.i. ha^{-1} 0.5% Adigor® adjuvant to 4 leaf to early tillering annual ryegrass and oats on 16th August. Weather conditions at spraying were: Temp. 19 °C, Delta T 4.5 °C, wind NW 5-10 km h^{-1}. Travel speed was kept constant at 18 km h^{-1}. Assessments were conducted at 9 and 22 days after application.

Results:

Figure 19 shows the % control of annual ryegrass from using Spray Seed applied via a range of nozzles and water volumes from the 2006 field trial. Statistical analysis was conducted (including ANOVA and factorial analysis), but no significant differences were found between treatments or between factors of spray quality or water volume. However, there was a trend towards improved control where water rate was increased, eg. 50 L ha^{-1} (mean 92% control), 75 L ha^{-1} (mean 93% control) and 100 L ha^{-1} (97% control). The efficacy of the air induction nozzle producing a coarse spray quality (93% control) in this trial was equivalent to the TT nozzle producing a medium spray quality (mean 94% control) and the standard XR nozzle producing a fine spray quality (95% control).

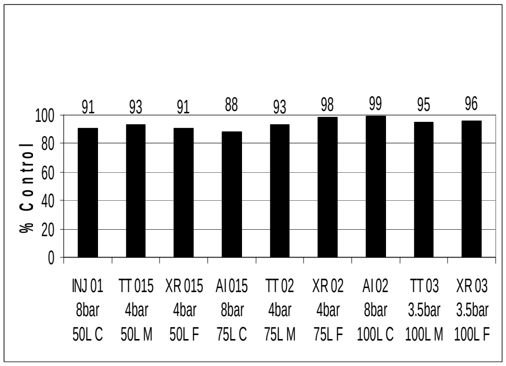

Figure 19. Spray Seed efficacy on annual ryegrass 28 days after application in WA in 2006.

Spray quality: fine (F), medium (M), coarse (C); nozzle types: Hardi INJET (INJ), Turbo TeeJet (TT), TeeJet XR (XR) and TeeJet AI (AI); nozzle sizes: 01, 015, 02, 03 and spray volumes at 50 L ha^{-1} (50L), 75 L ha^{-1} (75L) and 100 L ha^{-1} (100L).

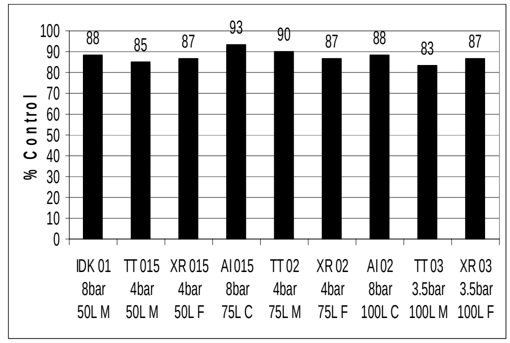

Figure 20. Spray Seed efficacy on annual ryegrass (7 DAA in SA, 2006).

Spray quality: fine (F), medium (M), coarse (C); nozzle types: Hardi INJET (INJ), Turbo TeeJet (TT), TeeJet XR (XR) and TeeJet AI (AI); nozzle sizes: 01, 015, 02 and 03; spray volumes at 50 L ha^{-1} (50L), 75 L ha^{-1} (75L) and 100 L ha^{-1} (100L).

Figure 20 shows the % control of annual ryegrass from using Spray Seed applied via a range of nozzles and water volumes from the field trial in SA in 2006.

Table 43 shows the results of the factorial analysis looking at spray quality and water volume. In this trial, the optimal water rate was found to be 75 L ha^{-1} which was significantly better than either 50 L ha^{-1} or 100 L ha^{-1}. The efficacy of the air induction nozzles producing a coarse spray quality in this trial was significantly better than the standard XR or TT nozzle delivering a fine and medium spray quality respectively.

Table 43: Factorial analysis for spray quality and water volume for Spray Seed

Level means for factor spray quality	**Untransformed data**
Fine treatments	86.67^b
Medium treatments	86.11^b
Coarse treatments	90.00^a
F-test probability	**3.20%**
LSD (P = 0.05)	**3.04**
Level means for factor water volume	**Untransformed data**
50 L treatments	86.67^b
75 L treatments	90.00^a
100 L treatments	86.11^b
F-test probability	0.032
LSD (P = 0.05)	3.04

a and b – not significantly different.

The results from the Axial trial conducted in SA in 2007 demonstrated 100% control of all oats in all treatments regardless of the water volume or spray quality chosen. There were only minor differences in efficacy when it came to annual ryegrass control. The most notable of these was when an extremely coarse spray quality was used and efficacy was reduced compared to the standard nozzle, 91% control v. standard XR nozzle (97% control). All other spray qualities from fine to very coarse gave equivalent levels of control of annual ryegrass compared with the standard nozzle delivering a fine spray quality.

The results from the Spray Seed trial in SA in 2007 on annual ryegrass demonstrated a response to water volume. 80 L ha^{-1} gave 85% control of annual ryegrass versus 40 L ha^{-1} which gave 80 % control. In terms of spray quality, fine to very coarse delivered equivalent levels of control to the standard nozzle generating a fine spray quality. The only exception was the nozzle delivering an extremely coarse spray quality, which slightly reduced efficacy (79% control) compared to the standard nozzle (83% control).

Discussion:
The results from these four trials indicate that Spray Seed and Axial efficacy in the control of annual ryegrass and oats when applied with a TeeJet AI, TeeJet AIXR, Hardi INJET or Hardi MiniDrift nozzles, producing a coarse spray quality, is equivalent or better than the standard XR or Turbo TeeJet nozzles, producing a fine or medium spray quality. It is important to ensure these nozzles are operated at correct operating pressures and water volumes are increased in order to maintain adequate coverage of the target weeds.

The added benefit of using a coarse spray quality is that herbicide drift can be dramatically reduced, which is of major benefit to people and the environment.

Given these trials were designed to represent two of the most challenging situations, there may be scope for air induction type nozzles, producing a coarse spray quality, to be used with many other herbicides on a range of other weeds. More trial work needs to be conducted for Axial and other herbicides to confirm these findings so that product recommendations can be refined and changes to product labels may be made.

Acknowledgements:
The author would like to acknowledge Ag Xtra for spraying the trials in SA and Kalyx Crop Research for spraying the trial in WA. Also, Lester Snooke, Simon Kerin and Brian Staines from Syngenta for conducting weed control assessments for the trial in WA. Acknowledgement must also be made to the assistance given by Garth Wickson and Charissa Rixon from Syngenta, Graham Betts from ASK GB, Peter Alexander and Jake Lanyon from TeeJet Australasia and Hardi Australia for supplying nozzles.

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Where is Precision Agriculture heading? Variable rate and data management?

Author: Ed Cay

Contact No: 08 8821 4128

Organisation: gps-Ag

Key messages:

- There is a common feeling in the industry that increased input prices will lead to more interest in Variable Rate Technology (VRT), therefore more competition in the marketplace and a good result for growers.
- There are three components to site specific crop management *hardware, data management and agronomy.*
- It is very difficult to tie all three areas together as they require specialised skills that interact with each other.
- Increased adoption will be assisted by the development of VRT support services that bring together the hardware support (improved variable rate systems), agronomy (advice on inputs) and data management (logging, recording and processing your individual data) for growers which will help remove barriers to adoption.

Increased adoption of Variable Rate Technology this sowing season is a sign of the times. Whilst some farmers may have bought fertilizer early last year at much lower prices, next season there seems to be no way to escape the huge fertilizer prices now being experienced. So efficiency gains are going to be imperative for many farmers next year.

Taking small, simple but effective steps is the best way for growers to keep moving forward in an area as complex as VRT. Getting on with the basics like variable rate (VR) soil amelioration, yield mapping and setting up the airseeder or spreader for VRT is the best approach that growers can take as they look to adopt more efficient practices.

However, VRT is a total package and a meeting point of agriculture and technology with some inherent complications. It is a multi-faceted solution – GPS receiver, electronic controller hardware, drive mechanisms and sensors, mapping software, file transfer and agronomy.

Nevertheless, with growers now forced to be more cost conscious than ever before, and Australian economic studies from even before the 'pre fertiliser price hike' showing benefits from VRT averaging up to $22/ha per farm*, the future is bright for VR with the service industry striving to meet the needs of growers. That is, as the adoption of VR is accelerated by increased fertiliser and pesticide prices, growers will see changes in the expertise, availability and simplicity of VR services.

Adoption relies on integration

In guidance and autosteer, compatibility between components and brands has been a long-time frustration for growers, although compatibility is getting better all the time! In site specific crop management, the compatibility between the data processor, hardware supplier and the agronomist is a similar problem. Linking all the components of VRT together is the key to cohesion between them. The problems can be highly variable (pun not intended) including:

1. Office issues:
    a. How is the prescription transferred to the tractor?
    b. How was the prescription written – the software used and the format of the prescription file?
    c. Is the prescription named and identifiable in the tractor?

2. Tractor issues:
    a. Does the controller accept the files?
    b. Is the GPS receiver working correctly?
    c. Is the controller working?
    d. Do the paddock boundaries on the map match the paddock?

3. Implement issues:
    a. Are the multitude of sensors working?
    b. Are the drives working correctly?
    c. Is the rate being controlled correctly?

4. Agronomy:
    a. Are the rates being varied according to the correct agronomic factors?
    b. What do the answers mean for next year's crop?

In addition to the above, often the most daunting of these factors for most growers is managing all the data that is available or produced.

Many growers find themselves inheriting mapping software that came with their machinery purchase or that is incorporated into a financial package, and while merit is there, often the time and inclination to enter and process their own data lasts only a few days or until the next job comes up! Anecdotal evidence suggests this process has had a low level of adoption due to the time and expertise required. Some new innovations in web delivery will help growers in this area, as the data is processed by professionals and then available on simplified, very specific prescription making websites that take out a lot of the complication that full software packages can have.

As growers take the next step in VRT, it is critical that all the components of the system be well planned and managed. This may be done by growers themselves, or by consultants with precision agriculture (PA) skills and/or data managers. Given the forseen demand, the latter is starting to develop as a service in the PA industry.

Finding the personnel to assist growers in combining all the components of VRT is usually best done by asking other farmers that are currently practicing variable rate application. Talking to other growers that have the same equipment, similar variability, comparable amounts of spatial data/layers and most importantly, similar technology knowledge has been shown to be an incredibly successful catalyst for farmers to get started with VRT.

Farmers learning from farmers
Building on the successful formula of a Southern Precision Agricultural Association (SPAA) project run throughout most of the major cropping areas of SA and Victoria in 2007, a proposed Riverine Plains focus group will provide a fantastic opportunity for farmers to compare with other farmers and to utilise external VRT technical support.

Farmers will have exposure to services and advice in all areas of VRT and just as importantly, other growers to talk to about issues and solutions. According to feedback surveys from participants, the project focus groups in 2007 proved to be an invaluable way of demystifying some of the barriers for adopting VRT and to give growers the information they needed to get started.

There is no doubt that the price of inputs is placing variable rate technology in the forefront of more growers minds and with simplified methods of getting started along with a sensible approach to the basics, the industry should see a sharp increase in adoption. 2008/09 is a perfect time to see if variable rate technology is a worthwhile investment for your business!

*Some studies of interest relating to the economics of VRT include

1. Farmer Case Studies on the Economics of PA Technologies (McCallum, M. 2008)
2. The Economic Benefits of Precision Agriculture: Case Studies from Australian Grain Farms (Robertson et al, 2007)

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No-Till farming has re-ignited a passion for agriculture:

A case study of the Alday family, Sea Lake

Author: Vanessa Grieger

Contact No: 03 5382 0422

Organisation: Victorian No-Till Farmers Association

Key message:
- No-till has increased the flexibility of the cropping system.

The change to no-till from a relatively conventional Mallee farming system in 2005 re-ignited a passion for agriculture for the Alday family of Sea Lake. One year rolled into the next looking for incremental gains in a conventional system while being constantly frustrated by issues outside of their control.

"We felt that no-till allowed us to make the best decisions with the knowledge at hand, rather than speculate on the range of scenarios that conventional cropping was throwing at us," says Grant, who farms with his wife Bron, and parents David and Jean.

Some of the challenges under a conventional system of farming included:
- Sowing early increased grass numbers.
- Waiting for a flush of grass often led to a sand blasted crop.
- The preparation of a level seed bed occurred regardless of weeds present, wasting a working or stimulating another germination.
- The incorporation of Trifluralin during April led to mixed results in a late break.
- Pre-drilling urea was speculation.
- Limited ability to increase cropped area with a favourable break.
- No ability to set paddocks aside with a poor break, due to wind erosion.

Since adopting no-till the Aldays have enjoyed the flexibility and control of waiting for the break, then making decisions based on facts.

"Determining how brome grass control could be achieved in no-till was an issue that took some coming to terms with. The advice from many was to start no-till with clean paddocks, gradually bringing others in. I felt we needed two machines to sow two systems because one would do a poor job of both. With the benefit of the experience of many in the district we went straight to 12 inch spacing. We have found that controlling brome grass is far easier in a no-till system," says Grant.

Agronomy is widely regarded as the most important component of a successful no-till operation. The Alday's feel that technology, including machinery, allow the implementation of many agronomic principles. In recent years the family has adopted as much technology as farm scale has allowed.

The changes in crop varieties, chemicals, precision agriculture, agronomic advice, tillage practices and professional support have all come at a perfect time for the Aldays and many others across Western Victoria. "The flexibility in the cropping program is greater and the seeding tractor does around 300 hours a year compared to an estimated 1000 + hours under a conventional system."

The down side is the nocturnal nature of extra hours on the spray tractor and a list of mistakes along the way. These include overgrazing brown manured vetch, not levelling the ground before beginning no-till, poor monitoring of whole paddocks for summer spraying and reduced competition due to blocked hoses in their worst rye grass paddock.

The Alday's sow with a triple bin Flexi-coil and a Flexicoil bar with 550lb breakout. The machine is fitted with Maxipoint knife points, Primary Sales double chute, Eagle Exhaust residue deflectors and Agmaster press wheels. The plan for 2008 is to eliminate seed bounce with diffusers and to sow by prescription using variable rate.

The future may include controlled traffic with a 12 m disc or an 18 m tyned machine, accepting that it doesn't perfectly match a 9 m front and 36 m boom. Liquid trace element and fungicide application is of interest, as are weed seekers. Sheep may not have a place.

The wish list for the future includes shorter seasoned varieties with greater frost tolerance, which may allow topcropping before harvest, a more reliable break crop and some alternative chemistry to reduce reliance on commonly used herbicides. The Aldays would also like to see more stable commodity pricing which allows both end users and producers to prosper.

Figure 21. Sloop Vic and Yagan sown 17th May 2007

Change of mindset 18 years ago:

A case study of George and Barbara Burdett, Wickliffe

Author: Vanessa Grieger

Contact No: 03 5382 0422

Organisation: Victorian No-Till Farmers Association

Key message:

- When considering no-till farming, have a look at what others have done, ask questions, and try not to make the same mistakes (George Burdett).

The most difficult thing to change when starting with no-till was his mindset, according to George Burdett. George has been recently elected to the VNTFA committee and farms with his wife Barbara at Wickliffe. George and Barbara started No-till in the mid 1980's, their main reason for changing was to improve their soil structure. It has taken a number of years to get no-till working properly on their farm and to get the soil started. The hardest thing to change was their idea about row spacing and moving from 7" spacing to 300mm (12") spacings.

They crop 900 ha out of their 1000 ha property and have an annual rainfall of 550 mm, with 405 mm falling in the growing season. They run a mixed livestock cropping operation which is mainly cropping and includes some oaten hay. The crops grown include wheat, barley, canola, beans and oats (hay). All crops are no-tilled: there is nothing that is not no-tilled. All crops are sown with a 10 metre Janke bar with a parallelogram system, 30 cm row spacing, Janke presswheels and a Simplicity triple bin. George also uses autosteer and sees the main benefit of autosteer is to "keep me in farming longer".

The benefits of no-till they have seen to date are less waterlogging, less compaction and less soil disturbance. The biggest advantage of no-till is the improvement in soil structure. Moving to no-till has also improved their timeliness of operations as well.

Some of the agronomic changes made include incorporating grass weed herbicides by sowing and managing insects using Integrated Pest Management strategies.

George's advice to others looking at getting into no-till is to have a look at what others have done, ask questions, and try not to make the same mistakes.

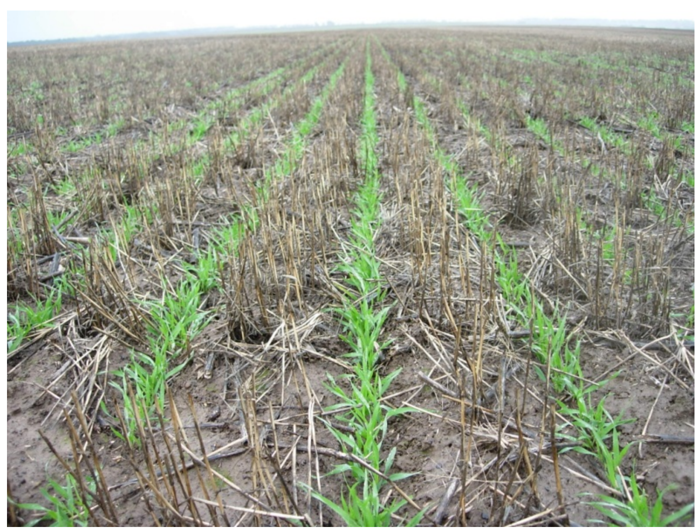

Figure 22. George Burdett's no-till farming system